Technical Memorandum

Channel Capacity Report
2021 Restoration Year

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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
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

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 correspond to flows that would not significantly increase flood risk from Restoration Flows in the Restoration Area. This annual report will recommend updating then-existing channel capacity 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 (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.

Typically, then-existing channel capacity is reported in an annual comprehensive Channel Capacity Report (CCR) that is prepared and circulated for public comment. For the 2021 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 2021 Restoration Year will only summarize the current then-existing channel capacity, as well as describe any studies or projects that could result in changes to then-existing channel capacity for the 2022 Restoration Year. This includes evaluation of a levee improvement project completed in 2020 within the Middle Eastside Bypass that will allow for an increase of then-existing channel capacity.

Previous CCRs can be found on the SJRRP website:

http://www.restoresjr.net/restoration-flows/levee-stability-channel-capacity/

2.0 Then Existing Channel Capacity

To determine the upper limit of Restoration Flows that can be conveyed in each channel, the SJRRP has completed comprehensive evaluations of over 60 miles of levees which 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 within the channel (in-channel) to prevent water on the levee itself which also reduces the risk of a levee failure. This summary provides the upper limit of Restoration Flows, which is referred to as "then-existing" channel capacity that can be conveyed in each reach based on levee capacity. Then-existing channel capacities in the Restoration Area were determined for the 2020 Restoration Year for the following reaches: Reach 1, Reach 2, Reach 3, Reach 4A, and Reach 5 of the San Joaquin River and the Eastside Bypass flood bypasses. A map of the Restoration Area can be found on the SJRRP website:

http://www.restoresjr.net/wp-content/uploads/2020/11/20130325_SJRRPreaches--scaled.jpg

This year's CCR does not recommend changes to the 2020 then-existing channel capacities, and channel capacities will remain the same for the 2021 Restoration Year. However, a summary of how then-existing channel capacity was determined for each reach is described below based on whether geotechnical data was used or if Restoration Flows are to remain in-channel (the water surface elevation in the river remains below the levees). A complete discussion of the data and analysis conducted to determine previous then-existing channel capacities can be found in the previous CCRs on the SJRRP website:

http://www.restoresjr.net/restoration-flows/levee-stability-channel-capacity/

For Reach 2A, the lower 2.5 miles of Reach 4A, Reach 4B2, Middle Eastside Bypass and Mariposa Bypass adequate data was available to perform a geotechnical analysis and these results were used to determine then-existing channel capacity. 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 initial then-existing capacity was determined in the 2018 CCR, which was later updated in the 2020 CCR to consider the removal of the weirs within the Merced National Wildlife Refuge.

In-channel capacities were the best estimate of then-existing channel capacities for Reach 2B, Reach 3, portions of Reach 4A, Reach 5, and Lower Eastside Bypass. The studies used to determine the capacities in these reaches are summarized in the 2017 and 2018 CCRs.

Table 1 identifies then-existing channel capacities and the method used to determine the capacity for each reach. Then-existing channel capacities in Table 1 do not consider limitations to Restoration Flows as it relates to agricultural seepage. For the 2021 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. Table 1 also notes 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*, which can be found on the SJRRP website:

https://www.restoresjr.net/restoration-flows/seepage-projects/

Table 1.
2021 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	1,070[5]	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 to approximately 2,140 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.
[5] In 2019 one of the weirs that allowed for flow diversions within the Merced National Wildlife Refuge was removed, so the capacity would be 1,070 cfs based on geotechnical data.

It should be acknowledged that then-existing channel capacities identified in this report are applicable to Restoration Flows only 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, and even though the flows can exceed current levee seepage and slope stability criteria (which define then-existing capacity limits) they have not historically resulted in significant levee failures.

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. 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. A summary of immediate, near-term, and long-term actions that can impact then-existing channel capacity can be found in the 2020 CCR. The SJRRP is continuing to work on several projects related to changing site-specific channel capacity. A status update on advancement of the progress for some of these projects are as follows:

- Construct Mendota Pool Bypass and Reach 2B Improvements. The Compact Bypass would route flows and fish around the Mendota Pool and would improve channel capacity to at least 4,500 cfs from Reach 2B to Reach 3. A summary of the work completed can be referenced at the following website:

  http://www.restoresjr.net/projects/restoration/2b-and-mendota-reach-bypass/

- Construct levee and fish passage improvements in the Middle Eastside Bypass (the Eastside Bypass between the Sand Slough Control Structure and Mariposa Bypass). The improvements that will impact channel capacity include reinforcing two miles of right levee along the Eastside Bypass to improve levee stability and reduce seepage (Reach O levee improvements). The Reach O levee improvements strengthen the weakest portion of the levees in the Middle Eastside Bypass and were completed at the end of 2020. The improvement included constructing a soil-bentonite cutoff wall that is approximately 30-40 feet deep along the center of the levee crown. The improvements also included the replacement of six corrugated metal culverts with reinforced concrete culverts. The Reach O levee improvement will allow an overall increase in then-existing capacity of the Middle Eastside Bypass. The final increase will depend on an evaluation of subsidence, and the existing geotechnical data of the remainder of the reach. Information regarding the Reach O levee improvements can be referenced at the following website:

  http://www.restoresjr.net/program-prepares-for-reach-o-levee-work/

- Another improvement includes removing two weirs located in the Eastside Bypass and operated by U.S. Fish and Wildlife Service within the MNWR to allow for fish passage. Removal of the weirs began in 2019 and will be completed in 2021 or 2022.

The projects described above, including the Reach O levee improvements in the Middle Eastside Bypass will improve channel capacity for Restoration Flows and future flood releases. As described in the 2020 CCR, flood releases during 2018 and 2019 highlighted a situation where Restoration Flows can mix with flood flows when Friant Dam is not in flood operations, but tributaries of the San Joaquin River are in flood operations. During any such occurrence, DWR and Reclamation will continue to coordinate on the best way to minimize flood risk. This is a rare case and is not expected to have much significance on levee stability within the Restoration

Area. This is especially true in those reaches where agricultural seepage limitations currently exist.

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, as well as others were considered in developing SJRRP studies and monitoring to determine then-existing channel capacity. A comprehensive list of studies and monitoring activities being completed by 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 2022 CCR include:

- The San Joaquin Levee Evaluation (SJLE) Project led by DWR assists the SJRRP in continuing to assess flood risks associated with the SJRRP with respect to levee seepage and stability. DWR is continuing to identify potential future remediation needs and associated costs for improvement of the levees in the Restoration Area.

- Ongoing updates and assessment of the modeling tools. The SJRRP has developed hydraulic and sediment transport modeling tools to evaluate the flow, seepage, and structural actions as part of meeting the Restoration Goal of the Settlement. Due to continued subsidence some of the modeling tools have been updated to reflect the most recent data depending on the location, priority and effort. DWR and Reclamation plan to conduct additional surveys to determine if all or some of the modeling tools need additional updates.

- Reporting of erosion monitoring of the channel and channel banks conducted by DWR to identify levee erosion areas that may potentially compromise levee integrity for consideration of future management actions (e.g., flow reduction, revetment, armoring, etc.). DWR will be providing a plan designed to provide proactive detection of hazards prior to incurring damage to infrastructure, property, and communities.

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

- Continuing and expanding vegetation surveys to obtain information on the establishment and recruitment of vegetation. This information can be used by the SJRRP to determine if actions need to be taken to address capacity issues as a result of increased roughness from vegetation within the channel and helps inform availability of fish habitat. The SJRRP is currently working on a plan to expand the existing monitoring program to better assess how new channel growth may affect channel capacity to help inform the Lower San Joaquin Levee District (LSJLD) maintenance activities.

5.0 References

San Joaquin River Restoration Program (SJRRP). 2012. *San Joaquin River Restoration Program Environmental Impact Statement/Report.* Available from: https://www.usbr.gov/mp/nepa/nepa_projdetails.cfm?Project_ID=2940. Accessed on March 27, 2017.

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