SAN JOAQUIN RIVER
RESTORATION PROGRAM

Bureau of Reclamation
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Updated 2022 Restoration Allocation & Default Flow Schedule

February 18, 2022

Introduction

The following transmits the updated 2022 Restoration Allocation and Default Flow Schedule to the Restoration Administrator for the San Joaquin River Restoration Program (SJRRP), consistent with the January 2020 (version 2.1) Draft Restoration Flow Guidelines (Guidelines). This Restoration Allocation and Default Flow Schedule provides the following:

- Forecasted water year Unimpaired Runoff: the estimated flows that would occur absent regulation on the river. This value is also known as the "Natural River," "Unimpaired Runoff," "Unimpaired Inflow," or "Full Natural Flow," and is utilized to identify the water year type.
- Hydrograph Volumes: the annual allocation hydrograph based on water year unimpaired runoff, utilizing Method 3.1 with the Gamma Pathway (RFG-Appendix C, Figure C3) agreed to by the Parties in December 2008.
- Default Flow Schedule: the schedule of Restoration Flows in the absence of a recommendation from the Restoration Administrator.
- Additional Allocations: the hypothetical Restoration Allocations that would result from 10%, 50%, 75%, and 90% probability of exceedance of the Unimpaired Runoff forecast.
- Unreleased Restoration Flows: the amount of Restoration Flows not released due to channel capacity constraints, without delaying completion of Phase 1 improvements.
- Flow targets at Gravelly Ford: the flows at the head of Reach 2, and estimated scheduled releases from Friant Dam adjusted for the assumed Holding Contract demands and losses in Exhibit B.
- Restoration Budget: the volumes for the annual allocation, spring flexible flow, base flow, riparian recruitment, and fall flexible flow.
- Remaining Flow Volume: the volume of Restoration Flows released, the remaining volume available, and associated limitations and flexibility.

- Operational Constraints: the flow release limitations based on downstream channel capacity, regulatory, or legal constraints.

Consistent with Paragraph 18 of the Settlement, the Restoration Administrator shall make recommendations to the Secretary of the Interior concerning the manner in which the hydrographs shall be implemented. As described in the Guidelines, the Restoration Administrator is requested to recommend a flow schedule showing the use of the entire annual allocation during the upcoming Restoration Year or otherwise identify Unreleased Restoration Flows and categorize recommended flows by account, If a recommendation is not provided by the Restoration Administrator, the Capacity Constrained Default Flow Schedule (Table 6b) or the most recently approved schedule will be implemented.

Per the Guidelines, Reclamation will update the Restoration Allocation on a regular monthly schedule and may also update the allocation beyond that regular schedule when conditions warrant. **It is requested that the Restoration Administrator return a recommendation on or before March 1, 2022.**

Forecasted Unimpaired Runoff

Unimpaired Runoff represents the natural water production of a river basin, unaltered by upstream diversions, storage, or by export or import of water to or from other watersheds (a.k.a "Unimpaired Inflow" or "Natural River" or "Full Natural Flow"). It is calculated for the period of a water year. The forecast of the Unimpaired Runoff determines the volume of Restoration Flows available for the Restoration Year (i.e. the Restoration Allocation). Information for forecasting the Unimpaired Runoff includes:

- Observation of Unimpaired Runoff into Millerton Lake to support the water supply allocation[1];
- The California Department of Water Resources (DWR) Bulletin 120 latest update for San Joaquin River inflow to Millerton Lake Unimpaired Flow, and/or the most current DWR Bulletin Water Supply Index (WSI)[3];
- The National Weather Service (NWS) Ensemble Streamflow Prediction (ESP) Water Supply Forecast for the San Joaquin River at Millerton Lake[5];
- Other forecast models, ground-based observations, remotely-sensed observations, hydrologic models, analysis of historic patterns, and short-term weather forecasts as appropriate.

Table 1 shows the water year 2022 (October 1, 2021 to September 30, 2022) observed accumulated and forecasted water year Unimpaired Runoff into Millerton Lake. This table also includes the published DWR forecast, the DWR forecast adjusted for an expected runoff for the current month, the NWS forecast with and without a 7-day smoothing function applied to remove the day-to-day variance, and the NWS forecast with 7-day smoothing and adjustment for the expected runoff for the current month (Reclamation adjusts the DWR and NWS values by replacing the forecasted runoff for the current month with Reclamation's own estimate of runoff for the current month, which increases accuracy and incorporates the latest data). Figure 1a plots

DWR and NWS forecast values over the entire water year, while Figure 1b shows the most recent period in detail.

Table 1 — San Joaquin River Water Year Actuals and Forecasts at Millerton Lake, in Thousands of Acre-Feet (TAF)

	Forecast Exceedance Percentile				
	90%	**75%**	**50%**	**25%**	**10%**
Accumulated Unimpaired Runoff (“Natural River”) February 16, 2022 [1]	338.0				
Accumulated Unimpaired Runoff as percent of normal [2]	120%				
DWR, February 15, 2022 [3] (Published Value)	1,014	1,257[7]	1,500	1,867[7]	2,239
DWR, February 17, 2022 [4] (Runoff Adjusted)	1,023	1,260	1,497	1,856	2,216
NWS, February 17, 2022 [5] (Published Daily Value)	1,080	1,260	1,500	1,730	2,210
Smoothed NWS, February 17, 2022 [6] (7-day Smoothing)	1,158	1,316	1,544	1,835	2,319
Smoothed NWS, February 17, 2022 [4] (Runoff Adjusted)	1,155	1,315	1,543	1,835	2,320

[1] http://www.usbr.gov/mp/cvo/vungvari/milfln.pdf

[2] Based on average accumulation of Unimpaired Runoff

[3] B120: http://cdec.water.ca.gov/cgi-progs/iodir?s=b120, or B120 Update: http://cdec.water.ca.gov/cgi-progs/iodir_ss/b120up, or WSI: http://cdec.water.ca.gov/cgi-progs/iodir/WSI.2020 . April-July runoffs are converted to Water Year equivalents in this table.

[4] The adjusted data has been updated with the actual Unimpaired Runoff through the current date and projected out for the remainder of the month.

[5] https://www.cnrfc.noaa.gov/ensembleProduct.php?id=FRAC1&prodID=9

[6] The NWS smoothed data uses a 7-day triangular weighted moving average, where the most recent day (n) is given greater weight than each previous forecast day (n-1, 2, 3, etc.); this reduces noise stemming from ESP model input. The following formula is used: $((Forecast_{n} * 1) + (Forecast_{n-1} * 0.857) + (Forecast_{n-2} * 0.714) + (Forecast_{n-3} * 0.571) + (Forecast_{n-4} * 0.429) + (Forecast_{n-5} * 0.286) + (Forecast_{n-6} * 0.143)) / 4$

[7] Values at the 75% exceedance and 25% exceedance are interpolated.

The DWR Bulletin 120 forecast for February 1 (issued February 8) and updated February 15 was adjusted by Reclamation to better align with observed runoff conditions to date and projections for the remainder of the month (becoming the “Runoff Adjusted DWR values”). The NWS forecast has been smoothed and a similar adjustment made for observed runoff conditions to date. These steps are shown in Table 1.

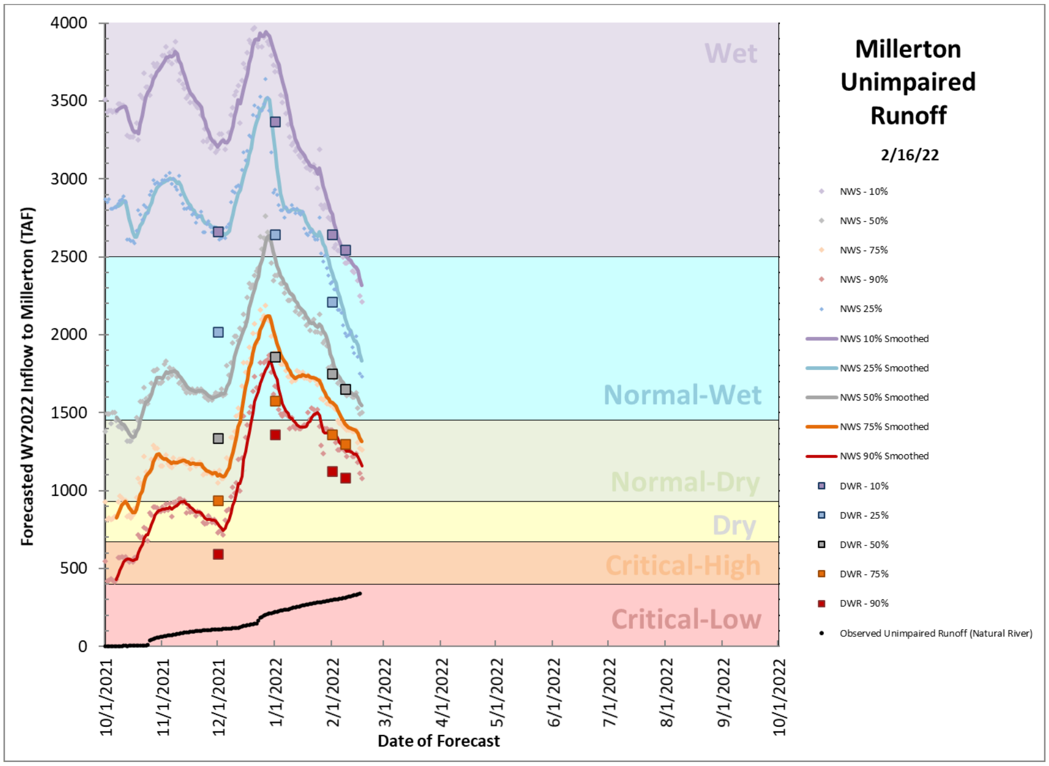

Figure 1a — Plot of 2022 Water Year forecasts. This includes both NWS Ensemble Streamflow Prediction Forecasts and DWR Forecasts

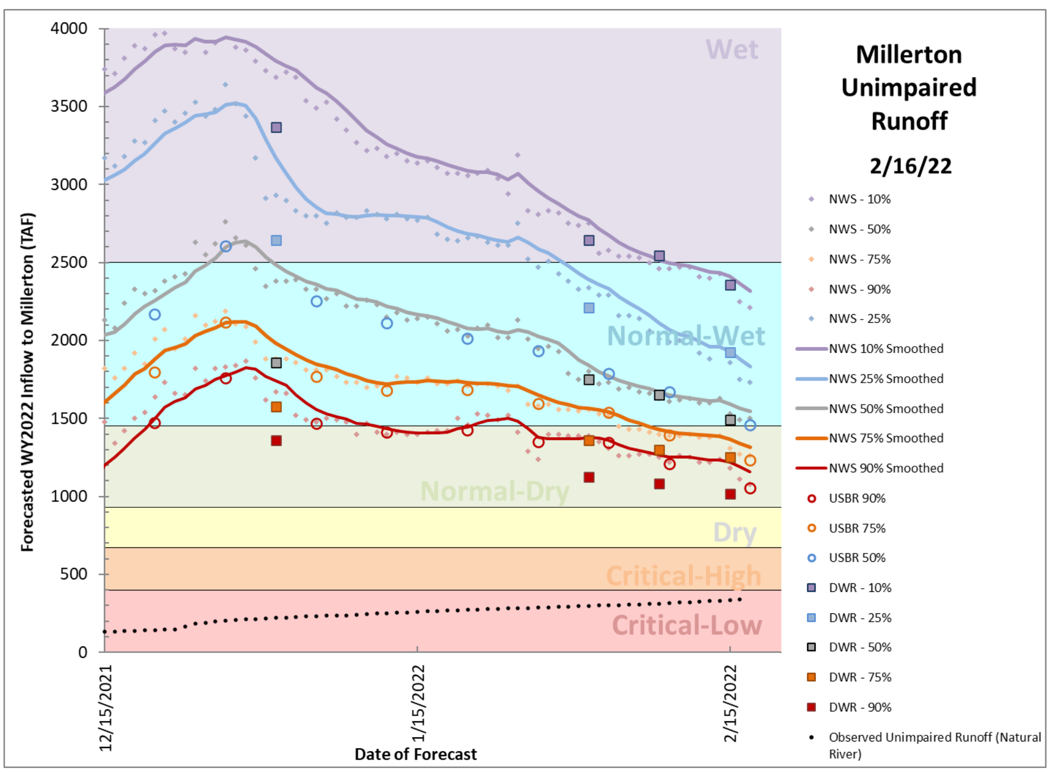

Figure 1b — Detail plot of most recent forecasts. Also shown are Reclamation's "hybrid" forecast with open circles.

After prodigious precipitation in December, January and the first half of February have been completely dry. This has resulted in recent melt and sublimation of the existing snowpack. Snow monitoring has been strengthened this year with additional modeling efforts, a return to full sampling of snow courses, and four or five Airborne Snow Observatory (ASO) flights planned. There are four snow pillows that are not properly functioning in the watershed, increasing our reliance upon ASO surveys. The first ASO survey resulted in Reclamation revising its consensus on snowpack volume downward, effectively decreasing the anticipated runoff at all exceedances.

An example of the magnitude of the change in snowpack snow water equivalent depth is shown in Figure 2. Most models were overestimating snow across all elevations. The magnitude of the snow depth overestimate was greatest above 12,000’ and below 6,000’; however the snow volume overestimate was greatest between 7,000’ and 11,000’, where most of the watershed lies.

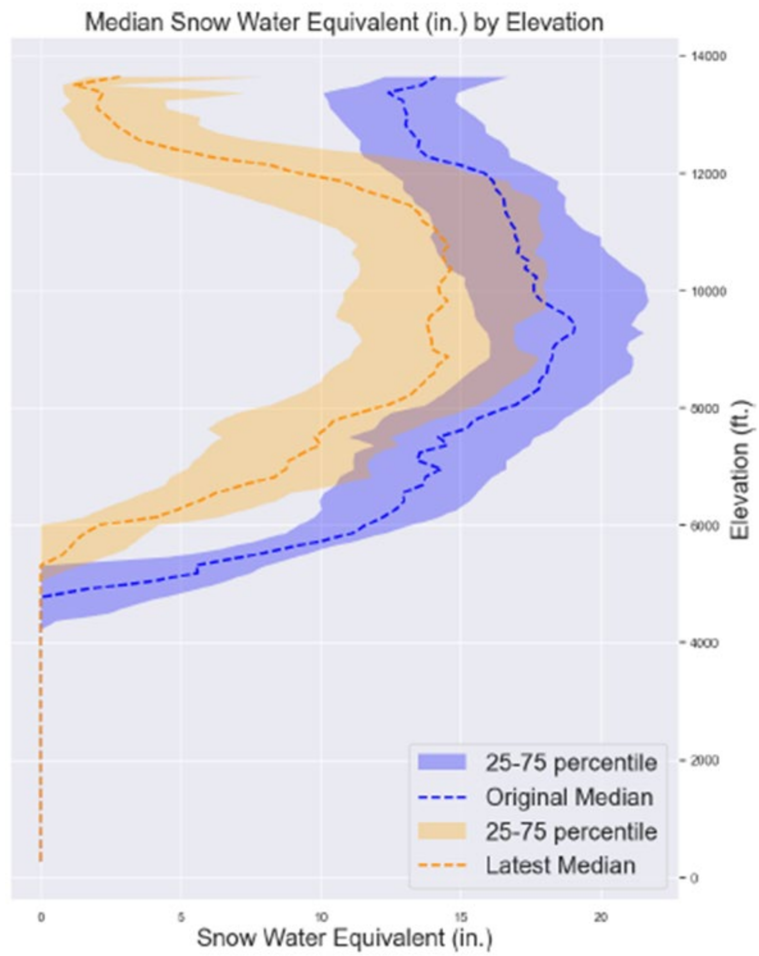

Figure 2 — Elevation profiles of SWE depth in the San Joaquin. The blue trace is from the iSnobal model before ASO assimilation. The iSnobal model had a similar profile to other snowpack models at the time (e.g. NOHRSC, NWS Snow 17). The yellow trace shows the snowpack distribution after SWE depths were corrected using the February 6-7 ASO survey. Graphic courtesy of M3Works.

Table 2 depicts the aggregate snowpack volume from various models and Reclamation's consensus estimate, which leans heavily toward the ASO data, but is nudged upward slightly due to small amounts of uncertainty in the aerial snowpack measurements in forested areas.

Table 2 — Total snowpack volume (TAF of Snow Water Equivalent) depicted by four models, an ASO measurement, and a consensus estimate for February 17, 2022.

	Snowpack Model Volumes					
	CNRFC	NOHRSC	CU Boulder	iSnobal (M3W)	Aerial Snow Survey (ASO)	Reclamation Consensus
February 17, 2022	862	748	922 [8]	679 [9]	666 [10]	**591**

[8] CU Boulder "Real-time SWE" model from February 14.

[9] The "iSnobal" model for the San Joaquin is produced by M3Works under a contract with ASO. The model was run on Feb 7 using ASO data. The report predicts a total of 679 TAF, which includes snow over frozen lakes and reservoirs. Removing the snow over lakes and reservoirs would yield 666 TAF

[10] The first Aerial Snow Survey was completed February 6-7. Snowpack volume does not include snow over water bodies.

Runoff yields (i.e. runoff efficiencies) are trending higher than the previous water year. Runoff efficiencies since October 1 are estimated to be 35-45% and are expected to rise further proportional to surface water input. The natural river is predicted to average around 1250 cfs through the remainder of February as warmer temperatures melt the lower elevation snowpack. Subsequent snowpack measures will enable Reclamation to calculate and track runoff yields over time to verify the runoff forecasts.

Combining Forecasts

Staff from the South-Central California Area Office of Reclamation and SJRRP jointly track and evaluate the accuracy of runoff forecasts on a regular basis. Based on the age of these forecasts, the short-term and long-term weather forecasts, the climatological outlook, observed Unimpaired Runoff, and other available information, a hybrid forecast is generated. The weighting of the different components is regularly evaluated and selected using the best available information and professional judgment. **For the current allocation, the DWR "runoff adjusted" and NWS "smoothed runoff adjusted" forecasts are combined with a 40/60 blending respectively**. **An additional offset is applied to the blended forecast to compensate for a demonstrated overestimation of snowpack.** This offset was -50 TAF at the 90% exceedance, rising to -90 TAF at the 10% exceedance. Reclamation seldom applies an offset to the two primary forecast products, yet in this instance the ASO data indicated 30% less snowpack than expected and it was evident that the NWS model was overestimating snowpack volume. Offsets were preferable to a heavier weighting of the DWR forecast, which would have distorted the 10% and 25% exceedances for the sake of the 90% and 75% exceedances, or vice versa. This blending and offsetting results in the Hybrid Unimpaired Runoff Forecasts shown in Table 3 and is also shown in Figure 1b.

Table 3 — Current Blending and Hybrid Unimpaired Runoff Forecasts (TAF)

	Forecast Probability of Exceedance using blending				
	90%	**75**%	**50**%	**25**%	**10**%
Blending Ratio (DWR/NWS)	40/60 with additional offset (90%: -50, 75%: -60, 50%: -70, 25%: -80, 10%: -90)				
Hybrid Unimpaired Runoff Forecast (TAF)	1,054	1,235	1,457	1,766	2,192

Restoration Allocation

As per the Guidelines, the **75% exceedance** forecast is used for the allocation under current hydrologic conditions to set the Restoration Flow Allocation. Table 4 below, from the Guidelines version 2.1, depicts the progression of forecast exceedances used to set the Restoration Allocation.

Table 4 — Guidance on Percent Exceedance Forecast to Use for Allocation

		Date of Forecast Used for the Allocation					
	Value (TAF)	**January**	**February**	**March**	**April**	**May**	**June**
If the 50% forecast is:	Above 2200	50	50	50	50	50	50
	1600 to 2200	75	75	50	50	50	50
	900 to 1599	75	**75**	75	50	50	50
	500 to 899	90	90	75	50	50	50
	Below 500	90	90	90	90	75	50

Applying the forecast blending and offsets determined by Reclamation and using the 75% exceedance forecast dictated by the Guidelines, Reclamation calculates an **Unimpaired Runoff hybrid forecast of 1,235 TAF and a Normal-Dry Water Year Type. This provides a Restoration Allocation of 254.413 Thousand Acre-Feet (TAF) as measured at Gravelly Ford (GRF).** Combined with Holding Contracts on the San Joaquin River, **this equates to a Friant Dam Release of approximately 371.358 TAF**. Other hypothetical allocations are presented in Table 5 as grayed values and indicate the range of probable forecasts and the resulting Restoration Allocations.

Table 5 — SJRRP Water Year Type and Allocation for 2022 Restoration Year Shown with Other Hypothetical Values in Gray

	Forecast Probability of Exceedance using proposed blending				
	90%	**75%**	50%	25%	10%
Hybrid Unimpaired Runoff Forecast (TAF)	1,054	**1,235**	1,457	1,766	2,192
Water Year Type	Normal-Dry	**Normal-Dry**	Normal-Wet	Normal-Wet	Normal-Wet
Restoration Allocation at GRF (TAF)	230.047	**254.413**	284.336	327.625	387.306
Friant Dam Flow Releases (TAF)	346.992	**371.358**	401.281	444.570	504.251

Contractual Obligation Considerations

Consistent with Section 10004(j) of the San Joaquin River Restoration Settlement Act, the Settlement and the Settlement Act do not modify the rights and obligations of the United States under the Purchase Contract between Miller and Lux and the United States (Purchase Contract) and the Second Amended Exchange Contact between the United States, Department of the Interior, Bureau of Reclamation and Central California Irrigation District, San Luis Canal Company, Firebaugh Canal Water District, and Columbia Canal Company (Exchange Contract). Reclamation's obligations in the Purchase Contract and Exchange Contract remain unchanged. This is consistent with Condition 17 of Reclamation's 2013 Water Rights order addressing Restoration Flows.

Although hydrologic conditions in 2022 are wetter than 2021, the state is still recovering from a two-year drought and the Shasta basin has not recovered to the extent that the Sierra Nevada has. The recent dearth of storms reaching the state has further challenged California's water storage and the possibility remains, though small, that the Exchange Contract cannot be fully met through South-of-Delta pumping. Restoration staff will continue to coordinate with other units of the CVP and their potential to impact operations or allocations at Friant Dam.

Default Flow Schedule

The Default Flow Schedule, derived from Exhibit B in the Settlement, identifies how Reclamation will schedule the Restoration Allocation for the current Water Year Type and Unimpaired Runoff volume absent a recommendation from the Restoration Administrator. The Guidelines provide detail on how a Default Flow Schedule is parsed from the allocation volume. This approved method of distributing water throughout the year is referred to as "Method 3.1" with the "gamma pathway."

Exhibit B Method 3.1 Default Flow Schedules

Table 6a shows the Basic Default Flow Schedule flows and corresponding Restoration Allocation volumes for the entire year absent channel capacity and seepage constraints, including total releases from Friant Dam and Restoration Flows releases in excess of Holding Contracts.

Volume is distributed as various flow rates across the year as per the methods explained in the Guidelines.

Table 6b shows the Capacity Constrained Default Flow Schedule volumes with all expected operational constraints, primarily controlled by seepage limitations in Reach 4A. Any volume within the Spring Flexible Flow Account and Fall Flexible Flow Account that cannot be released on the default schedule is shifted to times with available capacity as per the Guidelines. This Capacity Constrained Default Flow Schedule depicted in Table 6b will be implemented in the absence of a specific recommendation by the Restoration Administrator. **With these known constraints, a Restoration Flow volume of 71.1 TAF is generated that cannot be scheduled for release without shifting outside of the flexible flow periods (which would require a Water Supply Test). This volume would become Unreleased Restoration Flows (URFs) under the Capacity Constrained Default Flow Schedule.** This is an estimated volume of water, actual URF volumes will depend on several factors including the Restoration Administrator Recommendation, flow schedule to-date, recapture of Restoration Flows at Mendota Pool, and real-time assessments of groundwater constraints.

Table 6a — Basic Default Flow Schedule

Flow Period	Flow (cfs)				Volume (TAF)	
	Friant Dam Release	Holding Contracts [11]	Flow Target at GRF	Restoration Flow at GRF	Friant Dam Release	Restoration Flow at GRF
Mar 1 – Mar 15	500	130	375	370	*14.876*	*11.008*
Mar 16 – Mar 31	1500	130	1375	1370	*47.603*	*43.478*
Apr 1 – Apr 15	2500	150	2355	2350	*74.380*	*69.917*
Apr 16 – Apr 30	555	150	410	405	*16.516*	*12.053*
May 1 – May 28	350	190	165	160	*19.438*	*8.886*
May 29 – Jun 30	350	190	165	160	*22.909*	*10.473*
July 1 – July 29	350	230	125	120	*20.132*	*6.902*
Jul 30 – Aug 31	350	230	125	120	*22.909*	*7.855*
Sep 1 – Sep 30	350	210	145	140	*20.826*	*8.331*
Oct 1 – Oct 31	350	160	195	190	*21.521*	*11.683*
Nov 1 – Nov 6	700	130	575	570	*8.331*	*6.783*
Nov 7 – Nov 10	700	130	575	570	*5.554*	*4.522*
Nov 11 – Nov 30	350	120	235	230	*13.884*	*9.124*
Dec 1 – Dec 31	350	120	235	230	*21.521*	*14.142*
Jan 1 – Jan 31	350	100	255	250	*21.521*	*15.372*
Feb 1 – Feb 28	350	100	255	250	*19.438*	*13.884*
				Totals	***371.358***	***254.413***

Table 6b — Capacity Constrained Default Flow Schedule

Flow Period	Flow (cfs)				Volume (TAF)		
	Friant Dam Release	Holding Contracts [11]	Flow Target at GRF	Restoration Flow at GRF	Friant Dam Release	Restoration Flow at GRF	Unreleased Restoration Flow [12]
Mar 1 – Mar 15	551	130	426	421	*16.387*	*12.519*	*-1.511*
Mar 16 – Mar 31	551	130	426	421	*17.480*	*13.354*	*30.124*
Apr 1 – Apr 15	571	150	426	421	*16.982*	*12.519*	*57.398*
Apr 16 – Apr 30	571	150	426	421	*16.982*	*12.519*	*-0.467*
May 1 – May 28	611	190	426	421	*33.922*	*23.369*	*-14.484*
May 29 – Jun 30	350	190	165	160	*22.909*	*10.473*	*0.000*
July 1 – July 29	350	230	125	120	*20.132*	*6.902*	*0.000*
Jul 30 – Aug 31	350	230	125	120	*22.909*	*7.855*	*0.000*
Sep 1 – Sep 30	350	210	145	140	*20.826*	*8.331*	*0.000*
Oct 1 – Oct 31	350	160	195	190	*21.521*	*11.683*	*0.000*
Nov 1 – Nov 6	551	130	426	421	*6.555*	*5.008*	*1.776*
Nov 7 – Nov 10	551	130	426	421	*4.370*	*3.338*	*1.184*
Nov 11 – Nov 30	425	120	310	305	*16.844*	*12.084*	*-2.960*
Dec 1 – Dec 31	350	120	235	230	*21.521*	*14.142*	*0.000*
Jan 1 – Jan 31	350	100	255	250	*21.521*	*15.372*	*0.000*
Feb 1 – Feb 28	350	100	255	250	*19.438*	*13.884*	*0.000*
				Totals	***300.298***	***183.353***	***71.060***

[11] In recent years, Holding Contract demands have been higher than assumed under Exhibit B of the Settlement, in which case, flows at Friant are increased to achieve the Gravelly Ford Flow Target.

[12] This estimate of URF volume is based on the most constraining reach, with Spring Flexible Flows redistributed March 1 through May 28 as necessary and Fall Flexible Flows redistributed Sept 3 through December 28 as necessary up to channel capacity constraints. Actual URF volume will depend on the Restoration Administrator's recommendations.

Exhibit B Restoration Flow Budget

Table 7 shows the components of the annual water budget for February 1, 2022, through February 28, 2023 (i.e. the Restoration Year). The Continuity Flow Account, Spring Flexible Flow Account, Riparian Recruitment Flow Account, and Fall Flexible Flow Account reflect the Exhibit B hydrograph for the current Restoration Allocation. The expected 116.945 TAF for Holding Contracts is shown. The volume for each flow account may change with subsequent Restoration Allocations.

Table 7 — Restoration Budget with Flow Accounts

Period	Holding Contract Demand (TAF)	Restoration Flow Accounts (TAF)			
		Continuity Flow Account	Spring Flexible Flow Account	Riparian Recruitment Flow Account	Fall Flexible Flow Account
Feb 1 – Feb 28	–	*0*	*111.028*	–	–
Mar 1 – Apr 30	*16.919*	*25.428*		–	–
May 1 – May 28	*10.552*	*8.886*		*0*	–
May 29 – Jul 29	*25.666*	*17.375*	–		–
Jul 30 – Aug 31	*15.055*	*7.855*	–	–	–
Sep 1 – Sep 30	*12.496*	*8.331*	–	–	*6.942*
Oct 1 – Nov 30	*17.177*	*25.175*	–	–	
Dec 1 – Dec 31	*7.379*	*14.142*	–	–	
Jan 1 – Feb 28	*11.702*	*29.256*	–	–	–
	116.945 [13]	***136.443***	***111.028***	***0***	***6.942***
		254.413 *(Base Flow Volume)*			
	371.358 *(Friant Release Volume)*				

[13] In recent years, Holding Contract demands have been higher than assumed under Exhibit B of the Settlement, in which case, flows at Friant are increased to achieve the Gravelly Ford Flow Target.

[14] Buffer Flow volumes are based on actual releases, and are not an allocated volume per se.

Remaining Flow Volumes

The amount of water remaining for scheduling is the volume of flows released from Friant Dam in excess of releases required to meet Holding Contract demands, less past releases. Table 8 tracks these balances among the four flow accounts. Tracking these four flow accounts is necessary for application of the Water Supply Test. The released to date volumes are derived from quality-assurance/quality-control daily average data when available, and partly from provisional data posted to CDEC, and thus may have future adjustments. Such adjustments may also affect the remaining flow volume.

Note that the Restoration Administrator has the option on the return of URF exchanges in 2022.

Table 8 — Estimated Restoration Flow Volume Remaining and Released to Date

Flow Account		Yearly Allocation (TAF)	Released to Date [15] (TAF)	Remaining Flow Volume (TAF)
Base Flows	Continuity Flow Account (Mar 1 — Feb 28)	*136.443*	*0*	*136.443*
	Spring Flexible Flows (Feb 1 – May 28)	*111.028*	*0*	*111.028*
	Riparian Recruitment Flows (May 1 — Jul 29)	*0*	*0*	*0*
	Fall Flexible Flows (Sep 3 – Dec 28)	*6.942*	*0*	*6.942*
Buffer Flows		—	*0*	—
Unreleased Restoration Flows (Sales and Exchanges)		—	*0*	*0*
Unreleased Restoration Flows (Returned Exchanges)		—	*0*	*0*
Purchased Water		—	*0*	*0*
		Totals:	***0***	***254.413***

[15] As of 1/12/2022

Available URF Exchange Returns

Reclamation is in the process of extending and revising three existing Unreleased Restoration Flow exchanges. The available water for return to the Restoration Administrator, incorporating the expected agreement revisions, is shown in Table 9.

Table 9 — Volume available from URF Exchange Returns

Exchange Partner	Period of return [16]	Minimum Required Return (TAF)	Maximum Annual Return (TAF)	Notes
AEWSD	Mar-Sep	3.500	3.500 [16]	Expires in 2024, requiring the use of 3,500 AF for each of the remaining three years
FID	Flexible	0	2.000	Exchange expires in 2023
FID	Mar-Sep	0	3.600	Exchange is reduced by 10% per year
OCID	Mar-Sep	0	Up to 3.000	Return ratio depends upon Class 1 declaration

[16] unless otherwise by mutual agreement

Operational Constraints

Operating criteria, such as channel conveyance capacity, ramping rate constraints, scheduled maintenance, reservoir storage, contractual obligations, and downstream seepage concerns, may restrict the release of Restoration Flows. Table 10 summarizes known 2022 operational constraints.

Table 10 — Summary of Operational Constraints

Type of Constraint	Period	Flow Limitation
Levee Stability	Currently in effect	1,210 cfs in Reach 2B
	Currently in effect	2,600 cfs in Eastside Bypass
	Currently in effect	2,350 cfs in Reach 5
Channel Conveyance / Seepage Limitation	Currently in effect, see latest Flow Bench Evaluation for precise values	Reach 2A: 800 – 820 cfs @ GRF
		Reach 3: Approx. 850 cfs @ MEN
		Reach 4A: Approx. 300 cfs @ SDP
USFWS Biological Opinion	Until consultation for “Phase 2”	1,660 cfs of Restoration Flows through Eastside Bypass

The 2022 Channel Capacity Report identifies a maximum flow in Reach 2B of 1,210 cfs due to levee stability constraints. This results in a maximum release from Friant Dam between 1,310 cfs and 1,540 cfs depending on the time of year. The 2022 Restoration Year Channel Capacity Report also identifies a maximum flow in the Middle Eastside Bypass of 2,600 cfs, which has increased from the 2021 Channel Capacity Report value of 1,070 cfs due to the completion of the Reach O levee improvements project and the removal of two weirs within the Eastside Bypass.

Flow bench evaluations were conducted on December 28, 2021 and again on January 7, 2022 focusing on Reach 4A. These two analyses indicated that flows of up to 300 cfs could be passed through Reach 4A without reaching seepage limitations. An updated flow bench evaluation is expected to be completed by late February or early March.

In 2020, multiple flow bench evaluations were conducted to verify expected seepage thresholds in Reach 2A and Reach 3. Analysis revealed a seepage limitation of 800 to 820 cfs in Reach 2A (measured at the GRF gauge) and 850 cfs in Reach 3 (measured at the MEN gauge). Flows have not approached seepage limitations in Reach 2 or Reach 3 following these 2020 evaluations. These flow limitations fluctuate with prevailing groundwater conditions and may be slightly lower or higher at a given time. The limitation in Reach 3 must accommodate both Restoration Flows and diversion to Arroyo Canal, thus Reach 3 is the limiting reach in certain times of the year. SJRRP will coordinate with the Restoration Administrator on specific flow schedules that are close to these limits.

Reclamation will inform the Restoration Administrator of any changes to groundwater conditions that are likely to result in a reduction in scheduled Restoration Flows, will implement monitoring of groundwater conditions as necessary, and will adjust Friant Dam releases and/or Mendota Pool recapture (as preferred by the Restoration Administrator) to stay within seepage and channel capacity constraints.

2022 Allocation History

The Restoration Allocation are adjusted multiple times between the date of the initial allocation and the final allocation; issuances will generally take place on a monthly schedule but may also be issued based on rapidly changing hydrologic conditions. The Restoration Administrator is responsible for contingency planning and managing releases to stay within the current allocation to the extent possible, in accordance with the Guidelines. Table 11 summarizes the Allocation History for this Restoration Year.

Table 11 — 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 13, 2022	30/70	1,678 TAF (@ 75%)	Normal-Wet	315.297 TAF	0 (thru 1/12/2022)
Update	February 18, 2022	40/60 w/ offsets	1,235 TAF (@ 75%)	Normal-Dry	254.413 TAF	0 (thru 2/17/2022)

Appendix A: Abbreviations, Acronyms, and Glossary

af	Acre-feet
ARS	USDA Agricultural Research Service
ASO	Airborne Snow Observatory
CALSIM	California Statewide Integrated Model
CCID	Central California Irrigation District
CDEC	California Data Exchange Center
cfs	Cubic feet per second
CVP	Central Valley Project
Delta	Sacramento–San Joaquin Delta
DWR	California Department of Water Resources
ESP	Ensemble Streamflow Prediction
Exhibit B	Exhibit B of the Settlement depicting Default Hydrograph
GRF	Gravelly Ford Flow Gauge
Guidelines	Restoration Flow Guidelines
LSJLD	Lower San Joaquin Levee District
NWS	National Weather Service
QA/QC	Quality Assurance/Quality Control (i.e. finalized)
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
Restoration Year	the cycle of Restoration Flows, March 1 through February 28/29
RWA	SJRRP Reclaimed Water Account
Secretary	U.S. Secretary of the Interior
Settlement	Stipulation of Settlement in *NRDC, et al., v. Kirk Rodgers, et al.*
SJREC	San Joaquin River Exchange Contractors
SJRRP	San Joaquin River Restoration Program
SLCC	San Luis Canal Company
SWE	Snow Water Equivalent
SWP	State Water Project
TAF	thousand acre–feet
URF	Unreleased Restoration Flows
WSI	DWR Water Supply Index
WY	Water year, October 1 through September 30

Appendix B: Previous Year (2020) Flow Accounting

Table B — Restoration Flow Accounting and Unreleased Restoration Flows, and Holding Contracts, for the period February 2020 through February 2021. Flood management releases to San Joaquin River did not occur during this period. This accounting includes a returned Unreleased Restoration Flow Exchange. The unused Restoration Allocation was 0.270 TAF.

<table>
<tr><th rowspan="2">Flow Period</th><th rowspan="2">Gravelly Ford 5 cfs requirement (TAF)</th><th rowspan="2">URF disposed</th><th colspan="7">Released Restoration Flow Volumes (TAF)</th></tr>
<tr><th>Continuity Flow</th><th>Spring Flexible Flow</th><th>Fall Flexible Flow</th><th>Riparian Recruitment Flow</th><th>Buffer Flow</th><th>Flexible Buffer Flow</th><th>URF returned</th></tr>
<tr><td>Feb 1 – Feb 28</td><td>–</td><td></td><td>–</td><td>0</td><td>–</td><td>–</td><td>–</td><td>–</td><td></td></tr>
<tr><td>Mar 1 – Mar 31</td><td>8.015</td><td></td><td>6.676</td><td>0</td><td>–</td><td>–</td><td>0.605</td><td>–</td><td></td></tr>
<tr><td>Apr 1 – Apr 30</td><td>11.268</td><td>40.131</td><td>9.572</td><td>0</td><td>–</td><td>–</td><td>0</td><td>–</td><td></td></tr>
<tr><td>May 1 – May 31</td><td>13.478</td><td></td><td>15.867</td><td>1.982</td><td>–</td><td rowspan="4">0</td><td rowspan="2">0</td><td rowspan="5">0</td><td></td></tr>
<tr><td>Jun 1 – Jun 30</td><td>12.845</td><td>5.277</td><td>9.572</td><td>–</td><td>–</td><td></td></tr>
<tr><td>Jul 1 – Jul 31</td><td>15.269</td><td></td><td>10.554</td><td>–</td><td>–</td><td>0</td><td></td></tr>
<tr><td>Aug 1 – Aug 31</td><td>15.231</td><td>4.195</td><td>11.189</td><td>–</td><td>–</td><td>0</td><td></td></tr>
<tr><td>Sep 1 – Sep 30</td><td>13.789</td><td></td><td>11.125</td><td>–</td><td>0</td><td>–</td><td>0</td><td>0.487</td></tr>
<tr><td>Oct 1 – Oct 31</td><td>13.704</td><td></td><td>12.184</td><td>–</td><td>0</td><td>–</td><td>0</td><td rowspan="3">0</td><td></td></tr>
<tr><td>Nov 1 – Nov 30</td><td>11.627</td><td></td><td>13.894</td><td>–</td><td>0</td><td>–</td><td>0</td><td></td></tr>
<tr><td>Dec 1 – Dec 31</td><td>11.183</td><td></td><td>14.231</td><td>–</td><td>0</td><td>–</td><td>0</td><td></td></tr>
<tr><td>Jan 1 – Jan 31</td><td>9.989</td><td></td><td>13.464</td><td>–</td><td>–</td><td>–</td><td>0</td><td>–</td><td></td></tr>
<tr><td>Feb 1 – Feb 28</td><td>8.554</td><td>13.900</td><td>8.600</td><td>–</td><td>–</td><td>–</td><td>0</td><td>–</td><td></td></tr>
<tr><td rowspan="6"></td><td rowspan="5">144.958</td><td rowspan="4">63.502</td><td>136.443</td><td>1.982</td><td>0</td><td>0</td><td>0.605</td><td>0</td><td rowspan="3">0.487</td></tr>
<tr><td colspan="4">138.425 (Allocated Restoration Flows)</td><td colspan="2">0.605 (all Buffer Flows)</td></tr>
<tr><td colspan="6">139.030 (Restoration Flows Affecting Friant water supply)</td></tr>
<tr><td colspan="7">139.517 (Restoration Flows released to river)</td></tr>
<tr><td colspan="5">201.927 (Restoration Allocation Used)</td><td colspan="3"></td></tr>
<tr><td></td><td></td><td colspan="7">284.475 (Friant Dam Releases — excludes disposed URFs)</td></tr>
</table>

Appendix C: History of Millerton Unimpaired Runoff

Table C — Water Year Totals in Thousand Acre-Feet

Water Year [1]	Unimpaired Runoff [2]	SJRRP Water Year Type [3]	Water Year [1]	Unimpaired Runoff [2]	SJRRP Water Year Type [3]	Water Year [1]	Unimpaired Runoff [2]	SJRRP Water Year Type [3]	Water Year [1]	Unimpaired Runoff [2]	SJRRP Water Year Type [3]
1901	3,227.9	Wet	1933	1,111.4	Normal-Dry	1965	2,271.191	Normal-Wet	1997	2,817.670	Wet
1902	1,704.0	Normal-Wet	1934	691.5	Dry	1966	1,298.792	Normal-Dry	1998	3,160.759	Wet
1903	1,727.0	Normal-Wet	1935	1,923.2	Normal-Wet	1967	3,233.097	Wet	1999	1,527.040	Normal-Wet
1904	2,062.0	Normal-Wet	1936	1,853.3	Normal-Wet	1968	861.894	Dry	2000	1,735.653	Normal-Wet
1905	1,795.4	Normal-Wet	1937	2,208.0	Normal-Wet	1969	4,040.864	Wet	2001	1,065.318	Normal-Dry
1906	4,367.8	Wet	1938	3,688.4	Wet	1970	1,445.837	Normal-Dry	2002	1,171.457	Normal-Dry
1907	3,113.9	Wet	1939	920.8	Dry	1971	1,416.812	Normal-Dry	2003	1,449.954	Normal-Dry
1908	1,163.4	Normal-Dry	1940	1,880.6	Normal-Wet	1972	1,039.249	Normal-Dry	2004	1,130.823	Normal-Dry
1909	2,900.7	Wet	1941	2,652.5	Wet	1973	2,047.585	Normal-Wet	2005	2,826.872	Wet
1910	2,041.5	Normal-Wet	1942	2,254.0	Normal-Wet	1974	2,190.308	Normal-Wet	2006	3,180.816	Wet
1911	3,586.0	Wet	1943	2,053.7	Normal-Wet	1975	1,795.922	Normal-Wet	2007	684.333	Dry
1912	1,043.9	Normal-Dry	1944	1,265.4	Normal-Dry	1976	629.234	Critical-High	2008	1,116.790	Normal-Dry
1913	879.4	Dry	1945	2,134.633	Normal-Wet	1977	361.253	Critical-Low	2009	1,455.379	Normal-Wet
1914	2,883.4	Wet	1946	1,727.115	Normal-Wet	1978	3,402.805	Wet	2010	2,028.706	Normal-Wet
1915	1,966.3	Normal-Wet	1947	1,121.564	Normal-Dry	1979	1,829.988	Normal-Wet	2011	3,304.824	Wet
1916	2,760.5	Wet	1948	1,201.390	Normal-Dry	1980	2,973.169	Wet	2012	831.582	Dry
1917	1,936.2	Normal-Wet	1949	1,167.008	Normal-Dry	1981	1,067.757	Normal-Dry	2013	856.626	Dry
1918	1,466.8	Normal-Wet	1950	1,317.457	Normal-Dry	1982	3,317.171	Wet	2014	509.579	Critical-High
1919	1,297.5	Normal-Dry	1951	1,827.254	Normal-Wet	1983	4,643.090	Wet	2015	327.410	Critical-Low
1920	1,322.5	Normal-Dry	1952	2,840.854	Wet	1984	2,042.750	Normal-Wet	2016	1,300.986	Normal-Dry
1921	1,604.4	Normal-Wet	1953	1,226.830	Normal-Dry	1985	1,135.975	Normal-Dry	2017	4,395.400	Wet
1922	2,355.1	Normal-Wet	1954	1,313.993	Normal-Dry	1986	3,031.600	Wet	2018	1,348.979	Normal-Dry
1923	1,654.3	Normal-Wet	1955	1,161.161	Normal-Dry	1987	756.853	Dry	2019	2,734.772	Wet
1924	444.1	Critical-High	1956	2,959.812	Wet	1988	862.124	Dry	2020	886.025	Dry
1925	1,438.7	Normal-Dry	1957	1,326.573	Normal-Dry	1989	939.168	Normal-Dry	2021	521.853	Critical-High
1926	1,161.4	Normal-Dry	1958	2,631.392	Wet	1990	742.824	Dry			
1927	2,001.3	Normal-Wet	1959	949.456	Normal-Dry	1991	1,027.209	Normal-Dry			
1928	1,153.7	Normal-Dry	1960	826.021	Dry	1992	807.759	Dry			
1929	862.4	Dry	1961	647.428	Critical-High	1993	2,672.322	Wet			
1930	859.1	Dry	1962	1,924.066	Normal-Wet	1994	824.097	Dry			
1931	480.2	Critical-High	1963	1,945.266	Normal-Wet	1995	3,876.370	Wet			
1932	2,047.4	Normal-Wet	1964	922.351	Dry	1996	2,200.707	Normal-Wet			

[1] 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.

[2] 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.

[3] 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 and Error

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)	Error (Unimpaired Runoff / Allocation)
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 / 0 [1]
2015	Restoration Flows	Sep 28	327	0	327.410	-0.410 / 0
2016	Restoration Flows	Sep 30	1300.986	263.295	1,300.986	0 / 0
2017	Restoration Flows	Jul 10	4,444	556.542	4,395.400	+48.600 / 0
2018	Restoration Flows	May 22	1,427	280.258	1,348.979	+78.021 / +10.503
2019	Restoration Flows	May 20	2,690	556.542	2,734.772	-44.772 / 0
2020	Restoration Flows	June 19	880	202.197	886.025	-6.025 / -1.345
2021	Restoration Flows	June 25	529	70.919	521.853	+7.147 / 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).