Technical Memorandum

Channel Capacity Report
2024 Restoration Year

SAN JOAQUIN RIVER
RESTORATION PROGRAM

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List of Abbreviations and Acronyms

CCAG	Channel Capacity Advisory Group
CCR	Channel Capacity Report
CFS	Cubic feet per second
DWR	Department of Water Resources
LiDAR	Light Detection and Ranging
LSJLD	Lower San Joaquin Levee District
MNWR	Merced National Wildlife Refuge
NRDC	Natural Resources Defense Council
NOD	Notice of Determination
PEIS/R	Program Environmental Impact Statement/Environmental Impact Report
Reclamation	Bureau of Reclamation
Restoration Area	San Joaquin River Restoration Program Restoration Area
RM	River mile
ROD	Record of Decision
SJLE Project	San Joaquin Levee Evaluation Project
SJRRP	San Joaquin River Restoration Program
SJR	San Joaquin River
SMP	Seepage Management Plan

Definitions

San Joaquin River Restoration Program (SJRRP): The SJRRP (also abbreviated as Program) was established in late 2006 to restore and maintain fish populations in good condition in the mainstem of the San Joaquin River (SJR) below Friant Dam to the confluence of the Merced River, while reducing or avoiding adverse water supply impacts.

Settlement: In 2006, the SJRRP was established to implement the Stipulation of Settlement in *NRDC, et al., v. Kirk Rodgers, et al*.

Program Environmental Impact Statement/Environmental Impact Report (PEIS/R): The Bureau of Reclamation (Reclamation), as the federal lead agency under the National Environmental Policy Act (NEPA) and the California Department of Water Resources (DWR), the state lead agency under the California Environmental Quality Act (CEQA), jointly prepared a Program Environmental Impact Statement/Report (PEIS/R) and signed a Record of Decision and Notice of Determination (ROD and NOD), respectively, in 2012 to implement the Settlement.

Channel Capacity Advisory Group (CCAG): The Channel Capacity Advisory Group provides focused input to Reclamation's determination of "then-existing channel capacity" within the Restoration Area.

Then-existing channel capacity: The channel capacity within the Restoration Area that corresponds to flows that would not significantly increase flood risk from Restoration Flows in the Restoration Area. The annual Channel Capacity Report will include recommendations of then-existing channel capacity for the upcoming Restoration Year based on recently completed evaluations.

In-channel capacity: The channel capacity at which the water surface elevation is maintained at or below the elevation of the outside ground at the levees (i.e., along the landside levee toe).

1.0 Introduction

The San Joaquin River Restoration Program (SJRRP) was established in late 2006 to implement a Stipulation of Settlement (Settlement) in *NRDC, et al., v. Kirk Rodgers, et al*. The U.S. Department of the Interior, Bureau of Reclamation (Reclamation), the Federal lead agency under the National Environmental Policy Act (NEPA), and the California Department of Water Resources (DWR), the State lead agency under the California Environmental Quality Act (CEQA), prepared a joint Program Environmental Impact Statement/Report (PEIS/R) to support implementation of the Settlement. The Settlement calls for releases of Restoration Flows, which were initiated in 2014 and are specific volumes of water to be released from Friant Dam during different water year types, according to Exhibit B of the Settlement. Federal authorization for implementing the Settlement is provided in the San Joaquin River Restoration Settlement Act (Act) (Public Law 111-11). Reclamation signed the Record of Decision (ROD)/Notice of Determination (NOD) on September 28, 2012. Both the PEIS/R and the ROD/NOD committed to establishing a Channel Capacity Advisory Group (CCAG) to determine and update estimates of then-existing channel capacities as needed and to maintain Restoration Flows at or below estimates of then-existing channel capacities.

Then-existing channel capacities in the Restoration Area (the San Joaquin River between Friant Dam and the confluence of the Merced River) correspond to flows that would not significantly increase flood risk from Restoration Flows. Then-existing channel capacity is reported in an annual comprehensive Channel Capacity Report (CCR) that is prepared and circulated for public comment. The CCR describes the proposed then-existing channel capacity for the upcoming Restoration Year, and the projects and analyses that were performed to update the capacity from the previous year's CCR. For the 2024 Restoration Year, the SJRRP will not be recommending any changes in then-existing channel capacity, so a public review was deemed not necessary. The CCR for the 2024 Restoration Year will only summarize the current then-existing channel capacity and update activities of the SJRRP that relate to flow and channel capacity.

Previous CCRs can be found on the SJRRP website:

Levee Stability / Channel Capacity – San Joaquin River Restoration Program (restoresjr.net)

2.0 Then Existing Channel Capacity

The SJRRP has completed comprehensive evaluations of over 60 miles of levees to determine the upper limit of Restoration Flows that can be conveyed in each channel. Evaluations include a drilling program and seepage and stability modeling to evaluate the risk of levee failure. For those levees that have not been evaluated, the SJRRP keeps Restoration Flows below the levees (in-channel) to reduce the risk of a levee failure. This upper limit, which is referred to as "then-existing" channel capacity, is the maximum Restoration Flow that can be conveyed in each reach based on levee capacity. Then-existing channel capacities in the Restoration Area were determined for the 2022 Restoration Year for all of the leveed reaches that can convey Restoration Flows: Reach 2, Reach 3, Reach 4A, and Reach 5 of the San Joaquin River and the Eastside and Mariposa Bypasses, flood bypasses for the San Joaquin River. A map of the Restoration Area can be found on the SJRRP website:

20130325_SJRRPreaches--scaled.jpg (1855×2560) (restoresjr.net)

There were no studies or projects that occurred in 2023 that would result in changes in channel capacity. Therefore, this year's CCR does not recommend changes to the 2022 then-existing channel capacities (as done in 2023), and the then-existing channel capacities will remain the same for the 2024 Restoration Year. A summary of how then-existing channel capacity was determined for each reach, and the CCR that describes the study used to determine each reach's capacity, is described below.

For Reach 2A, the lower 2.5 miles of Reach 4A, Reach 4B2, and the Middle Eastside and Mariposa Bypasses, adequate data was available to perform a geotechnical analysis on the levees and these results were used to determine then-existing channel capacity for these reaches. The study details used to determine the then-existing channel capacity for Reach 2A and the lower 2.5 miles of Reach 4A are included in the 2018 CCR. The study details used to determine the then-existing channel capacity for Reach 4B2 and the Mariposa Bypass are included in the 2020 CCR. For the Middle Eastside Bypass, the 2022 CCR was used to update the capacity of the reach after the completion of a levee improvement project in 2020. In-channel capacities are the best estimate of then-existing channel capacities for Reach 2B, Reach 3, portions of Reach 4A, Reach 5, and the Lower Eastside Bypass. The studies used to determine the capacities in these reaches are summarized in the 2017 and 2018 CCRs. A complete discussion of the data and analyses conducted to determine previous then-existing channel capacities can be found in the previous CCRs on the SJRRP website:

Levee Stability / Channel Capacity – San Joaquin River Restoration Program (restoresjr.net)

Table 1 identifies then-existing channel capacities for each reach, and whether the capacity is based on geotechnical data or if Restoration Flows are to remain in-channel. Then-existing channel capacities in Table 1 do not consider limitations to Restoration Flows as it relates to agricultural seepage. For the 2024 Restoration Year, releases of Restoration Flows in Reach 2A, Reach 3, and Reach 4A continue to be limited by agricultural seepage, and not levee stability. Footnotes in Table 1 note current limitations of Restoration Flows based on agricultural seepage.

Details of how these seepage limits are determined and limit Restoration Flows are in the *Seepage Management Plan* (SMP), which can be found on the SJRRP website:

Seepage Projects – San Joaquin River Restoration Program (restoresjr.net)

Table 1.
2024 Then-existing Channel Capacity

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
Lower Eastside Bypass	2,890	In-channel
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 due to agricultural seepage with Reach 2A thresholds being updated in Appendix H of the SMP and published in 2024.
[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, with two seepage projects expected to increase the seepage limitation in 2024 once completed.

It should be acknowledged that then-existing channel capacities identified in this report are applicable to Restoration Flows, not flood management releases, and are often much less than the flows the channels will convey during flood events. Flood releases are routed based on a different set of criteria, which can exceed current levee seepage and slope stability criteria (which define then-existing capacity limits).

Moderately high flows occurred in 2022 with the release of water from Friant Dam to meet the Exchange Contract at Mendota Pool. These flows began from Friant Dam on April 1, 2022 and continued through July 9, 2022, affecting Reach 1, 2A, and 2B. Flows reached a maximum flow rate of 1,246 cfs at the head of Reach 2B, with a mean flow rate of 880 cfs, and were generally designed to stay at or below the then-existing channel capacity of Reach 2B set at 1,210 cfs.

The 2023 Water Year was the second wettest year on the San Joaquin River (with records from 1901). Two series of atmospheric rivers impacted the Southern Sierra Nevada, first from December 17, 2022 through January 17, 2023; and again from February 24 through March 30, 2023. Storms were generally cold, producing low snowlines and relatively modest runoff response given the extreme precipitation received. Friant Dam began making flood management releases to the San Joaquin River on January 5, 2023, ceasing flood releases from February 6 through March 7, 2023, and continuing flood management releases through July 26, 2023. Flood

management releases reached a maximum of 10,058 cfs on May 21 and exceeded 8,000 cfs from Friant Dam for a total of 74 days. There were long periods where then-existing channel capacity was exceeded, resulting in widespread levee seepage and erosion, particularly in Reach 2A and in portions of Reach 2B and the flood bypasses. Figure 1 shows an example of levee seepage on the right landside of the levee caused by flood management releases estimated to be 9,350 cfs in Reach 2A.

Figure 1.
Drone photograph by LSJLD looking upstream (east) into Reach 2A from upstream of the Bifurcation Structure.

3.0 Program Actions

Throughout the implementation of the SJRRP, the maximum downstream extent and rate of Restoration Flows to be released would be limited to then-existing channel capacity, except when agricultural seepage or other constraints (e.g., construction, maintenance, etc.) are more limiting. As channel or structure modifications are completed, corresponding maximum Restoration Flow releases would be increased in accordance with then-existing channel capacity and the release schedule set in the Settlement. A comprehensive list of immediate, near-term, and long-term actions that can impact then-existing channel capacity can be found in the 2020 CCR. There are two projects that the SJRRP is currently working on that could have an effect on site-specific channel capacity. A status update on these projects are as follows:

- **Mendota Pool Bypass and Reach 2B Improvements Project.** The project would route flows and fish around the Mendota Pool to provide volitional fish passage to allow salmon to complete their lifecycle. A fish screen will prevent fish from entering the Mendota Pool when water deliveries are made from Friant Dam to Mendota Pool. The project will also include setback levees to create floodplain habitat and improve channel capacity to at least 4,500 cfs in Reach 2B. In September 2021, the first construction project, the replacement of Mowry Bridge was completed. The bridge replacement will provide a haul route for future construction, operation and maintenance access, and a stable structure for the City of Mendota's municipal water supply line. Several other elements of the project continue in preliminary design, including the setback levees. The major components of this project are scheduled for completion in 2028. A summary of the project can be found at the following website:

  Reach 2B and Mendota Pool Bypass – San Joaquin River Restoration Program (restoresjr.net)

- **Arroyo Canal and Sack Dam Improvements Project.** This project is another integral project in restoring salmon to the San Joaquin River and will provide fish passage around Sack Dam and adds a fish screen on the Arroyo Canal to prevent entrainment of juvenile Chinook salmon in the canal. The project will replace the functions of Sack Dam by allowing water to enter the Arroyo Canal and the efficient passing of flows up to 4,500 cfs into Reach 4A, and fish passage. The project is currently at 90% design and construction is scheduled for 2025. A summary of the work completed can be referenced at the following website:

  Arroyo Canal Fish Screen and Sack Dam Bypass Project – San Joaquin River Restoration Program (restoresjr.net)

4.0 Program Studies and Monitoring

There are several factors that can impact and limit channel capacity including levee construction or integrity (e.g., insufficient slope stability factor of safety or underseepage factor of safety); flow duration and timing that could saturate the levee and cause instability; erosion of the stream banks that could cause potential levee failure; sedimentation or scouring; ground subsidence; and increased roughness from vegetation. These factors and others were considered in developing SJRRP studies and monitoring to determine then-existing channel capacity. A comprehensive list of studies and monitoring activities of the SJRRP can be found in the 2020 CCR. The following describes the ongoing studies and monitoring activities that may be conducted during the next Restoration Year and included in the 2025 CCR:

- DWR and Reclamation continue to collect aerial photography and perform topographic surveys of the river and floodplains. The information will allow the SJRRP to understand how the river continues to change, and how those changes are affecting actions of the SJRRP, including the documentation of then-existing channel capacities. In 2021, DWR collected aerial photography and performed Light Detection and Ranging (LiDAR) remote sensing of the entire San Joaquin Valley, including the Restoration Area. The LiDAR and bathymetry data is currently available and will be used to develop topographic models of the rivers and floodplains, as needed. Supplemental bathymetric and topographic surveys may be conducted to supplement the LiDAR, and to monitor subsidence in the Restoration Area.

- The SJRRP also continues to update its hydraulic and sediment transport modeling tools to evaluate the flow, seepage, and structural actions as part of meeting the Restoration Goal of the Settlement. To support the emergency response to the significant flood flows that occurred during the 2022/2023 flood season, DWR's Division of Flood Management (DFM) updated the hydraulic models in much of the Restoration Area with 2021 LiDAR and 2022 bathymetry in some areas. Although these updated models were helpful for responding to the flood emergency, additional review and calibration of the models are needed before they can be used to develop new estimates of then-existing channel capacity or to be used to further projects. DWR plans to assess the models in 2024 and update them, as needed. High water surveys conducted in Reach 2A, Reach 2B, Reach 4A, Reach 5, and the Eastside Bypass will be used to help calibrate the models.

- Reclamation, DWR and the USGS continue to operate and maintain several flow and water level stage gages along the San Joaquin River and tributaries between Friant Dam and the Merced confluence. These gages are used to determine the flow and river stage in each reach of the river to ensure applicable flow releases do not exceed then-existing channel capacity. All of the gages are available online at the California Data Exchange Center (CDEC).

- DWR is currently performing vegetation surveys of Reach 2A and the Middle Eastside Bypass to better assess how vegetation growth may affect channel capacity in the flood system. The monitoring includes photographs and visual descriptions taken along vegetation transects in the channel to understand the general type, heights, and densities of vegetation along these reaches.

- DWR observed erosion along the right levee of the Middle Eastside Bypass between West Washington Road and the Eastside Bypass Control Structure that was caused by high flood flows from the 2022/2023 flood season. DWR documented the extent and severity of erosion by taking photos and conducting land and drone topographic surveys. The information will be provided to the Levee District so they can determine if potential repairs may be needed.

- DWR continues to monitor general erosion throughout the Restoration Area. DWR will be doing an initial assessment of erosion potentially caused by the most recent flood flows. DWR plans to use aerial photography, onsite observation, and drone topography to identify erosion. This effort will support partial update or amendment of the Bank Erosion Study presented in the 2022 CCR.

- DWR plans to evaluate the potential impacts to channel capacity caused by sedimentation and/or erosion near and upstream of the Chowchilla Bypass Bifurcation Structure on the upstream end of Reach 2B. In the past, monitoring and modeling done by DWR showed that the sediment in that area has minimal impact on channel capacity. DWR plans to continue this assessment by collecting topography and documenting conditions from the latest flood season.

5.0 References

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