Appendix A Timing of Flow Analysis

Understanding how Restoration Flows would split between Reach 4B1 and the Middle Eastside Bypass under each alternative required a modeling analysis. The analysis considered the capacity of each reach under each alternative and whether the flow entering the Project area was Restoration Flow or Flood Flow. The San Joaquin River Restoration Program (SJRRP) would manage Restoration Flows and route the flows based on the alternative design. The Lower San Joaquin Levee District (LSJLD) would manage Flood Flows. The exact management regime is not known, but the analysis assumed that the LSJLD would choose to keep Flood Flows in the bypass system.

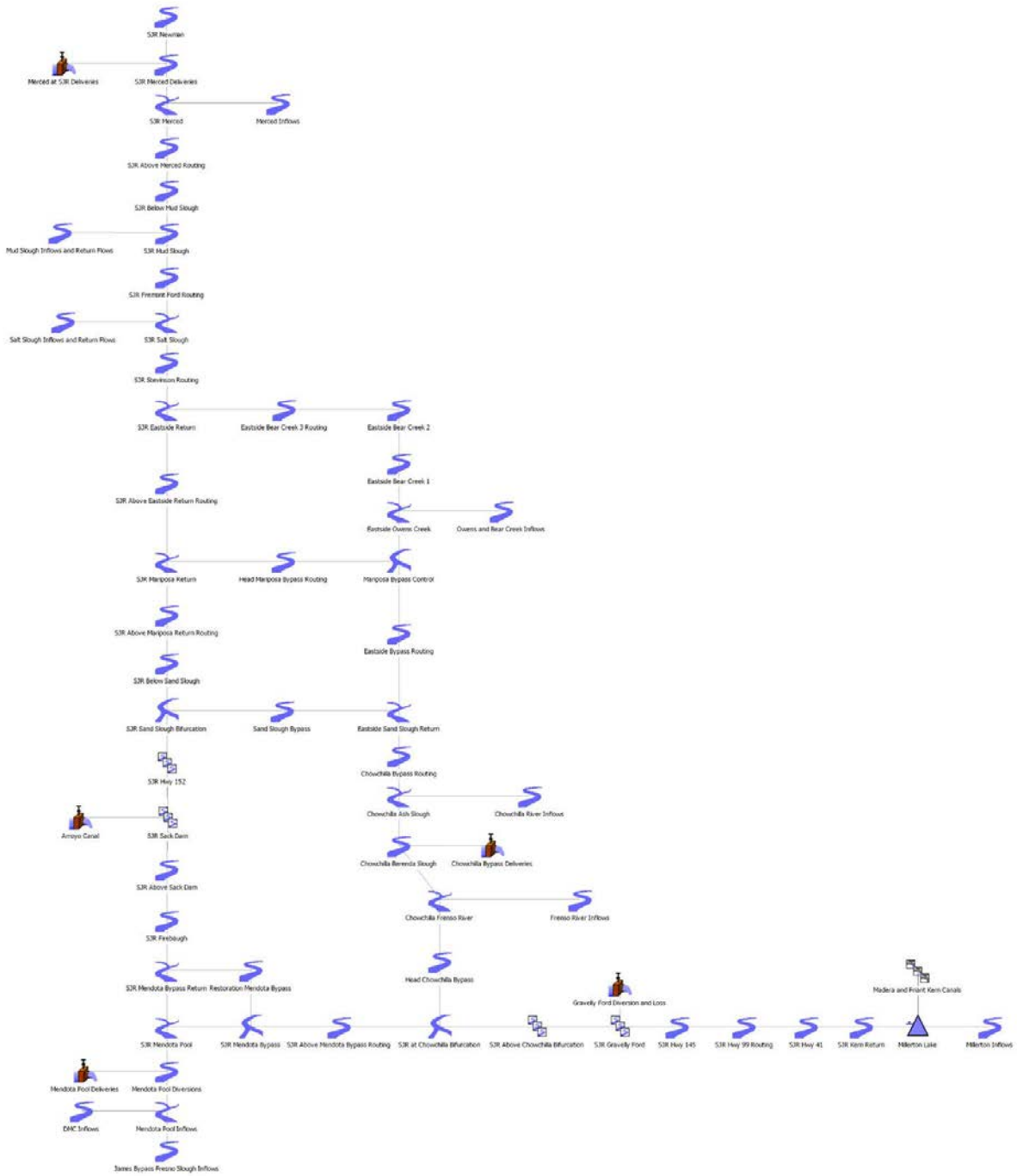
The analysis used results from the SJRRP daily operations model to conduct a timing of flow analysis. Reclamation developed the SJRRP daily operations model in Riverware, a versatile hydrologic modeling software package. The SJRRP daily operations simulates daily hydrology and operations in Millerton Lake, Friant Dam, and the restoration reaches (includes Reach 4B1 and Middle Eastside Bypass). The model run period is 82 full water years from October 1, 1921 to September 30, 2003 (Reclamation 2012).

Figure A-1 shows the SJRRP daily operations model schematic. The figure shows flow routing from Millerton Lake to the end of Reach 5. The daily operations model simulated eight restoration flow scenarios. Restoration Flows from the Settlement's Exhibit B (see Figure A-2) was used to estimate restoration flows out of Millerton Lake.

1. Alternative 1A: First 4,500 cfs into Reach 4B1; remaining flows into Middle Eastside Bypass
2. Alternative 1B: First 4,500 cfs of Restoration Flows into Reach 4B1, no flood flows in Reach 4B1; remaining flows including flood flows into Middle Eastside Bypass
3. Alternative 2A: First 16,000 cfs into Middle Eastside Bypass; then 475 cfs into Reach 4B1; remaining flows into Middle Eastside Bypass
4. Alternative 2B: First 16,000 cfs into Middle Eastside Bypass; then 475 cfs of Restoration Flows into Reach 4B1 (no flood flows); remaining flows into Middle Eastside Bypass
5. Alternative 3A: First 475 cfs into Reach 4B1; remaining flows into Middle Eastside Bypass.
6. Alternative 3B: First 475 cfs of Restoration Flows into Reach 4B1 (no flood flows); remaining flows into Middle Eastside Bypass
7. Alternative 4A: First 1,500 cfs into Reach 4B1; remaining flows into Middle Eastside Bypass

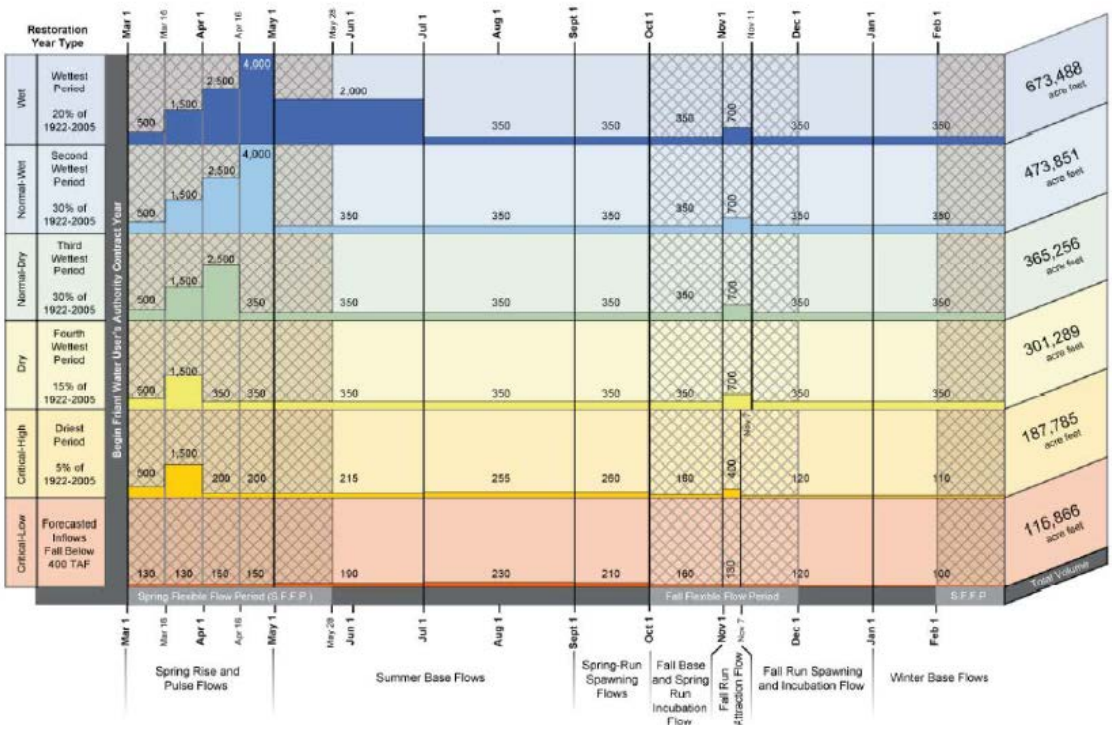
8. Alternative 4B: First 1,500 cfs into Reach 4B1 (no flood flows); remaining flows into Middle Eastside Bypass

Alternative 1A flows were used for this flow analysis.



SOURCE: SJRRP 2009.

Figure A-1.
SJRRP daily operations model schematic



Source: SJRRP 2009.

Figure A-2.
Restoration Flow Schedules, by Restoration Year Type, Settlement Exhibit B Stair-Step Allocations

A.1 Calculation of Flood Flows

To estimate flood flows entering Reach 4B1, days with allocated restoration flow releases from Millerton Lake were flagged (see Table A-1 for allocated restoration flows by hydrologic year type). On days when there was flows in excess of restoration flows entering Reach 4B1, those flows were flagged as flood flows. Figure A-3 shows the total annual flood flows by hydrologic year for the entire model period.

Table A-1.
Restoration Flow Allocation from Millerton Lake by hydrologic year type (in cfs)

		Critical Low	Critical High	Dry	Normal-Dry	Normal-Wet	Wet
Fall Base and Spring Run Incubation Flow	Oct 1 - Oct 31	160	160	350	350	350	350
Fall-Run Attraction Flow	Nov 1 - Nov 6	130	400	700	700	700	700
Fall-Run Spawning and Incubation Flow	Nov 7 - Nov 10	120	120	700	700	700	700
	Nov 11 - Dec 31	120	120	350	350	350	350
Winter Base Flows	Jan 1 - Feb 28	100	110	350	350	350	350
Spring Rise and Pulse Flows	Mar 1 - Mar 15	130	500	500	500	500	500

		Critical Low	Critical High	Dry	Normal-Dry	Normal-Wet	Wet
	Mar 15 - Mar 31	130	1500	1500	1500	1500	1500
	Apr 1 - Apr 15	150	200	350	2500	2500	2500
	Apr 16 - Apr 30	150	200	350	350	4000	4000
Summer Base Flows	May 1 - Jun 30	190	215	350	350	350	2000
	Jul 1 - Aug 31	230	255	350	350	350	350
Spring-Run Spawning Flows	Sep 1 - Sep 30	210	260	350	350	350	350

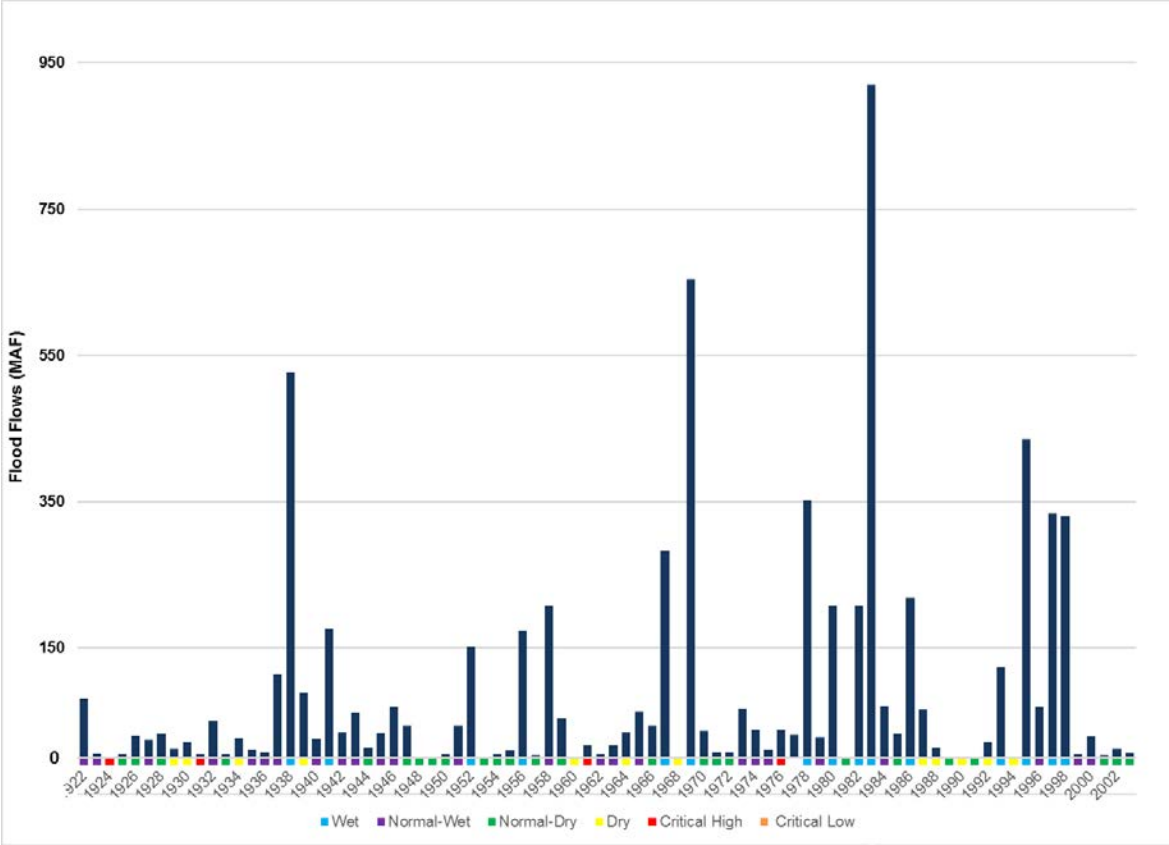


Figure A-3.
Annual Flood Flows by hydrologic year type

A.2 Results

During flood events, all flows in the Reach 4B/ESB Project area would be Flood Flows. The LSJLD would manage these flows as it sees appropriate, and could route all flows into the bypass system (even under alternatives where the Reach 4B1 channel is improved). Flood events occur during many years, as shown in Figure A-4.

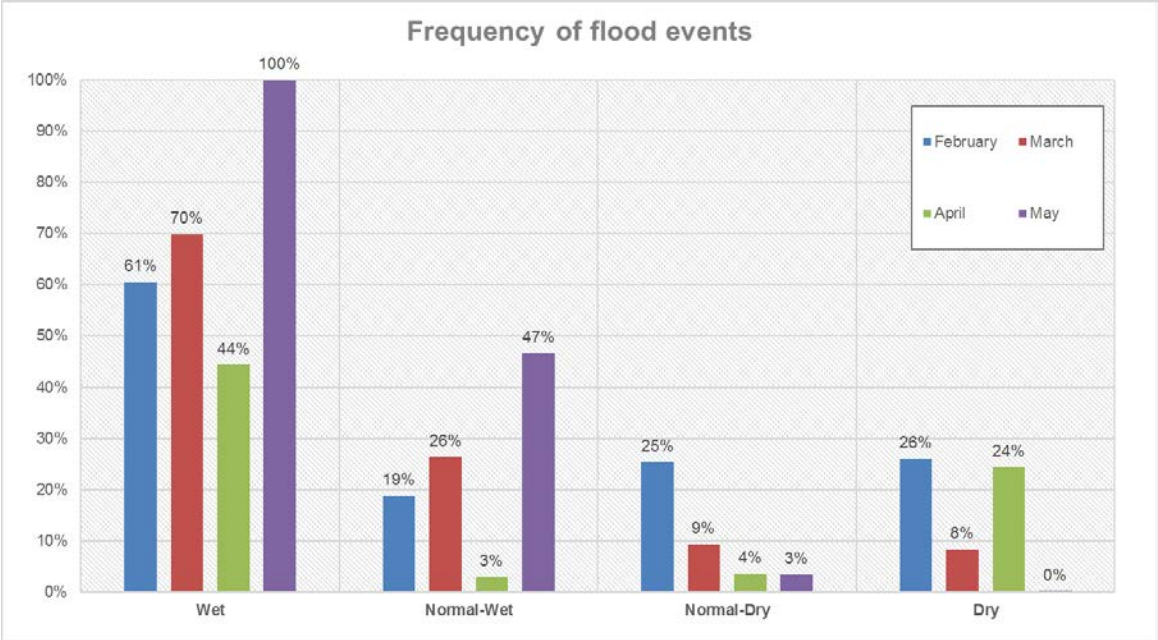


Figure A-4.
Frequency of Flood Events

Figure A-5 shows the frequency of flood flows during a normal-wet year (1932). Under these hydrologic conditions, Friant would release flood flows for about three weeks in February and two weeks in March. During these periods (shaded blue in the figure), the Reach 4B1 headgates would be closed and the only flow in the reach would be from local inflow. Figure A-6 shows similar information for an example wet year (1938). The figures only show the periods that Friant would make flood releases, but flows into Reach 4B1 would also be limited at times that Kings River flood flows are entering Mendota Pool and routing additional Friant releases into the Chowchilla Bypass.

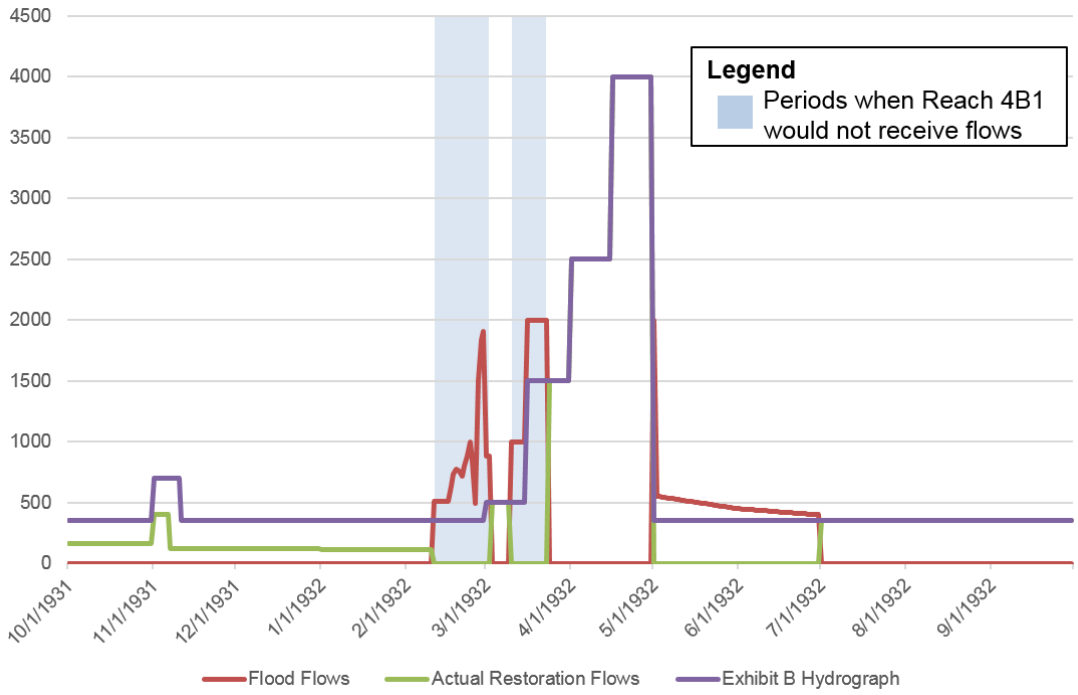


Figure A-5.
Flood Flows in a Normal-Wet Year (1932)

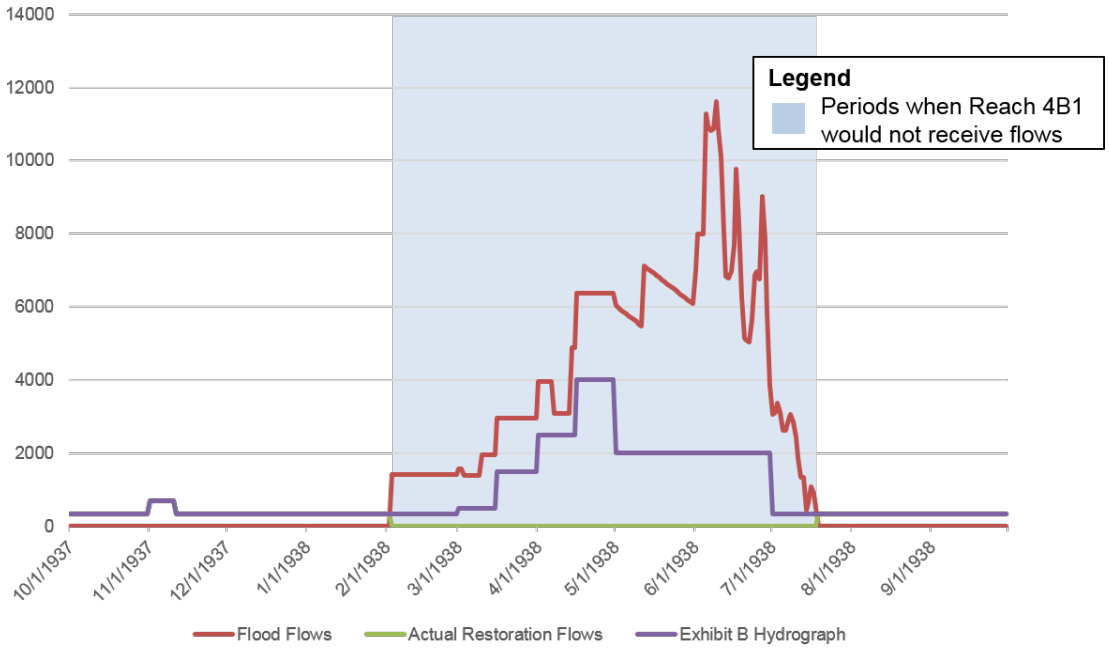


Figure A-6.
Flood Flows in a Wet Year (1938)

A.3 References

U.S Bureau of Reclamation (Reclamation) 2012. San Joaquin River Restoration Daily Flow Model (SJRRW) Documentation for the Reach 4B Study, Technical Report No. 86-68210-2012-04. September 18, 2012.

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