

Technical Memorandum

Public Review Draft

**Channel Capacity Report
2015 Restoration Year**



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San Joaquin River Restoration Program

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List of Abbreviations and Acronyms

CBBS	Chowchilla Bypass Bifurcation Structure
CCAG	Channel Capacity Advisory Group
CDEC	California Data Exchange Center
CFS	Cubic feet per second
CPT	Cone Penetration Test (Cone Penetrometer Test)
CVFPP	Central Valley Flood Protection Plan
CVFED	Central Valley Floodplain Evaluation and Delineation
CVFPB	Central Valley Flood Protection Board
Delta	Sacramento-San Joaquin Delta
DMC	Delta-Mendota Canal
DTM	Digital Terrain Model
DWR	Department of Water Resources
FSRP	Flood System Repair Project
GAR	Geotechnical Assessment Report
GDR	Geotechnical Data Report
GOR	Geotechnical Overview Report
LMAs	Local Maintaining Agencies
LSJLD	Lower San Joaquin Levee District
LSJRFC Project	Lower San Joaquin River Flood Control Project
MNWR	Merced National Wildlife Refuge
NRDC	Natural Resources Defense Council
NULE	Non-Urban Levee Evaluation
O&M	Operations and Maintenance
PEIS/R	Program Environmental Impact Statement/Environmental Impact Report
RACER	Remedial Alternatives and Cost Estimates Report
Reclamation	Bureau of Reclamation
Restoration Area	San Joaquin River Restoration Program Restoration Area
RFMP	Region Flood Management Plan
RM	River mile
ROD	Record of Decision
SJLE	San Joaquin Levee Evaluation
SJRRP	San Joaquin River Restoration Program
SPFC	State Plan of Flood Control
WSE	Water surface elevation
WSP	Water surface profile
ULE	Urban Levee Evaluation
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USJR	Upper San Joaquin River

Definitions

San Joaquin River Restoration Program (SJRRP): The SJRRP 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: 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 Areas that correspond to flows that would not significantly increase flood risk from Restoration Flows in the Restoration Area. Then-existing channel capacities currently being followed were defined from an analysis included in the PEIS/R; this annual report will recommend updating then-existing channel capacity based on recently completed evaluations.

In-channel capacity: The flow 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 **1.0 Executive Summary**

2 **Background**

3 The San Joaquin River Restoration Program (SJRRP) was established in late 2006 to implement
4 a Stipulation of Settlement (Settlement) in NRDC, et al., v. Kirk Rodgers, et al. The U.S.
5 Department of the Interior, Bureau of Reclamation, the Federal lead agency under the National
6 Environmental Policy Act, and the California Department of Water Resources (DWR), the State
7 lead agency under the California Environmental Quality Act, prepared a joint Program
8 Environmental Impact Statement/Report (PEIS/R) to support implementation of the Settlement.

9 The Settlement calls for releases of Restoration Flows, which were initiated in 2014 and are
10 specific volumes of water to be released from Friant Dam during different water year types,
11 according to Exhibit B of the Settlement. Federal authorization for implementing the Settlement
12 is provided in the San Joaquin River Restoration Settlement Act (Act) (Public Law 111-11).
13 Reclamation signed the Record of Decision (ROD) on September 28, 2012. Both the PEIS/R and
14 the ROD committed to establishing a Channel Capacity Advisory Group (CCAG) to determine
15 and update estimates of then-existing channel capacities as needed and to maintain Restoration
16 Flows at or below estimates of then-existing channel capacities. Then-existing channel capacities
17 in the Restoration Area (leveed reaches within the San Joaquin River between Friant Dam and
18 the confluence of the Merced River and the flood control bypass) correspond to flows that would
19 not significantly increase flood risk from Restoration Flows. This Channel Capacity Report is for
20 the 2015 Restoration Year and is the second report in a series of reports prepared annually. The
21 2015 Report, prepared in coordination with the CCAG, fulfills the commitments in the ROD.

22 The primary objective of this report is to provide the CCAG and the public a summary of the
23 prior Restoration Year's data, methods, and estimated channel capacities and recommendations
24 for monitoring and management actions for the following year. Identifying then-existing channel
25 capacity is critically important to ensure the release of Restoration Flows would not significantly
26 increase flood risk in the Restoration Area. This report only considers flood risks associated with
27 levee failure when estimating then-existing channel capacity; all other potential material impacts,
28 including agricultural seepage, are addressed in other analyses.

29 **CCAG Roles and Responsibilities**

30 The CCAG is comprised of members from the Bureau of Reclamation (Convener), California
31 Department of Water Resources (DWR, Co-convener), U.S. Army Corps of Engineers
32 (USACE), Lower San Joaquin Levee District, and the Central Valley Flood Protection Board.
33 The role of the CCAG is to: (1) provide independent review of Reclamation's estimates of then-
34 existing channel capacity as needed; (2) provide independent review of Channel Capacity
35 Reports; (3) participate in CCAG meetings; (4) provide independent and timely review of data;
36 and (5) provide input and guidance on monitoring and management actions.

1 **Study Area**

2 This Channel Capacity Report focuses on the portion of the Restoration Area where levees exist
 3 along channels to control flows. The leveed reaches on the San Joaquin River start at Gravelly
 4 Ford (River Mile 226.9) and continue to the Merced River confluence (River Mile 118.2). The
 5 study area also includes the Eastside Bypass from Sand Slough Connector to the confluence with
 6 Bear Creek and the Mariposa Bypass.

7 **Findings and Recommendations**

8 Then-existing channel capacities are defined as flows that would correspond to the appropriate
 9 levee slope stability and underseepage Factors of Safety based on USACE criteria for levees.
 10 The application of the criteria requires the collection and evaluation of data at locations
 11 throughout the Restoration Area. Until adequate data are available to apply the USACE criteria,
 12 the release of Restoration Flows would be limited to those that would remain in-channel (the
 13 water surface elevation in the river remains below the levees). Based on the results of technical
 14 studies summarized in this Report and detailed in Appendices, the 2015 recommended then-
 15 existing channel capacities will be the same as 2014 for the San Joaquin River and flood
 16 bypasses and are described in Table ES-1 below.

17 **Table ES-1**
 18 **Current and Recommended Then-existing Channel Capacity**

Reach	Current and Recommended Then-existing Channel Capacity (cfs)
Reach 2A	1,630
Reach 2B	1,120
Reach 3	2,760
Reach 4A	970
Reach 4B1	Not Analyzed
Reach 4B2	930
Reach 5	1,940
Middle Eastside Bypass	370
Lower Eastside Bypass	2,890
Mariposa Bypass	350

19

20 **Current Channel Capacity Studies and Related Work Completed**

21 The following technical studies and related work that were included in the 2014 Report continue
 22 to support the recommended then-existing channel capacities in this report.

23 **In-channel Capacity Study**

24 The In-channel Capacity Study for the San Joaquin River and the Eastside and Mariposa
 25 bypasses between Friant Dam and the confluence with the Merced River was conducted in 2013.

- 1 This study provides initial channel capacity estimates within leveed reaches that can inform then-
- 2 existing channel capacity prior to sufficient data becoming available to determine levee slope
- 3 stability and underseepage Factors of Safety.

- 4 Computed water-surface profiles were compared to the outside ground elevations adjacent to
- 5 both the left and right levees along the extent of each reach. The in-channel flow capacity of each
- 6 reach was determined to be the highest flow rate through the reach where the water-surface
- 7 elevation is at or below the outside ground elevation for any part of the reach. Results for each
- 8 reach are summarized in Table ES-2 below; these inform the 2014 and the 2015 recommended
- 9 then-existing channel capacity outlined in Table ES-1.

1
2

Table ES-2.
Summary of In-channel Capacity for Each Side of Levee by River Reach

Reach	Levee Side	In-channel Capacity ¹ (cfs)
Reach 2A	Left	2,430
Reach 2A	Right	1,630
Reach 2B (Entire Reach)	Left	0
Reach 2B (Entire Reach)	Right	0
Reach 2B (Excluding Mendota Pool) ²	Left	1,120
Reach 2B (Excluding Mendota Pool) ²	Right	1,550
Reach 3	Left	3,680
Reach 3	Right	2,760
Reach 4A	Left	970
Reach 4A	Right	1,340
Reach 4B2	Left	1,370
Reach 4B2	Right	930 ³
Reach 5 (All Levees)	Left	1,940
Reach 5 (All Levees)	Right	2,500
Reach 5 (Excluding Left Levee downstream of Mud Slough)	Left	2,350
Reach 5 (Excluding Left Levee downstream of Mud Slough)	Right	2,500
Middle Eastside Bypass (Eastside Bypass Reach 2)	Left	10
Middle Eastside Bypass (Eastside Bypass Reach 2)	Right	370
Lower Eastside Bypass (Eastside Bypass Reach 3)	Left	2,970
Lower Eastside Bypass (Eastside Bypass Reach 3)	Right	2,890
Mariposa Bypass	Left	650
Mariposa Bypass	Right	350

- 3 ¹ Capacity based on outside ground elevations.
4 ² Portion of reach above influence of Mendota Pool (about River Mile 209.5).
5 ³ Capacity excludes localized deep depressions, which would reduce capacity to 50 cfs.

6 Middle Eastside Bypass Geotechnical Assessment

7 As a preliminary component of the San Joaquin Levee Evaluation (SJLE) Project and to further
8 investigate in-channel capacity results in the Middle Eastside Bypass relative to levee
9 performance, preliminary levee seepage and stability analyses were completed at three sites with
10 the lowest in-channel capacity along the left levee bank. The analysis was performed to better
11 understand the potential levee seepage and stability impacts in a reach with low outside ground
12 elevations compared to the channel, resulting in unreasonably low in-channel capacity.

1 Table ES-3 summarizes the acceptable maximum water surface elevation, and approximate
2 height of water on the waterside levee toe compared to the relative outside ground. The analysis
3 results and recommendations summarized in Table ES-3 and in Appendix D are based on
4 preliminary data. The results and recommendations should be refined once more detailed
5 information becomes available.

6 **Table ES-3.**
7 **Summary of Preliminary Analysis Results for Channel Capacity Assessment¹**

Site	Maximum Water Surface Elevation (feet, NAVD88)	Approximate Height of Water on the Levee ²
1	100.7	1.2
2	104.0	6.5
3	101.7	3.7

8 ¹ Height of water on the levee at a particular location does not necessarily translate directly to another site, i.e. if water were at
9 a height of 1 foot on the levee at Site 1 then the height of water on the levee at a different location could be different.

10 ² Height of water relative to the typical outside ground elevation.
11

12 The geotechnical assessment indicates that a water surface elevation of 100.7 ft on the left levee
13 would contain flows of at least 570 cfs without causing levee stability impacts. Because the right
14 levee in-channel capacity is 370 cfs and was not part of the preliminary geotechnical assessment,
15 the in-channel capacity of the Middle Eastside Bypass is 370 cfs.
16

1 **Future Program Actions with the Potential to Impact Then-existing** 2 **Channel Capacity**

3 Throughout Settlement implementation, the maximum downstream extent and rate of
4 Restoration Flows to be released would be limited to then-existing channel capacities. As
5 channel or structure modifications are completed with additional environmental compliance,
6 Restoration Flow releases would be correspondingly increased in accordance with then-existing
7 channel capacities and with the release schedule. If release of water from Friant Dam is required
8 for flood control purposes, concurrent Restoration Flows would be reduced by an amount
9 equivalent to the required flood control release. If flood control releases from Friant exceed the
10 concurrent scheduled Restoration Flows, no additional releases above those required for flood
11 control would be made for SJRRP purposes. Until sufficient data are available to determine the
12 levee seepage and stability Factors of Safety, Reclamation would limit initial Restoration Flow
13 releases to those flows which would remain in-channel. When sufficient data are available to
14 determine the Factors of Safety, Reclamation would limit the release of Restoration Flows to
15 those flows which would maintain standard USACE levee performance criteria at all times.

16 This Report, similar to the 2014 Report, describes both the future Program studies and
17 monitoring and non-program actions with the potential to inform then-existing channel capacity.
18 The future Program technical studies continue to include verification and monitoring of in-
19 channel capacity, the implementation of the San Joaquin Levee Evaluation Project (includes
20 geotechnical exploration and analysis), continued study and updates to the Reach 2A
21 Morphology Study (as needed), continued subsidence monitoring and study, as well as a
22 vegetation study. The Program monitoring activities may continue to include: gage monitoring,
23 water surface profile surveys, aerial and topographic surveys, erosion monitoring, vegetation
24 surveys, and suspended sediment monitoring.

25 There are other entities that are active in the Restoration Area and whose programs may help
26 inform or impact then-existing channel capacity. The SJRRP will need to closely coordinate and
27 collaborate with these entities by sharing data and coordinating specific actions along the river
28 that can inform or impact channel capacity. These entities and activities include the Lower San
29 Joaquin Levee District's periodic operation and maintenance of the bypass system and river
30 channel; the U.S. Fish & Wildlife Service operation of weirs within the boundaries of the
31 Merced National Wildlife Refuge along the Middle Eastside Bypass (Eastside Bypass Reach 2),
32 and DWR/FloodSAFE efforts such as the Non-Urban Levee Evaluations, the Regional Flood
33 Management Planning effort and the Flood System Repair Project. The SJRRP will continue to
34 coordinate with these non-Program efforts and actions, and the CCAG will consider the effect of
35 these actions in future Channel Capacity Reports.

2.0 Introduction

1
2 The San Joaquin River Restoration Program (SJRRP) was established in late 2006 to implement
3 a Stipulation of Settlement (Settlement) in *NRDC, et al., v. Kirk Rodgers, et al.* The U.S.
4 Department of the Interior, Bureau of Reclamation (Reclamation), the Federal lead agency under
5 the National Environmental Policy Act (NEPA), and the California Department of Water
6 Resources (DWR), the State lead agency under the California Environmental Quality Act
7 (CEQA), prepared a joint Program Environmental Impact Statement/Report (PEIS/R) to support
8 implementation of the Settlement. The Settlement calls for releases of Restoration Flows.
9 Restoration Flows were initiated in 2014 and are specific volumes of water to be released from
10 Friant Dam during different water year types, according to Exhibit B of the Settlement. Federal
11 authorization for implementing the Settlement is provided in the San Joaquin River Restoration
12 Settlement Act (Act) (Public Law 111-11). Reclamation signed the Record of Decision (ROD)
13 on September 28, 2012. Both the PEIS/R and the ROD committed to establishing a Channel
14 Capacity Advisory Group (CCAG) to determine and update estimates of then-existing channel
15 capacities as needed and to maintain Restoration Flows at or below estimates of then-existing
16 channel capacities. Then-existing channel capacities in Restoration Area (the San Joaquin River
17 between Friant Dam and the confluence of the Merced River) correspond to flows that would not
18 significantly increase flood risk from Restoration Flows. Sections of the PEIS/R applicable to the
19 CCAG are included in Appendix A of this Report.

20 This Channel Capacity Report for the 2015 Restoration Year (2015 Report) is the second in the
21 series of annual reports required to fulfil the commitments in the ROD. The first annual Channel
22 Capacity Report (2014 Report) was prepared for the 2014 Restoration Year and was finalized on
23 January 29, 2014. The 2014 Report can be found at the SJRRP website under the following link:
24 [http://restoresjr.net/program_library/02-Program_Docs/2014/Channel_Capacity_Report_Final_-](http://restoresjr.net/program_library/02-Program_Docs/2014/Channel_Capacity_Report_Final_-_2014_Accessible.pdf)
25 [2014_Accessible.pdf](http://restoresjr.net/program_library/02-Program_Docs/2014/Channel_Capacity_Report_Final_-_2014_Accessible.pdf).

26 The 2014 Report provided an update to the PEIS/R then-existing channel capacities and
27 highlighted future studies and data gaps that will be key in informing future channel capacities.
28 Since there are no significant channel capacity studies that have been completed since the 2014
29 Report, this report will not be revising the recommendation for then-existing channel capacities
30 for the 2015 Restoration Year. In doing so, this report will only describe past studies used to
31 directly support the recommendations for then-existing channel capacity, updates to studies
32 described in the 2014 Report, and new studies that have been initiated since the 2014 Report.
33 The 2015 Report will also continue to summarize and provide updates of the future actions, and
34 the studies and monitoring that will impact future then-existing channel capacities.
35

36 The 2015 Report will be available for a 60-day public review and comment period beginning on
37 September 3, 2014. Comments are due on November 3, 2014 to Reclamation and DWR and
38 may be addressed to the following:
39

1 Alexis R. Phillips-Dowell, Senior Engineer
2 Department of Water Resources, South Central Region Office
3 3374 East Shields Avenue
4 Fresno, CA 93726

5 OR

6 Katrina Harrison, Project Engineer
7 Bureau of Reclamation, San Joaquin River Restoration Program
8 2800 Cottage Way, W-1727
9 Sacramento, CA 95825

10 **2.1 Objective**

11 This Channel Capacity Report is required by the SJRRP PEIS/R and the corresponding ROD.
12 The primary objective of the report is to provide the CCAG and the public a summary of the
13 prior year's data, methods, and estimated channel capacities and recommendations for
14 monitoring and management actions for the following year. In doing so, it will present data,
15 evaluations, estimates of then-existing channel capacity, and management actions to address
16 levee stability, hydraulics, and sediment transport within the system in accordance with levee
17 performance standards. Identifying then-existing channel capacity is critically important to
18 ensure the release of Restoration Flows in 2015 will not significantly increase flood risk in the
19 Restoration Area. This report only considers flood risks associated with levee failure when
20 estimating then-existing channel capacity. All other potential material impacts, including
21 agricultural seepage, are addressed in other analyses.

22 This report shall be prepared annually in coordination with the CCAG. The purpose of the
23 CCAG is to provide independent review of estimated then-existing channel capacities,
24 monitoring results, and management actions to address vegetation and sediment transport within
25 the systems as identified by the Bureau of Reclamation (Reclamation).

26 **2.2 CCAG Roles and Responsibilities**

27 The CCAG is comprised of the following organizations and representatives:

- 28 • Bureau of Reclamation (Convener):
 - 29 - Pablo Arroyave, Deputy Regional Director (primary)
 - 30 - Alicia Forsythe, SJRRP Program Manager (alternate)
- 31 • CA Department of Water Resources (Co-convener):
 - 32 - Paula Landis, Chief, Division of Integrated Regional Water Management (primary)
 - 33 - Kevin Faulkenberry, Chief, South Central Region Office (alternate)
- 34 • U.S. Army Corps of Engineers:
 - 35 - To be determined, Project Manager (primary)

1 - Christy Jones, Lead Water Manager (alternate)

2 • Lower San Joaquin Levee District:

3 - Reggie Hill, General Manager (primary)

4 - Robert Tull (alternate)

5 • Central Valley Flood Protection Board:

6 - Len Marino, Chief Engineer (primary)

7 - Ali Porbaha, Senior Engineer (alternate)

8 The roles and responsibilities of the CCAG members are as follows:

- 9 • **Provide independent review of Reclamation’s estimates of then-existing channel**
10 **capacity as needed:** Provide an independent review of Reclamation’s estimated then-
11 existing channel capacities, monitoring results, and management actions to address levee
12 stability, hydraulics, and sediment transport within the system estimated by Reclamation in
13 accordance with standard USACE levee performance criteria.
- 14 • **Provide independent review of Channel Capacity Reports:** Annually or in the event
15 Reclamation proposes increasing the upper limit of releases for Restoration Flows,
16 Reclamation will release a public report detailing the new upper limits of releases and data
17 and methods used to develop the new upper limits of releases. The CCAG provides input
18 during the development of these public reports.
- 19 • **Participate in Channel Capacity Advisory Group meetings:** Reclamation organizes
20 working meetings for the CCAG to review progress made in developing the annual reports.
21 These meetings are an opportunity for the CCAG to comment on content as it is developed.
22 CCAG members attend and participate in working meetings.
- 23 • **Provide independent and timely review of data:** The CCAG provides a timely review of
24 data, analytical methodology, and results used to estimate the then-existing channel
25 capacities.
- 26 • **Provide input and guidance on monitoring and management actions:** Reclamation
27 provides occasional updates on on-going erosion monitoring and management results –
28 including monitoring of potential erosion sites – to the CCAG. The CCAG provides
29 comments on information provided through these updates.

30 **2.3 Channel Capacity Technical Factors**

31 There are several factors that can impact and limit channel capacity. The following is a summary
32 of the factors that could be considered when evaluating and recommending then-existing channel
33 capacities, as well as determining potential future improvements and other management actions
34 of the SJRRP.

- 35 • **Levee Integrity** - Channel capacity may be limited if the levee is not constructed to design
36 criteria (e.g., insufficient slope stability Factor of Safety or underseepage Factor of Safety) or

1 if there is insufficient data to assess levee performance. In addition, observations (e.g., boils,
2 sloughing, seepage, etc.) made of the performance of a levee during historical flow releases
3 can also provide information on levee integrity and stability. Considering the observations, as
4 well as other factors may result in an increase or decrease channel capacity.

- 5 • **Erosion** - Stream bank erosion that encroaches on the levee prism or has a significant
6 potential to encroach on the levee prism increases the potential for levee failure. Therefore,
7 channel capacity may be limited if erosion is present that could result in levee failure during
8 a flow release.
- 9 • **Duration and Timing and Flow Releases** –The duration and timing of flow releases may
10 cause water to be against a levee for a period of time which could result in the levee
11 becoming saturated. As the levee becomes saturated, seepage through and sloughing of the
12 soil can occur, which could result in the loss of foundation stability and ultimately potential
13 levee failure.
- 14 • **Sediment Transport** - Sedimentation or scouring may change the geometry of the channel
15 and increase or decrease channel capacity.
- 16 • **Subsidence** - Ground subsidence may change the geometry of the channel and increase or
17 decrease channel capacity. Subsidence may also reduce freeboard, thus increasing the
18 potential for overtopping during flow releases.
- 19 • **Vegetation** - In-channel vegetation may impact flow and stage and is measured by channel
20 roughness in a hydraulic analysis. Changes in in-channel vegetation can increase or decrease
21 channel capacity.
- 22 • **Operation and Maintenance** - Levee operation and maintenance (O&M) programs are
23 necessary to assess changed conditions that could impact channel capacity and to provide
24 flood fight capability in case of levee failure. Channel capacity may be limited if there are
25 inadequate O&M resources to monitor conditions that could affect channel capacity.
- 26 • **Constructed Improvements** - Levee construction may improve levee integrity or channel
27 geometry and increase channel capacity.
- 28 • **Additional Factors** - Other future conditions (i.e. climate change, structures, land
29 encroachments, etc.) not listed above, or those recommended by the CCAG will also be a
30 consideration in evaluating channel capacity.

31 The above factors, as well as others are being considered as part of the current or future SJRRP
32 studies and monitoring to determine then-existing channel capacity.

33 **2.4 PEIS/R Approach to Minimizing Flood Risk**

34 As outlined in the PEIS/R, Reclamation will minimize flood risk from Restoration Flows
35 throughout the Settlement implementation process by undertaking three integrated measures: (1)
36 establish a CCAG and determine and update the estimates of then-existing channel capacities as
37 needed; (2) maintain Restoration Flows below estimates of then-existing channel capacities; and
38 (3) closely monitor erosion and perform maintenance and/or reduce Restoration Flows as
39 necessary to avoid erosion-related impacts. The CCAG was established in coordination with
40 Department of Water Resources (DWR) and prior to the release of Restoration Flows for the

1 2014 Restoration Year. Reclamation is to prepare an annual report, which would include data
2 and methods used to develop estimates of then-existing channel capacities. A draft report is
3 provided to the CCAG for its review and comment for a period of 60 days. In the event that
4 comments or recommendations are received from the Advisory Group within 60 days,
5 Reclamation would be required to consider and respond to such comments and prepare a final
6 report for distribution to the CCAG within 60 days of the close of the draft report review period.
7 Reclamation will not increase Restoration Flows above the previously determined then-existing
8 channel capacities until 10 days after the final report is prepared and distributed to the CCAG.
9 Draft reports include the data, methods, and estimated channel capacities; flow limits and any
10 maintenance activities; and monitoring efforts and management actions. Draft and final reports
11 will be made available to the public concurrent with their distribution to the CCAG. This report
12 is the second in the series of annual Channel Capacity Reports.

13 Reclamation will convene the CCAG as required until 2030, but may stop earlier, provided that
14 then-existing channel capacities are determined to equal or exceed the maximum proposed
15 Restoration Flows throughout the Restoration Area. If after 2030 then-existing channel capacities
16 decrease such that full Restoration Flows cannot be conveyed, the CCAG would be reconvened
17 and function as described above until such time that the then-existing channel capacities are
18 determined to equal or exceed the full Restoration Flows.

19

3.0 Study Area

The San Joaquin River originates from the Sierra Nevada Mountains and carries snowmelt from mountain meadows to the valley floor before turning north and becoming the backbone of tributaries draining into the San Joaquin Valley. It is California's second longest river and discharges to the Sacramento-San Joaquin Delta (Delta) and, ultimately, to the Pacific Ocean through San Francisco Bay.

In 1944, Reclamation completed construction of Friant Dam on the San Joaquin River. With the completion of Friant-Kern Canal in 1951 and Madera Canal in 1945, Friant Dam diverted San Joaquin River water supplies to over 1 million acres of highly productive farmland along the eastern portion of the San Joaquin Valley. In 1959, construction of the Lower San Joaquin River Flood Control Project (LSJRFC Project) began. The LSJRFC Project was completed in 1967 and provides flood protection along the San Joaquin River and tributaries in Merced, Madera, and Fresno Counties. The LSJRFC Project includes 108 river miles (RMs), 191 miles of levees, and protects over 300,000 acres. An additional 67 miles of non-Project levees also provide flood projection along the San Joaquin River.

The study area starts from the Friant Dam and ends at the confluence of the San Joaquin River with the Merced River. The Channel Capacity Report will focus on the portion of the study area where levees exist along channels to control flows. The leveed reaches on the San Joaquin River start at Gravelly Ford (RM 226.9) and continue to the Merced River confluence (RM 118.2). The study area also includes the Eastside Bypass from Sand Slough Connector to the confluence with Bear Creek and the Mariposa Bypass. The study area is shown in Figure 3-1.

The study area reaches are shown in Figure 3-2 and are describe below. Currently SJRRP flows pass through Reaches 1 through 4A, through the Sand Slough Connector Channel and into the Eastside Bypass, where they travel through Eastside Bypass before entering Reach 5 of the San Joaquin River. Since Reach 1 does not have levees, it is not the focus of the analyses included in this report and is not discussed further. The flood capacities of each of the reaches within the study area, as part of the overall flood control system are shown in Figure 3-3 (DWR, 1985).

3.1 Reach 2

Reach 2 marks the beginning of the LSJRFC Project levees and therefore the start of this Report's study area. Reach 2 begins at Gravelly Ford and extends approximately 24 miles downstream to the Mendota Pool, continuing the boundary between Fresno and Madera counties. This reach is a meandering, low-gradient channel. Reach 2 is subdivided at the Chowchilla Bypass Bifurcation Structure (CBBS) into two subreaches. Both Reach 2A and Reach 2B were dry in most months prior to the SJRRP. Reach 2A is subject to extensive seepage losses. Reach 2B is a sandy channel with limited conveyance capacity. Reach 2A has a flood design capacity of 8,000 cubic feet per second (cfs) while Reach 2B has a flood design capacity of 2,500 cfs. In Reach 2B, seepage problems are reported to occur at discharges in excess of 1,300 cfs (McBain & Trush, 2002). The levees in Reach 2B are not part of the LSJRFC Project. As part of the SJRRP, setback levees are anticipated to be constructed in Reach 2B to increase its capacity to at least 4,500 cfs.

1 **3.2 Reach 3**

2 Reach 3 begins at Mendota Dam and extends approximately 23 miles downstream to Sack Dam.
3 Reach 3 conveys flows of up to 800 cfs from the Mendota Pool for diversion to the Arroyo Canal
4 at Sack Dam, maintaining year-round flow in a meandering channel with a sandy bed. This reach
5 continues along the boundary between Fresno and Madera counties. The sandy channel
6 meanders through a predominantly agricultural area, and diversion structures are common in this
7 reach. Reach 3 has a flood design capacity of 4,500 cfs. The levees in Reach 3 are also not part
8 of the LSJRFC Project. Flood flows from the Kings River are conveyed to Reach 3 via Fresno
9 Slough and Mendota Dam.

10 **3.3 Reach 4**

11 Reach 4 is approximately 46 miles long, and is subdivided into three distinct subreaches. Reach
12 4A begins at Sack Dam and extends to the Sand Slough Control Structure. Other than short 1-2
13 mile levee segments at the downstream end, levees in Reach 4A are not part of the LSJRFC
14 Project (Figure 3-3). This subreach is dry in most months except under flood conditions and
15 SJRRP flows. Reach 4B1 begins at the Sand Slough Control Structure and continues to the
16 confluence of the San Joaquin River and the Mariposa Bypass. Only the lower 2 miles of Reach
17 4B1 levees just upstream of the Mariposa Bypass are part of the LSJRFC Project. All flows
18 reaching the Sand Slough Control Structure are diverted to the flood bypass system via the Sand
19 Slough Bypass, leaving Reach 4B1 perennially dry for more than 40 years, with the exception of
20 agricultural return flows. Reach 4B1 has a flood design capacity of 1,500 cfs, but the current
21 channel capacity is unknown and could be zero in some locations (SJRRP, 2011). As part of the
22 SJRRP, setback levees may be constructed in Reach 4B1 to increase its capacity to at least 475
23 cfs and possibly up to 4,500 cfs, depending on the alternative. Reach 4B2 begins at the
24 confluence of the Mariposa Bypass, where flood flows in the bypass system rejoin the mainstem
25 San Joaquin River. Reach 4B2 extends to the confluence of the Eastside Bypass. The levees in
26 this reach are all part of the LSJRFC Project. Reach 4B2 has a capacity of 10,000 cfs.

27 **3.4 Reach 5**

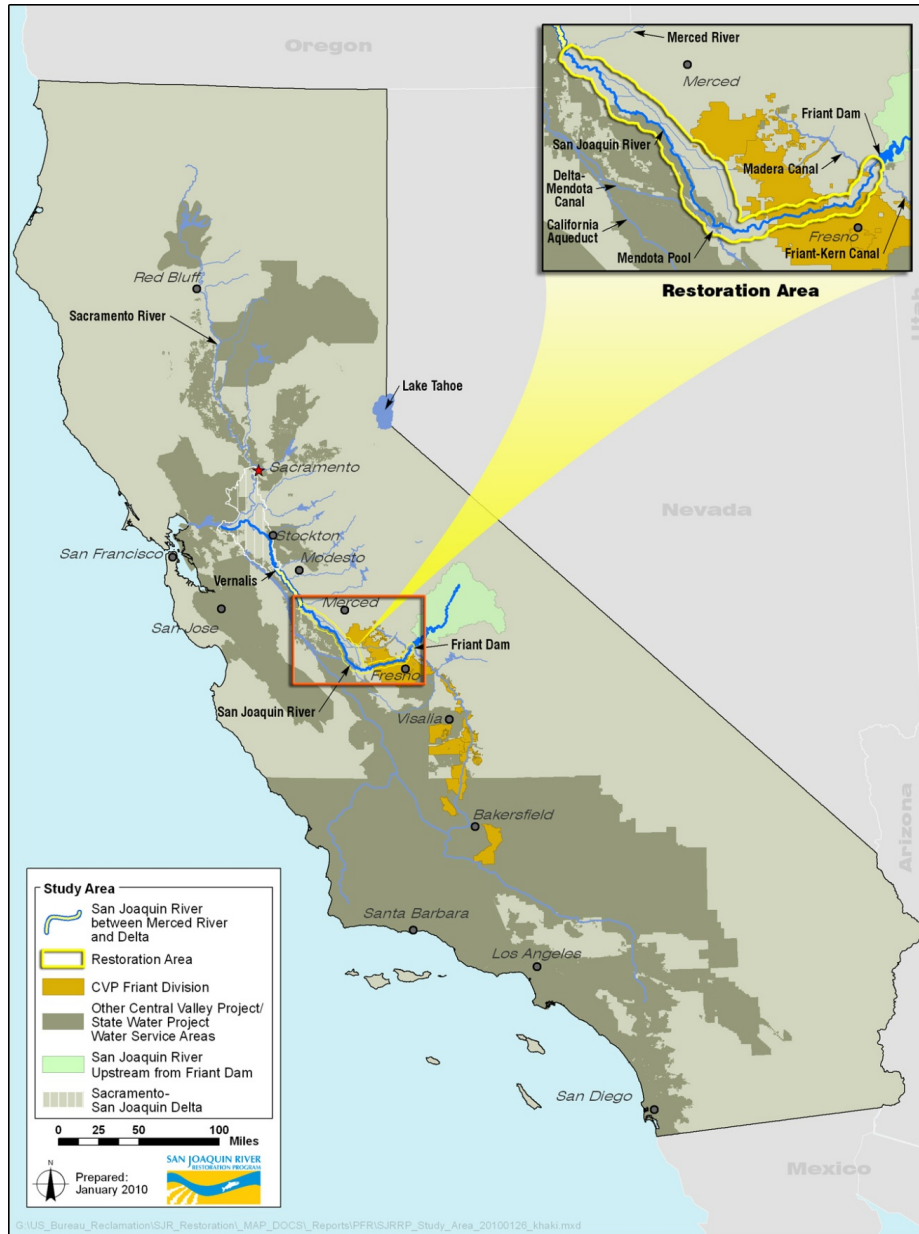
28 Reach 5 of the San Joaquin River extends approximately 18 miles from the confluence of the
29 Eastside Bypass downstream to the Merced River confluence. This reach receives flows from
30 Mud and Salt sloughs, and channels that run through both agricultural and wildlife management
31 areas. Much of Reach 5 includes levees that are within the LSJRFC Project. Reach 5 is the end of
32 the study area and has a flood design capacity of 26,000 cfs.

33 **3.5 Eastside Bypass and Mariposa Bypass**

34 The Middle Eastside Bypass (Reach 2) extends from Sand Slough Connector Channel to the
35 Eastside Bypass Control Structure. Flood flows from Reach 4A of the San Joaquin River and the
36 Upper Eastside Bypass (Reach 1) and the Chowchilla Bypass can be diverted into the bypass at

1 the head of this reach. The Merced Wildlife Refuge is in the middle of this reach of the bypass
2 and diverts some flows to its Refuge by using two weirs. The Lower Eastside Bypass (Reach 3)
3 extends from the head of the Mariposa Bypass to the head of Reach 5, and receives flows from
4 Deadman, Owens, and Bear creeks. The Mariposa Bypass extends from the Mariposa Bypass
5 Control Structure to the head of Reach 4B2. A drop structure is located near the downstream end
6 of the Mariposa Bypass that dissipates energy from flows before they enter the mainstem San
7 Joaquin River. The flood design flow for the Middle Eastside Bypass (Reach 2) is 16,500 cfs; the
8 Lower Eastside Bypass (Reach 3) is between 12,000 cfs at its upstream end and 18,500 cfs just
9 downstream of its confluence with Bear Creek; and 8,500 cfs for the Mariposa Bypass. As part
10 of the SJRRP, the Middle and Lower Eastside bypasses may be used for Restoration Flows, but
11 its overall design flood capacity will not be increased.

1



2

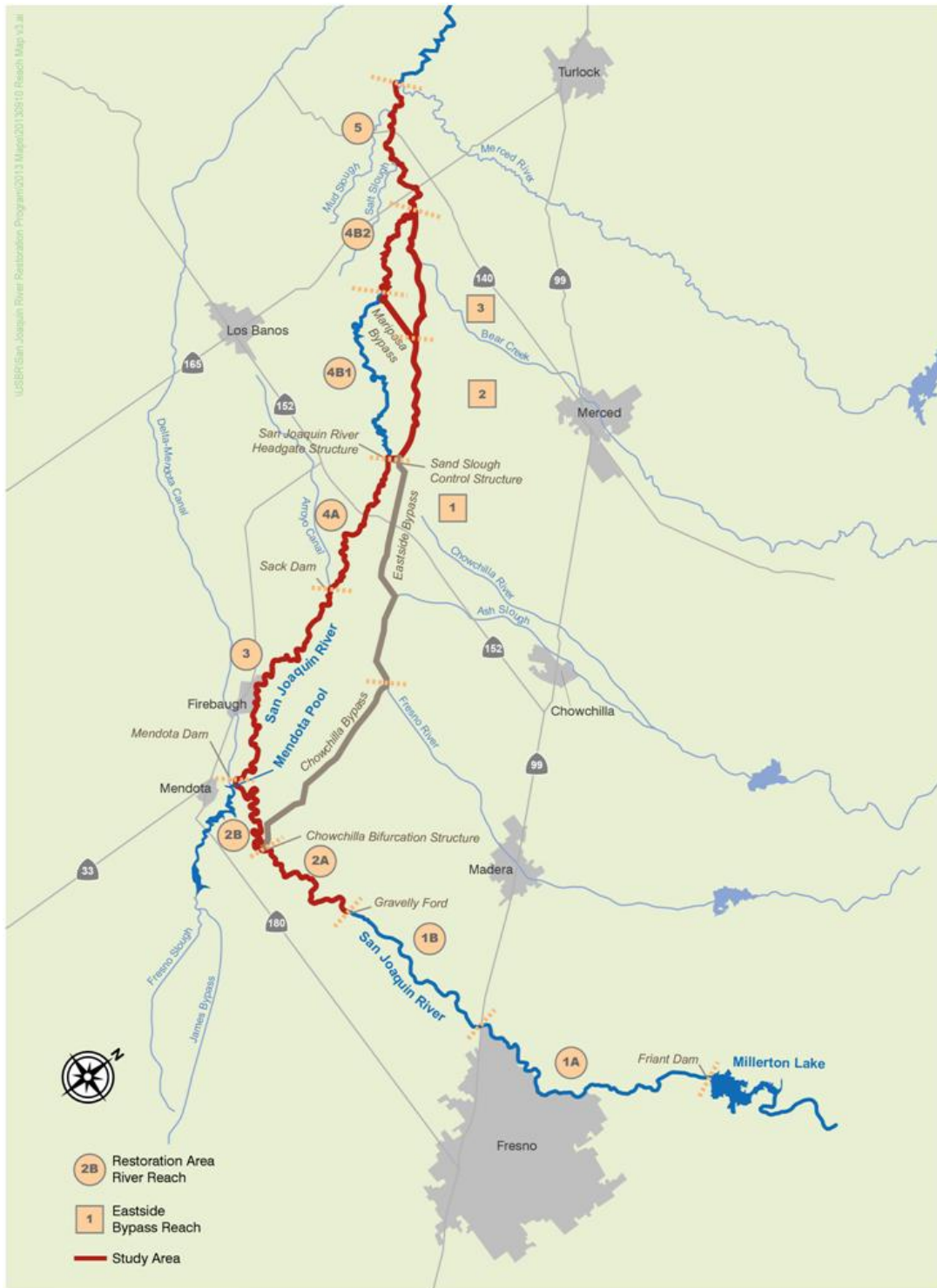
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Figure 3-1.

San Joaquin River Restoration Program Location

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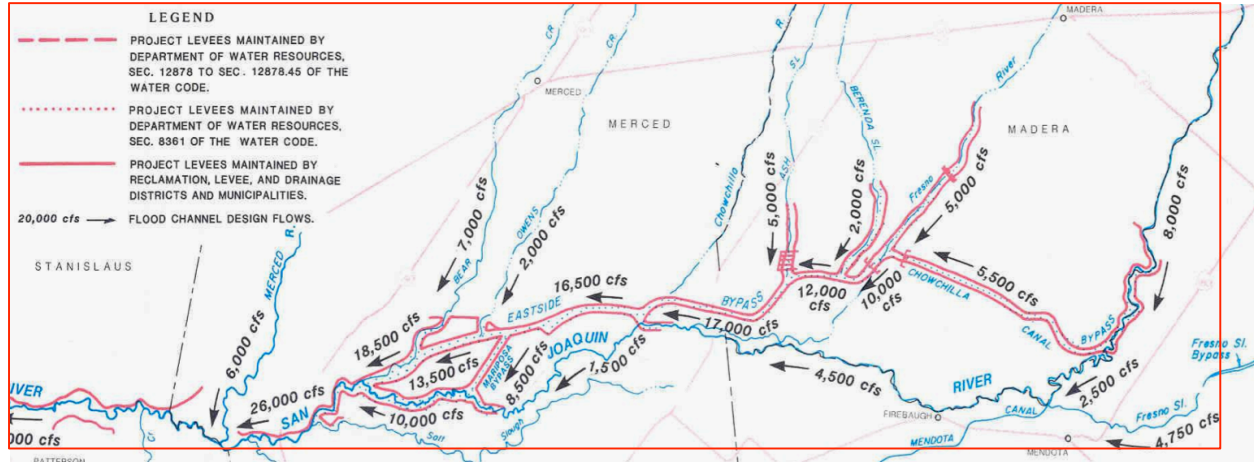
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Figure 3-2.

San Joaquin River Reaches and Flood Bypass System

San Joaquin River Restoration Program



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Figure 3-3.

Flood Channel Design Flows

4.0 Then-existing Channel Capacity Criteria

Then-existing channel capacities, as defined for this report, consider levee stability and seepage, but not other factors like agricultural seepage. This section presents the levee evaluation criteria described in the PEIS/R for determining then-existing channel capacity and briefly describes the process that will be used to collect data and perform analyses to determine levee conditions to further refine then-existing channel capacity estimates.

4.1 PEIS/R Levee Criteria

An objective of the SJRRP is to minimize increases in flood risk due to the release of Restoration Flows. To achieve this objective, the PEIS/R included the levee design criteria developed by USACE in Design and Construction of Levees Engineering and Design Manual (Manual No. 1110-2-1913) (USACE 2000) Engineering Manual: Slope Stability (Manual No. 1110-2-1902) (USACE 2003), and Design Guidance for Levee Underseepage (Engineering Technical Letter No. 1110-2-569) (USACE 2005). The levee design criteria and guidelines are to be applied throughout the Restoration Area.

The levee criteria are included in the PEIS/R to reduce the risk of levee failure to less-than-significant-levels by meeting levee slope stability and underseepage Factors of Safety. The PEIS/R states that Restoration Flows should not cause the levee slope stability Factor of Safety to be below 1.4, or the underseepage Factor of Safety to be reduced below the value corresponding to an exit gradient at the (landside) toe of the levee of 0.5. The levee slope stability Factor of Safety is defined as the ratio of available shear strength of the top stratum of the levee slope to the necessary shear strength to keep the slope stable (USACE 2003). The application of the levee slope stability Factor of Safety of 1.4 is required for federally authorized flood control projects. The underseepage Factor of Safety is defined as a ratio of the critical hydraulic gradient to the actual exit gradient of seepage on the levee. USACE design guidance recommends that the allowable underseepage factor of safety used in evaluations and/or design of seepage control measures should correspond to an exit gradient at the toe of the levee of 0.5 (in general this would provide a Factor of Safety of 1.6), but states that deviation from recommended design guidance is acceptable when based and documented on sound engineering judgment and experience (USACE 2005). The SJRRP will continue to coordinate with DWR, CVFPB, and USACE to ensure appropriate methods and criteria are used in all levee evaluations and design.

Until adequate data are available to determine these Factors of Safety, Reclamation would limit the release of Restoration Flows to those that would remain in-channel. In-channel flows are flows that maintain a water surface elevation at or below the elevation of the landside levee toe (i.e., the base of the levee). When sufficient data is available to determine the levee slope stability and underseepage Factors of Safety, Reclamation would limit Restoration Flows to levels that would correspond to the appropriate levee slope stability Factor of Safety of 1.4 or higher and an underseepage Factor of Safety corresponding to an exit gradient at the toe of the levee of 0.5 or lower at all times. Implementing this measure would reduce the risk of levee

1 failure due to underseepage, through-seepage, and associated levee stability issues to less-than-
2 significant levels.

3 In addition, systematic levee condition monitoring would be implemented as described in more
4 detail in PEIS/R Appendix D, “Physical Monitoring and Management Plan.” Observation of
5 levee erosion, seepage, boils, impaired emergency levee access, or other indications of increased
6 flood risk identified through ongoing monitoring at potential erosion sites would indicate that the
7 minimum Factors of Safety are not met and would trigger immediate reductions in Restoration
8 Flows at the site. Such observations would supersede channel capacity estimates, and Restoration
9 Flows would be reduced in areas where these conditions occur.

10 **4.2 Future Evaluation Process**

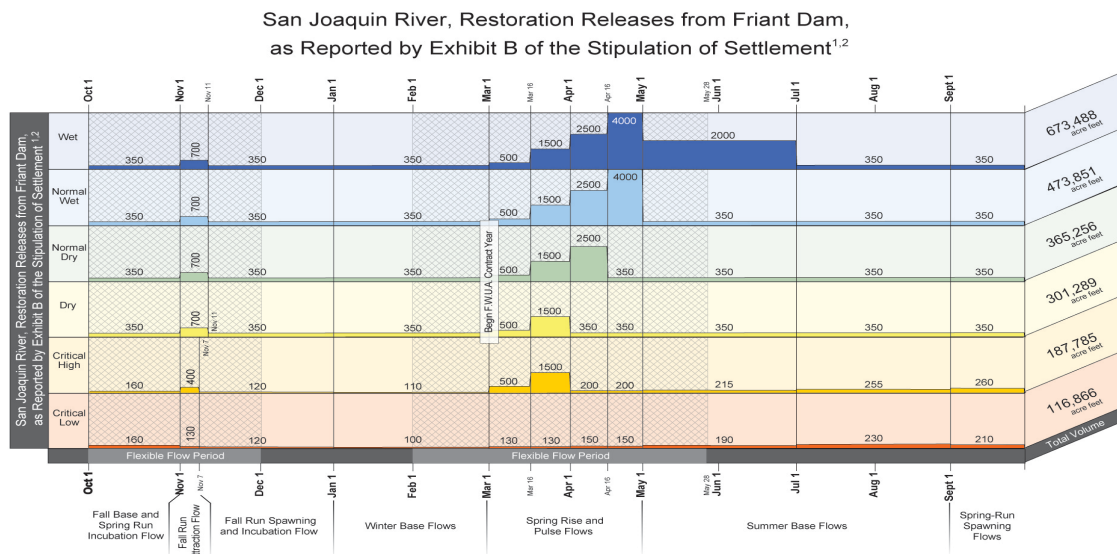
11 The SJRRP will continue to complete and update the studies necessary to determine then-
12 existing channel capacity. This includes, in part, collecting and assessing the necessary
13 geotechnical data to determine the appropriate levee slope stability and underseepage Factors of
14 Safety. To complete this task, the San Joaquin Levee Evaluation Project (SJLE Project) was
15 initiated by DWR. The SJLE Project includes collecting geotechnical data along the river and
16 flood bypasses, evaluating the levee geotechnical performance at various water surface
17 elevations, and identifying levees and appropriate actions to improve levee performance. The
18 goal of this evaluation is to gain adequate information on the levees to determine the levee slope
19 stability and underseepage Factors of Safety. This will provide Reclamation with the necessary
20 information to make decisions on Restoration Flow releases that will reduce the risk of levee
21 failure. Details of the SJLE Project and other studies and monitoring that may be used to inform
22 channel capacities are summarized in the Section 10 - Future Program Studies and Monitoring
23 with the Potential to Inform Then Existing Channel Capacity.

1 **5.0 Data and Analytical Tools**

2 The following sections describe the data and analytical tools used to determine then-existing
3 channel capacity. The sections provide an overview of the restoration hydrograph and hydraulic,
4 sediment transport modeling and levee assessment tools. This section also includes a summary of
5 the overall strategy Reclamation and DWR developed for the coordination and application of the
6 hydraulic and sediment modeling tools.

7 **5.1 Restoration Hydrograph**

8 The SJRRP flow hydrograph involves a spring and a fall pulse with base flow releases of 350 cfs
9 from Friant Dam in the summer and winter months in most year types. These hydrographs are
10 provided in Exhibit B of the Settlement and the Restoration Flow hydrograph at Friant Dam is
11 summarized in Figure 5-1. Spring flow pulses range from 1,500 cfs maximum release in a
12 critical-high year type, to a 4,000 cfs release in a wet year type. The Restoration Administrator,
13 an independent individual called for in the Settlement, makes recommendations to the Secretary
14 of the Interior on how best to shape the hydrograph to meet the Restoration Goal of the
15 Settlement. The Restoration Administrator has the flexibility to adjust the hydrographs,
16 consistent with the Settlement, including releasing buffer flows of up to 10 percent, mobilizing
17 gravel with an up to 8,000 cfs pulse, and flexibly scheduling the spring pulse volume within a
18 period defined as 28 days in advance of the Settlement Exhibit B hydrographs (i.e. beginning on
19 February 1 with 500 cfs), and 28 days later than the Exhibit B hydrographs (ending on May 28 at
20 4,000 cfs). The fall pulse volume may be flexibly scheduled from October 1 to November 30. In
21 wet year types, an additional volume is available for riparian recruitment that can extend 60 to 90
22 days past the end of the spring pulse flow.
23



1 - NRDC v Rodgers, Stipulation of Settlement, CIV NO. S-88-1658 - LKK/OGH, Exhibit B, September 13, 2008
 2 - Hydrographs reflect assumptions about seepage losses and tributary inflows which are specified in the settlement

Figure 5-1.

Restoration Flow Hydrograph at Friant Dam

In order to determine the Restoration Hydrograph, Reclamation will first use DWR forecasts to predict the unimpaired inflow to Millerton Lake. Then this volume is allocated to the Friant Division long-term contractors and water users in Reach 1 per Reclamation standard practice, and to the SJRRP using a calculation called Method 3.1 gamma. Reclamation then submits an allocation and a default flow schedule to the Restoration Administrator, with flow volumes by type (i.e., base flow, spring pulse, fall pulse, riparian recruitment). The Restoration Administrator responds with a flow recommendation using the flexibility as described above to change the flow schedule. Reclamation confirms that the Restoration Administrator recommendation is consistent with all applicable regulation (Settlement, Water Board Orders, channel capacity), accepts the recommendation, and then implements the schedule.

Based on the schedule identified in the Settlement, Restoration Flows will begin on January 1, 2014. At present, the river system is not capable of passing the full Restoration Flows, and so flows are released up to the then-existing channel capacity. This Report provides Reclamation’s analysis of then-existing channel capacities, and the CCAG was formed to provide a peer review of that analysis in helping Reclamation determine the recommend flow rates for this river system that can safely be passed. Preparation of this Report and review by the CCAG will continue until such time as the full Restoration Flow hydrograph can be implemented.

The studies described in Section 7 of this report evaluate a maximum flow of 4,500 cfs in each of the study reaches. This maximum flow is based on the Settlement required capacity in Reach 2B and Reach 4B. Restoration Flows may be as high as 8,000 cfs in the upper reaches to perform functions such as flushing spawning gravels, but are expected to attenuate so not to exceed existing channel capacity in Reach 2B.

1 **5.2 Hydraulics**

2 One-dimensional (1-D) steady-state Hydrologic Engineering Center’s River Analysis System
3 (HEC-RAS) hydraulic models of the 150-mile reach of the San Joaquin River and Bypass
4 System between Friant Dam RM 267.6 and the mouth of the Merced River (RM 118.2) were
5 developed and validated by Tetra Tech, Inc. (Tetra Tech) and DWR to support the SJRRP. Two-
6 dimensional (2-D) hydrodynamic models of all of the reaches except for Reach 5 were developed
7 by Reclamation. DWR developed a site specific model of a 2.5-mile segment of the downstream
8 portion of Reach 2A.

9 **5.2.1 1-D Modeling**

10 The HEC-RAS hydraulic models provide a means of evaluating current 1-D hydraulic conditions
11 along the river and flood bypass system over a range of flows, including those specified in the
12 Settlement and flood events (Tetra Tech, 2014). The 1-D models have been used to perform a
13 number of analyses related to channel capacity, including:

- 14 • Assess channel capacities, including an evaluation of the degree to which sedimentation
15 would affect channel capacities in Reach 2A.
- 16 • Provide input to sediment-transport analyses, including an evaluation of the sediment-
17 transport behavior in Reaches 2A, 2B and 3.
- 18 • Assess potential effects of Restoration Flows on levee underseepage, levee erosion and
19 stability, channel stability and flood carrying capacity.

20 **5.2.2 2-D Modeling**

21 Reclamation has developed 2-D hydrodynamic models for reaches 1B, 2A, 2B, 3, 4A, 4B1, 4B2
22 of the San Joaquin River and the Eastside Bypass. The 2-D models use the depth-averaged St.
23 Venant equations and an unstructured mesh to model water surface elevation, depth, and
24 velocities and report the above plus bed shear stress, critical sediment diameter, and sediment
25 transport capacity at each quadrilateral or triangular mesh cell. Applications of 2-D models for
26 channel capacity studies could include modeling of side channels, bank erosion, local flow
27 velocity and eddy patterns, as well as flow over in-channel bars and levees.

28 **5.3 Sediment Transport**

29 1-D and 2-D sediment transport models are also being employed by the SJRRP. These models
30 were developed to evaluate the effects of SJRRP actions on sediment transport along the river
31 and flood bypasses. The existing sediment transport models were developed using Reclamation’s
32 SRH modeling system and incorporate the same foundational input data used in the hydraulic
33 models described above.

34 **5.3.1 1-D Modeling**

35 Reclamation developed SRH-1D sediment transport models to assess the reach-averaged erosion
36 and deposition impacts of the SJRRP to Reaches 1 through 5 in the PEIS/R. These models would
37 be useful for evaluating future channel capacity studies by simulating the future reach-averaged
38 sediment transport, erosion and deposition in the SJR and flood bypass system under various

1 flow routing scenarios. However, SRH-1D and other 1-D models are limited in their ability to
2 simulate local sediment transport conditions resulting from topographic variability within a cross
3 section, in river bends, around structures (such as bifurcations), and the differences between
4 channel and floodplain deposition.

5 **5.3.2 2-D Modeling**

6 Tetra Tech developed and calibrated a 2-D sediment-transport model for the approximately
7 2.5-mile reach immediately upstream from the CBBS. The model was developed to provide a
8 refined tool that can be used to predict the behavior of the downstream portion of Reach 2A and
9 to provide a more accurate estimate of sediment movement from Reach 2A through the San
10 Joaquin River Control Structure at the CBBS and into Reach 2B under various conditions (Tetra
11 Tech, 2013a). This model was used to complete a Reach 2A Sediment Study, which is
12 summarized in the 2014 Report. This model will likely continue to be used in future evaluations
13 of the sediment conditions within the vicinity of the CBBS.

14 **5.4 Geotechnical**

15 A preliminary seepage and stability analyses to evaluate levee impacts in the Middle Eastside
16 Bypass was performed using the 2-D finite element software program SEEP/W, developed by
17 GEO-SLOPE International, Ltd. The model uses topographic and geotechnical data to analyze
18 underseepage and excess pore-water pressure. This is to determine exit gradients and the
19 controlling water surface elevation that may result in failure due to underseepage. The levee
20 slope stability analysis was performed using SLOPE/W, a 2-D limit equilibrium stability analysis
21 software program developed by GEO-SLOPE International, Ltd. following the Spencer Method.
22 The same topography used for the seepage analysis was also used for the slope stability analysis.
23 Pore-water pressures calculated by the SEEP/W models are imported into SLOPE/W. The model
24 uses effective shear strengths for the different soil layers to determine the minimum factor of
25 safety for surfaces that affect the overall stability of the levee for different water surface
26 elevations. The SEEP/W and SLOPE/W tools are used in the geotechnical evaluations of the San
27 Joaquin Levee Evaluation Project described in Section 10.1.2.

28 **5.5 Modeling Strategy**

29 Numerical modeling has been a key tool used by the SJRRP to develop designs for the site-
30 specific projects and perform quantitative evaluation of SJRRP actions. A range of models have
31 been developed and applied for this work, including hydraulic, sediment transport, vegetation,
32 temperature, flow routing, levee stability, and groundwater models. In response to comments
33 received by the CCAG during the preparation of the 2014 Report, Reclamation and DWR have
34 developed a strategy for two of these sets of modeling tools—hydraulic and sediment transport—
35 and how these tools will be reviewed, used, and distributed.

36 The SJRRP has developed hydraulic and sediment transport modeling tools to evaluate then-
37 existing channel capacity, as well as to complete other studies and actions implemented by the
38 SJRRP. Having separate tools available for different modeling applications provides the

1 flexibility to meet both efficiency and accuracy needs. No single model was deemed appropriate
2 to effectively model all aspects that are necessary to understand the actions of the SJRRP. In
3 response to the preparation of the 2014 Report, the SJRRP received comments that a transparent
4 modeling methodology and coordination effort is needed to evaluate and determine then-existing
5 channel capacity including quantifying in-channel capacity, assessing changes to flood
6 operations, and identifying potential maintenance needs.

7 In response to these comments, Reclamation and DWR have developed a strategy memorandum
8 specifically for the hydraulic and sediment transport modeling, which is included in Appendix B.
9 The strategy summarizes the models available, general differences, and preferred usage to
10 develop and evaluate SJRRP actions. Selection of the appropriate tool for any specific study,
11 including channel capacity, will depend on the purpose of the study, level of detail needed, and
12 the preference of the agency performing the analysis. The additional complexity caused by
13 employing different models that can generally meet similar objectives is necessary to ensure that
14 the appropriate models are being utilized for the appropriate purpose. The tools used to
15 determine then-existing channel capacities for the 2015 Restoration Year were primarily the 1-D
16 hydraulic model. However, the 2-D hydraulic and 1-D and 2-D sediment transport models were
17 used and will continue to be used in other studies to evaluate channel capacity.

6.0 Current Then-existing Channel Capacity

For the 2014 Restoration Year, the SJRRP limited Restoration Flow releases to then-existing channel capacities recommended in the 2014 Report. These capacities were based on the In-channel Capacity Study and Middle Eastside Geotechnical Assessment described in Section 7.0 of the 2014 Report. Limiting Restoration Flows to these capacities reduced the risk of levee failure due to under-seepage and saturation adjacent to the levees. The current then-existing channel capacities are shown in Table 6-1.

Table 6-1

Current Then-existing Channel Capacity

Reach	Current Then-existing Channel Capacity (cfs)
Reach 2A	1,630
Reach 2B	1,120
Reach 3	2,760
Reach 4A	970
Reach 4B1	Not Analyzed
Reach 4B2	930
Reach 5	1,940
Middle Eastside Bypass	370
Lower Eastside Bypass	2,890
Mariposa Bypass	350

7.0 Completed Channel Capacity Studies and Related Work

In the 2014 Report, five studies were evaluated to recommend then-existing channel capacities. Of the five studies, only two studies—In-channel Capacity Study and Middle Eastside Geotechnical Assessment—were directly used to make the capacity recommendation. So, for this report, the same In-channel Capacity Study and the Middle Eastside Bypass Geotechnical Assessment will remain in this section of the report to support this year’s then-existing channel capacities. The other studies can be found in the 2014 Report. There have been no additional studies that have been completed to refine the recommendations in the 2014 Report.

7.1 In-channel Capacity Study

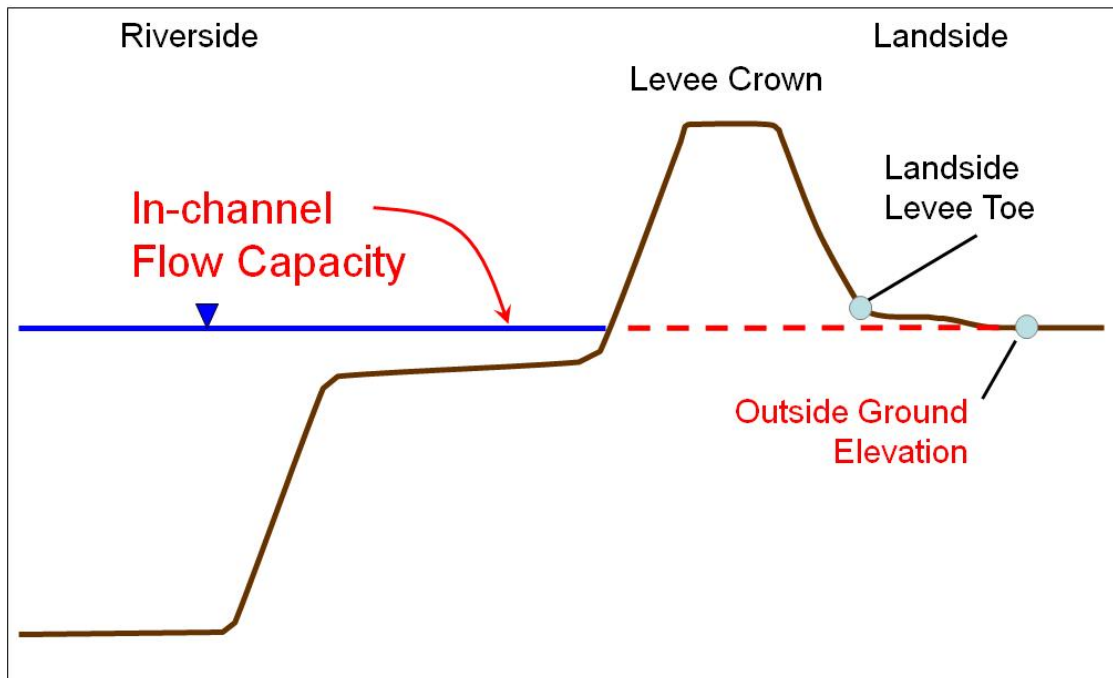
A channel capacity study of the San Joaquin River and the Eastside and Mariposa bypasses between Friant Dam and the confluence with the Merced River was conducted. That study, the *San Joaquin River In-channel Capacity Analysis* (Tetra Tech, 2013b), dated February 14, 2013,

1 is included in Appendix C. This study provides initial channel capacity estimates within leveed
2 reaches that can inform then-existing channel capacity prior to sufficient data becoming available
3 to determine levee slope stability and underseepage Factors of Safety.

4 In general, the purpose of the study was to identify the flow in each reach at which the water-
5 surface elevation would stay below the levees in each reach. Specific tasks included determining
6 the channel capacity for each reach, as well as the approximate length of the left and right bank
7 levee where the water surface elevation of 2,000 cfs and 4,500 cfs flows exceeded the outside
8 ground elevation. The *Working Draft Framework For Implementation* (Reclamation, 2012),
9 dated Jun 19, 2012, identifies a Restoration Flow release of up to 2,000 cfs as a necessary core
10 action for successful implementation of the Settlement. Therefore, this study also determined the
11 length of levee for the 2,000 cfs threshold. The following sections summarize the study.

12 **7.1.1 Methodology and Assumptions**

13 The in-channel capacity was evaluated for each subreach that is bounded by levees in Reaches
14 2A, 2B, 3, 4A, 4B2, 5, Middle Eastside Bypass, Lower Eastside Bypass, and the Mariposa
15 Bypass. As part of the SJRRP, new setback levees are being evaluated for Reach 4B1 to safely
16 convey Restoration Flows. Since the current capacity is assumed to be negligible, it is assumed
17 that no Restoration Flows will be conveyed in this reach until channel capacity improvements are
18 made. Therefore, Reach 4B1 was not included in this analysis. Setback levees are also
19 anticipated to be constructed in Reach 2B, but because Restoration Flow releases will be routed
20 through this reach prior to construction so in-channel capacity was evaluated for this reach. This
21 analysis was completed for those levees upstream from the direct influence of the Mendota Pool.
22 The 1-D HEC-RAS hydraulic models, discussed in Section 5.2 - Data and Analytical Tools were
23 used for the analysis. As an initial step, the landside levee toe elevations were identified for each
24 reach. In this analysis, the outside ground elevation adjacent to the landside levee toe was
25 selected to represent the elevation of the landside levee toe. The elevations were identified at
26 each hydraulic model cross-section primarily through inspection of the cross-sectional
27 topography and were verified through review of the aerial photography and contour mapping.
28 The outside ground elevations were selected for both the left and right levees. In-channel
29 capacities reported in this analysis are based on water-surface profiles developed by running the
30 models over a series of local flows. Figure 7-1 is a conceptual figure of the outside ground
31 elevation location and the in-channel flow capacity.



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Figure 7-1.
Levee Schematic Defining Levee Features and In-channel Capacity

7.1.2 Analysis and Results

Computed water-surface profiles were compared to the outside ground elevations adjacent to both the left and right levees along the extent of each reach. The in-channel flow capacity of each reach was determined to be the highest flow rate through the reach where the water-surface elevation is at or below the outside ground elevation for any part of the reach. Results for each reach are described in the following sections and are summarized in Table 7-1.

1
2

Table 7-1.
Summary of In-channel Capacity for Each Side of Levee by River Reach

Reach	Levee Side	In-channel Capacity ¹ (cfs)
Reach 2A	Left	2,430
Reach 2A	Right	1,630
Reach 2B (Entire Reach)	Left	0
Reach 2B (Entire Reach)	Right	0
Reach 2B (Excluding Mendota Pool) ²	Left	1,120
Reach 2B (Excluding Mendota Pool) ²	Right	1,550
Reach 3	Left	3,680
Reach 3	Right	2,760
Reach 4A	Left	970
Reach 4A	Right	1,340
Reach 4B2	Left	1,370
Reach 4B2	Right	930 ³
Reach 5 (All Levees)	Left	1,940
Reach 5 (All Levees)	Right	2,500
Reach 5 (Excluding Left Levee downstream of Mud Slough)	Left	2,350
Reach 5 (Excluding Left Levee downstream of Mud Slough)	Right	2,500
Middle Eastside Bypass (Eastside Bypass Reach 2)	Left	10
Middle Eastside Bypass (Eastside Bypass Reach 2)	Right	370
Lower Eastside Bypass (Eastside Bypass Reach 3)	Left	2,970
Lower Eastside Bypass (Eastside Bypass Reach 3)	Right	2,890
Mariposa Bypass	Left	650
Mariposa Bypass	Right	350

3 ¹ Capacity based on outside ground elevations.
 4 ² Portion of reach above influence of Mendota Pool (about RM 209.5).
 5 ³ Capacity excludes localized deep depressions, which would reduce capacity to 50 cfs.

6 In **Reach 2A**, along the right and left levees, the highest local flow for which the water-surface is
 7 at or below the outside ground elevation is 1,630 and 2,430 cfs, respectively (Figures 3 through 5
 8 in Appendix C). For about 3.3 miles of this reach, the water surface at Restoration Flows of
 9 4,500 cfs would be at or above the outside toe of the levee.

1 In **Reach 2B**, outside ground elevations along the lower portion of this reach are generally lower
2 than the normal pool elevation at Mendota Dam (Figures 6, 7, 8, and 9 in Appendix C). When
3 considering the entire reach, including Mendota Pool, the capacity along both sides of the
4 channel is 0 cfs. As a result, the existing flow capacity was evaluated for the entire reach as well
5 as only for the portion of the reach upstream from the influence of the pool. When only the
6 portion of the reach upstream from the influence of the pool is considered, the highest local flow
7 in which the water surface is at or below the outside ground elevation is about 1,120 cfs along
8 the left levee and 1,550 cfs along the right levee. For about 17.7 miles of this reach, the water
9 surface at Restoration Flows of 4,500 cfs would be at or above the outside toe of the levee
10 (includes the levees influenced by Mendota Pool).

11 In **Reach 3**, outside ground elevations are reasonably high along much of the reach except for an
12 area immediately upstream of Sack Dam (Figures 10 through 12 in Appendix C). Flow capacity
13 in this area is limited by a depression on the right side that has a capacity of 2,760 cfs. On the left
14 side of the channel, the capacity of the outside ground elevation is 3,680 cfs. For about 7.1 miles
15 of this reach, the water surface at Restoration Flows of 4,500 cfs would be at or above the
16 outside toe of the levee.

17 In **Reach 4A**, the maximum local flow for which the water-surface is at or below the outside
18 ground elevation is 1,340 cfs for the right levee and 970 cfs for the left levee (Figures 13 through
19 16 in Appendix C). The water surface elevation is above the outside ground for almost all of the
20 Reach at 4,500 cfs. For about 17.8 miles of this reach, the water surface at Restoration Flows of
21 4,500 cfs would be at or above the outside toe of the levee.

22 In **Reach 4B2**, the ground adjacent to the right levee in Reach 4B2 has many depressions, but
23 due to one localized and deep depression along the right levee, the in-channel capacity is limited
24 to about 50 cfs (Figures 17 through 20 in Appendix C). Aerial photographs and contour mapping
25 indicate that these depressions are relatively small, and can contain water even at low flows,
26 which would not make them a levee stability issue. If these local, right side depressions are
27 excluded from the analysis, the capacity along the right levee increases to 930 cfs. The outside
28 ground along the left levee is not as low, which results in an in-channel capacity of
29 approximately 1,370 cfs. For about 14.0 miles of this reach, the water surface at Restoration
30 Flows of 4,500 cfs would be at or above the outside toe of the levee.

31 In **Reach 5**, most of the areas with limited capacities occur along the mid- to upper- portion of
32 this reach, but one exception is a levee feature that exists along the left side of the channel near
33 the downstream end of the reach (Figures 21 through 24 in Appendix C). The highest local flow
34 for which the water-surface is at or below the outside ground elevation is 1,940 and 2,500 cfs
35 along the left and right levees, respectively. However, since much of the outside ground adjacent
36 to the left levee contains many local depressions, these results likely represent a conservative
37 estimate of the in-channel flow capacity in this reach. For about 3.7 miles of this reach, the water
38 surface at Restoration Flows of 4,500 cfs would be at or above the outside toe of the levee.

39 In the **Middle Eastside Bypass** (Eastside Bypass Reach 2), at the upstream end of this reach, the
40 channel bed is near the elevation of the ground outside of the levees on both the right and left
41 sides. The computed water-surface profiles indicate that the highest local flow for which the
42 water-surface is at or below the outside ground elevation along the left levee is about 10 cfs, and
43 along the right levee is 370 cfs. These low in-channel capacities are the result of the low outside

1 ground elevations compared to the channel bed. However, a low-flow channel keeps much of
2 these flows confined several hundred feet away from the levees. So, to better characterize the
3 potential levee impacts along the reach, sites with a capacity of less than 300 cfs were identified
4 and a preliminary geotechnical analysis was completed (see Section 7.2).

5 In the **Lower Eastside Bypass** (Eastside Bypass Reach 3), the computed water-surface profiles
6 indicate that the highest local flow for which the water-surface is at or below the outside ground
7 elevation along the left levee is 2,970 cfs and along the right levee is 2,890 cfs (Figures 29
8 through 31 in Appendix C). For about 3.6 miles of this reach, the water surface at Restoration
9 Flows of 4,500 cfs would be at or above the outside toe of the levee.

10 In the **Mariposa Bypass** along the left and right levees, the highest local flow for which the
11 water-surface is at or below the outside ground elevation is 650 and 350 cfs, respectively
12 (Figures 32 through 35 in Appendix C). As evident from the low in-channel capacity, the outside
13 ground elevations in this reach are relatively low when compared to the main flow channel, but
14 they are also relatively uniform throughout the entire reach. For about 6.6 miles of this reach, the
15 water surface at Restoration Flows of 4,500 cfs would be at or above the outside toe of the levee.

16 **7.2 Middle Eastside Bypass Geotechnical Assessment**

17 The In-channel Capacity Study (Section 7.1) identified three locations along the Eastside Bypass
18 with unusually low channel capacities ranging from 10 cfs to 240 cfs. As a preliminary
19 component of the SJLE Project, and to further investigate in-channel capacity results in the
20 Middle Eastside Bypass relative to levee performance, preliminary levee seepage and stability
21 analyses were completed at each of these three sites. Analyses of the remainder levees of the
22 Eastside Bypass will be performed under subsequent SJLE Project tasks. This preliminary
23 analysis was performed to better understand the potential levee seepage and stability impacts in
24 the reach with high ground elevations along the landside levee toe resulting in unreasonably low
25 in-channel capacity. That analysis, the *Middle Eastside Bypass Geotechnical Assessment* dated
26 August 30, 2013 (URS, 2013), is included in Appendix D. The analyses were conducted using
27 geotechnical exploration data collected as part of the SJLE Project, which will be documented in
28 subsequent SJLE Project data reports. Additional geotechnical analyses in this and other reaches
29 will be completed as part of the SJE Project (see Section 10.1) and documented in subsequent
30 SJLE Project analysis reports.

31 **7.2.1 Background and Past Levee Performance**

32 Until adequate data are available to determine levee performance, the SJRRP is limiting the
33 release of Restoration Flows to those that would remain in-channel. The purpose of this analysis
34 is to determine the amount of water that can be placed on the waterside levee slopes without
35 exceeding geotechnical criteria for stability and seepage at the three critical sites along the left
36 levee of the Middle Eastside Bypass (Figure 1, Appendix D). Site 1 occurs in the upper portion
37 of the reach with an in-channel capacity of 10 cfs. Site 2 is located adjacent to the Merced
38 Wildlife Refuge and has an in-channel capacity of 120 cfs. Site 3 occurs about 6,500 feet
39 downstream of Site 1 and has an in-channel capacity of 230 cfs.

40 Documented past performance events in the area of the Middle Eastside Bypass include seepage,
41 boils, sloughing, cracking, widespread erosion, and near overtopping. However, there have been
42 no documented reports of breaches. Based on the observations made by the Lower San Joaquin

1 Levee District (LSJLD) staff, the primary issues appear to be chronic seepage and inundation
2 once water gets on to the waterside levee slopes (i.e., not necessarily highwater events).
3 Underseepage may cause piping and internal erosion of material due to excessive pore water
4 pressure under the foundation blanket layers, and may negatively impact slope stability by
5 reducing effective stresses in both embankment and foundation soils. Underseepage conditions
6 are generally expressed by an average vertical exit gradient. Excessive gradients can result in the
7 formation of sand boils, piping and levee failure if left unrepaired.

8 **7.2.2 Geotechnical Approach and Criteria**

9 The analyses completed at the three sites were limited to levee seepage and stability. Due to the a
10 lack of exploration data along the levee toe, cross sections were developed at the sites using
11 available levee crest drilling data that was laterally extrapolated to capture the landside and
12 waterside toes. At each site, sensitivity cases were analyzed for four different water surface
13 elevations (WSE), which were used to interpolate the WSE corresponding to acceptable criteria
14 for seepage and stability.

15 For the seepage analysis, underseepage conditions are generally expressed by an average vertical
16 exit gradient. The average vertical exit gradient criteria used for the assessment are shown in
17 Table 4-1 of Appendix D. The allowable vertical gradients range from less than 0.5 for the
18 landside levee toe, and between 0.5 and 0.8 for landward locations up to 150 feet from the levee
19 toe.

20 For the slope stability analysis, the same stratigraphy and models used in the seepage analysis
21 were used to assess slope stability. A factor of safety number is typically used to characterize the
22 stability of a slope, which is the ratio of the available shear strength to the shear strength required
23 for equilibrium. A minimum factor of safety of 1.4 is required for slip surfaces that could affect
24 the overall stability of the levee (i.e. deeper seated failures that intersect with the levee crown
25 and impact the full height of the levee).

26 The three sites were analyzed for seepage and slope stability using a series of sensitivity models
27 to cover a range of possible field conditions. Soil strength and seepage parameters selected for
28 the analysis were determined using a combination of exploration data, engineering judgment, the
29 knowledge of the materials in the area and the recommendations of the DWR Levees and
30 Evaluations Program.

31 **7.2.3 Analysis and Results**

32 At **Site 1**, a 3 feet to 4 feet deep landside ditch is located approximately 30 feet from the landside
33 levee toe. Based on the exploration data available, the levee embankment is comprised of a
34 mixture of silty and clayey sand, silt and clay. Subsurface materials consist of silts and clays with
35 interbeds of silty sand and clayey sand. Due to variability of the landside blanket conditions and
36 the presence of the ditch, a sensitivity analysis was completed assuming varying blanket
37 thicknesses ranging from 1.5 feet to 10 feet thick. In general, the analysis shows that
38 underseepage is the controlling geotechnical failure mode for the Site 1 if the landside ditch is
39 empty and slope stability if the landside ditch is full. Approximately 1-foot (ditch empty) and
40 about 5 feet (ditch full) of water on the levee would be acceptable for this site.

41 At **Site 2**, where there is no landside ditch, available exploration data shows the levee
42 embankment is comprised of silts and clays. Subsurface materials are similar to those at Site 1,

1 but overall the landside blanket is thicker. A landside 12.5 foot-deep-blanket was assumed and
 2 sensitivity analysis consisted of reducing the strength parameters for the top three soil layers and
 3 increasing the permeability contrast between the blanket and the underlying aquifer layer. The
 4 analysis shows that landside slope stability is the controlling geotechnical failure mode and
 5 approximately 6.5-foot of water on the levee would be acceptable for this site.

6 At **Site 3** there is also not a landside ditch, but there is a slight landside depression approximately
 7 30 feet landward of the landside levee toe. Based on the exploration data available, the levee
 8 embankment is similar to Site 2. Subsurface materials are comprised of silts and clays with
 9 interbeds of sand, silty sand and clayey sand. The landside blanket is variable in this area, but
 10 was assumed to be between 5- to 6-foot-thick. Two sensitivity analyses were completed that
 11 consisted of modifying the boundary conditions, and increasing the permeability contrast
 12 between the blanket and aquifer. In general, the analysis shows that underseepage is the
 13 controlling geotechnical failure mode and approximately 3.5-foot of water on the levee would be
 14 acceptable at this site.

15 Table 7-2 summarizes the acceptable maximum water surface elevation, and approximate height
 16 of water on the waterside levee toe compared to the relative outside ground elevation. The
 17 analysis results and recommendations summarized in Table 7-2 and in Appendix D are based on
 18 preliminary data and the results and recommendations should be refined once more detailed
 19 information becomes available.

20 **Table 7-2.**
 21 **Summary of Preliminary Analysis Results for Channel Capacity Assessment¹**

22

Site	Maximum Water Surface Elevation (feet, NAVD88)	Approximate Height of Water on the Levee ²
1	100.7	1.2
2	104.0	6.5
3	101.7	3.7

23 ¹ Height of water on the levee at a particular location does not necessarily translate directly to another site, i.e. if water were at
 24 a height of 1 foot on the levee at Site 1 then the height of water on the levee at a different location could be different.

25 ² Height of water relative to the typical outside ground elevation

26 After the acceptable WSEs were determined at the critical sites, the 1-D HEC-RAS hydraulic
 27 models were used to determine the corresponding flow at each site. For Site 1, the flow that
 28 corresponds to 100.7 feet (NAVD88) is about 520 cfs. For Site 2, the flow that corresponds to
 29 104.0 feet (NAVD88) is greater than 4,500 cfs. For Site 3, the flow that corresponds to 101.7 feet
 30 (NAVD88) is about 2,270 cfs. These flows are higher than the report in-channel capacity flows
 31 identified in Section 7.1 above. However, because the right levee in-channel critical site is
 32 370 cfs and was not part of the preliminary geotechnical assessment, the in-channel capacity of
 33 the Middle Eastside Bypass is 370 cfs.

34

8.0 Recommended Then-existing Channel Capacities

The purpose of this section is to recommend then-existing channel capacities based on results from the current channel capacity studies summarized in the previous sections of this report.

Then-existing channel capacities are defined as flows that would not significantly increase flood risk from Restoration Flows in the Restoration Area. To reduce this risk, the PEIS/R included levee design criteria for levee slope stability and underseepage Factors of Safety based on USACE criteria for levees. The application of the criteria requires the collection and evaluation of data at locations throughout the Restoration Area. Until adequate data are available to apply the USACE criteria, the release of Restoration Flows would be limited to those that would remain in-channel (the water surface elevation in the river remains below the levees).

Since no additional studies have been completed to better inform channel capacity, the In-channel Capacity Study summarized in Section 7.1 and the Geotechnical Analysis of the Middle Eastside Bypass summarized in Section 7.2 continue to provide the best information for determining then-existing channel capacities. The results in these two studies were again used to recommend then-existing channel capacities. This information uses in-channel capacity as the best estimate of then-existing channel capacities for all reaches. The only exception is the Middle Eastside Bypass, in which adequate data was available to perform a geotechnical analysis.

Based on the results summarized in Sections 7.1 and 7.2 and detailed in Appendices C and D, the recommended then-existing channel capacities for the San Joaquin River and flood bypasses are described below.

- The recommended then-existing channel capacity for Reach 2A is 1,630 cfs based on a low point along the right levee approximately 1.6 miles upstream from the CBBS.
- The recommended then-existing channel capacity for Reach 2B is 1,120 cfs based on a low point along the left levee approximately 4.6 miles upstream of the Mendota Dam. The influence of the Mendota Pool was not considered because normal pool water surface elevations in the pool are already higher than some outside ground elevations adjacent to levees and Restoration Flows would not significantly change this water surface due to the requirements to operate Mendota Dam to maintain a relatively constant pool elevation.
- The recommended then-existing channel capacity for Reach 3 is 2,760 cfs based on a low depression along the right levee about 11.4 miles upstream of Sack Dam.
- The recommended then-existing channel capacity for Reach 4A is 970 cfs based on a low area along the left levee just upstream of Sand Slough.
- The recommended then-existing channel capacity for Reach 4B2 is 930 cfs based on the low ground elevation along the right levee approximately one mile downstream of the confluence of the Mariposa Bypass. The three major depressions were not considered in this or the previous analysis, which would limit the flow to 50 cfs, since these depressions would likely fill with water and not cause levee stability concerns.
- The recommended then-existing channel capacity for Reach 5 is 1,940 cfs, based on a low point along the right levee near the downstream end of the reach.

- 1 • The recommended then-existing channel capacity for the Middle Eastside Bypass (Eastside
2 Bypass Reach 2) is 370 cfs. The left levee has an in-channel capacity of 10 cfs, but further
3 geotechnical analysis of the low areas below 300 cfs showed that the maximum acceptable
4 water surface elevation on the levee would correspond to a flow of over 500 cfs. However,
5 the next lowest capacity is 370 cfs, which is along the right levee.
- 6 • The recommended then-existing channel capacity for the Lower Eastside Bypass (Eastside
7 Bypass Reach 3) is 2,890 cfs based on the low point along the right levee just downstream of
8 the Eastside Bypass Control Structure.
- 9 • The recommended then-existing channel capacity for the Mariposa Bypass is 350 cfs based
10 on a low point along the right levee about 1.3 miles upstream of the drop structure.

11 Table 8-1 summarizes the current and recommended then-existing channel capacities for each
12 reach of the San Joaquin River and the flood bypasses. As stated previously, this report
13 recommends no change in the then-existing channel capacities from the 2014 Report.

14
15

Table 8-1.
Current and Recommended Then-existing Channel Capacity

Reach	Current Then-existing Channel Capacity (cfs)	Recommended Then-existing Channel Capacity (cfs)
Reach 2A	1,630	1,630
Reach 2B	1,120	1,120
Reach 3	2,760	2,760
Reach 4A	970	970
Reach 4B1	Not Analyzed	Not Analyzed
Reach 4B2	930	930
Reach 5	1,940	1,940
Middle Eastside Bypass	370	370
Lower Eastside Bypass	2,890	2,890
Mariposa Bypass	350	350

9.0 Future Program Actions with the Potential to Improve Then-existing Channel Capacity

Throughout Settlement implementation, the maximum downstream extent and rate of Restoration Flows to be released would be limited to then-existing channel capacities. As channel or structure modifications are completed with additional environmental compliance, maximum Restoration Flow releases would be correspondingly increased in accordance with then-existing channel capacities and with the release schedule. Consistent with the commitments made in the PEIS/R ROD, Restoration Flows would be reduced, as needed, to address material seepage impacts, as identified in the Physical Monitoring and Management Plan in Appendix D of the PEIS/R. If releases of water from Friant Dam is required for flood control purposes, concurrent Restoration Flows would be reduced by an amount equivalent to the required flood control release. If flood control releases from Friant exceed the concurrent scheduled Restoration Flows, no additional releases above those required for flood control would be made for SJRRP purposes.

Until sufficient data are available to determine the levee seepage and stability Factors of Safety, Reclamation would limit Restoration flow releases to those flows, which would remain in-channel. When sufficient data are available to determine the Factors of Safety, Reclamation would limit the release of Restoration Flows to those flows which would maintain standard USACE levee performance criteria at all times.

The following sections identify potential immediate, near-term and long-term actions by the SJRRP to address changes in then-existing channel capacity due to changes in the channel or Settlement implementation. All potential actions and projects are not listed below and may change each year as additional information is provided. If any of these actions increase then-existing channel capacities, a new Channel Capacity Report will be prepared prior to Reclamation increasing Restoration Flows.

9.1 Immediate Actions

Potential responses to a reduction in channel capacity continue to include removal of vegetation and debris and/or restrictions on Restoration Flows that would exceed channel capacity. Vegetation removal would be conducted by mechanical or chemical means. Nonnative plant removal would receive priority over removal of native species. These responses could include unplanned emergency actions or actions taken within the water year. Immediate actions are described at a project-level in the PEIS/R including specific details in the Physical Monitoring and Management Plan in Appendix D.

Since the start of Interim Flows, the SJRRP has implemented flow limitations and immediate flow reductions to address issues related to then-existing channel capacity, mainly for groundwater seepage and will continue to do so on an as-needed basis during the release of Restoration Flows.

1 **9.2 Near-Term Actions**

2 In addition to immediate actions, the SJRRP is evaluating sediment, vegetation and operational
3 and maintenance projects that are being considered for implementation in the next couple of
4 years (near-term) to address the potential to maintain or increase then-existing channel
5 capacities. The following sections update the anticipated implementation schedules of the actions
6 described in the 2014 Report, as well as provide updates to the activities related to seepage
7 management.

8 **9.2.1 Sediment Removal Projects**

9 Sediment deposition in the Eastside Bypass contributes to reduced channel capacities. At present,
10 there is one proposed project to remove sediment from the river system near the confluence of
11 the Eastside Bypass (Eastside Bypass Reach 2) and Reach 4B1 of the San Joaquin River. An
12 Appraisal level study was conducted for this project in 2013, and a technical memorandum was
13 completed documenting the concepts and costs for this study. This project has the potential to
14 increase the low flow channel capacity in the Middle Eastside Bypass, which parallels Reach
15 4B1. It is expected that this project will be completed in the summer of 2015.

16 **9.2.2 Vegetation Removal Projects**

17 Vegetation within the channel can reduce channel capacity by increasing channel roughness.
18 Vegetation management may be necessary to maintain then-existing channel capacities.
19 Reclamation is continuing to work with a local non-profit, the San Joaquin River Parkway and
20 Conservation Trust, to identify, manage, and monitor invasive aquatic and riparian species. The
21 existing program is anticipated to continue into the future.

22 **9.2.3 Operations and Maintenance Improvements**

23 Overall operation and maintenance including vegetation and sediment management, structure
24 and gate operations, levee stability and integrity of the San Joaquin River and flood bypasses can
25 impact then-existing channel capacity. Reclamation is continuing to actively pursue a financial
26 assistance agreement with the LSJLD to fund LSJLD's efforts to adapt to changes in
27 maintenance type and frequency and to make modifications to existing operations to account for
28 changes as a result of the release of SJRRP Restoration Flows, such as increases in vegetation
29 growth or increased maintenance or operation of structures.

30 **9.2.4 Seepage Management Plan**

31 Reclamation has developed a Seepage Management Plan and Seepage Project Handbook to
32 guide efforts related to groundwater seepage. It should be noted that the actions and findings of
33 the Seepage Management Plan, although related to channel capacity is being reported as it relates
34 to agricultural seepage only. However, data collection and seepage projects will be closely
35 coordinated to determine effect on channel capacities. Reclamation operates such that
36 groundwater levels do not exceed thresholds that could cause seepage issues due to Restoration
37 Flow releases.

38 There are 93 groups of assessor parcels that may need seepage projects and will be evaluated for
39 impacts. Reclamation will be gradually implementing seepage projects by parcel group based on
40 flow restriction. Reclamation plans to implement the first 3 projects in 2014 or 2015. The

1 Seepage Management Plan and Seepage Project Handbook can be found at the SJRRP website
2 under the following link: <http://restoresjr.net/flows/Groundwater/index.html#SMP>.

3 **9.3 Long-Term Actions**

4 Long-term actions by the SJRRP will be needed to achieve then-existing channel capacities in
5 the San Joaquin River and flood bypasses that can convey maximum Restoration Flow releases.
6 Potential long-term actions could include, but would not be limited to, the following: providing a
7 larger floodplain between levees through the acquisition of land and construction of setback
8 levees; re-grading of land between levees; construction of sediment traps; sediment removal;
9 levee improvements; construction of grade control structures; and channel grading.

10 Long-term actions would require a determination of need, identification for funding, and site-
11 specific environmental compliance documentation. These actions would be considered by the
12 SJRRP to allow the continued increase of then-existing channel capacity to meet full Restoration
13 Flows.

14 The SJRRP is continuing to work on several long-term projects related to increasing site-specific
15 channel capacity as provided for in the Settlement paragraphs 11(a) and 11(b). These projects
16 include the following activities to be completed in future years:

- 17 • Construct Mendota Pool Bypass. Building a bypass around the Mendota Pool to convey at
18 least 4,500 cfs from Reach 2B to Reach 3. This could also include a fish screen or positive
19 fish barrier to avoid fish straying into Mendota Pool.
- 20 • Modify Reach 2B to convey at least 4,500 cfs. The channel would be modified to expand its
21 capacity to at least 4,500 cfs with integrated floodplain habitat. New levees would be
22 constructed to accommodate Restoration Flows, increasing the flood capacity of the reach.
- 23 • Modify Reach 4B1 to convey at least 475 cfs. Reach 4B would be modified to convey at least
24 475 cfs with integrated floodplain habitat. In addition to modifications of the Reach 4B1
25 channel to convey at least 475 cfs, the Settlement and the San Joaquin River Restoration
26 Settlement Act, Public Law 111-11, Section 10009(f)(2)(B) also requires that a determination
27 be made on increasing the channel capacity to 4,500 cfs. Modification of the San Joaquin
28 River Headgate Structure and other structures would also need to be completed to enable fish
29 passage and flow routing. These modifications are to be made consistent with the decision as
30 to whether 4,500 cfs is routed through Reach 4B1.

31 **9.4 Framework for Implementation**

32 All of the immediate, near-term, and long-term actions identified above are included in the
33 SJRRP's recently updated *Framework for Implementation*. The *Framework for Implementation*
34 prioritizes SJRRP actions and provides a realistic schedule and associated future funding need to
35 form the basis of continued implementation of the Settlement and the Settlement Act. The
36 revised *Framework* accomplishes the following:
37

- 1 1. Prioritizes the SJRRP “core” actions to allow for a more focused and thoughtful
2 implementation of the Settlement and Settlement Act;
- 3 2. Provides an accurate and achievable reflection of budget and schedule for planning and
4 transparency purposes; and,
- 5 3. More clearly assigns roles and responsibilities for each Implementing Agency to allow for
6 better agency budget planning and more efficient planning and approval for construction
7 actions.

8 To do this, the Implementing Agencies have prioritized projects and activities in five-year
9 increments, with a focused “vision” for each five-year increment. Each vision has been
10 formulated to make incremental and measurable progress in achieving both the Restoration and
11 Water Management goals of the Settlement. The visions are intended to provide focus for each
12 five-year increment to prioritize work and available funding – instead of trying to do everything
13 at once, the visions limit and focus actions on what can realistically be achieved within the five
14 year span assuming a realistic funding outlay for the five years.

15 In the first 5 years (by 2020), the SJRRP’s priority is to get a flow capacity of 1,300 cfs
16 throughout the river system and fix the major fish passage barriers. This includes the Mendota
17 Pool Bypass. This would allow for unsupported adult upstream migration of at least some fish
18 (i.e. functional connectivity), and the start of a population. By 2025, the SJRRP’s priority is to
19 get a flow capacity of at least 2,500 cfs throughout the river, and to build the Reach 2B levees to
20 4,500 cfs. Based on conservative initial assumptions, this will require some levee construction
21 work. By 2030, the SJRRP’s priority is to increase channel capacity in all reaches to 4,500 cfs
22 and implement the remaining Phase 1 projects, as specified in the Settlement. Based on initial
23 assumptions and without geotechnical data and analysis, the San Joaquin River channel capacity
24 of 4,500 cfs will require extensive levee construction. With regard to actions to increase channel
25 capacity, the San Joaquin Levee Evaluation (SJLE) Project is assisting the SJRRP in assessing
26 flood risks associated with the SJRRP based on geotechnical data. Once this evaluation is
27 complete, then-existing channel capacities will be refined according to the USACE levee
28 seepage and slope stability criteria. At that time, the SJRRP will have a better understanding of
29 what levee projects that are described in the Settlement will be needed.

30

10.0 Future Program Studies and Monitoring with the Potential to Inform Then-existing Channel Capacity

There are several factors that can impact and limit channel capacity. Potential factors could include overall 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. Other future conditions, such as climate change and operation and maintenance while not directly impacting channel capacity, could have long-term impacts on overall performance of the conveyance system. These factors, as well as others were considered in developing future SJRRP studies and monitoring to determine then-existing channel capacity. The following section summarizes the specific studies and data collection activities planned by the SJRRP to allow a better understanding of then-existing channel capacity or changes in channel capacity.

10.1 Technical Studies

The 2014 Report described several future technical studies that either build on the studies described in Section 7.0 – Current Channel Capacity Studies and Related Work Completed or will provide additional information necessary to identify future then-existing channel capacities. All of those studies are currently being conducted and the following describes a status update of these activities.

10.1.1 Verification and Monitoring of In-channel Capacity

The In-channel Capacity Verification and Monitoring study is being conducted by DWR to validate the existing in-channel capacities determined in the In-channel Capacity Study (Section 7.1) in critical areas and implement a monitoring program to ensure that changes in in-channel capacity can be promptly identified.

Specifically, DWR will be collecting additional topographic surveys to verify the 2008 LiDAR and evaluating impacts to in-channel capacity from the operation of the Merced Wildlife Refuge Weirs in the Middle Eastside Bypass. DWR will also develop an in-channel water surface elevation monitoring plan to evaluate future changes in the in-channel capacity due to vegetation, sedimentation, or other channel changes. The objective is to develop a monitoring plan for the critical locations identified in each reach that limit the flow capacity of the reach. The plan will include a review of the existing monitoring stations to determine if they are close enough and adequate for monitoring the critical sites. If the existing monitoring sites are not adequate, new sites will be identified in consultation with other on-going programs so that new stage and flow measuring devices can be installed. The plan will verify that the correlations of gaged flows to the water-surface elevations/stages at the critical locations are good and reliable. The study is expected to be completed by the end of 2014.

1 **10.1.2 San Joaquin Levee Evaluation Project**

2 The SJLE Project assists the SJRRP in assessing flood risks associated with the SJRRP with
3 respect to levee seepage and stability. Completion of this study will help determine and update
4 then-existing channel capacity based on meeting USACE levee seepage and stability criteria
5 using geotechnical data. Under the SJLE Project, DWR is performing geotechnical explorations,
6 to assess the integrity of the existing levees within the Restoration Area with respect to seepage
7 and stability. The Project will also identify potential alternatives to remediate the existing levees.
8 As portions of SJLE Project study area overlap with DWR's Non-Urban Levee Evaluation
9 (NULE) Project, which is summarized in Section 11.3.1 of this report, the SJLE Project will be
10 using some of the NULE Project data and processes.

11 DWR has completed in June 2013, geotechnical explorations of Priority 1 levees including Cone
12 Penetrometer Tests (CPTs) and borings. DWR also implemented electrical resistivity imaging
13 (ERI) to identify conditions that may indicate the presence of paleo-channels beneath the
14 existing levees. The purpose of this work is to help plan a more cost-efficient supplemental
15 subsurface exploration plan for Priority 1 levees. The field work for the ERI work was completed
16 in March 2014 and the final report is scheduled for completion in May 2014. The final
17 Geotechnical Data Report that summarizes all of the data collection efforts is expected in
18 December 2014, and the Geotechnical Overview Report that includes analysis of and
19 recommendation for levee improvements will be following in April 2015. Details of the specific
20 tasks that will be completed as part of this study are summarized in Section 10.1.2 of the 2014
21 Report.

22 **10.1.3 Reach 2A Morphology Study**

23 The Reach 2A Sediment Study was carried out in the lower portion of Reach 2A to investigate
24 the sediment deposition upstream from the CBBS, which may have been a result of the 2009
25 through 2011 Interim Flow releases and the 2010 and 2011 flood flow releases. The study
26 showed that in the short-term, Interim and Restoration flows did not have a significant impact on
27 channel capacity in the lower portion of Reach 2A. Additional work has not been completed
28 since the preparation of the 2014 Report; however, if changes in sediment movement through the
29 lower portion of Reach 2A occur due to an increase in flow magnitude or frequency, additional
30 work in the form of a Reach 2A Morphology Study may be completed. This study would help
31 the SJRRP determine the short-term and long-term channel response in Reach 2A and the CBBS
32 and its potential impact on then-existing channel capacity. This information can also be used to
33 assess the potential need to change then-existing channel capacity in Reach 2A or take
34 immediate or long term-actions. The goal will be to provide the SJRRP with a better
35 understanding of expected long-term Reach 2A channel capacity changes and Reach 2B and
36 Chowchilla Bypass sediment supply through the CBBS. The initial study was described in
37 Section 7.3 of the 2014 Report; a summary of the potential work that could be completed is in
38 Section 10.1.3 of the 2014 Report.

39 **10.1.4 Subsidence Monitoring and Studies**

40 This following section briefly describes the methods and results of the subsidence monitoring
41 and levee surveys completed since 2011 by the Bureau of Reclamation, Mid-Pacific Region,
42 Division of Design and Construction, Surveys and Mapping Branch (MP-220) and the California
43 Department of Water Resources, South Central Region Office (DWR-SCRO) for the San
44 Joaquin River Restoration Program (SJRRP). Additional details are also provided in *Technical*

1 *Memorandum, Subsidence Monitoring* and included in Attachment E. The results of the
2 monitoring are being used to study subsidence within the Restoration Area and to support the
3 various studies that will help the SJRRP determine changes in then-existing channel capacities as
4 a result of subsidence.

5 ***Reclamation Geodetic Control Network***

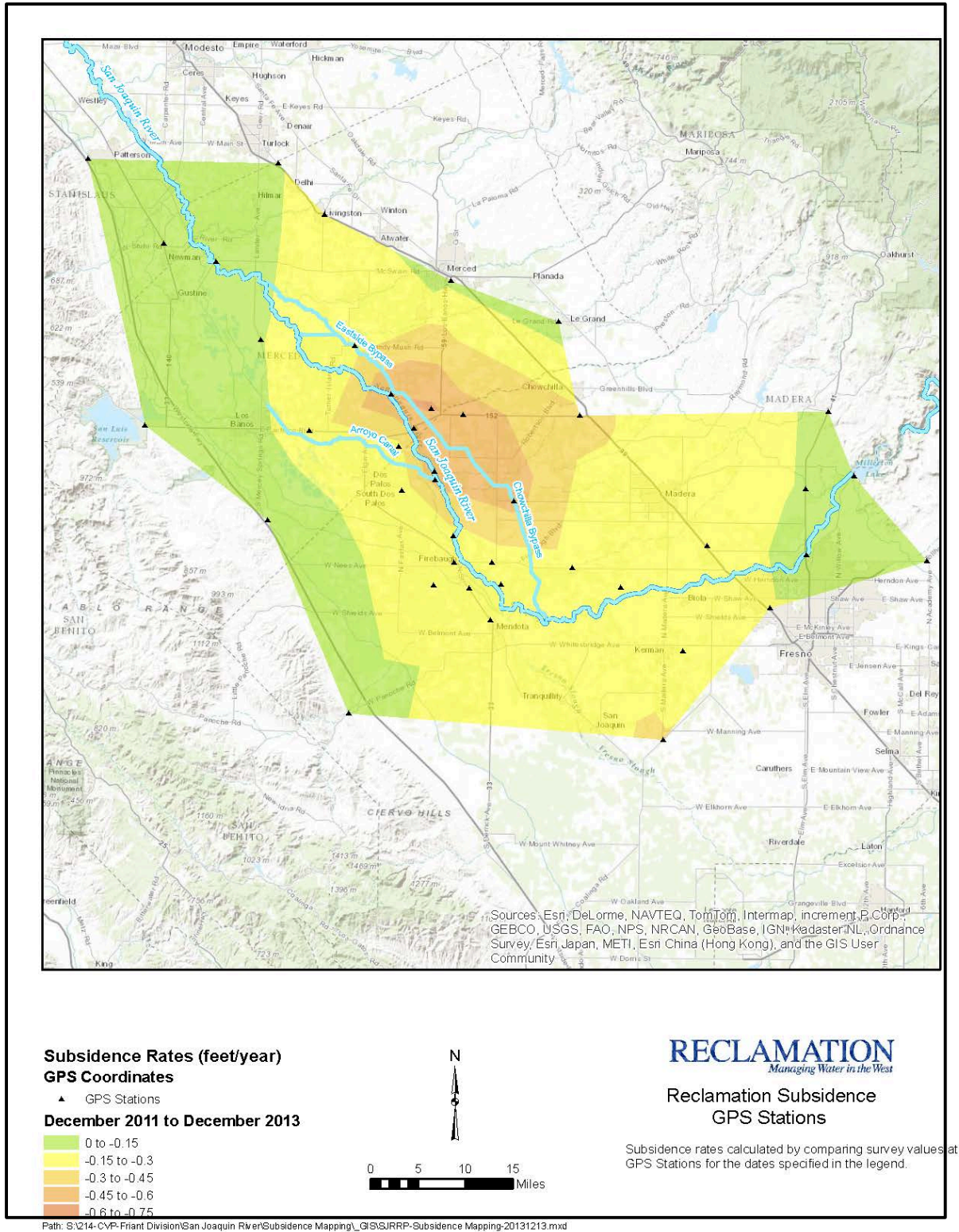
6 In 2011, Reclamation established the SJRRP Geodetic Control Network, using static GPS
7 methods, to investigate subsidence within the SJRRP Restoration and surrounding study areas.
8 To monitor the rate of subsidence over time, Reclamation conducts bi-annual surveys, in July
9 and December, of the established network made up of 85 control points. The control point
10 elevations are updated after each survey and are used by the SJRRP to study subsidence, as well
11 as to provide more accurate horizontal and vertical control for other studies.

12 After each survey, Reclamation prepares exhibit maps that compare the most recent data with the
13 data from the previous survey, as well as from previous years. The exhibit maps give a good
14 overall picture of the subsidence trends within the SJRRP Restoration Area. Figure 10-1 shows
15 the calculated annual subsidence rates ranging from about 0.15 ft/year to 0.75 ft/year based on
16 survey data collected in December 2011 and December 2013, and averaged over a two year
17 period. The calculated annual subsidence rates will vary with time, but in general, appear to
18 either remain constant, or in some areas increase since the start of the surveys. Appendix E
19 includes exhibit maps comparing the six month monitoring events (calculated as annual
20 subsidence rates) starting in December 2011 through December 2013.

21 Beginning in May 2012 Reclamation began monitoring the Arroyo and Temple-Santa Rita (TSR)
22 Canals to understand the localized subsidence near Sack Dam. This data is being collected to
23 support the design efforts for the Arroyo Canal Fish Screen and Sack Dam Fish Passage Project.
24 The project is currently on hold until the SJRRP can better understand the magnitude of future
25 subsidence and the effect of subsidence on the final design and operations.

26 The SJRRP is using the semiannual monitoring data and the Arroyo and TSR survey, in part to
27 support and update the technical memorandum *Subsidence Design Criteria for the San Joaquin*
28 *River Restoration Program (DRAFT), Technical Memorandum No. SUB-1* (Reclamation, 2013),
29 which documents subsidence within the SJRRP Restoration Area, and establishes recommended
30 subsidence criteria that will be applied to the designs for future site-specific projects in Reach
31 2B, Reach 4B, and at the Arroyo Canal diversion in Reach 3. A final draft of the Technical
32 Memorandum will be circulated for comment, and finalized in late 2014.
33

San Joaquin River Restoration Program



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Figure 10-1.
Regional Subsidence Map

1 ***DWR Capacity Studies and Analysis***

2 In late 2012 and again in 2013, DWR completed surveys of the tops of approximately 65 miles
3 of levees within the downstream portion of Reach 2A; the Eastside Bypass from its confluence
4 with the Fresno River to the Eastside Bypass Control Structure; and the Mariposa Bypass.
5 Profiles that compare the 2008 LiDAR with the top of the levee surveys from 2012 and 2013 for
6 the survey data are shown in Appendix E. In addition to the above surveys, DWR also completed
7 surveys in 2013 and 2014 of the levee and channel in the lower portion of Reach 3, Reach 4A,
8 and the Middle Eastside Bypass; however, this data has not been finalized at the time of the
9 preparation of this Report.

10 The 2012 processed survey data was used to estimate annual subsidence rates by calculating the
11 difference between the 2012 data and the 2008 LiDAR elevations. The estimated annual rates
12 from 2012 were used to develop 1-D hydraulic models of the flood bypasses to determine
13 potential future impacts to flood flow capacity as a result of subsidence. The findings of this
14 study were summarized in Section 7.4 of the 2014 Report. A comparison levee the survey data
15 collected in 2012 and the follow-up survey in 2013 shows that the average annual rates of
16 subsidence range from less than 0.2 ft/year to about 1.2 ft/year. The areas with the highest rates
17 of subsidence, such as Road 4 within the bypass, correspond with those identified by
18 Reclamation's Geodetic Control Network surveys. However, the average annual calculated rates
19 for the Geodetic Control Network surveys and the levee surveys can vary. This is because of the
20 differences in the survey extent and location, data collection method (top of levee versus control
21 points), and the overall density of points collected (100 – 300 ft intervals along the levees versus
22 a single control point).

23 To better understand the effects of continued subsidence on channel capacity, DWR will use the
24 levee and channel survey data to complete a flow capacity study in the lower portion of Reach 3,
25 Reach 4A and the Middle Eastside Bypass. The study includes analysis of the data collected in
26 2012, 2013 and 2014, an update of the 1-D hydraulic modeling tools, and an update to in-channel
27 capacities, if necessary. The results of the study will also inform the geotechnical evaluations
28 being completed as part of the SJLE Project, and the Verification and Monitoring of In-channel
29 Capacity study.

30 In addition to completing the channel capacity study, DWR has started to move forward with a
31 sediment transport study within the flood bypasses. The study is designed to better understand
32 and quantify how sedimentation will affect channel capacity and to provide information on the
33 amount of sediment removal that may be required to maintain necessary design flow capacities.
34 Results from the sediment transport study could provide information to further evaluate bypass
35 flow capacities, as well as refine certain aspects of the design for the Reach 4B, Eastside Bypass
36 and Mariposa Bypass Channel and Structural Improvements Project.

37 **10.1.5 Vegetation Modeling**

38 Reclamation will use existing SRH-2D hydraulic models to quantify potential increases in river
39 stage given increases in riparian growth in reaches that convey the SJRRP Restoration Flows.
40 This study will help the SJRRP determine if action needs to be taken to maintain or reduce then-
41 existing channel capacities. It is expected that the analysis will be performed in Reaches 2A and
42 4A as they have the highest potential for vegetation recruitment as a result of rewetting. The

1 existing conditions Reclamation-built 2-D models, described briefly in Section 5.0 -- Data and
2 Analytical Tools, will be used as a starting condition. The potential increase in vegetation will be
3 estimated using analogs to surrounding reaches. Various methods will be used to predict the
4 increase in river stage due to increasing vegetation density. A technical report documenting the
5 effect of vegetation roughness in Reaches 2A and 4A is expected in early 2015.

6 **10.2 Monitoring Activities**

7 The SJRRP is continuing various monitoring activities for different studies and purposes. The
8 monitoring described below will guide implementation of the Settlement for observing and
9 adjusting to changes in physical conditions within the Restoration Area including those changes
10 that may impact channel capacity. These monitoring activities are described in the *Physical*
11 *Monitoring and Management Plan*, which is in Appendix D of the PEIS/R. The following
12 sections describe the monitoring that may be undertaken on an as-needed basis.

13 **10.2.1 Flow monitoring**

14 The objective of continuing to monitor flow is to ensure compliance with the hydrograph
15 releases in Exhibit B of the Settlement and any other applicable flow releases without exceeding
16 then-existing channel capacity. Reclamation, DWR and the USGS currently maintain 23 flow
17 and staff gages along the San Joaquin River and tributaries between Friant Dam and the Merced
18 confluence. These gages are used to determine the flow in each reach of the river. All of the
19 gages shown in Figure 10-2 below are telemetered and available online at the California Data
20 Exchange Center (CDEC). Each of the operating agencies also conducts periodic flow
21 measurements in order to develop and adjust rating curves as necessary. Final daily average data
22 is determined monthly by Reclamation, as requested by DWR, and annually by the USGS. Flow
23 monitoring stations provide calibration data for hydraulic models and a key dataset for
24 comparison and evaluation. Monitoring of these stations would continue as needed to help ensure
25 Restoration Flows do not exceed then-existing channel capacities.
26

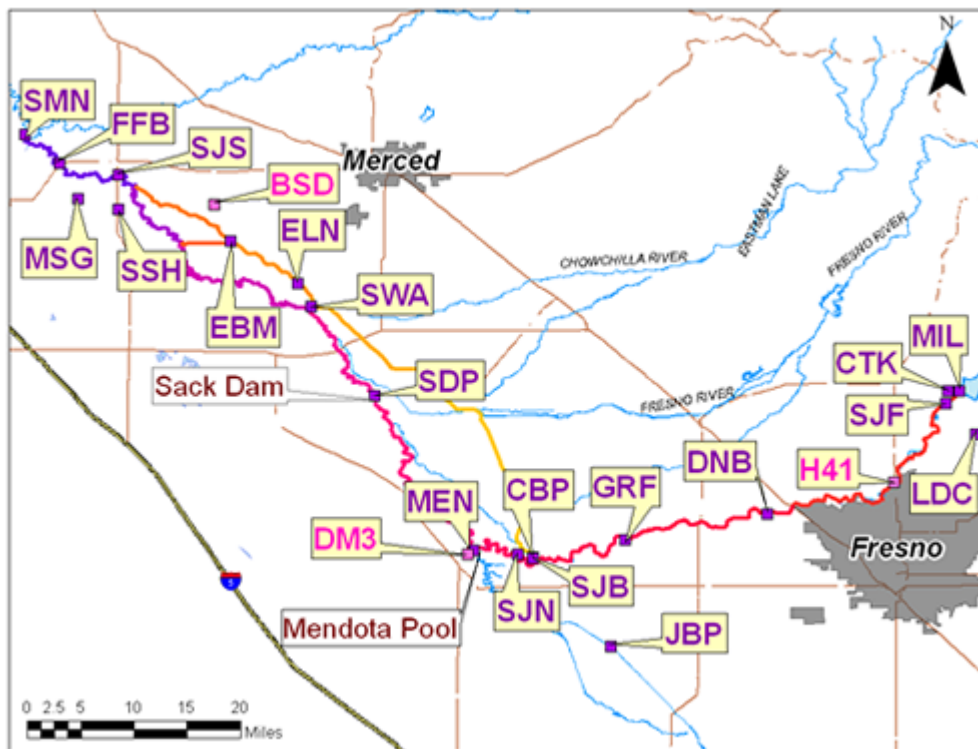


Figure 10-1.

Current flow gages (purple) and staff gages (pink) available on CDEC

10.2.2 Water surface profile surveys

Along with flow monitoring, water surface profile (WSP) surveys help inform the SJRRP of the potential changes in stage and channel capacity as a result of a change in specific or reach-wide conditions due to vegetation, channel work and sediment transport. In 2014, additional WSP surveys may be completed in some reaches, depending on flow releases from Friant and model calibration needs.

10.2.3 Aerial Photography and Topographic surveys

The purpose of the aerial photography and topographic surveys is to obtain information about the river stage, hydraulic roughness, river width, and bed elevation to assist with scientific studies that would inform the SJRRP about how flows are impacting then-existing channel capacities. A number of survey data sets have been collected in this region before and after the Settlement to support the SJRRP. The most current topography was the aerial LiDAR completed in 2008 and bathymetric surveys that were completed in 2010/2011. Because of subsidence experienced in the Restoration Area and the uncertainties on the rates of subsidence, additional LiDAR surveys will be collected in the latter part of 2014. Bathymetry surveys in some reaches will be completed in 2014, as needed. New terrain surfaces will be created with this updated topographic data and will be used for site-specific designs and to update hydraulic models and studies which could be used to inform then-existing channel capacity.

1 Aerial photography with both natural color and infrared will be completed at the same time as
2 LiDAR in late 2014.

3 DWR also has conducted multiple topographic surveys in Reaches 2A, and 2B between 2008
4 and 2013. The goal is to monitor long-term changes in these reaches to identify depositional and
5 erosional trends and potential effects to channel capacity in these reaches. The current phase of
6 this study involves using the survey data to estimate volume changes that have occurred. DWR
7 will continue to periodically complete additional surveys, as needed, and surveys are likely for
8 2014.

9 **10.2.4 Erosion Monitoring**

10 Erosion monitoring of the channel and channel banks would be conducted by the SJRRP to
11 identify areas that may potentially compromise levee integrity for consideration of future
12 management actions and projects (flow reduction, revetment, armoring, etc.). Monitoring would
13 be completed using several standard methodologies and protocols commonly employed by
14 DWR, reclamation districts, and/or USACE to monitor levee erosion. These surveys would
15 assess the condition of potential erosion sites, and could include a variety of techniques such as
16 aerial photography and topographic surveys.

17 **10.2.5 Vegetation surveys**

18 The purpose of the previous and future vegetation surveys is to obtain information on the
19 establishment and recruitment of vegetation. This information can be used by the SJRRP to
20 determine if actions need to be taken to address capacity issues as a result of increased channel
21 roughness from vegetation. Annual surveys have occurred since 2011 and future surveys will be
22 conducted annually as part of baseline SJRRP monitoring. The extent and scope of the
23 monitoring is discussed in Section 10.2.5 of the 2014 Report.

24 **10.2.6 Suspended Sediment**

25 Reclamation continues to collect data to manage channel capacity through the development of an
26 annual sediment hydrograph for the Restoration Area. Each year, the USGS collects suspended-
27 sediment, bedload, bed gradation data, and stream discharge eight times at six locations. These
28 sampling sites, listed in the order of the downstream direction, are: Highway 41, Skaggs Bridge,
29 Gravelly Ford, 1.3 miles west of Napa Ave (above CBBS), below CBBS, and below Mendota
30 Dam. This information will be useful to DWR and Reclamation as they develop studies on the
31 sedimentation impacts on channel capacity in the San Joaquin River and flood bypasses.

11.0 Non-Program Actions and Studies that May Influence Future Channel Capacity

There are several other entities that are active in the Restoration Area and whose programs may help inform or impact then-existing channel capacity. The SJRRP will need to closely coordinate and collaborate with these entities by sharing information and data, as well as coordinating specific actions along the river that can inform or impact channel capacity. This section provides recent updates of the programs, actions, and studies of other agencies that could impact or allow a better understanding of future channel capacity within the SJRRP Restoration Area. The 2014 Report provides a more complete description of these activities of these agencies. A new DWR program, the Flood System Repair Project, was also added to this report.

11.1 Lower San Joaquin Levee District

The LSJLD is a local agency that is responsible for operation, maintenance, and emergency management of the LSJRFC Project, which is part of the State Plan of Flood Control (SPFC) facilities within the SJRRP Restoration Area. The LSJLD operates and maintains levees, bypasses and other facilities built in connection with the SPFC and these actions directly impact the capacities of the reaches in the study area. The LSJLD is continuing to complete the last two bank stabilization projects in Reach 2A. Four of the six sites have been completed and the LSJLD intends to start work on one of the remaining sites this year, and the other to follow as resources allow.

11.2 Merced National Wildlife Refuge

The U.S. Fish & Wildlife Service (USFWS) currently operates a pair of weirs within the boundaries of the MNWR along the Middle Eastside Bypass (Eastside Bypass Reach 2) that could have an impact on channel capacity. These weirs are referred to as the upper and lower wildlife refuge weirs, since they are located at the upstream and downstream intersections of the MNWR and the bypass. These structures have the ability to check water both upstream of the MNWR and within its boundaries for diversion to the various wetlands operated by USFWS. When the boards are placed into the weirs, they can have an impact on water surface elevation and capacity of the bypass.

11.3 DWR

In implementation of its FloodSAFE initiative, DWR is leading three specific efforts within the SJRRP Restoration Area that may affect channel capacity.

11.3.1 Non-Urban Levee Evaluations

As a component of its FloodSAFE initiative, DWR has been performing geotechnical evaluations of over 1,800 miles of levees throughout the Central Valley. The evaluations are

1 divided into the Urban Levee Evaluations (ULE) Project for levees protecting populations
2 greater than 10,000 and the NULE Project for remaining levees including a portion of the levee
3 features within the Restoration Area. The evaluations are limited to Project levees and
4 appurtenant Non-Project levees, which protect part of a basin partially, protected by Project
5 levees or may impact the performance of Project levees.

6 As discussed in the 2014 Report, the subsurface exploration portion of the program was
7 completed in 2012 and consisted of approximately 5 CPTs and 1 exploratory boring on the levee
8 crest per mile with occasional explorations on the levee toe. A total of 164 CPTs and 40 borings
9 were drilled on or along levees in Reaches 2A, 3, and 4A. A total of 125 CPTs and 46 borings
10 were drilled along the Eastside Bypass and Chowchilla Bypass Canal. The Geotechnical Data
11 Report (GDR) for this effort was completed in February 2014. NULE Geotechnical Overview
12 Report (GOR) analysis is being performed currently and seepage and stability results will be
13 presented in the GOR for existing levees. The GOR will also include proposed alternatives for
14 remediating the existing levees. The GOR is expected to be completed by mid to late 2014. The
15 NULE assessments and SJLE Project will continue to coordinate data collection efforts and
16 findings, which could be used to inform next year's then-existing channel capacity.

17 **11.3.2 Regional Flood Management Planning**

18 As part of its FloodSAFE initiative, DWR is also coordinating a Regional Flood Management
19 Planning effort for the Central Valley. The regional planning effort supports locally-developed
20 Region Flood Management Plans (RFMP) and is an important step in refining and implementing
21 the Central Valley Flood Protection Plan (CVFPP). The main goal of the RFMP is to identify
22 high priority regional flood risk reduction solutions that are both economically viable and
23 implementable. As part of the regional planning effort, the Upper San Joaquin River (USJR)
24 Region, that encompasses a significant part of the Restoration Area, was created.

25 The USJR Region is currently preparing a RFMP that describes the region's flood hazards, flood
26 control systems, and ultimately the vision for a FloodSAFE region. Currently, there are 86
27 projects and management actions that are being proposed for the RFMP and it is expected that
28 several of the proposed projects will reduce flood risk in the Restoration Area. Ten SJRRP
29 projects are currently included on the USJR Region's project list and the USJR Region has been
30 coordinating with the SJRRP on potential projects that could increase then-existing channel
31 capacities in the Restoration Area. This planning effort will help illuminate the regional flood
32 risk reduction benefits of the SJRRP.

33 The USJR Region is diligently working to complete the RFMP and several sections of the RFMP
34 have been drafted. The USJR is also finalizing a method for ranking projects and actions. In its
35 work on the RFMP, monthly coordination with regional stakeholders has been essential in
36 soliciting input and comments on the projects and regional priorities. One of the regional project
37 implementation strategies is to "bundle" projects together in packages that will greatly increase
38 the multi-benefit funding possibilities for the regional projects and actions. This could help to
39 integrate the regional projects and make them and implementable. Ultimately, the RFMP will
40 help inform the federal, state, and local agencies of the regional flood management needs and
41 lead to implementation of the projects and actions needed for a FloodSAFE region. The last part
42 of the regional planning effort in the USJR Region is to work with the regional stakeholders to

1 develop a financial plan to identify a strategy to fund the priority actions with a collection of
2 federal, state, and local funding sources. The plan is scheduled to be complete in August of 2014.

3 **11.3.3 Flood System Repair Project**

4 As part of its FloodSAFE initiative, DWR is also implementing one of the CVFPP's near-term
5 priority actions, the Flood System Repair Project (FSRP) to help Local Maintaining Agencies
6 (LMAs) reduce flood risks in non-urban areas. Through FSRP, DWR is assisting LMAs by
7 providing them with technical and financial support to repair documented critical problems with
8 flood control facilities of the State Plan of Flood Control (SPFC) in non-urban areas.

9 The objectives of the FSRP are to repair documented critical problems like erosion sites (50-feet
10 in length or less), hydraulic control structures, and deteriorated levee patrol roads. Under the
11 FSRP, DWR is working with the LSJLD to re-rock 25.5 miles of levee roadways to provide all-
12 weather access to the levees. This will help reduce flood risks by improving the reliability of the
13 levees for levee monitoring during flood events. In addition, the FSRP is working with the
14 LSJLD to modernize the Chowchilla Bypass, San Joaquin River, Eastside Bypass, and Mariposa
15 Bypass control structures electronic gate controls. These improvements will improve the system
16 operations by providing a more reliable system and allowing the ability to adjust gate settings
17 quicker for more efficient operation. The LSJLD prepared the plans and specifications and is
18 working with DWR on the schedule and funding. The LSJLD is in the process of acquiring the
19 needed permits. The current plan is for the work to start in the spring of 2015.

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1 **13.0 Appendices**

- 2 A. PEIS/R Text Related to Channel Capacity, 2012
- 3 B. Hydraulic and Sediment Transport Modeling Strategy, 2014
- 4 C. San Joaquin River In-channel Capacity Analysis, 2013
- 5 D. Middle Eastside Bypass Geotechnical Assessment, 2013
- 6 E. Draft Technical Memorandum, Subsidence Monitoring, 2014