San Joaquin River Restoration Program

Restoration Administrator's 2023 Report to Settling Parties

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May 2024

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1 Introduction

This Restoration Administrator's Report on the status of the San Joaquin River Restoration Program (Program) is prepared in accordance with the Stipulation of Settlement filed September 13, 2006, in the case of *NRDC, et al., v. Kirk Rodgers, et al*. Pursuant to the Stipulation of Settlement (Settlement), the Restoration Administrator (RA) , with the assistance of the Technical Advisory Committee (TAC) will prepare an annual report which shall include a summary of settlement implementation activities of the previous year, findings of research and data collection, any additional recommended measures to achieve the Restoration Goal of the Settlement, a summary of progress and impediments in meeting targets established pursuant to Settlement Paragraph 11 (Paragraph 11), and a summary of expenditures from the Account.

2 Overview of 2023 Hydrology, Friant Operations, and Restoration Flows

The 2023 water year (October 1, 2022 – September 30, 2023) started out with average precipitation and runoff for the first couple of months, then proceeded to become very wet. A series of large storms in early and mid-December 2022 were followed by large atmospheric river events in late December and mid-January. By mid-December 2022, there was already forecasted to be at least an "Average" runoff water year (based on precipitation to date), and by mid-January 2023 the forecasted runoff was at 200% of average. Until the end of July 2023, San Joaquin River operations by Bureau of Reclamation (Reclamation) and upstream water managers was centered on flood control operations.

Water year 2023 ended up being the second highest runoff year of record, and the highest snowfall year. The Restoration Allocation was "Wet" throughout all of Reclamation's Allocations. Flood control releases to the river commenced on January 5, 2023, prior to the first Restoration Allocation of the year, which occurred on January 20, 2023. Restoration Flows were set to the channel- or seepage-capacity limited flows for March 1 – late May 2023 (what they would have been if not for flood control releases).

As has been discussed in previous Annual Reports, the San Joaquin River Settlement Exhibit B[1] (Exhibit B) flows for the August – September period (June – September in less than "Wet" years) are insufficient to keep the river connected through Reaches 4 and 5, thus shifting water from the Spring Flexible Flow period (through May 28 each year) into the summer months is required to maintain full river connectivity. The shifting requires a "water supply test" pursuant to the Restoration Flow Guidelines[2] (RFG's), which assesses whether shifting of flows would cause a water supply impact on the Friant Water Contractors. Since Millerton Lake was full with high inflows continuing into August, there was no available reservoir space to allow shifting of water past July 28 (the end of Wet Year Riparian Recruitment Flows). Wet Year Riparian Recruitment Flows as specified in Exhibit B were able to be utilized through July 28, 2023, to maintain river connectivity, then 10 Thousand Acre Feet (TAF) of URF exchanges were utilized in addition to Exhibit B flows to maintain river connectivity from the end of July into the middle of October.

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[1] Stipulation of Settlement, United States District Court Easter District of California in NRDC vs Rodgers, 13 September 2006.

[2] San Joaquin River Restoration Program Restoration Flow Guidelines, Ver. 2.1, January 2020.

The following graphics show the major events and flows for water year 2023 (Figure 1, Figure 2).

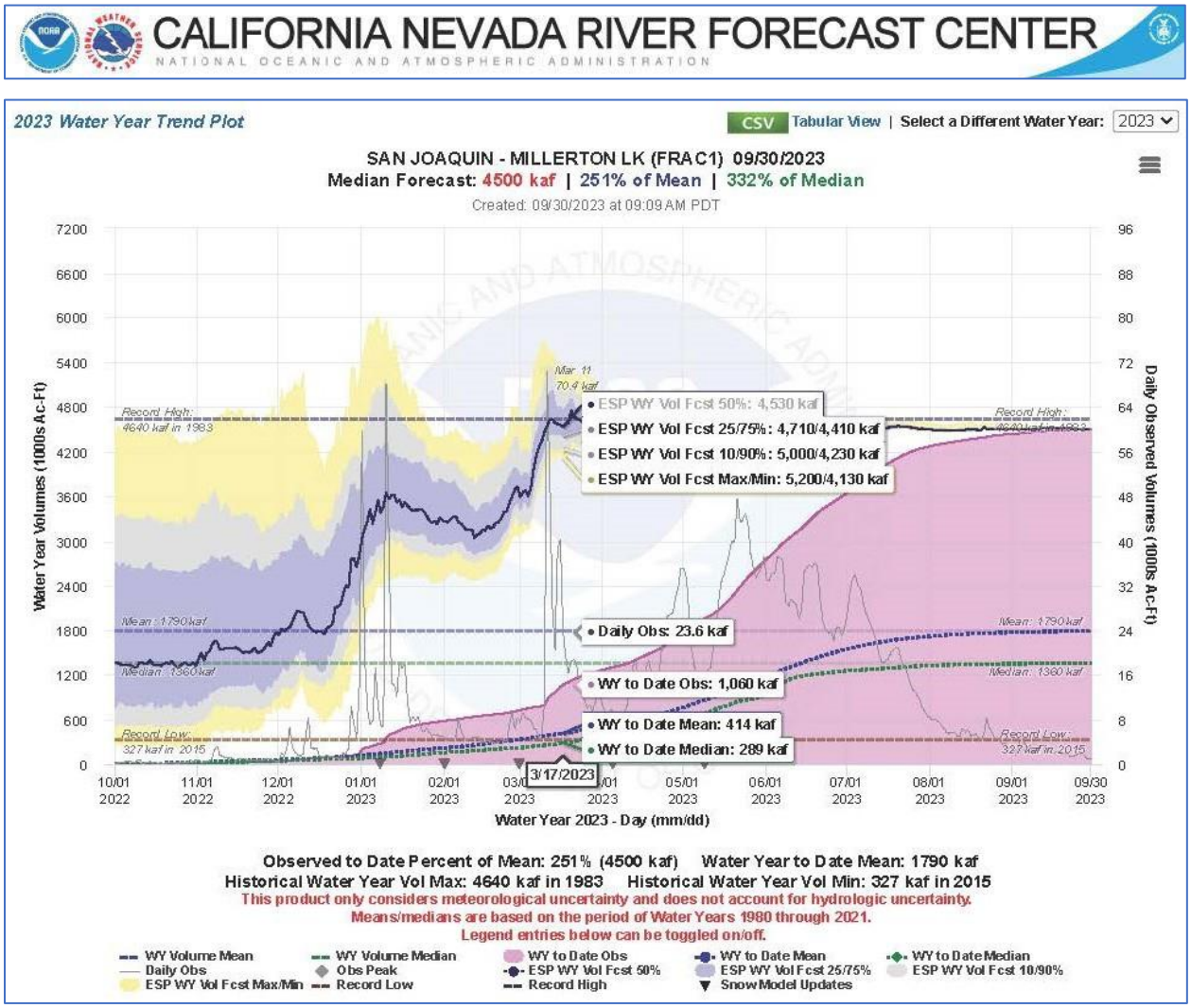

Figure 1. Water Year Trend Plot from the California Nevada River Forecast Center (CNRFC)[3]

[3] CNRFC - Ensemble Products - FRAC1 (noaa.gov)

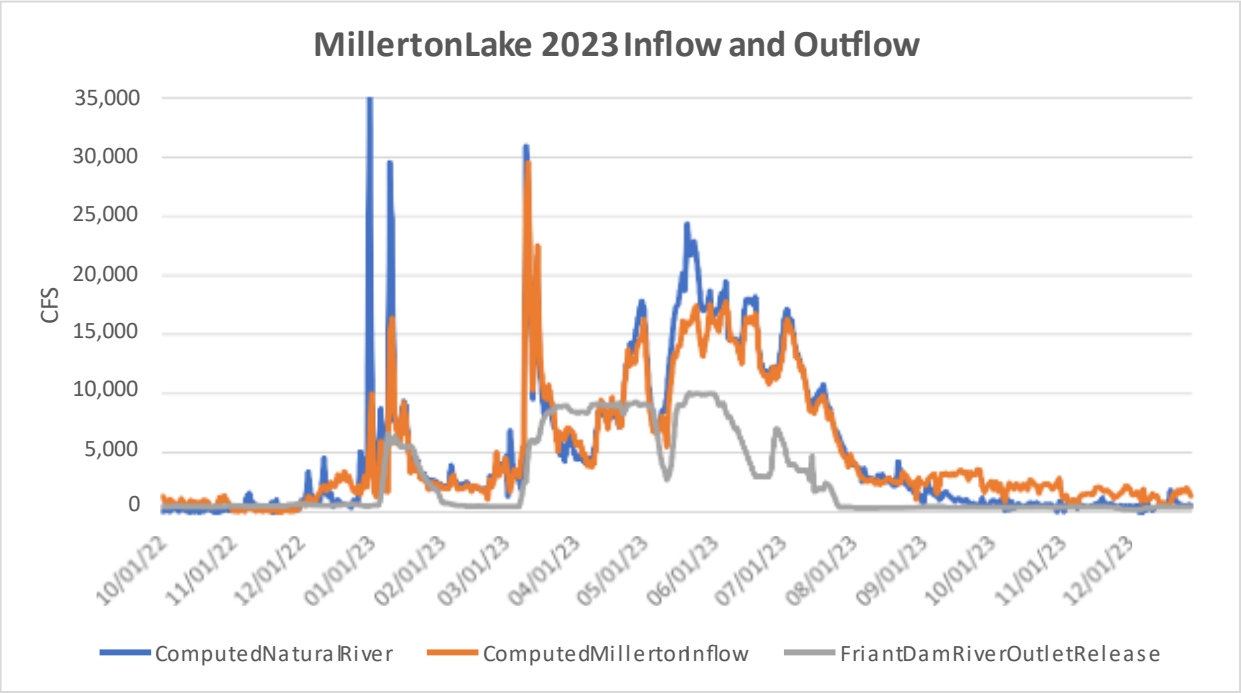

Figure 2. Millerton Lake Computed Natural River Flows, Computed Inflow, and Measured Outflow.[4]

Since October 2023, full Exhibit B Restoration Flows were maintained, with the exception of a 15 day period of substantially lower flows that was requested by Reclamation for maintenance at Mendota Pool (see Section 5.9).

3 Program Milestones and Accomplishments during 2023

This Section provides an overview of specific Program milestones and accomplishments for 2023.

- As mentioned previously, 2023 was the second highest runoff year on record. Trap and haul of adult Central Valley spring-run Chinook salmon from Reach 5 to Reach 1 was not conducted during spring 2023 due to high flows that prevented field crews from safely implementing trap and haul monitoring activities. However, based on adult returns during previous year flood operations, it is assumed that high flows likely created volitional fish passage conditions into Reach 1 during the spring months.
- Juvenile and adult spring-run Chinook salmon from the Interim Salmon Conservation and Research Facility (iSCARF) were released in the Restoration Area in 2023 (see Section 4 for additional details). Many of the juvenile fish successfully migrated out to and through the Sacramento/San Joaquin Delta, as evidenced by capture of some of the released fish at various monitoring locations in the Delta.

[4] QA/QC data from the San Joaquin River Restoration Program daily Operations spreadsheet, Ver. 41s, December 29, 2023.

- The 2023 Restoration Allocation was for the Settlement-defined Wet water year type, with an allocation of 557.038 TAF (measured at Gravelly Ford). As described in Section 2, Restoration Flow releases from January 2023 through July 2023 represented a very small portion of the total releases from Friant Dam, as much of the total flow release was for flood control purposes.
- The Program continued work on the major Paragraph 11(a) projects, including advancing design and analysis of the Compact Bypass and Arroyo Canal/Sack Dam bypass projects. Progress included realty actions, collection of geotechnical data from multiple sites, and design work tasks.
- In the period of September through December 2023, the Program released a partial 60% Design package for the Arroyo Canal/Sack Dam complex, and shared hydraulic modeling results for the current design. A partial 90% design package is due for release in January 2024.
- Reclamation's Upper San Joaquin Watershed Forecasting team provided periodic runoff forecasts throughout the winter and spring, integrating disparate indicators of snowpack, runoff efficiency, and forecasted runoff. This information was used to inform Allocations through the winter, spring and early summer. The Forecast team provided technical briefings through the monthly Millerton Forecast Advisory Committee (now renamed as the Upper San Joaquin Watershed Forecasting Discussion group).
- The National Marine Fisheries Service (NMFS) completed and released the 2023 Technical Memorandum[5] that outlined the spring-run Chinook salmon release and monitoring plans for 2024, plus methods for identification of spring-run Chinook salmon outside of the San Joaquin River. Appendix A of the NMFS Technical Memo provides an overview of fish releases, rotary screw trap monitoring, telemetry monitoring, and adult broodstock releases in the San Joaquin River from late fall 2022 through fall 2023. The 2024 Technical Memorandum[6] provides details on fish releases and monitoring for 2023.
- A 2023 Channel Capacity Report[7] (CCR) was published by the Channel Capacity Advisory Group (CCAG) to update estimates of then-existing channel capacities in the Restoration Area to ensure Restoration Flows would be kept below levels that would increase flood risk. Separate from channel capacity, flows in Reaches 3 and 4A are limited by to avoid seepage impacts to adjacent lands. Channel capacities are applicable to Restoration Flows only and are often much less than the flows the channels will convey during flood events. Channel capacities in 2023 are summarized in Table 1.

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5 2023-sjrrp-spring-run-tech-memo.pdf (noaa.gov)

6 2024-01-292024-sjrrp-spring-run-tech-memo.pdf (noaa.gov)

7 Technical Memorandum Channel Capacity Report 2023 Restoration Year

Table 1. 2023 Then-existing Channel Capacity, showing In-channel (typically seepage) and Geotechnical Assessment (typically levee issues) flow limitations for Restoration Flows

Reach	Then-Existing Channel Capacity (cfs) [1]	Method Used to Determine Then-Existing Channel Capacity
Reach 2A	6,000 [2]	Geotechnical Assessment
Reach 2B	1,210	In-channel
Reach 3	2,860 [3]	In-channel
Reach 4A	2,840 [4]	Geotechnical Assessment and In-channel
Reach 4B1	Not Analyzed	–
Reach 4B2	4,300	Geotechnical Assessment
Reach 5	2,350	In-channel
Middle Eastside Bypass	2,600	Geotechnical Assessment
Mariposa Bypass	1,800	Geotechnical Assessment

1. Then-existing channel capacity shown in this table is based on levee stability only and does not consider Restoration Flow limitations related to agricultural seepage.
2. Capacity not assessed for flows greater than 6,000 cfs. Restoration Flows are limited to approximately 600 cfs due to agricultural seepage.
3. Restoration Flows are limited to approximately 850 cfs due to agricultural seepage.
4. Restoration Flows are limited to approximately 300 cfs due to agricultural seepage.

- Work on the Salmon Conservation and Research Facility (SCARF) continued in 2023 with a scheduled commissioning and stocking date in mid-2024. Until the SCARF is commissioned, the iSCARF continues to produce the required numbers of spring-run Chinook salmon needed to support Program objectives and research.
- Although not directly part of the Program, the Friant-Kern Canal Middle Reach Capacity Correction Project was largely constructed during 2023, although work continues into 2024. The capacity project is a joint effort between Friant Water Authority and the Reclamation. The Project seeks to address needed repairs to 33 miles of the 152-mile-long Friant-Kern Canal, which has lost 60% of its design capacity due to land subsidence caused by groundwater overdraft conditions that occurred during California's 2011-2016 drought.[8]

[8] Middle Reach Capacity Correction — Friant Water Authority, Friant-Kern Canal Middle Reach Capacity Correction Project | Mid-Pacific Region (usbr.gov)

4 Progress toward Achieving Paragraph 11, 13, and 14 Requirements during 2023

This Section provides an overview of progress towards meeting Paragraph 11, 13, and 14 requirements of the Settlement in 2023.

- In the period of September through December 2023, the Program released a partial 60% Design package for the Arroyo Canal/Sack Dam complex, and shared hydraulic modeling results for the current design. A partial 90% Design package is due for release in January 2024.
- The Program continues to undertake geotechnical investigations for the construction of the Compact Bypass and associated levees, having finally resolved various landowner challenges around access. This allowed progress on the final design of the Compact Bypass control structure and related facilities.
- The Program continues to advance targeted realty actions to relieve seepage constraints in Reaches 2, 3, and 4 of the Restoration Area.
- In collaboration with Friant Water Authority, Reclamation is undertaking a detailed evaluation of flow losses in Reach 1, with the objective of better understanding and potentially monitoring losses from seepage, diversions, groundwater pumping, or other causes in Reach 1. Depending on results and success, this initiative may be expanded to Reach 2 or elsewhere in the Restoration Area.

Pending completion of the Paragraph 11 modifications, the Program is undertaking interim measures to continue the process of salmon reintroduction, build fish stocks, and to continue to collect valuable monitoring data to further inform future adaptive management actions. Specifically, in 2023:

- The California Department of Fish and Wildlife (CDFW) continued work on the Salmon SCARF in 2023. Commissioning, and then populating the facility, is slated for the first half of 2024.
- The Program continued to produce spring-run Chinook salmon brood stock at the iSCARF, utilizing the selected foundation stock from the Feather River Fish Hatchery.
- The Program completed several Young-of-Year and Yearling Juvenile Spring-run Chinook salmon releases into Reaches 1 and 5, as well as the release of mature fish into Reach 1. The details of those releases are best documented in the *NMFS "2024 Technical Memorandum Regarding the Accounting of San Joaquin River Spring-run Chinook Salmon at the Central Valley Project and State Water Project Sacramento-San Joaquin Delta Fish Collection Facilities"*[9].

[9] 2024-01-292024-sjrrp-spring-run-tech-memo.pdf (noaa.gov)

- Adult Releases - A total of 270 adult spring-run Chinook salmon broodstock cultivated at the iSCARF were released by the CDFW into Reach 1A of the San Joaquin River in 2023. Genetic tissue samples of all broodstock adults were taken at the iSCARF for use in later parentage analysis of future adult returning fish.
- Juvenile Young-of-Year Releases - From February – March 2023, two groups of juvenile spring-run Chinook salmon were released to the San Joaquin River. Groups were released in Reaches 4 or 5 for movement out to the ocean. A total of 190,716 juveniles were released. All these juveniles had coded wire tags and adipose fin clips. A total of 1,092 of the juveniles were subsequently observed at the Central Valley Project (CVP) or State Water Project San Joaquin Delta Fish Collection Facilities. It is likely that the high spring flows from the San Joaquin River and through the Delta helped the outmigration survival of the juvenile spring- run Chinook salmon this year.
- Yearling Releases – in August and December, a total of 5,943 yearling spring-run Chinook salmon were released into Reach 1 of the San Joaquin River[9].
- Trap and haul of adult Central Valley spring-run Chinook salmon in Reach 5 was not conducted during spring 2023 due to high flows that prevented field crews from safely implementing trap and haul monitoring activities. However, it is assumed that high flows likely created volitional adult fish passage conditions into Reach 1 during the spring months.
- Trap and haul of adult fall-run Chinook salmon did not occur in 2023 and the Hills Ferry Barrier was emplaced to prevent upstream migration into the Restoration Area. However, dozens (by some reports, hundreds) of adult fall-run Chinook salmon made it to the Eastside Bypass Control Structure, Sack Dam or as far as Mendota Dam in early December of 2023. The large release of water from the dewatering of Mendota Dam in late November may have attracted some of these fall-run Chinook salmon upstream, as well as providing sufficient flows to allow adult salmon to pass East Side Bypass and Sack Dam.

5 Program Challenges and Recommendations 2023

This section provides an overview of some of the key challenges facing the implementation of the Program and, where germane, provides recommendations to address the challenges.

5.1 Evolving Challenges

The Settlement is often referred to by some of the Settling Parties as just that, a settlement - essentially a contract to be fulfilled. It is generally not considered a restoration project per se, nor necessarily adaptive (other than flows and various operational biological decisions and studies). However, there is potential that simply fulfilling the 2006 Settlement will be insufficient to achieve the Restoration Goal. The ecological and physical world in the San Joaquin Valley has continued to change since the signing of the Settlement in 2006. In particular:

a) Spring-Run Chinook salmon populations throughout the Central Valley have continued to decline.

b) CDFW lists fall- and late-fall-run Chinook Salmon as a State of California Species of Special Concern under the California Endangered Species Act and NOAA lists them as a Species of Concern under the federal Endangered Species Act (ESA) due to concerns over population size and hatchery influence. Fall-run Chinook salmon, both wild stocks and hatchery produced salmon, support a commercial and recreational fishery.

c) California's State Water Resources Control Board (SWRCB) is considering updates to the Bay-Delta Plan (Plan) for the San Joaquin River and its tributaries at the Merced River confluence and downstream. In 2018 it adopted the objective to release between 30 and 50 percent of the February-June unimpaired flows of those tributaries for water quality and fish habitat improvement. The SWRCB has indicated the upper San Joaquin River (above the Merced River confluence) would not be subject to this objective while the Program is being implemented. However, the SWRCB has stated the upper San Joaquin River may be included in future updates of the Plan if the results of Program implementation are not satisfactory.

d) Climate change is and will have impacts on the San Joaquin River watershed. The specifics of these impacts are unknown but will potentially result in a more volatile hydrology for the watershed (e.g., wetter wet years and drier dry years than the historic record).

e) The Sustainable Groundwater Management Act is in place and could start to have substantial impacts on land and water use in the Restoration Area.

5.2 Continuing Challenges

In discussing the continuing challenges facing the Program, it is helpful to reflect on the path traveled by the Program from 2006 to 2023. The Settlement between the Plaintiffs (NRDC *et al*.), Defendants (Reclamation *et al*.), and Defendant Intervenors (the Friant Contractors) was signed in 2006. The Settlement is an agreement for a specified volume of water to be taken from the Friant Contractors contractual supply and instead released down the San Joaquin River, with Reclamation also undertaking various river improvements to allow for Restoration Flows and salmonid passage. From the Settlement, Paragraph 2:

> *The Parties agree that a goal of this Settlement is to restore and maintain fish populations in "good condition" in the main stem of the San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish (the "Restoration Goal"). The Parties also agree that a goal of this Settlement is to reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in this Settlement (the "Water Management Goal").*

And from Paragraph 4:

The Parties acknowledge that, in addition to certain specified obligations, this Settlement establishes a framework for accomplishing the goals of this Settlement, specifically the Restoration Goal and the Water Management Goal, and that the accomplishment of those goals requires the performance of activities, such as environmental review, design, and construction, the details of which will be developed subsequently under the terms of this Settlement. The Parties further acknowledge that the implementation of this Settlement will occur over many years and agree to cooperate in good faith to achieve the goals of this Settlement.

A schedule and budget for implementing the Settlement was developed, although the parties to the Settlement realized that there may be disruptions, delays, and unforeseen circumstances that may delay implementation or drive-up costs.

5.2.1 Third party impacts

The Settlement parties recognized that federal authorization was required for several aspects of Settlement implementation and worked with congressional delegations to craft the "San Joaquin River Restoration Settlement Act". The Act directed the Secretary of the Interior to design and construct facilities and to acquire property as described in the Settlement, and also authorized funds to be appropriated for implementation. Importantly, though, the Act also addressed concerns from various stakeholders about impacts of the Settlement (characterized as "third party impacts").

During Congressional hearings while considering the Act, several stakeholders who were not party to the Settlement voiced concerns about potential impacts. As a result, the Act contains several provisions intended to safeguard the interests of these stakeholders, including:

a) Requiring reintroduction of Spring-Run Chinook pursuant to Section 10(j) of the Endangered Species Act;
b) Avoiding any material adverse impacts to third parties from groundwater seepage;
c) Avoiding any impacts on contract water allocations for CVP long-term contractors other than the Friant Contractors, and
d) Mitigating impacts (of implementation of the Settlement) on adjacent and downstream water users and landowners (third parties).

The Act was signed into law in 2009; however, the 2006 Settlement was not revisited to accommodate the additional obligations that Congress had placed upon the Program. In addition to design, compliance with state and federal environmental requirements, land acquisition and water rights proceedings that would be expected to underpin Settlement implementation, the Act also required a 10(j) designation, consultation with virtually any stakeholder who might seek to claim a third-party impact, and a substantially protracted implementation schedule as a result. Reclamation has adopted a very cautious approach to identifying potential third party impacts and has sought to mitigate those potential impacts in advance, rather than identifying impacts during the course of implementation and then working to mitigate as needed. As will be described in more detail below, this cautious approach has resulted in substantial delay and increased cost in implementing Paragraph 11 and 13 actions in the Settlement. Reclamation did not seek eminent domain for required real estate until more than 15 years after the Settlement was executed, choosing instead to enter lengthy purchase or easement negotiations for most parcels acquired. In particular, extensive measures to avoid any seepage impacts whatsoever to landowners near or

adjacent to the river (despite those same parcels suffering greater seepage or inundation impacts from repeated flood control release occasions), has severely limited the ability to release Restoration Flows.

Many of the potential third party impacts were identified during the hearings on the Settlement[10], or in a subsequent Congressional Research Services report[11] at CRS 17-18.A list of potential third party concerns regarding implementation of the Settlement identified during the hearing included:

- *potential flooding and loss of crops and property in areas without adequate river channels;*
- *possible operational constraints related to the protection of reintroduced salmon under the Endangered Species Act (ESA; 16 U.S.C. §§ 1531-1543);*
- *potential impacts on existing salmon populations in San Joaquin tributaries and associated water uses;*
- *potential effects on surface and groundwater supplies, and water rights; and*
- *adequate program funding for Settlement implementation and other non-San Joaquin restoration projects (e.g., Trinity River restoration).*

Most of these anticipated impacts either never occurred, or were mitigated (for example, avoiding ESA impacts to third parties by designation of reintroduced spring-run Chinook salmon as a Nonessential Experimental Population). There were some potentially substantive impacts that Reclamation worked diligently to avoid or mitigate; however, more recently various relatively trivial operational details and design decisions are being elevated to the level of third-party impacts (e.g., who has control of a particular gate or level setting, even for facilities owned by Reclamation). This raises a concern about stakeholders maneuvering to either ensure implementation of the Program to the benefit of specific stakeholders, or to extract financial or other concessions from the Program.

Unless Reclamation can develop a more refined and narrow definition of "third party impacts", or unless Congress can update the Settlement Act to reflect current circumstances, the delays precipitated by the Settlement Act will continue.

5.2.2 Mendota Pool Dewatering

The owner of Mendota Dam petitioned Reclamation to have Restoration Flows stopped for a period of time in 2023 to allow inspection and maintenance of the dam. The request from the owner of the dam represented that the dam "has been historically dewatered every few years to perform a safety inspection" which suggests a routine type of activity. Reclamation avowed there was no alternative to granting the request based on the Settlement Act, water rights, and other authorities; however, no summary of the analysis was provided. It was not apparent that Reclamation nor the dam owner has sought or received any authorizations (e.g. ACOE 401 or 404 permit, or CDFW 1600 permit), nor considered alternatives to the dewatering (e.g. dewatering at a time when biological impacts would be minimal or conducting inspections in the wet using

[10] *Oversight Hearing on The San Joaquin River Restoration Settlement Act,* before the Water and Power Subcommittee of the Committee on Resources, U.S. House of Representatives, (September 21, 2006).

[11] San Joaquin River Restoration Settlement, November 9, 2007

cofferdams or other mechanisms). This dewatering of the San Joaquin River to facilitate a relatively routine inspection, without permits or consideration of approaches to minimize impacts to the Restoration Goal, sets a poor precedent and a low bar for dewatering for the convenience of owners of facilities or levees to be granted dewatering privileges for routine activities.

Reclamation and the dam owner did work diligently to minimize the duration of the outage and to mitigate flow impacts and were largely successful in those efforts. Flows from Friant Dam were reduced for approximately two weeks, and the San Joaquin River channel never completely dried (although low flows in the 10's of cfs were present in Reaches 2B and 3).

5.3 Continuing Challenges, as identified in Previous Annual Reports

In Annual Reports going back several years, a number of key challenges persist across multiple years. Several are listed here:

From the 2014 RA Annual Report:

Reclamation staff spends tremendous time and resources interacting with stakeholders, across almost all facets of the Program. The Restoration Program is essentially a public program (implemented by state and federal agencies), that will impact thousands of square miles, hundreds of thousands of people, and will have substantial economic implications for effected stakeholders. It is not clear that the original Settlement Agreement envisioned the level of resources that would be necessary to fully integrate a wide diversity of stakeholders into almost every single Program decision.

It is not clear that the original Settlement Agreement, nor early year Program scheduling and budgeting efforts grasped the true extent of stakeholder involvement, and the extensive resources that would need to be dedicated to that stakeholder involvement as the project transitioned from early planning phases to implementation phases. It is possible that stakeholder scrutiny, and required stakeholder interaction, could continue to increase as the Program enters into large-scale construction projects.

From the 2015 RA Annual Report: *The Program will need to procure, mitigate, or secure thousands of acres of land in fee, via easement, or as some sort of mitigation. Mitigation for seepage impacts (up to 20,000 + acres assessed, easement procured and/or otherwise mitigated), land for construction (10,000 acres plus, depending on alignments, in fee or for construction access), and land for mitigation (potentially several thousand acres for agricultural lands preservation and giant garter snake habitat mitigation). In total, land payments to secure fee title, easements, or to address mitigation obligations will total hundreds of millions of dollars. The federal process for valuing and securing land or easements is exacting and slow; the vast area to be addressed in some way by the Program will make this a formidable challenge for the duration of the Program.*

From the 2017 RA Annual Report, Schedule and Budget Concerns: *Implementation of the Funding Constrained Framework within the budget and schedule agreed to by the Settling Parties*

and stakeholders will require relentless focus on schedule and budget efficiency by the Program, as well as anticipation of challenges, continuous marshalling of support from elected officials as well as other departments within Reclamation, and constant communications with a bevy of stakeholders.

Also from the 2017 RA Annual Report: *Program staff attrition is a constant challenge. The Program attracts highly capable staff and is a highly challenging work assignment. For a variety of reasons (moving on, and usually up) Program staff have ample opportunities to find other positions. The Program does not particularly plan for vacancies (e.g. all key staff find, recruit and train their prime lieutenant); thus, turnover of key staff is always a disruption to progress of the Program.*

5.4 Challenges That Remain From the 2022 RA Annual Report

As described above, there are various challenges that have vexed Program implementation virtually since the outset of the Program – essentially, these are permanent challenges to the program. These challenges were all identified in 2022 and are restated here, with updates as warranted.

5.4.1 Forthcoming Funding Challenges

2022 Summary: To date, the Federal commitment and expenditures for Settlement-related programs and facilities has been over $500M, with additional State commitment and expenditures of over $135M. Unfortunately, remaining construction funding needs (for completion of the Paragraph 11(a) projects) will be over $750M, in addition to ongoing annual Program funding for administration, required monitoring and accounting, and various prevention, mitigation and enhancement measures required by the Program permits and authorization documents.

Unfortunately, both Federal and State funding commitments to the Program have been declining. CVP discretionary funding for the Program has declined from $35M/year in 2016 – 2019 to less than $21M in 2022, 2023 and 2024 fiscal years. The State will have sufficient funding in current appropriations to complete the SCARF hatchery and complete various staffing assignments through 2024, but there is minimal or no funding beyond that point.

It will be an urgent matter for the non-Federal Settling Parties to find ways to advocate for additional funding from both Federal and State sources in the near term, to ensure sufficient funding availability in FY 2025 and beyond.

2023 Update: All Parties to the Settlement are actively working to secure additional funding for the Program; however, the federal budget picture is opaque. This remains a formidable challenge.

5.4.2 State Participation Required

2022 Summary: The San Joaquin River Settlement resulted in a river restoration program led by the Federal government to mitigate for the impacts of its dam construction and water diversion operations. However, although this effort is led by and largely funded by the Federal government,

there will be tremendous benefits to the state of California once the Program is fully implemented. Additionally, a restored San Joaquin River will fall much more under the State's dominion and control than the dry riverbed that existed pre-Restoration.

For example, the SWRCB has an important role in monitoring, accounting for, and enforcing flows in the San Joaquin River, to assist in avoiding or minimizing avoidable losses from groundwater-induced pumping or unauthorized surface diversions, and to generally help to ensure that either Settlement or SWRCB water rights terms are in place and enforced for the benefit of the public trust.

Likewise, the CDFW will have a leading role in monitoring biological conditions on the river, and evaluating whether riverine resources are maintained in good condition (the Settlement was born out of a lawsuit that included an allegation that Reclamation was not preserving fish downstream of Friant Dam in good condition, pursuant to California Fish & Game code §5937). In addition, CDFW will soon complete the SCARF conservation hatchery that will substantially increase Chinook salmon restoration on the San Joaquin River.

In addition, the California Department of Water Resources (DWR) has led numerous initiatives in support of the Restoration Program, primarily focused on channel capacity in Reaches 2-5 and sediment management planning in Reach 1. This State support has been valuable for the Program to date; however, an even stronger lead State role will be required. Once construction of the Paragraph 11(a) improvements has been completed, Reclamation will in many ways revert to managing federal water storage and delivery facilities, and the key State agencies (SWRCB, DWR, and CDFW) will need to play a lead role in prohibiting any activities that would not be in accordance with State regulations and policies. If anything, State agencies need to increase funding, presence, and engagement with the San Joaquin River to better prepare for the future handover of many river restoration and management responsibilities.

2023 Update: California state-wide budget shortfalls have translated to the Program, with CDFW and DWR Program-specific budgets at a minimum. The Settlement Parties are working to request additional funding for the state-specific Program functions such as the SCARF, biological monitoring and DWR design support.

5.4.3 Stakeholder Challenges

2022 Summary: As described in previous Annual Reports, there are many stakeholders (landowners, operators who utilize the river for water conveyance, nearby entities or facilities potentially impacted by Program operations, and landowners adjacent to the San Joaquin River) with an interest in, or potentially impacted by, the Program. Reclamation has worked with numerous landowners to secure access, easements, or fee title for lands where Project facilities or impacts will occur. Many of those landowner interactions have been amicable, many have been protracted, and a handful have been adversarial. To date, Reclamation on behalf of the Program has not undertaken eminent domain or condemnation for a parcel, despite having the ability and authorization to do so as a last resort. As a result, progress on key facilities (e.g., design and construction of the Compact Bypass) has been delayed for years.

Real estate actions have been a source of cost and delay for the Program since the advent of Program activities, with occasional improvements in the process. Unfortunately, completion of

real estate actions is likely to be a continued source of cost and delay throughout the completion of construction of Paragraph 11(a) activities. Escalation of construction costs, in combination with program delays, have contributed to substantially higher costs than originally predicted.

2023 Update: This remains a substantial challenge for the Program.

5.4.4 Biological Challenges

2022 Summary: There continues to be numerous biological and fishery challenges with achieving the Restoration Goal, some of which were known or suspected during the crafting of the Settlement and others that have come to light during the early phases of reintroduction and restoration. The Program and TAC continue to work to better understand and remediate various challenges.

Flow challenges (mostly related to conveyance capacity status and high seepage losses everywhere in the river) and in-river temperature challenges (due to the physical limitations of Millerton Lake's small reserve of cold water) have been known for some time, and quantification of those challenges under different operations scenarios continues. Biological challenges, such as what appears to be relatively low salmon egg-to-emergence success, and what appear to be relatively high predation levels of juvenile salmon, were only suspected when the Settlement was crafted and are currently receiving considerable study. The biological study program that the Program and Implementing Agencies are pursuing in the river cover all of the in-river life stages as well as many habitat types and areas and will yield results and conclusions that will ultimately allow the Restoration Goal to be successful. Unfortunately, due to the funding challenges identified above, study programs are now less robust than in prior years.

2023 Update: Numerous biological and fishery challenges to the implementation of the Restoration Goal remain; however, the monitoring and study work accomplished each year by the Program's Implementing Agencies helps to better understand the causes behind the challenges. With completion of river passage and flow improvements, adaptive management will start to allow relief from some of these biological stressors.

5.4.5 Operations Challenges

2022 Summary: Key operational issues or concerns were identified and discussed within the Program and Reclamation's South-Central California Area Office (SCCAO), and with stakeholders including DWR, U.S. Geologic Survey (USGS), Central California Irrigation District (CCID) and Henry Miller Reclamation District No. 2131 (HMRD). As of 2022, high priority operations issues continued to include:

- Excess seepage losses (much greater than anticipated in Exhibit B of the Settlement) in several reaches of the river, most notably Reach 1 and Reach 4 (Exhibit B assumed the use of the natural river channel in Reach 4B rather than the East Side Bypass, thus the high flow loss rates in the East Side Bypass were not anticipated).
- Flow changes by non-Program operations or diverters to meet demands or targets that cause substantial fluctuations in Restoration Flows, notably observed at Gravelly Ford and below Sack Dam.

- Substantial unexplained swings in river flows, potentially from changes in seepage rates or from unauthorized or unreported water injections, withdrawals, groundwater pumping, and/or transfers.

The Program has made, and continues to make, progress on addressing operational issues such as flow changes, particularly for the GRF and SDP[12] compliance points, and coordinated river operations are much improved from just a few years ago. However, resolving losses due to surface diversions, groundwater pumping, and monitoring issues will continue to be challenging, as most are not directly under the control of Reclamation and will involve working with the SWRCB, landowners, diverters, and other river operators to solve.

As described elsewhere in this Annual Report, the TAC, in conjunction with Program and SCCAO staff, worked to better characterize and understand these operational issues (TAC contributions to synoptic flow measurements, water rules initiatives, water temperature modeling, cold water pool management, and comments on Groundwater Sustainability Plans (GSP's) are prime examples).

2023 Update: Seepage losses and undisciplined non-Program operations continue to be a challenge for ensuring that Restoration Flows released from Friant Dam pursuant to the Settlement actually remain in the San Joaquin River to support the Restoration Goal.

5.4.6 Flow-Related Challenges: Transition Between Years with Restoration Flows

2022 Summary: Exhibit B has Spring Flexible Flow provisions, which allows water from the Restoration Year that commences on March 1 to be utilized as early as February 1 (during the previous Restoration Year), either in place of the prior Restoration Year flows or as a supplement. This is particularly useful when a wetter Restoration year follows a drier year, as a portion of any shortfalls from the earlier drier year may be partially alleviated by the ability to transfer flows from the upcoming wetter water year.

However, no equivalent provision allows water to be shifted from the current Restoration Year to the following Restoration Year; thus, if the current year is wetter and is followed by drier conditions, no excess winter water may be used to ease shortages after March 1. Therefore, it is possible for Restoration Flows to drop precipitously from the end of February to March 1 without the ability to smooth the transition. This issue remains an outstanding issue and recommendation from the previous Annual Report.

This phenomenon occurred in early 2020. Restoration Year 2019 was classified as a "Wet" Restoration Year type, and Restoration Flows of 235 cfs past GRF were scheduled through February. Restoration Year 2020 started out with a "Dry" classification, which fell to "Critical High" by the February Allocation. Although subsequent Allocations returned to only "Dry" conditions, the prospect of falling from 235 cfs to 100 cfs or less at GRF overnight was real.

A transfer of some 10,400 acre-feet from February to March 2021 was eventually secured through a work-around involving several Friant Contractors and an Unreleased Restoration Flows (URF)

[12] GRF and SDP are abbreviations used for the flow measurement points at Gravelly Ford (GRF) and downstream of Sack Dam (SDP)

exchange. However, the level of effort required to affect the exchange amounted to literally hundreds of hours by Program and Reclamation Contracts staff, Friant Contractors and the RA.

To date, exchanges have been utilized on two or three occasions to move water forward between Restoration Years; however, the exchanges have not been an efficient tool to move a modest amount of water. A more streamlined process, or a simple and modest carry forward allowance (e.g., 5 to 10 TAF), with specific rules for use (e.g., any carry-forward Restoration Flows must be used in March) would help to bridge future wet year-to-dry year transitions. Early season (January and February) forecasts and allocations are often relatively imprecise and are substantially revised in March and later forecasts and allocations. For context, "connectivity flows" to keep the San Joaquin River connected downstream of GRF at a minimal level require about 165 cfs at GRF, depending on season and weather conditions. A 165 cfs flow at GRF for the month of March would equal approximately 10 TAF.

Recommendation: Reclamation should work with the other Settling Parties to find a way to ensure modest February-to-March flexibility for Restoration Flow shifts, to allow better management of wet year-to-dry year transitions.

2023 Update: This recommendation has not yet been addressed.

5.4.7 Flow-Related Challenges: Conveyance Capacity Status

2022 Summary: Conveyance capacity for Restoration Flows remains largely constrained by groundwater levels and the need to avoid impacts to adjacent landowners due to real or perceived seepage potential associated with Restoration Flows. Although the Program has undertaken extensive efforts to model and monitor groundwater levels to assess seepage impacts, the shallow (within 20 feet of surface) groundwater interactions are complex and influenced by multiple factors. Low quality or inconsistent data from monitoring wells, variation in well response to river flow changes versus other influences, and different irrigation or other operating conditions are all challenges in assessing river-derived versus other factor groundwater impacts.

As of 2022, the most limiting reaches for Restoration Flows due to seepage were Reaches 3 and 4A. Channel capacities in Reach 3 are limited to about 800 cfs (subject to flow bench evaluation), inclusive of both Restoration Flows and deliveries to Arroyo Canal, although this reach has a flow capacity of 4,000 cfs for flood flows. Channel capacities in Reach 4A were limited to about 300 cfs of Restoration Flows, although this reach also has a capacity of 4,000 cfs for flood flows.

Various updates to the Seepage Management Plan are underway, which may serve to slightly reduce seepage limitations in some reaches. In addition, there were 6 seepage realty actions in process as of late 2022, with easement purchase in late 2023 or sometime in 2024 depending on the speed of appraisals, negotiations, and contracts. The seepage realty actions are targeted at several of the most-limiting constraints in Reaches 3 and 4A, so hopefully in-channel releases can be increased by the 2024 or 2025 Restoration Year. However, substantial resolution (e.g., flows up to the full intended Settlement levels) may be a decade away and likely constrained by funding availability.

Channel capacity constraints prevent the Program from releasing the full Restoration Flows and limit the progress and effectiveness of the Restoration effort. These constraints will

remain until Reclamation is successful in resolving key capacity limitations in the Restoration Area.

2023 Update: Conveyance capacity and seepage limits in 2023 remained as they were in 2022. Table 1 above shows channel capacity limitations; those limits are further reduced by seepage constraints. The Reach 3 seepage limit is 800 cfs (inclusive of both Restoration Flows and deliveries to Arroyo Canal, and in Reach 4A is 300 cfs. A handful of seepage actions (easement purchases) are in progress that may slightly relieve the most constraining conditions, substantial improvement in seepage limitations is likely to be years into the future.

5.4.8 Paragraph 11 Implementation Challenges

2022 Summary: As of the end of Restoration Year 2022, the 30% design level was completed for major facilities (the Arroyo Canal/Sack Dam complex and the Compact Bypass civil structures). There were no 10% designs in hand for the remaining canal and levee projects (South Canal, North and South levees). At this juncture, it doesn't seem likely that construction could commence on any of the major structures prior to 2025 at the earliest, and construction on some structures or levees may not commence until 2026 or later. Separate from the construction timeline, current well-reported inflation and supply chain issues will certainly have an impact on the cost of the projects.

The Settlement does not commit the Parties to completion of Paragraph 11 facilities by any date certain; however, 2025 will be 20 years after the execution of the Settlement and 17 years after the passage of the Settlement Act (Title X, Subtitle A of Public Law 111-11).

In several other RA Annual Reports (most recently in 2021), concerns were expressed about the implementation schedule and budget for Program implementation and urged a relentless focus on cost reduction and implementation schedule. At this juncture, implementation of the Paragraph 11 projects will likely not be completed until well past 2025 and will ultimately cost considerably more than currently projected. These concerns have been shared with the non-Federal Settling Parties, with senior Program staff, and with Reclamation regional management.

It is likely that the schedule delays will have substantial cost implications as well. In California, construction costs from early 2021 to early 2023 have increased by as much as 30%.[13] The slow pace of design and construction will have real consequences to overall Program costs. Coupled with the funding challenges discussed above, there is a risk of the Program being in a state of "partial completion" for some time into the future.

2023 Update: The timeline for Paragraph 11 implementation has not accelerated. It is possible that an initial construction contract for work at Arroyo Canal/Sack Dam may be in place in 2025 with work in 2026, but that is not certain. There is no current schedule or budget for other Paragraph 11 projects. Construction of at least some phases of the 2B Compact Bypass project will be necessary to allow volitional fish passage past Mendota Dam, and completion of the 2B levees project will be necessary for relieving channel capacity constraints in Reach 2B.

[13] DGS California Construction Cost Index CCCI

5.4.9 Additional Considerations for Restoration Flow Guidelines

2022 Summary: 2023 brought a return to extended periods of flood control releases to the San Joaquin River from Friant Dam, last seen in 2019 and 2017. As during those two years, the transition from flood control releases to Restoration Flows was challenging, reflecting the very different Friant Dam operating objectives of dam operators and the Program.

Reclamation operators at Friant Dam have sole control (in consultation with the Army Corps of Engineers and upstream dam operators) over river releases during periods of flood control releases to best manage the reservoir for safety. However, once the peak of high inflows to the reservoir has passed and normal release operations are set to resume, dam operators seek to maximize storage in the reservoir, at times to the detriment of Restoration Flows to support the Restoration Goal. A separate memo outlining the impacts to the Restoration Goal of recent flood flow ramp down operations will be submitted, and key examples will include:

- In 2017, San Joaquin River flows were ramped down from flood control releases to Restoration Flow releases very quickly, with daily average flows falling from 9,000 cfs to 500 cfs in 20 days, and ramp down from a daily average of 3,820 cfs on July 10 to a daily average of 500 cfs on July 14, a period of only 4 days.
- Also in 2017, coordination of flood control release ramp down with downstream operators was deficient, resulting in zero, or near-zero flows for a two-week period in Reach 4 during and after flood control release operations.
- In 2019, Reclamation filled the reservoir early, utilizing all available flood space. For example, on July 1, the Corps of Engineers specified Millerton Lake storage level was 422 TAF while the actual Millerton Lake storage was 515 TAF. This resulted in an extended period of releases to the San Joaquin River as the only mechanism to address any Millerton Lake inflow variations. This in turn reduced the cold pool in Millerton Lake (needed for late summer temperature control), and reduced flexibility for shifting flows to the summer due to potential water supply impacts.

2023 Update: In 2023, Reclamation again filled Millerton Lake early. By late June, consensus estimates showed the likelihood of up to 600 TAF of inflow to Millerton for the month of July alone. On July 1, the reservoir was already at 444 TAF of 520 TAF capacity, with capacity for only 355 TAF to flow out via the canals. As a result, the additional water had to be released via the river, resulting in a steep ramp down of flood flows (2,400+ cfs to 400 cfs in six days), reduced the cold-water pool in Millerton Lake, and again reduced flexibility for shifting Restoration Flows to the summer due to potential water supply impacts.

6 Specific RA and TAC Activities Completed During 2023

The RA and TAC completed a variety of tasks during 2023 to support and contribute to Program implementation efforts as required by the Settlement. In addition to specific tasks assigned by the Settlement, the RA and TAC have broad latitude pursuant to the Settlement to consult with State and Federal representatives "on matters including, but not limited to, pre-permitting and pre-ESA consultation activities, sharing of information, and technical assistance during initial project development, planning, design, and implementation phases, and monitoring."[14] The following summarizes major RA and TAC activities for 2023:

- The RA provided Restoration Flow Recommendations throughout 2023. By the time of the first Recommendation (February 1, 2023), SCCAO had declared 'Uncontrolled Season' and was already making flood control releases to the San Joaquin River. Uncontrolled Season and flood control releases to the San Joaquin River remained in place until late July, when Restoration Flows resumed.

- In support of Restoration Flow recommendations, flow and river condition monitoring by the RA, TAC members, and Program staff was nearly continuous; additionally, one or two weekly flow and operations coordination calls hosted by the Program were attended by the RA and one or more TAC members. Additional meetings, calls, discussions, and flow scenario evaluations (including extensive flow and temperature modeling efforts) were undertaken by the RA and TAC to evaluate potential release scenarios in advance of each recommendation, particularly in January (first Restoration Flow Recommendation), around the end of flood control releases in July (resumption of Restoration Flows), and again prior to the dewatering of Mendota Pool (resumption of Restoration Flows).

- RA and TAC members worked on several water temperature monitoring, analysis, or modeling efforts with Implementation Agencies, including continuing to refine and utilize the empirical temperature/depth/volume tool for evaluating Millerton Lake temperatures and predicting the persistence of cold-water reservoir releases.

- The RA and TAC continued to work on initiatives to improve understanding of flow losses, diversions, flow accretions, gauging and accounting of flows on the San Joaquin River, including Restoration Flows.

- The RA and some TAC members participated in various meetings to update and refine the RFG's. In addition, the RA and TAC participated in discussions around improving the operational protocols, release targeting approach and water accounting for Reach 3 of the Restoration Area.

- The RA and TAC observed biological monitoring conducted by Program staff, including the release of adult spring-run Chinook salmon in Reach 1A downstream of

[14] Stipulation of Settlement, Exhibit D Paragraph C.9

Friant Dam, redd monitoring and rotary screw trapping efforts, and other data collection activities.

- The RA and TAC reviewed Program monitoring data, and discussed the results of the field monitoring studies with the Implementing Agencies. In particular, the RA and TAC tracked flow, temperature, and salmonid movement/migration data to inform current and future flow release decisions.

- The RA and the TAC were involved in numerous meetings and discussions regarding various Program initiatives, including:

  - Arroyo Canal/Sack Dam improvements process, including review and comment on various iterations of the Arroyo Canal Fish Screen and Sack Dam improvement facilities;

  - Monitoring seepage well status with regards to permissible Restoration Flows;

  - Input on fishery monitoring activities in response to flow release operations;

  - RFG meetings and RFG section drafting;

  - Weekly flow management conference calls;

  - Spawning and Incubation Small Interdisciplinary Group (SIG) and Draft Sediment Management Plan development; and,

  - Participation in Millerton Forecasting Advisory Committee now entitled the "Upper San Joaquin Watershed Forecasting Discussion" group.

- The RA and individual members of the TAC organized and led the following initiatives working with the Program, non-Federal Settling Parties, and Implementing Agencies:

  - Refinement of Excel-based water temperature gaming tools;

  - Various field trips to the San Joaquin River to observe biological study work and operations; and,

  - Coordination with Program staff and CVPIA staff on improved data management approaches and systems.

Monthly TAC meetings Convened by the RA: Monthly coordination calls involving TAC members were convened to address restoration issues, updates on meetings recently attended by TAC members, and general program updates. These meetings (conference calls) were useful in improving coordination among TAC members. There were no in-person TAC meetings in 2023.

RA Weekly Telephone Conferences with the Program Manager and Key Staff: The RA met via telephone on Monday mornings for an hour or more with the Program Manager and key senior Program and Implementing Agency staff throughout 2023 to discuss upcoming events, program schedule, emerging issues, coordination of efforts and other matters.

RA and TAC Member Participation in Regular Water Quality, Monitoring, and Flow Scheduling Conference Calls: The Program holds weekly conference calls involving the Implementing Agencies, Settling Parties, and RA/TAC to address water quality, flow monitoring, and flow scheduling issues. These meetings contributed to improving communication between the various Program participants on a range of flow scheduling and monitoring needs and activities.

Contribution to Technical Products of the Program and Implementing Agencies: The RA and TAC contributed (drafting, editing or proofreading) several technical work products produced by the Program and/or individual Implementing Agencies, including:

- Work products from the SIG, including the Draft Sediment Management Plan and the Phase 1 Spawning Habitat Improvement Plan.
- Continued refinement of the empirical reservoir and river temperature forecast models jointly operated by the Program and the TAC.
- Provided design and planning feedback on Arroyo Canal Fish Screen.

7 Priority RA/TAC Tasks for 2024

Due to limited RA and TAC funding for 2023 and 2024, the expanse of projects to be undertaken will be limited compared to some past years. The following list includes proposed 2024 RA/TAC priority tasks (including both tasks as required by the Settlement and focus areas that the RA and TAC feel are important to achieve Restoration Program goals). Given anticipated funding constraints for the RA and TAC for the next two years, the level of engagement and number of priority tasks is reduced from previous years.

Routine or Required Tasks

- Participate in December – January runoff forecasting meetings/calls.
- Develop Flow Recommendations, which includes modeling, gaming, and temperature assessment of flow scenarios, plus outreach to participants including TAC and the Program's Fish Management Work Group (FMWG) as required based on hydrologic conditions and Allocations received from Reclamation.
- Produce RA Annual Report.
- Conduct regular TAC calls.

Priority Tasks to Continue

- Continue participating in RFG meetings, which focus on working on the resolution of RFG issues. This will also include the Reach 3 "rules and accounting" initiative that the Program is leading.
- Review/Comment on Arroyo/Sack Dam project when design updates are available.
- Comment on designs for Reach 2B, Compact Bypass and Arroyo Canal/Sack Dam projects, when design updates are available.

- Host a brainstorming session on the state of the science, monitoring, and modeling for groundwater/surface water interactions.
- Coordination with the San Joaquin River Conservancy and other potential implementers of gravel or habitat projects. For example, provide feedback on recharge project, rearing habitat restoration, and Flood-MAR projects at Ball Ranch in Reach 1.

Lower Priority/Defer to 2025 or beyond, depending on funding.

- Continued initiatives for the Water Rules group work.
- Update the Spring-Run Chinook Salmon Reintroduction Recommendation to incorporate lessons learned from Restoration Flow operations, juvenile and adult release and return data, water temperature monitoring results, and in light of current Program construction status, channel flow capacity, SCARF and iSCARF funding, etc.
- Lead a "Lessons Learned" process with a focus on Restoration Flows and water temperatures, and how to improve progress towards the Restoration Goal. This would include assessing or gaming alternative reservoir release options for fisheries benefits and/or to preserve the Millerton Lake cold water pool.
- Participate in development of guidelines for third-party restoration or habitat projects on the San Joaquin River.
- Participate in the assessment of productivity limiting factors in the San Joaquin River.
- Complete the 2021 Dry River retrospective (waiting on FMWG for feedback and comments), possibly with additional insights from 2022 and 2023 operations.
- Interact with DWR and the Lower San Joaquin Levee District, to investigate a potential habitat pilot project in one of the flood bypasses.

8 2022 RA and TAC Expenditures

The following summary of expenditures was provided by National Fish and Wildlife Foundation (NFWF), the administrator of the grant that funds operations of the RA and TAC.

RA and TAC Expenditures, 2023

Restoration Administrator & Technical Advisory Committee Expenditures - 2023	
Organization	**2022 Expenditure Totals**
Tom Johnson	$126,277.01
Bill Luce Consulting	$10,577.20
Hanson Environmental Inc.	$9,357.80
McBain Associates	$49,137.65
The Bay Institute	$44,202.63
Trout Unlimited, Inc.	$5,995.00
FlowWest, LLC	$20,004.00
	$265,551.29
Restoration Administrator & Technical Advisory Committee Hours - 2023	
Organization	**2022 Hour Totals**
Tom Johnson	575.5
Bill Luce Consulting	54.8
Hanson Environmental Inc.	37
McBain Associates	298
The Bay Institute	248
Trout Unlimited, Inc.	29
FlowWest, LLC	88
	1330.30
NFWF Fee - 2023	$30,000.00
Task Order Expenditures & Hours - 2022	
Organization	
No Task Order expenditures in 2023	$0.00
Total Expenditures: RA, TAC, Task Orders, & Admin	***$295,551.29***

APPENDICIES

Appendix A: URF Revenues Appendix B: 2022 Flow Accounting

Appendix C: History of Millerton Unimpaired Runoff

Appendix D: Final Restoration Allocations

Appendix E: 2022 Hydroclimate and Outcomes

Appendix A: URF Revenues

Table E1 — URF Distributions (TAF)

Restoration Year	Gross Volume of URF Sales to Class 1	Gross Volume of URF Sales to Class 2	Net Volume of URF Sales to Class 1	Net Volume of URF Sales to Class 2	Gross Volume of URF put Into Exchanges	Net Volume of URF put Into Exchanges	Gross Volume of URFs Spilled	Gross Total URF
2013	–	–	–	–	12.694	12.694	–	**12.694**
2014	11.219	–	11.219	–	–	–	0.206	**11.425**
2015	–	–	–	–	–	–	–	**0**
2016	70.860	56.959	67.317	54.111	18.947	18.000	–	**146.766**
2017	5.474	364.967	5.200	346.716	2.491	2.366	–	**372.932**
2018	65.249	40.000	61.986	38.000	19.543	18.565	–	**124.792**
2019	–	326.954	–	310.607	16.298	15.482	22.509	**365.761**
2020	43.500	–	41.325	–	20.002	19.697	–	**63.502**
2021	–	–	–	–	–	–	–	**0**
2022	75.178	–	71.419	–	26.951	25.603	–	**102.128**
2023	–	372.048	–	353.446	–	–	–	**372.049**
Total	**271.480**	**1,160.928**	**258.466**	**1,102,880**	**116.926**	**112.407**	**22.715**	**1,572.049**

Table E2 — Expected URS Revenue for the restoration Fund

Restoration Year	Revenue Generated from URF Sales	Revenue Generated from URF Exchanges	Total URF Revenue
2013	–	–	–
2014	$3,470,650	–	$3,470,650
2015	–	–	–
2016	$9,686,790	–	$9,686,790
2017	$7,038,380	–	$7,038,380
2018	$6,123,858	$494,504	$6,618,362
2019	$6,393,286	$306,680	$6,699,966
2020	$8,922,481	$1,251,630	$10,174,111
2021	–	$525,000	$525,000
2022	$13,488,907	$1,909,267	$15,398,173
2023	$8,129,258	–	$8,129,258
Total	**$63,253,610**	**$4,487,081**	**$67,740,690**

Table E3 — URF Exchanges Returned to the Program (TAF)

Restoration Year	Volume Returned	Notes
2013	–	–
2014	11.425	From 2013 URF Exchange with FID, used for 2014 sales
2015	–	–
2016	–	–
2017	5.474	Returned from San Luis Reservoir, 5.200 net URF sold
2018	2.129	Returned from 2018 DEID exchange
2019	9.000	Returned to SLR from 2019 AEWSD and LTRID exchange, transferred to CVO for San Luis Unit supply
2020	0.487	Returned from FID from 2019 exchange
2021	10.425	Returned from multi-party 2020 exchange
2022	3.500	From 2016 URF Exchange with AEWSD
2023	10.167	3.500 AEWSD, 2.000 FID, 4.667 OCID
Total	**52.607**	

Appendix B: 2023 Flow Accounting

Flood management releases to San Joaquin River occurred January 5 to February 5, 2023, and March 8 to July 26, 2023. No releases for the Exchange Contract occurred during this Restoration Year. The final Restoration Allocation was 557.038 TAF. URF Sales and Exchanges removed from the Allocation totaled 373.859 TAF. Additionally, Unreleased Restoration Flow exchange returns of 10.167 TAF were released to the San Joaquin River, and 0 TAF of Buffer Flows. A total of 4.245 TAF was advanced into February 2023. The Restoration Allocation had a year-end balance of -0.002 TAF.

Table B – Restoration Flow Accounting and Unreleased Restoration Flows, and Holding Contracts, for the period February 2023 through February 2024.

Flow Period	Gravelly Ford 5 cfs requirement (TAF)	Other flows passing GRF (TAF)	URF sold or exch	Released Restoration Flow Volumes (TAF)						
				Continuity Flow	Spring Flexible Flow	Fall Flexible Flow	Riparian Recruitment Flow	Buffer Flow	Flexible Buffer Flow	URF returned
Feb1–Feb 28	–	–	–	–	4.245	–	–	–	–	–
Mar 1–Mar 31	9.219 [A1]	297.134	165.263	13.527	9.531	–	–	0	–	0
Apr 1–Apr 30	45.663 [A1]	458.132	0	11.901	11.008	–	–	0	–	0
May 1–May 31	47.324 [A1]	439.371	81.054	9.838	11.941	–		0		0
Jun 1–Jun 30	51.285 [A1]	320.110	96.000	9.521	–	–	4.600	0		0
Jul 1–Jul 31	48.532 [A1]	154.540	29.732	7.379	–	–		0	0	0
Aug 1–Aug 31	8.541	1.327	0	9.481	–	–	–	0		2.826
Sep 1–Sep 30	11.153	0	0	8.331	–	0.754	–	0		3.868
Oct 1–Oct 31	10.986	0	0	10.342	–	0	–	0		2.499
Nov 1–Nov 30	11.173	0	1.895	8.933	–	4.079	–	0	0	0
Dec 1–Dec 31	9.773	0	0	10.072	–	0	–	0		0.974
Jan 1–Jan 31	10.130	0.101	0	15.681	–	–	–	0	–	0
Feb 1–Feb 29	8.838	0	0	21.933	–	–	–	0	–	0
	272.616 [A1]	**1670.715**	**373.944**	**136.939**	**36.725**	**4.833**	**4.600**	**0**	**0**	**10.167**
				183.096 (allocated Restoration Flows)				**0** (all Buffer Flows)		
				183.096 (Restoration Flows affecting Friant water supply)						
				193.263 (Restoration Flows released to river)						
			557.040 (Restoration Allocation used))							
				2072.656 (Friant Dam releases – excludes removed URFs, Restoration Flows advanced into February, and excludes contributions from tributary inflows)						

A1. Calculations of the 5 cfs requirement are sensitive to gauge error at GRF or imprecision in Friant Dam release. The values for March through July are likely erroneously high and should instead be considered “Other Flows Passing GRF.”

Appendix C: History of Millerton Unimpaired Runoff

Water Year[A2]	Unimpaired Runoff [A3]	SJRRP Water Year Type[A4]
1901	3,227.90	Wet
1902	1,704.00	Normal-Wet
1903	1,727.00	Normal-Wet
1904	2,062.00	Normal-Wet
1905	1,795.40	Normal-Wet
1906	4,367.80	Wet
1907	3,113.90	Wet
1908	1,163.40	Normal-Dry
1909	2,900.70	Wet
1910	2,041.50	Normal-Wet
1911	3,586.00	Wet
1912	1,043.90	Normal-Dry
1913	879.4	Dry
1914	2,883.40	Wet
1915	1,966.30	Normal-Wet
1916	2,760.50	Wet
1917	1,936.20	Normal-Wet
1918	1,466.80	Normal-Wet
1919	1,297.50	Normal-Dry
1920	1,322.50	Normal-Dry
1921	1,604.40	Normal-Wet
1922	2,355.10	Normal-Wet
1923	1,654.30	Normal-Wet
1924	444.1	Critical-High
1925	1,438.70	Normal-Dry
1926	1,161.40	Normal-Dry
1927	2,001.30	Normal-Wet
1928	1,153.70	Normal-Dry
1929	862.4	Dry
1930	859.1	Dry
1931	480.2	Critical-High
1932	2,047.40	Normal-Wet
1933	1,111.40	Normal-Dry
1934	691.5	Dry
1935	1,923.20	Normal-Wet
1936	1,853.30	Normal-Wet
1937	2,208.00	Normal-Wet
1938	3,688.40	Wet
1939	920.8	Dry
1940	1,880.60	Normal-Wet
1941	2,652.50	Wet
1942	2,254.00	Normal-Wet
1943	2,053.70	Normal-Wet
1944	1,265.40	Normal-Dry
1945	2,134.63	Normal-Wet
1946	1,727.12	Normal-Wet
1947	1,121.56	Normal-Dry
1948	1,201.39	Normal-Dry
1949	1,167.01	Normal-Dry
1950	1,317.46	Normal-Dry
1951	1,827.25	Normal-Wet
1952	2,840.85	Wet
1953	1,226.83	Normal-Dry
1954	1,313.99	Normal-Dry
1955	1,161.16	Normal-Dry
1956	2,959.81	Wet
1957	1,326.57	Normal-Dry
1958	2,631.39	Wet
1959	949.456	Normal-Dry
1960	826.021	Dry
1961	647.428	Critical-High
1962	1,924.07	Normal-Wet
1963	1,945.27	Normal-Wet
1964	922.351	Dry
1965	2,271.19	Normal-Wet
1966	1,298.79	Normal-Dry
1967	3,233.10	Wet
1968	861.894	Dry
1969	4,040.86	Wet
1970	1,445.84	Normal-Dry
1971	1,416.81	Normal-Dry
1972	1,039.25	Normal-Dry
1973	2,047.59	Normal-Wet
1974	2,190.31	Normal-Wet
1975	1,795.92	Normal-Wet
1976	629.234	Critical-High
1977	361.253	Critical-Low
1978	3,402.81	Wet
1979	1,829.99	Normal-Wet
1980	2,973.17	Wet
1981	1,067.76	Normal-Dry
1982	3,317.17	Wet
1983	4,643.09	Wet
1984	2,042.75	Normal-Wet
1985	1,135.98	Normal-Dry
1986	3,031.60	Wet
1987	756.853	Dry
1988	862.124	Dry
1989	939.168	Normal-Dry
1990	742.824	Dry
1991	1,027.21	Normal-Dry
1992	807.759	Dry
1993	2,672.32	Wet
1994	824.097	Dry
1995	3,876.37	Wet
1996	2,200.71	Normal-Wet
1997	2,817.67	Wet
1998	3,160.76	Wet
1999	1,527.04	Normal-Wet
2000	1,735.65	Normal-Wet
2001	1,065.32	Normal-Dry
2002	1,171.46	Normal-Dry
2003	1,449.95	Normal-Dry
2004	1,130.82	Normal-Dry
2005	2,826.87	Wet
2006	3,180.82	Wet
2007	684.333	Dry
2008	1,116.79	Normal-Dry
2009	1,455.38	Normal-Wet
2010	2,028.71	Normal-Wet
2011	3,304.82	Wet
2012	831.582	Dry
2013	856.626	Dry
2014	509.579	Critical-High
2015	327.41	Critical-Low
2016	1,300.99	Normal-Dry
2017	4,395.40	Wet
2018	1,348.98	Normal-Dry
2019	2,734.77	Wet
2020	886.025	Dry
2021	521.853	Critical-High
2022	1059.492	Normal-Dry
2023	4506.923	Wet

A2 Water year is from Oct 1 through Sept 30, for example the 2010 water year began Oct 1, 2009. Unimpaired Runoff is based on Reclamation calculations, and hypothetical water year types are shown here; actual Restoration water year types are based on the final allocation, which may sometimes differ slightly from the calculated water year total.

A3 Also known as “Natural River” or “Unimpaired Runoff into Millerton” – This is the total runoff that would flow into Millerton Lake if there were no dams or diversions upstream. There was a lower level of precision prior to 1945. Friant Dam uses 1.9835 conversion from cfs to AF.

A4 The six SJRRP Water Year Types are based on Unimpaired Runoff and are not updated as climatology changes as per the Settlement. Critical-Low= <400 TAF, Critical-High=400-669.999 TAF, Dry= 670-929.999 TAF, Normal-Dry 930-1449.999, Normal-Wet 1450-2500, Wet>2500.

Appendix D: Final Restoration Allocations

Table D — History of Restoration Allocations

Year	Type	Date of Final Allocation Issuance [2]	Unimpaired Runoff Forecast in Final Allocation (TAF)	Restoration Allocation in Final Issuance (TAF)	Observed Unimpaired Runoff on Sep. 30 (TAF)	Unimpaired Runoff Forecast Error	Allocation Error
2009	Interim Flows			261.5	1,455.379	–	–
2010	Interim Flows			98.2	2,028,706	–	–
2011	Interim Flows			152.4	3,304.824	–	–
2012	Interim Flows			183	831.582	–	–
2013	Interim Flows			65.5	856.626	–	–
2014	Restoration Flows	Mar 3	518	0 [1]	509.579	+8.421 (+1.6%)	0 [1]
2015	Restoration Flows	Sep 28	327	0	327.410	-0.410 (-0.1%)	0
2016	Restoration Flows	Sep 30	1300.986	263.295	1,300.986	0 (0%)	0
2017	Restoration Flows	Jul 10	4,444	556.542	4,395.400	+48.600 (+1.1%)	0
2018	Restoration Flows	May 22	1,427	280.258	1,348.979	+78.021 (+5.8%)	+10.503
2019	Restoration Flows	May 20	2,690	556.542	2,734.772	-44.772 (-1.6%)	0
2020	Restoration Flows	Jun 19	880	202.197	886.025	-6.025 (-0.7%)	-1.345
2021	Restoration Flows	Jun 25	529	70.919	521.853	+7.147 (+1.4%)	0
2022	Restoration Flows	May 13	1072	232.470	1059.492	+12.508 (+1.2%)	+1.684
2023	Restoration Flows	May 18	4664	557.038	4506.923	+157.077 (+3.5%)	0

1. No water was provided under this Critical-High designation due to necessity for Friant dam to release flows for the Exchange Contract.
2. In 2018 with the completion of Version 2.0 of the Restoration Flows Guidelines, the date of final Restoration Allocation issuance was advanced from September 30 to May (or June under dry hydrologic conditions).

Appendix E: 2023 Restoration Allocation History, Hydroclimate, Forecasting Challenges, and Millerton Storage and Operations

This appendix documents the Restoration Allocation History in 2023 and provides additional detail on the 2023 water year (October 2022 through September 2023) hydroclimate and the resulting challenges in forecasting runoff.[15] Additionally it provides an overview of Millerton Reservoir operations.[16]

Restoration Allocation History

The progression of the Restoration Allocation from the Initial allocation on January 20, 2023, to the Final Allocation on May 18, 2023 is shown in Table 1. The methods and data used to develop the forecasts and allocations are described in the Restoration Allocations memos the Program issues on the dates in Table 1. The Restoration Flow Guidelines Version 2.1 provide guidance for the development of the Forecasts and Restoration Allocation.

Table 1: 2023 Restoration flow allocation history

Allocation Type	Issue Date	Forecast Blending Applied	Unimpaired Runoff Forecast (at forecast exceedance)	Year Type	Restoration Allocation at Gravelly Ford	Restoration Flows and URFs Released
Initial	January 20, 2023	0/100	3,403 TAF (at 50%)	Wet	556.542 TAF	0 (through January 19, 2023)
Updated	February 17, 2023	30/70	3,080 TAF (at 50%)	Wet	557.038 TAF	167.564 (through February 16, 2023)
Updated	March 14, 2023	0/100	4,537 TAF (at 50%)	Wet	557.038 TAF	179.992 (through March 13, 2023)
Updated	April 20, 2023	60/40 (0/0+50/+100/+200 offset)	4,569 TAF (at 50 %)	Wet	557.038 TAF	212.083 (through April 20, 2023)
Final	May 18, 2023	50/50	4,664 TAF (at 50%)	Wet	557.038 TAF	408.525 (through May 15, 2023)

Hydroclimate

The 2023 water year (October 2022 through September 2023) unimpaired runoff inflow to Millerton Lake of 4,507 thousand acre-feet (TAF) was 260% of average, the second highest in the

[15] Table 1, Figures 1 and 2, and hydroclimate and forecasting key points are derived from San Joaquin River Restoration Program (Program) and Millerton Joint Forecasting Team documents.

[16] Figure 3 is from the US Army Corps of Engineers

historical record, bringing an end to the 2020-2022 dry period (the 5th driest three consecutive years in the historical record). The Wet 2023 water year followed the Normal-Dry 2022 (San Joaquin River runoff 61% of average).

The San Joaquin River watershed above Friant Dam received 194% of its average precipitation in 2023 (CNRFC data). Most of the precipitation fell during two series of atmospheric rivers--the first series between December 27, 2022 and January 17, 2023, followed by a second series February 23, 2023 to March 15, 2023. Outside of this December-March period, November and August were also wet months, June was near-average, and the remaining months were below average.

The 2023 hydroclimate– rainfall, snow accumulation and depletion, temperature, and resulting runoff - had the following notable characteristics:

- 2023 had a record snowpack, exceeding 1969, 1983, and 2017. Five snow pillows and six snow courses set new records.
- Snow levels resulting in high-elevation rain were brief, limiting mid-winter runoff.
- Below-normal temperatures through mid-May resulted in a large low elevation snowpack later into the spring runoff season than normally occurs.
- The large snowpack melted slowly, resulting in steady snowmelt runoff and inflow into Millerton Lake through the summer.
- There is a waning influence of the 2020 Creek Fire on snowmelt runoff efficiency, which burned 38% of the watershed at low to middle elevations and due to soil and vegetation changes resulted in a temporary increase in the proportion of snowmelt that became runoff.

Runoff Forecast Challenges

Figure 1 plots the seasonal progression of the forecasts of the water year unimpaired runoff at Millerton Lake issued by DWR and the National Weather Service (NWS) via the California Nevada River Forecast Center (CNRFC). The Millerton Joint Forecasting Team's runoff estimate shown in Figure 2 was accurate within 3% after the second series of atmospheric rivers, thanks to the widening range of tools and improvements that enable a high level of forecasting precision. These improvements include:

- Five well-spaced Airborne Snow Observatory (ASO) LiDAR surveys of the watershed in 2023 (the 7th year)
- ASO data on snow albedo was relied upon more in 2023 to estimate incipient snowmelt.
- ASO data helped understand each snow pillow's bias.
- A Water Budget Model using runoff efficiency curves was tuned over the past 6 years with ASO data. A minimum of three flights are needed to obtain an accurate curve.
- Results from multiple tools and models can be compared.

However, the record-breaking 2023 snowpack presented additional challenges in 2023:

- Missing snow courses in northern portion of watershed due to staffing and safety concerns amplified uncertainty.
- Deep snowpack was challenging to core-sample accurately.

- Uncertainty about snowmelt rates in summer from the large, slowly melting snowpack. NWS forecasts tended to overestimate the effect of air temperature on melting, and the iSnobal model tended to melt the massive snowpack too fast.
- Uncertainty over snowpack density affects ASO data and models. There were virtually no density measurements at low elevations. Snow density measurements synchronized with aerial surveys are needed.
- Because only low-elevation snowmelt runoff occurred until mid-May, use of the Water Budget Model in 2023 was challenging.

The following measurement and analytical challenges compounded the uncertainty in runoff forecasts:

- The snow pillow network has several non-transmitting sites. Restoring those sites to functioning condition would improve fine-tuning of internal modeling products and comparison of assumptions with external products.
- Adding ground temperature and ground moisture sensors would improve cold content modeling and understanding of what triggers rapid snowmelt.

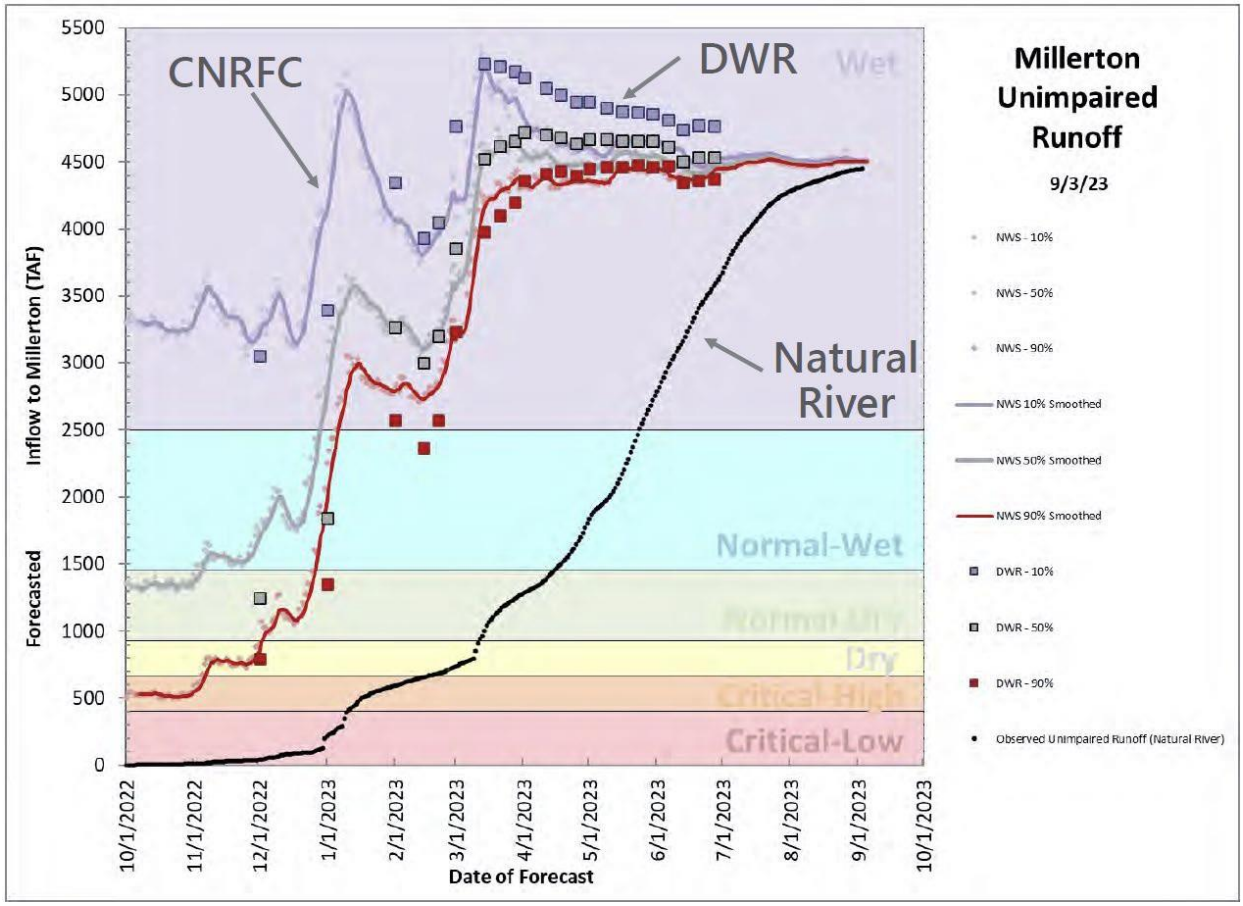

Figure 1. Plot of 2023 water year forecasts, including both NWS ensemble streamflow prediction forecasts and DWR forecasts.

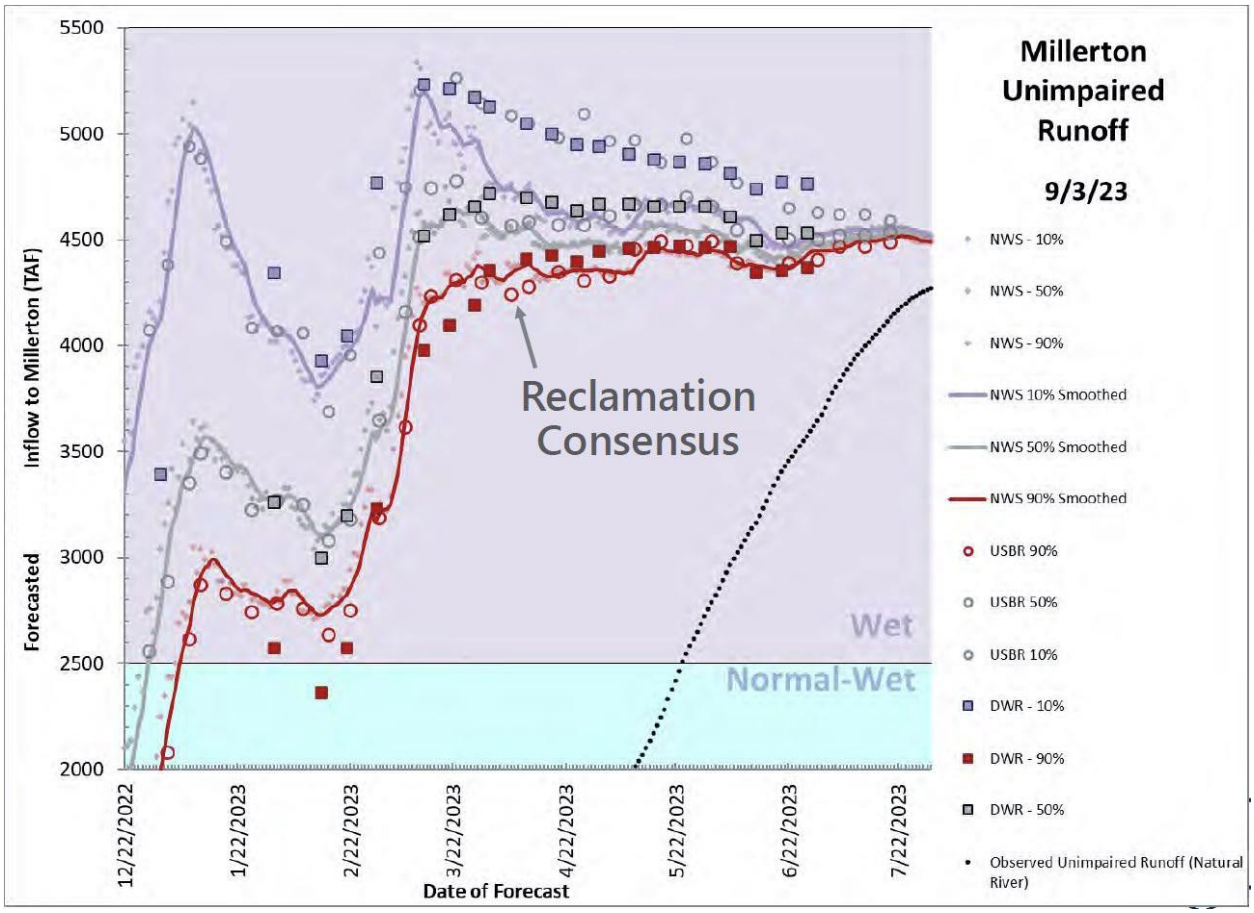

Figure 2. Plot of the Millerton Joint Forecasting Team's consensus forecast (USBR open circles labeled "Reclamation Consensus"), which blends NWS and DWR forecasts and gives weight to emerging models and information.

Millerton Lake Operations

Figure 3 plots (from top to bottom) the 2023 time series of:

a) Precipitation at Friant Dam. Most precipitation occurred in two series of atmospheric rivers, the first in December 2022 - January 2023 and the second in February 2023 - March 2023.
b) Lake storage volume (blue line) in relation to the allowable conservation storage (top of grey shaded area). Storage was near or above conservation pool limits January 2023 through July 2023.
c) Inflow (green line). During one warmer storm in early March, inflow peaked near 30,000 cfs, but otherwise runoff was moderated by cooler temperatures and slower snowmelt rates.
d) Outflow (orange line). Sum of river releases (for Holding Contracts, Restoration Flows, and flood control releases) and canal releases (Madera and Friant-Kern canals).

Flood control management releases occurred from January 5 through February 5, and again from March 8 through July 26, 2023.

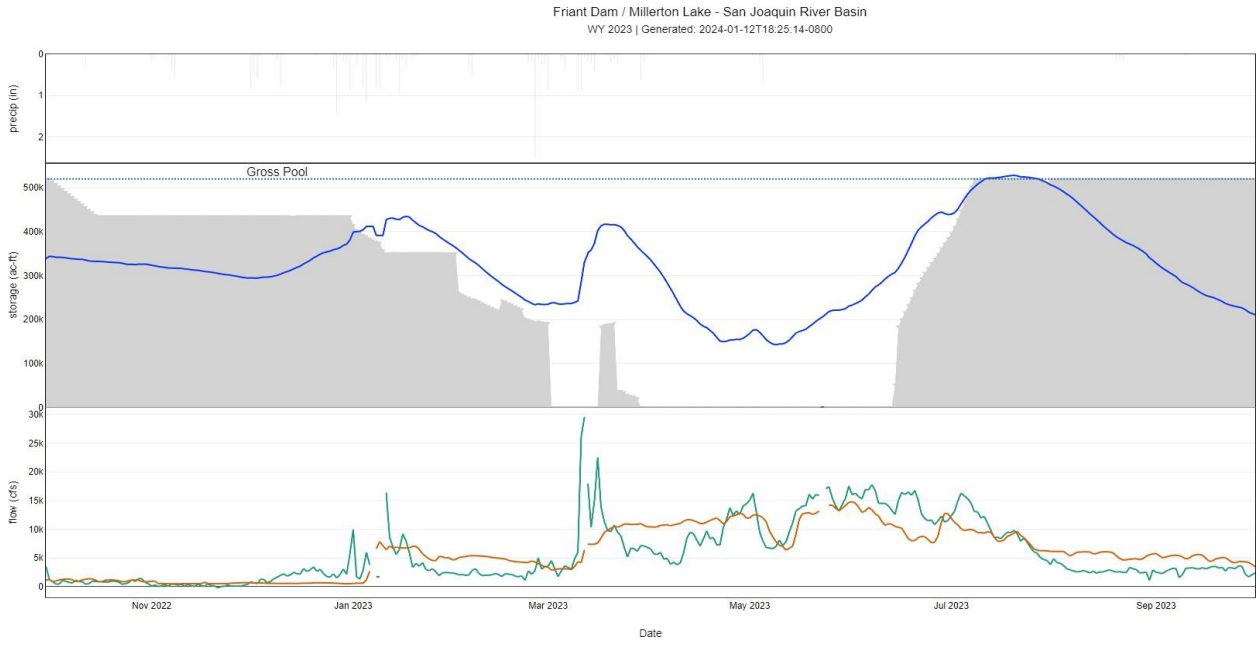

Figure 3. 2023 Water Year Millerton Lake Storage and Operations from Army Corps of Engineers. Grey is top of conservation storage in acre-feet, blue is reservoir storage in acre-feet, with gridlines at 100,000 acre-feet. Green is inflow in cfs, orange is outflow in cfs, with gridlines at 5,000 cfs.