Chapter 13.0 Hydrology – Surface Water Supplies and Facilities Operations

This chapter describes the environmental and regulatory settings for surface water supplies and facilities operations, as well as environmental consequences and mitigation measures, as they pertain to implementation of the Settlement. The discussion of surface water supplies and facilities operations existing conditions encompasses the entire study area, including the San Joaquin River system upstream from Friant Dam, from Friant Dam to the Delta, the Delta, and CVP and SWP water service areas. Implementing the action alternatives would change surface water supplies and facilities operations of the San Joaquin River from Friant Dam to the Delta, in the Delta, and in CVP and SWP water service areas. Changes in operations at Friant Dam and the recapture and recirculation of water to the CVP and SWP water service areas have the potential to result in impacts to groundwater or socioeconomic conditions, as described in Chapters 12, "Hydrology – Groundwater," and 22, "Socioeconomics," respectively, and are not considered as independent impacts outside of those resource areas or described in this chapter. Accordingly, potential impacts to surface water supplies and facilities operations are described in the San Joaquin River from Friant Dam to the Delta and in the Delta. Additional information on potential changes in surface water supplies and facilities operations throughout the study area is summarized at the end of this chapter, and provided in Appendix J, "Surface Water Supplies and Facilities Operations."

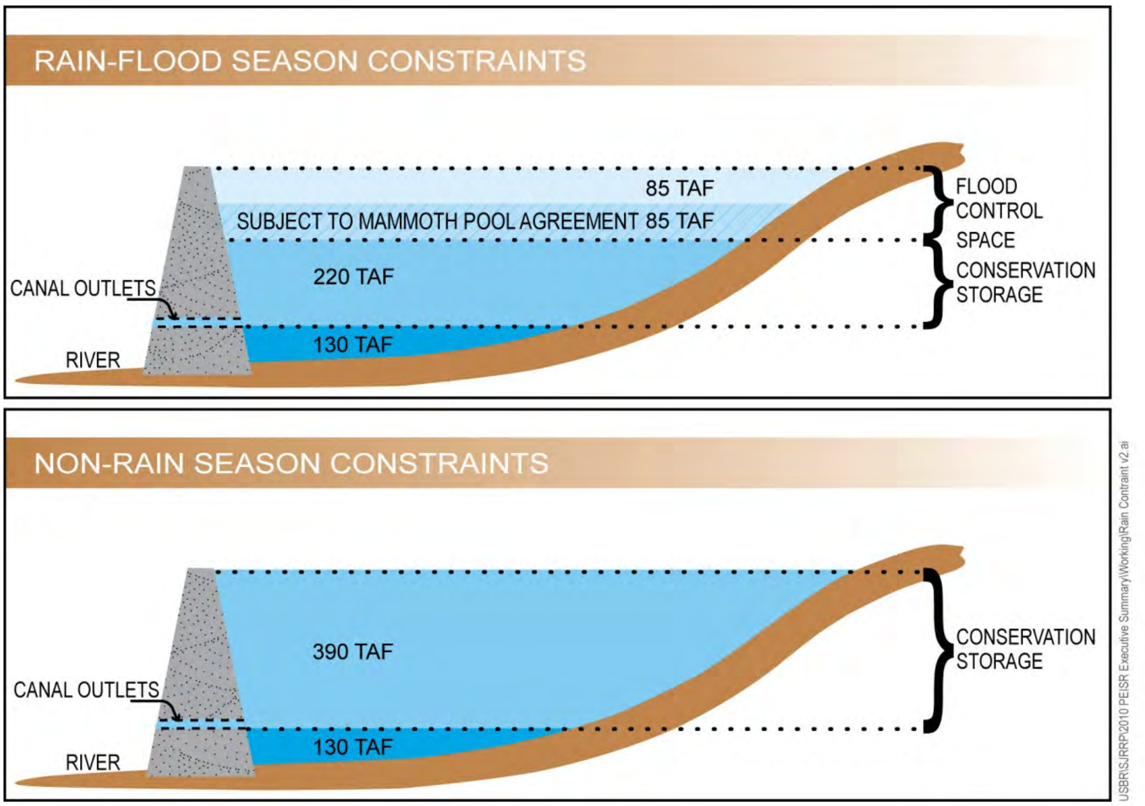
13.1 Environmental Setting

All major rivers in the Central Valley have been developed by construction of dams and conveyance facilities for water supply, flood control, and hydropower generation. Flows in the San Joaquin River downstream from Friant Dam are affected by water projects on the river's tributaries, imports to the river from other regions, diversions out of the river, return flows, and by Millerton Lake. This environmental setting section discusses physical environment conditions as they existed at the time that the NOP was published (August 22, 2007), consistent with Section 15125(a) of the CEQA Guidelines and as described in Chapter 3.0, "Considerations for Describing the Affected Environment and Environmental Consequences." Surface water supply and facilities operations are described for all five geographic subareas described in Chapter 1.0, "Introduction." Maps of the Restoration Area and river gage locations are found in Chapter 1.0, "Introduction," and Appendix D, "Physical Monitoring and Management Plan."

13.1.1 San Joaquin River Upstream from Friant Dam

Millerton Lake was formed by Friant Dam in 1942. It is the largest reservoir, by volume and surface area, on the San Joaquin River. The reservoir stretches 16 miles up into the river canyon and has more than 41 miles of shoreline. Millerton Lake has a volume of 524 TAF, a surface area of 4,905 acres, and an elevation of 580.6 feet above msl

(NAVD88 datum) at top of active storage. At top of active storage, the reservoir has a maximum depth of 287 feet. Figure 13-1 shows a conceptual representation of an active conservation space of 390 TAF during April through September, when there is little risk of rain floods. During the rainy season of October through March, up to 170 TAF of space in Millerton Lake is maintained for rain flood management (USACE 1955). Under present operating rules, up to 85 TAF of the flood management storage required in Millerton Lake may be provided by an equal amount of space in Mammoth Pool, located on the San Joaquin River upstream from Millerton Lake.

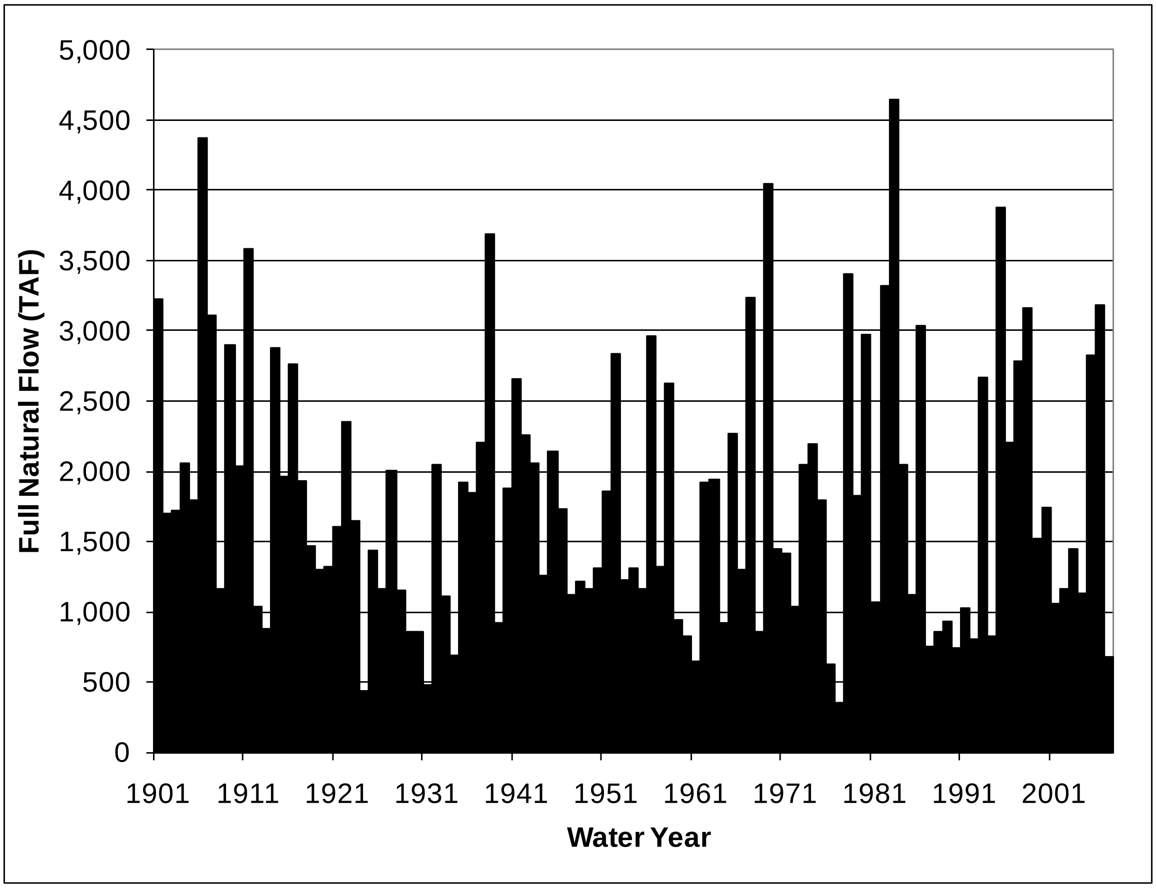


Source: Reclamation, 2003
Key: TAF = thousand acre-feet

Figure 13-1.
Conceptual Representation of Millerton Storage Requirements

Friant Dam is a 319-foot-high concrete gravity dam. Outlets to the Madera Canal (elevation 448.6) are located on the right abutment; outlets to the Friant-Kern Canal (elevation 466.6) are located on the left abutment. The spillway consists of an ogee overflow section, chute, and stilling basin at the center of the dam. The spillway is controlled by one 18-foot-high by 100-foot-wide drum gate, and two comparably sized Obermeyer gates. A river outlet works (elevation 382.6) is located to the left of the spillway within the lower portion of the dam. Information regarding power features on Friant Dam is found in Chapter 19.0, “Power and Energy.”

Millerton Lake drains an area of approximately 1,675 square miles and has an annual average unimpaired runoff of 1,818 TAF (WY 1901-2007), with a range of 362 to 4,642 TAF. Figure 13-2 shows the historical annual unimpaired runoff for the gage directly below Friant Dam. Several reservoirs in the upper portion of the San Joaquin River watershed, including Mammoth Pool and Shaver Lake, are used primarily for hydroelectric power generation (see Chapter 19.0, “Power and Energy”). Operation of these reservoirs affects timing of inflow to Millerton Lake. Big Sandy Creek, Fine Gold Creek, and several smaller, ephemeral streams also provide flows directly into the reservoir. Table 13-1 lists the Reclamation water rights for Millerton Lake.



Source: CDEC 2008, Gage ID MIL
Key:
TAF = thousand acre-feet

Figure 13-2.
Historical Annual Unimpaired Runoff Below Friant Dam, by Water Year

Table 13-1.
U.S. Bureau of Reclamation Water Rights for Millerton Lake

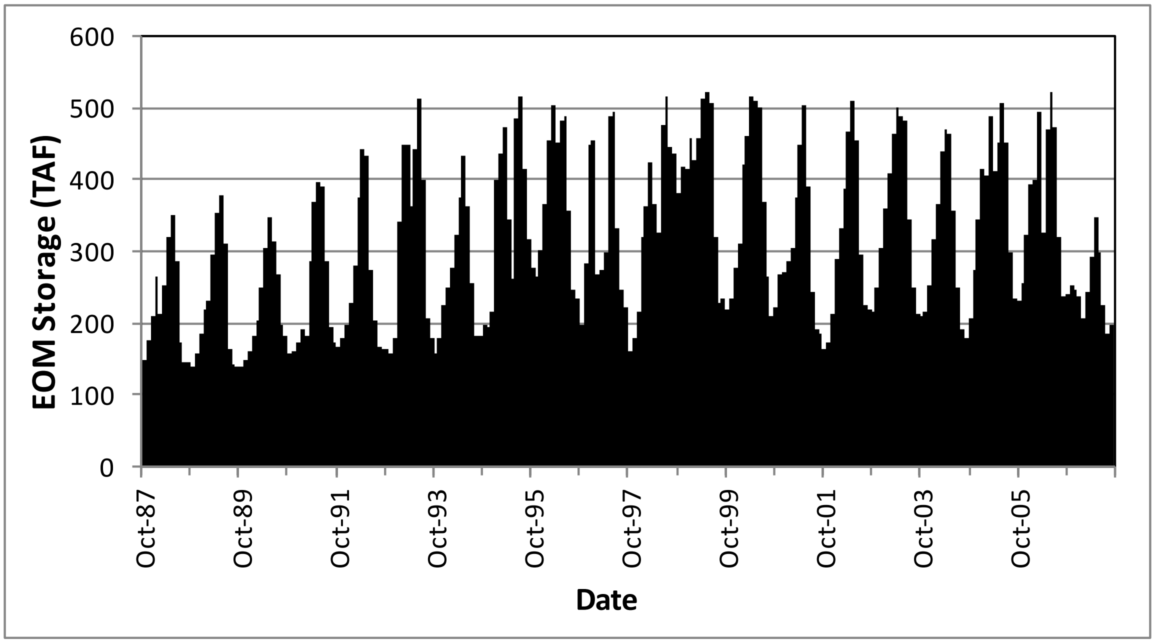
SWRCB Water Right Application		A000023	A000234	A001465	A005638
SWRCB Application Date		3/27/1915	1/19/1916	9/26/1919	7/30/1927
SWRCB Permit		000273	011885	011886	011887
SWRCB Permit Date		5/3/1917	6/29/1959	6/29/1959	6/29/1959
SWRCB License		001986	-	-	-
SWRCB License Date		10/17/1939	-	-	-
Maximum Direct Diversion (cubic feet per second)[1]		373	3,000	3,000	5,000
Maximum Storage (acre-feet/year)		-	500,000	500,000	1,210,000
Maximum Use (acre-feet/year)		44,340	2,124,077	2,124,077	3,916,795
Diversion Season per Purpose of Use	Domestic	4/1 – 7/1	2/1 – 10/31	2/1 – 10/31	2/1 – 10/31
	Irrigation	4/1 – 7/1	2/1 – 10/31	2/1 – 10/31	2/1 – 10/31
	Industrial	-	-	-	-
	Municipal	-	-	-	2/1 – 10/31
	Stock Watering	4/1 – 7/1	-	-	-
	Recreational	-	-	-	2/1 – 10/31
Storage Season per Purpose of Use	Domestic	-	11/1 – 8/1	11/1 – 8/1	11/1 – 8/1
	Irrigation	-	11/1 – 8/1	11/1 – 8/1	11/1 – 8/1
	Municipal	-	-	-	11/1 – 8/1
	Recreational	-	-	-	11/1 – 8/1
Place of Use Under Each Application for Consumptive Uses		Gross area of 5,431,000 acres per Map No. 214-208-3331, dated 7/19/1960, on file with the SWRCB	353,000 net acres within a gross area of 5,431,000 acres per Map No. 214-208-3331, dated 7/19/1960, on file with the SWRCB	353,000 net acres within a gross area of 5,431,000 acres per Map No. 214-208-3331, dated 7/19/1960, on file with the SWRCB	900,000 net acres within a gross area of 4,986,000 acres per Map No. 214-212-37, revised 12/13/1951; Map No. 1785-202-14, dated 5/11/2005, on file with the SWRCB

Source: SWRCB 2009

Note:
[1] Maximum combined direct diversions under Applications 234, 1465, and 5638 shall not exceed 6,500 cfs.

Key:
- = not applicable
SWRCB = State Water Resources Control Board

Millerton Lake is operated as an annual reservoir, in that most water supplies available in a given year are allocated with the expectation of delivery. Stored water carried over from a previous year usually occurs due to water user requests, but is done so at Reclamation's discretion. Median reservoir water level ranges from elevation 564 in late spring to elevation 497 in late summer. Figure 13-3 shows recent historical storage of Millerton Lake. Table 13-2 shows the historical monthly average storage in Millerton Lake by Restoration Year Types, as described in Appendix J, "Surface Water Supplies and Facilities Operations."



Source: CDEC 2008, Gage ID MIL
Key:
EOM = End-of-Month
TAF = thousand acre-feet

Figure 13-3.
Historical Millerton Lake End-of-Month Storage, Water Years 1988–2007

Table 13-2.
Historical Average Millerton Lake End-of-Month Storage by Year Type

Year Type[2]	End-of-Month Storage (TAF)[1]											
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
All Years	185	216	276	337	342	357	360	409	419	330	229	199
Wet	184	211	298	402	387	372	290	356	475	453	334	269
Normal-Wet	209	250	315	368	394	426	435	461	469	332	212	182
Normal-Dry	175	200	251	310	327	348	406	456	408	278	190	169
Dry	153	176	213	243	240	268	323	364	298	212	166	171
Critical-High	182	230	278	304	290	288	329	356	331	226	173	192
Critical-Low	228	234	245	252	235	226	218	213	231	210	192	197

Source: CDEC 2008, Gage ID MIL
Notes:
[1] Period of record Water Years 1951–2007; some years may be missing data.
[2] Restoration Year Types are defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
TAF = thousand acre-feet

Water deliveries, principally for irrigation, are made through outlet works to the Friant Kern and Madera canals, completed in 1949 and 1944, respectively. A river outlet works is located within the lower portion of the dam. Additional physical data pertaining to Friant Dam and Millerton Lake are presented in Table 13-3. River releases are made to comply with Holding Contract requirements, which are contracts between Reclamation and riparian water right holders between Friant Dam and Gravelly Ford. Consistent with the Holding Contracts, Reclamation makes river releases to maintain streamflow of at least 5 cfs past each Holding Contract diversion point, with the last being near Gravelly Ford. Under current conditions, specific releases are not made to the San Joaquin River to maintain fishery conditions downstream from Friant Dam. Chapter 11.0, "Hydrology – Flood Management," discusses flood management operations at Friant Dam in detail.

13.1.2 San Joaquin River from Friant Dam to Merced River

This section describes water operations within the Restoration Area for nine distinct river reaches/subreaches and several flood bypasses. A map of the Restoration Area and the river reaches is found in Figure 1-2 in Chapter 1.0, "Introduction."

Reach 1

Reach 1 conveys continuous flows through an incised, gravel-bedded channel to Gravelly Ford, forming part of the boundary between Fresno and Madera counties. Releases are made at Friant Dam to comply with Holding Contract requirements along Reach 1. Streamflow of at least 5 cfs is maintained past the last diversion near Gravelly Ford, with no requirements for streamflow into Reach 2. Reach 1 is subdivided into two subreaches, 1A and 1B, at SR 99.

The objective release from Friant Dam into Reach 1 is 8,000 cfs. Reach 1 of the San Joaquin River is hydraulically connected to 190 acres of sand and aggregate mining pits, with an additional 1,170 acres of pits in the surrounding floodplain (McBain and Trush 2002). These pits can attenuate flow and increase evaporation through ponding. There are no storage facilities in Reach 1. Diversions within this reach, not all of which are active on a regular basis, are listed in Appendix J, "Surface Water Supplies and Facilities Operations." Ten major road crossings in this reach can affect flow stage (McBain and Trush 2002). Agricultural return flows in Reach 1 are minor, but have reached up to 300 cfs on occasion (EPA 2007). Stormwater runoff from the Fresno Metropolitan Area is managed by the Fresno Metropolitan Flood Control District. All but five of the District's 161 drainage basins route stormwater to retention and detention facilities, limiting the urban surface runoff into Reach 1.

Reach 1A. Flows within Reach 1A are predominantly influenced by releases from Friant Dam, along with diversions and seepage losses. Mining pits in Reach 1 are primarily located in Reach 1A. Releases from Friant Dam typically range from 180 to 250 cfs in the summer and 40 to 100 cfs in the winter. Eighty-four water diversions are located along this reach, not all of which are active on a regular basis. Cottonwood Creek and Little Dry Creek, two intermittent streams, join the San Joaquin River in Reach 1A. Cottonwood Creek, draining 35.6 square miles, flows in from the north near the base of Friant Dam. Little Dry Creek, draining 57.9 square miles, joins the San Joaquin River from the south approximately 8 miles downstream from Friant Dam. Flows in Little Dry

Creek can be augmented from the Big Dry Creek flood control reservoir (McBain and Trush 2002). Flows from these two creeks must be included in the 8,000 cfs Reach 1A capacity limits when determining releases from Friant Dam (see Chapter 11.0, “Hydrology – Flood Management”).

Table 13-3.
Pertinent Physical Data – Friant Dam and Millerton Lake

General			
Unimpaired Flows of Friant Dam			
Average annual flow (WY 1901–2007)	1,818,000 acre-feet	Average flow	2,470 cfs
Min average daily inflow (Oct. 10, 1977)	0 cfs	Min average daily outflow (Oct. 20, 1940)	5.5 cfs
Max average daily inflow (Dec. 23, 1955)	61,700 cfs	*Spillway design flood*	
Max instantaneous inflow (Dec. 23, 1955)	97,000 cfs	Peak inflow	197,000 cfs
Max average daily outflow (June 6, 1969)	12,400 cfs	Peak outflow	158,500 cfs
Friant Dam and Millerton Lake[1]			
Friant Dam (concrete gravity)		**Millerton Lake**	
Elevation, top of parapet	587.6 feet above msl	*Elevations*	
Freeboard above spillway flood pool	3.25 feet	Minimum operating level[2]	468.7 feet above msl
Elevation, crown of roadway	583.8 feet above msl	Top of active storage capacity	580.6 feet above msl
Max height, foundation to crown of roadway	319 feet	Spillway flood pool	587.6 feet above msl
Total concrete in dam and appurtenances	2,135,000 yd^3	*Area*	
Dam Crest length		Minimum operating level	2,108 acres
Left abutment, nonoverflow section	1,478 feet	Top of active storage capacity	4,905 acres
Overflow river section	332 feet	Spillway flood pool	5,085 acres
Right abutment, nonoverflow section	1,678 feet	Drainage area	1,675 square miles
Total length	3,488 feet	*Storage capacity*	
Width of crest at elevation 581.25	20.0 feet	Minimum operating level[2]	130,740 acre-feet
Spillway (gated ogee)		Top of active storage capacity	524,250 acre-feet
		Spillway flood pool	559,300 acre-feet
Spillway Crest		**Outlets**	
		River outlets (110-inch dia. w/ 96-inch hollow jet valves)	
Gross	332 feet	Number and elevation	4 @ 382.6 feet above msl
Net	300 feet	Capacity at minimum pool	12,400 cfs
Crest elevation	562.6 feet above msl	Capacity at top of active storage	16,400 cfs
Discharge capacity (height = 18.0 feet)	83,160 cfs	*Diversion outlets, Madera Canal (91-inch dia. w/ 86-inch needle valve)*	

Table 13-3.
Pertinent Physical Data – Friant Dam and Millerton Lake (contd.)

Crest gates (1 drum and 2 Obermeyer)		Number and elevation	2 @ 448.6 feet above msl
Number and size	3 @ 100 feet by 18 feet	*Diversion outlets, Friant-Kern Canal (110-inch dia. w/ 96-inch hollow jet valve)*	
Top elevation when lowered	562.6 feet above msl	Number and elevation	4 @ 466.6 feet above msl
Top elevation when raised	580.6 feet above msl		
Friant-Kern Canal		**Madera Canal**	
Length	152 miles	Length	36 miles
Operating capacity below Friant Dam	5,000 cfs	Capacity below Friant Dam	1,250 cfs
Operating capacity at terminus of canal	2,000 cfs	Capacity at Chowchilla River	625 cfs

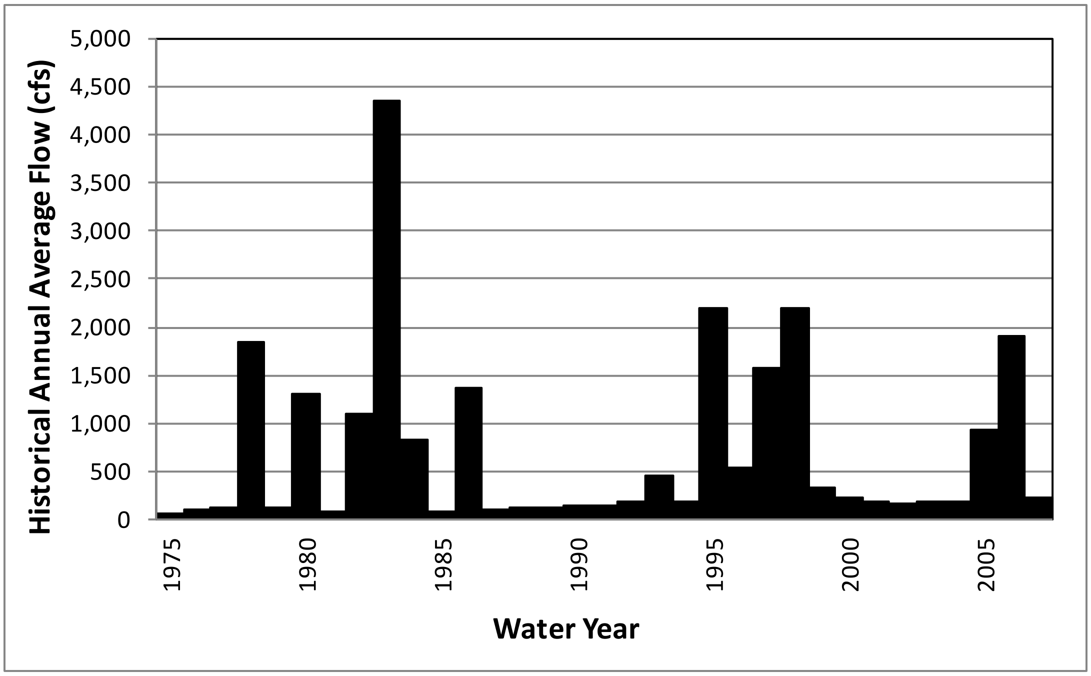
Source: USACE 1955 (revised 1980), with elevations revised to NAVD 1988
Notes:
[1] Elevations are given in North American Vertical Datum (NAVD) 1988.
[2] Minimum operating level generally corresponds with elevation of Friant-Kern Canal outlets.
Key:
cfs = cubic feet per second
Dec. = December
dia. = diameter
elevation XXX = elevation in feet above mean sea level
max = maximum
min = minimum
msl = mean sea level
Oct. = October
yd^3 = cubic yard

Since 1949, Reclamation has made average annual releases of approximately 117 TAF from Friant Dam to the San Joaquin River to comply with Holding Contract requirements upstream from Gravelly Ford. Additional river flows occur during years when releases are made to the San Joaquin River for flood management purposes. Releases made from Friant Dam for water diversions can range from 40 cfs to 250 cfs (McBain and Trush 2002), but are typically below 150 cfs (see Appendix J, “Surface Water Supplies and Facilities Operations”). Table 13-4 lists the streamflow gages located in or near this reach segment, their period of record, average streamflow, and maximum daily average flow. Figures 13-4, 13-5, 13-6, and 13-7 show historical annual average flows at the gages. Tables 13-5, 13-6, 13-7, and 13-8 show historical average monthly flows at the gages. Exceedence curves for these gages are shown in Appendix J, “Surface Water Supplies and Facilities Operations.” A rating table, which contains the relationship between the stage and discharge at a river cross section for the San Joaquin River below Friant Dam, is also shown in Appendix J, “Surface Water Supplies and Facilities Operations.”

Table 13-4.
Streamflow Gages in Reach 1A

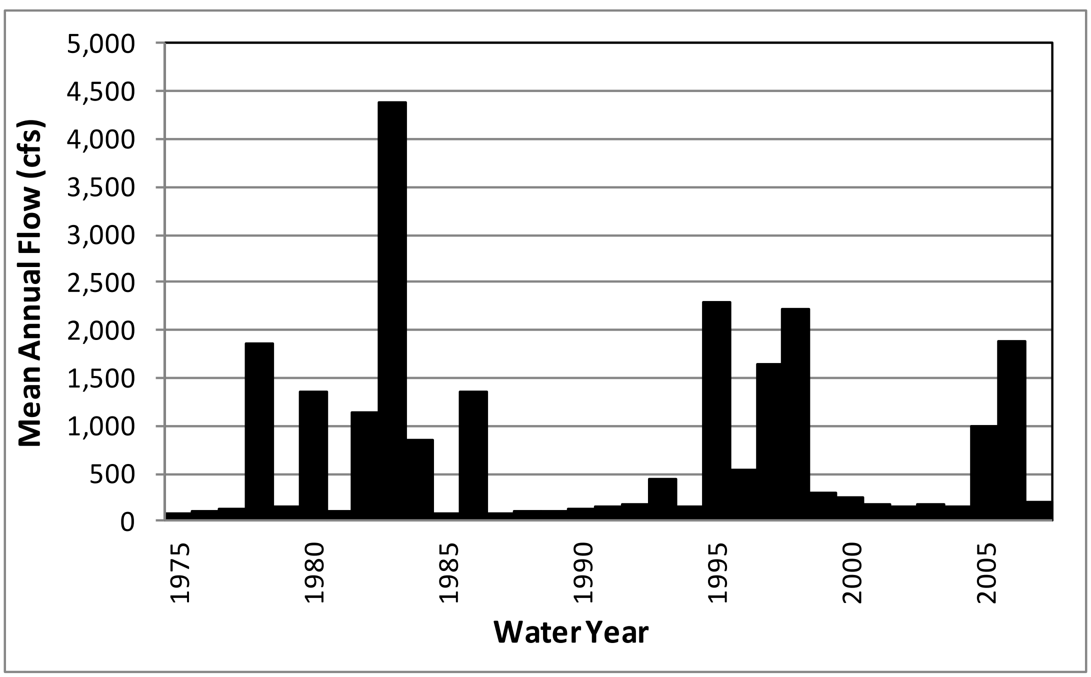
Gage Name	USGS Gage Station No. or CDEC ID	MP	Drainage Area (square miles)	Period of Record[1]	Average Streamflow (cfs)	Maximum Daily Average Streamflow (cfs) (date measured)
San Joaquin River release from Friant Dam	MIL	267.6	1,675	1975 – 2007	707	25,556 (January 4, 1997)
San Joaquin River below Friant Dam	11251000	266.0	1,676	1975 – 2007[2,3]	710	36,800 (January 3, 1997)
Cottonwood Creek near Friant Dam	CTK	NA	35.6	1975 – 2007	7	783 (January 27, 1983)
Little Dry Creek near Friant Dam	LDC	NA	57.9	1975 – 2007	22	2,457 (March 11, 1995)

Source: CDEC 2008; USGS 2008
Notes:
[1] Water years.
[2] Earlier records are available, coinciding with start of diversions from Friant Dam (1950). Data uses 1974 – 2007 to maintain consistency with other data in this reach as presented in table.
[3] Difference between Friant Dam releases and gage flow below dam caused by minor inflows and depletions between the two locations.
Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
ID = identification
MP = milepost
NA = not applicable/not available
No. = number
USGS = U.S. Geological Survey



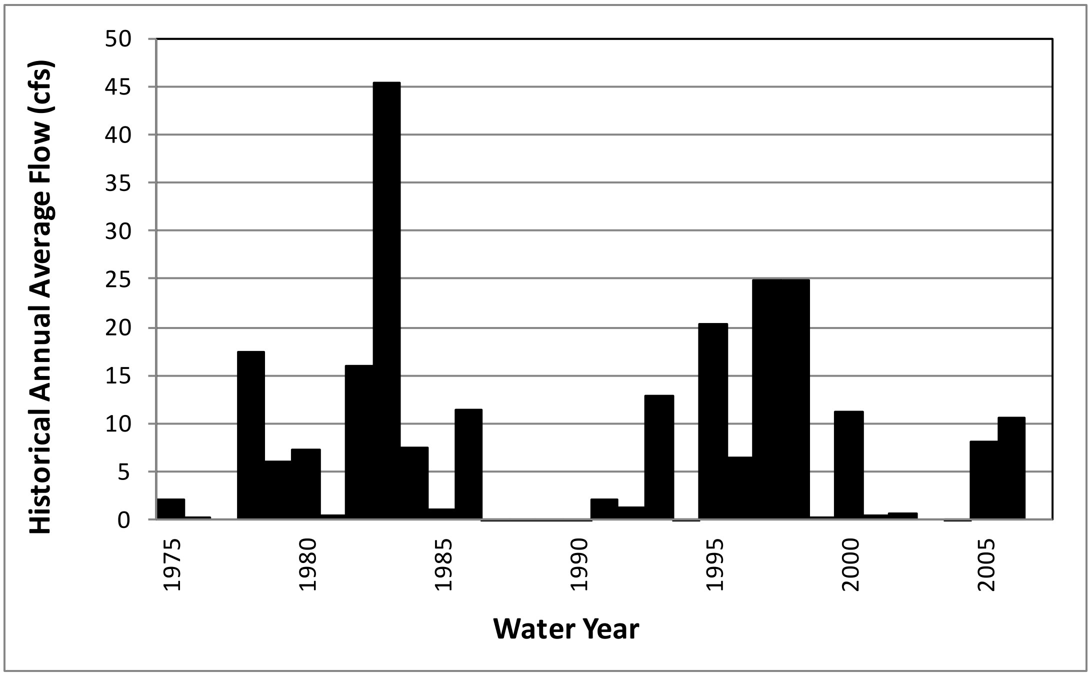
Source: CDEC 2008, Gage ID MIL
Key:
cfs = cubic feet per second

Figure 13-4.
Historical Annual Average Flow for Friant Dam Releases



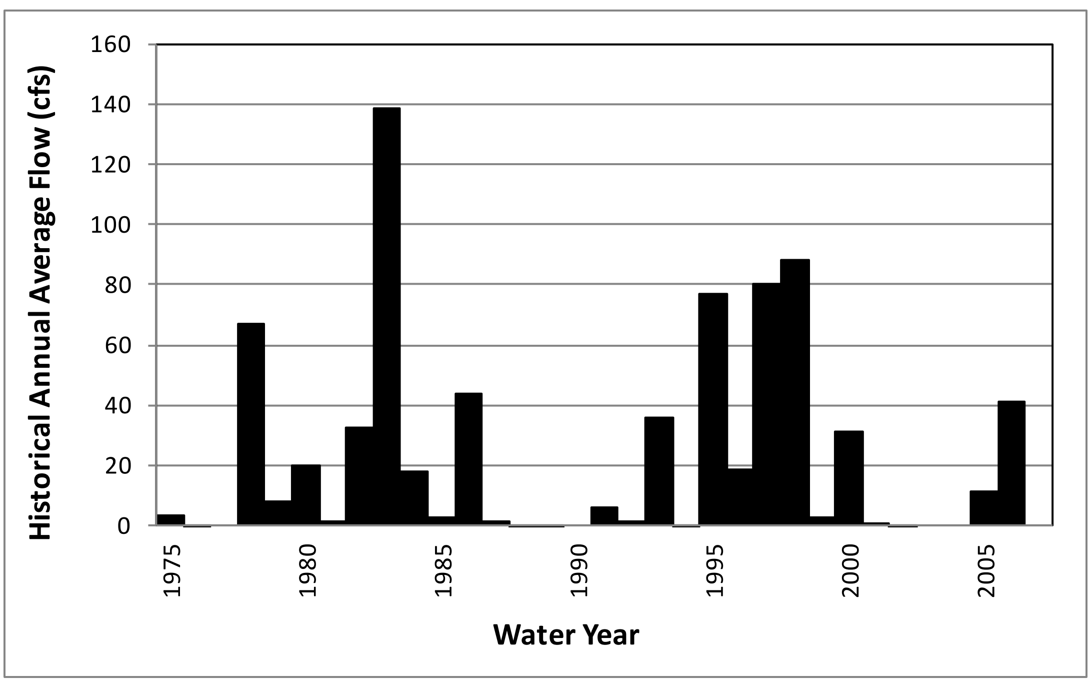
Source: USGS 2008, Gage Station No. 11251000
Key: cfs = cubic feet per second

Figure 13-5.
Historical Annual Average Flow for San Joaquin River Flow Below Friant Dam



Source: CDEC 2008, Gage ID CTK
Key: cfs = cubic feet per second

Figure 13-6.
Historical Annual Average Flow for Cottonwood Creek near Friant Dam



Source: CDEC 2008, Gage ID LDC
Key: cfs = cubic feet per second

Figure 13-7.
Historical Annual Average Flow for Little Dry Creek near Friant Dam

Table 13-5.
Historical Average Monthly Flows for Friant Dam Releases

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	187	199	306	635	823	1,078	1,599	1,423	1,162	731	258	254
Wet	146	277	600	1,609	2648	3,379	4,453	3,402	2,720	1971	371	402
Normal-Wet	321	301	444	682	281	410	269	349	281	239	195	173
Normal-Dry	152	116	92	81	86	89	132	156	191	207	202	196
Dry	128	101	83	67	77	105	145	167	200	225	222	195
Critical-High	86	68	51	62	52	107	109	171	172	171	160	132
Critical-Low	99	83	96	69	84	112	153	128	175	191	193	150

Source: CDEC 2008, Gage ID MIL
Notes:
[1] Period of record Water Years 1975 – 2007; some years may be missing data.
[2] Restoration Year Types are defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

Table 13-6.
Historical Average Monthly Flows for San Joaquin River Below Friant Dam

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	178	195	310	664	858	1,106	1,607	1,431	1,157	733	248	242
Wet	137	278	618	1,724	2,753	3,454	4,455	3,409	2,722	2,006	374	402
Normal-Wet	318	300	451	678	313	438	284	359	269	235	184	163
Normal-Dry	143	110	89	79	84	91	128	150	185	195	186	176
Dry	121	96	78	63	78	103	135	150	186	213	210	182
Critical-High	88	69	52	66	61	110	111	157	170	170	157	122
Critical-Low	90	69	97	68	92	107	151	115	177	194	195	150

Source: USGS 2008, Gage Station No. 11251000
Notes:
[1] Period of record Water Years 1975 – 2007; some years may be missing data.
[2] Restoration Year Types are defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

Table 13-7.
Historical Average Monthly Flows for Cottonwood Creek near Friant Dam

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	0	0	4	17	26	28	11	2	0	0	0	0
Wet	0	0	11	54	73	74	26	5	1	0	0	0
Normal-Wet	0	0	4	5	22	21	5	0	0	0	0	0
Normal-Dry	0	0	0	1	1	5	1	0	0	0	0	0
Dry	0	0	0	0	2	1	0	0	0	0	0	0
Critical-High	0	0	0	0	1	2	0	0	0	0	0	0
Critical-Low	0	0	0	0	0	0	0	0	0	0	0	0

Source: CDEC 2008, Gage ID CTK
Notes:
[1] Period of record Water Years 1975 – 2007; some years may be missing data.
[2] Restoration Year Types are defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

Table 13-8.
Historical Average Monthly Flows for Little Dry Creek near Friant Dam

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	0	1	12	43	84	84	39	7	2	0	0	0
Wet	0	2	31	143	249	252	87	20	6	0	0	0
Normal-Wet	0	2	17	7	65	44	10	1	0	0	0	0
Normal-Dry	0	0	1	1	3	13	2	0	0	0	0	0
Dry	0	0	0	0	6	3	1	0	0	0	0	0
Critical-High	0	0	0	0	2	1	0	0	0	0	0	0
Critical-Low	0	0	0	0	0	0	0	0	0	0	0	0

Source: CDEC 2008, Gage ID LDC
Notes:
[1] Period of record Water Years 1975 – 2007; some years may be missing data.
[2] Restoration Year Types are defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

Reach 1B. Flows within Reach 1B are predominantly influenced by inflow from Reach 1A, diversions and seepage losses. Fifteen water diversions are located along this reach, not all of which are active on a regular basis. Table 13-9 lists the gages located in or near this reach segment, their period of record, and average and maximum daily average streamflow. Figures 13-8, 13-9, and 13-10 show historical annual average flows at the gages. Tables 13-10, 13-11, and 13-12 show historical average monthly flows at the gages. Exceedence curves for these gages and a rating table for the San Joaquin River at Donny Bridge gage is shown in Appendix J, "Surface Water Supplies and Facilities Operations."

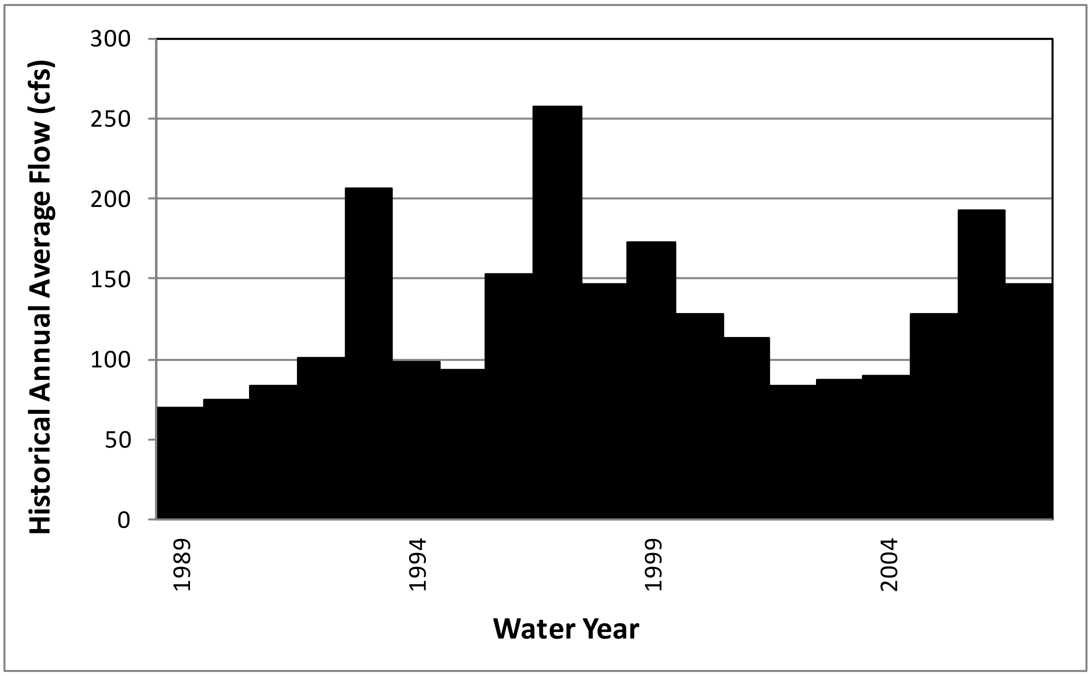
Table 13-9.
Streamflow Gages in Reach 1B

Gage Name	USGS Gage Station No. or CDEC ID	MP	Drainage Area (square miles)	Period of Record[1]	Average Streamflow (cfs)	Maximum Daily Average Streamflow (cfs) (date measured)
San Joaquin River at Donny Bridge	DNB	240.7	NA	1989 – 2007	122	7,900 (December 30, 1996) [2]
San Joaquin River at Skaggs Bridge	NA[3]	232.1	NA	1975 – 2007	215	7,900 (December 30, 1996)[2]
San Joaquin River near Biola[4]	11253000	NA	1,811	1953 – 1961	514	7,860 (April 7, 1958)

Source: CDEC 2008, USGS 2008, Reclamation 2007

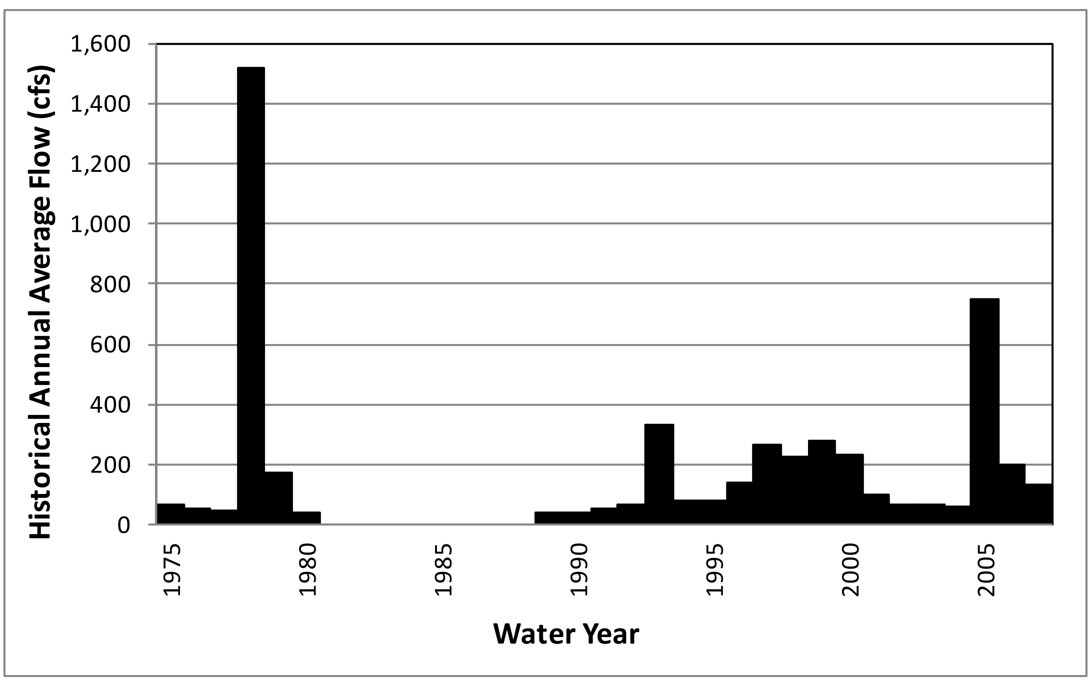
Notes:
[1] Water year.
[2] This maximum daily average streamflow was exceeded in the January 1997 flooding event.
[3] Data obtained from U.S. Department of the Interior, Bureau of Reclamation (2007)
[4] This gage has been discontinued.

Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
ID = identification
MP = milepost
NA = not applicable/not available
No. = number
USGS = U.S. Geological Survey



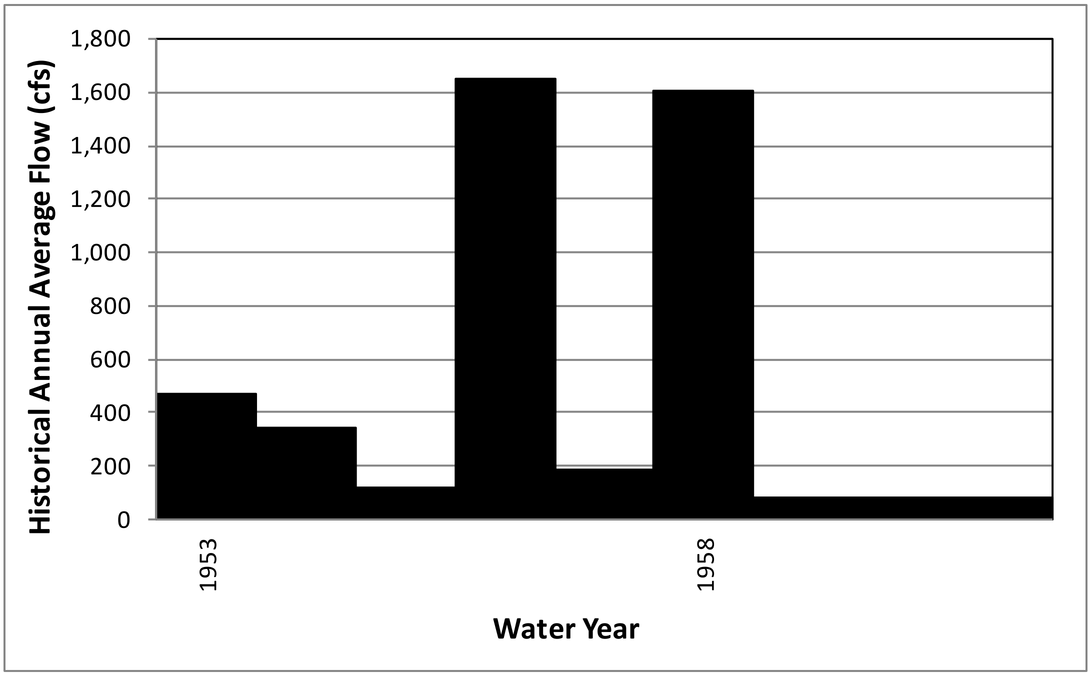
Source: CDEC 2008, Gage ID DNB
Key:
cfs = cubic feet per second

Figure 13-8.
Historical Annual Average Flow for San Joaquin River at Donny Bridge



Source: Reclamation 2007, Gage ID not available
Note: Data not available for 1981-1989 period.
Key:
cfs = cubic feet per second

Figure 13-9.
Historical Annual Average Flow for San Joaquin River at Skaggs Bridge



Source: USGS 2008, Gage Station No. 11253000
Key:
cfs = cubic feet per second

Figure 13-10.
Historical Annual Average Flow for San Joaquin River near Biola

Table 13-10.
Historical Average Monthly Flows for San Joaquin River at Donny Bridge

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	111	85	118	115	132	129	92	98	156	149	140	138
Wet	127	94	285	256	182	505	Data not available	187	202	173	199	158
Normal-Wet	90	70	57	53	308	72	98	75	269	192	129	115
Normal-Dry	100	84	75	72	70	91	80	81	96	95	99	119
Dry	81	67	63	51	64	77	86	97	115	131	133	125
Critical-High	Data not available											
Critical-Low	Data not available											

Source: CDEC 2008, Gage ID DNB
Notes:
[1] Period of record Water Years 1989 – 2007; some years may be missing data.
[2] Restoration Year Types are defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

Table 13-11.
Historical Average Monthly Flows for San Joaquin River at Skaggs Bridge

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
All Years	97	73	106	110	228	379	460	479	379	143	132	123
Wet	87	67	225	242	1,100	2,278	2,158	2,177	1,357	189	252	201
Normal-Wet	130	99	128	104	322	359	127	106	192	150	125	100
Normal-Dry	85	69	54	45	42	72	59	58	70	64	71	92
Dry	60	38	36	33	44	51	58	72	81	87	92	89
Critical-High	49	48	39	33	51	46	52	70	67	52	55	49
Critical-Low	44	40	42	44	31	36	52	34	51	47	57	45

Source: Reclamation 2007, Gage Station No. not available
Notes:
[1] Period of record Water Years 1975 – 2007; some years may be missing data.
[2] Restoration Year Types are defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

Table 13-12.
Historical Average Monthly Flows for San Joaquin River near Biola

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
All Years	289	176	333	711	601	495	1,099	1,198	813	148	128	194
Wet	80	68	903	2,687	2,056	1,547	4,205	4,331	3,152	280	139	187
Normal-Wet	Data not available											
Normal-Dry	455	262	193	175	232	238	261	386	167	118	139	241
Dry	72	74	49	23	54	89	97	92	108	123	119	108
Critical-High	89	59	175	132	54	81	84	97	70	64	58	52
Critical-Low	Data not available											

Source: USGS 2008, Gage Station No. 11253000
Notes:
[1] Period of record Water Years 1953 – 1961; some years may be missing data.
[2] Restoration Year Types are defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

Reach 2

Reach 2 marks the end of the incised channel, and is a meandering channel of low gradient. Reach 2 is subdivided into two subreaches, 2A and 2B, at the Chowchilla Bypass Bifurcation Structure. Reach 2 is typically dry; flows reach the Mendota Pool from Reach 2B or from the Fresno Slough only during periods of flood management releases. Flood flows in the San Joaquin and/or Kings rivers occurred at the Mendota Pool in 1997, 2001, 2005, and 2006. At all other times, the DMC is the primary source of water to the Mendota Pool. The Mendota Pool delivers water to the San Joaquin River Exchange Contractors Water Authority, other CVP contractors, wildlife refuges and management areas, and State water authorities. The Mendota Pool provides no long-term storage for water supply operations or flood management. Diversions for Reach 2 are listed in Appendix J, "Surface Water Supplies and Facilities Operations."

Reach 2 ends at Mendota Dam, and the Mendota Pool backwater extends up a portion of this subreach. The Mendota Pool averages about 400 feet wide, is generally less than 10 feet deep, and has a total capacity of about 8,500 acre-feet (Reclamation 2004). Mendota Dam, built in 1917, is owned and operated by the Central California ID. Mendota Dam is a flashboard and buttress dam 23 feet high and 485 feet long; the crest elevation is 168.5 feet.

The primary function of the Mendota Pool is to distribute water from the DMC and San Joaquin River to local diversion points. Manual gates and flashboards are opened or removed during periods of high flow to reduce seepage impacts on land surrounding Mendota Pool. A fish ladder exists at Mendota Dam, but has been inoperable for the last several decades.

Reach 2A. Reach 2A is typified by the accumulation of sand caused in part by backwater effects of the Chowchilla Bypass Bifurcation Structure and by a lower gradient relative to Reach 1. Gravelly Ford has high percolation losses, and flow is less than 50 cfs approximately 50 percent of the time (see Appendix J, "Surface Water Supplies and Facilities Operations"). Under steady-state conditions (i.e., losses are calculated under extended periods of steady flow), flow does not reach the Chowchilla Bypass Bifurcation Structure when discharge at Gravelly Ford is less than 75 cfs (McBain and Trush 2002).

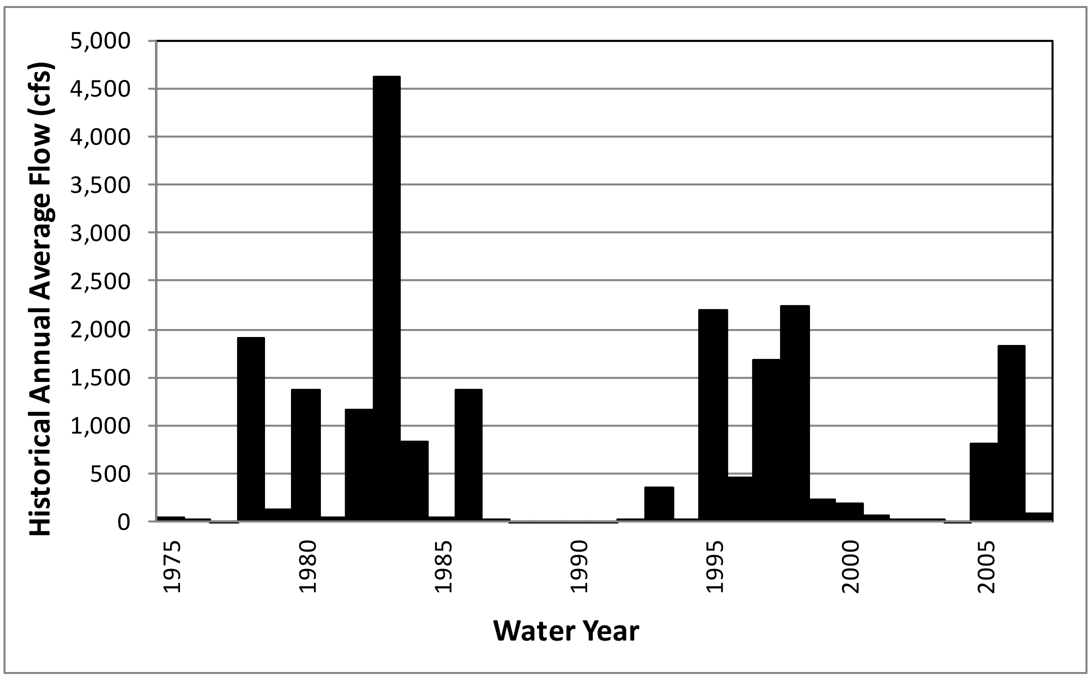
Reach 2A has a design channel capacity of 8,000 cfs to accommodate controlled releases from Friant Dam. Agricultural return flows within this reach are minor. Ten water diversions are located along this reach. Reach 2A has also been subject to local sand mining, although this has not caused the extensive channel degradation seen in Reach 1. Table 13-13 lists the gage located in this reach segment, its period of record, and average and maximum daily average streamflow. Figure 13-11 shows historical annual average flow at the gage. Table 13-14 shows historical average monthly flow at the gage. An exceedence curve and a rating table for the San Joaquin River at Gravelly Ford gage is shown in Appendix J, "Surface Water Supplies and Facilities Operations."

Table 13-13.
Streamflow Gage in Reach 2A

Gage Name	USGS Gage Station No. or CDEC ID	MP	Drainage Area (square miles)	Period of Record[1]	Average Streamflow (cfs)	Maximum Daily Average Streamflow (cfs) (date measured)
San Joaquin River at Gravelly Ford	GRF	236.9	NA	1975 – 2007	652	37,843 (January 4, 1997)

Source: CDEC 2008
Note:
[1] Water year.

Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
ID = identification
MP = milepost
NA = not applicable/not available
No. = number
USGS = U.S. Geological Survey



Source: CDEC 2008, Gage ID GRF
Key:
cfs = cubic feet per second

Figure 13-11.
Historical Annual Average Flow for San Joaquin River at Gravelly Ford

Table 13-14.
Historical Average Monthly Flows for San Joaquin River at Gravelly Ford

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	100	109	236	672	880	1,153	1,560	1,340	1,028	633	138	139
Wet	40	174	532	1,887	2,945	3,726	4,568	3,417	2,601	2,053	376	380
Normal-Wet	295	215	370	630	314	512	251	305	151	92	82	62
Normal-Dry	55	33	24	21	23	35	21	21	30	20	20	32
Dry	29	13	12	9	15	16	18	18	19	9	17	20
Critical-High	29	23	20	16	30	23	28	39	36	21	22	17
Critical-Low	17	21	13	20	13	5	2	3	3	1	6	5

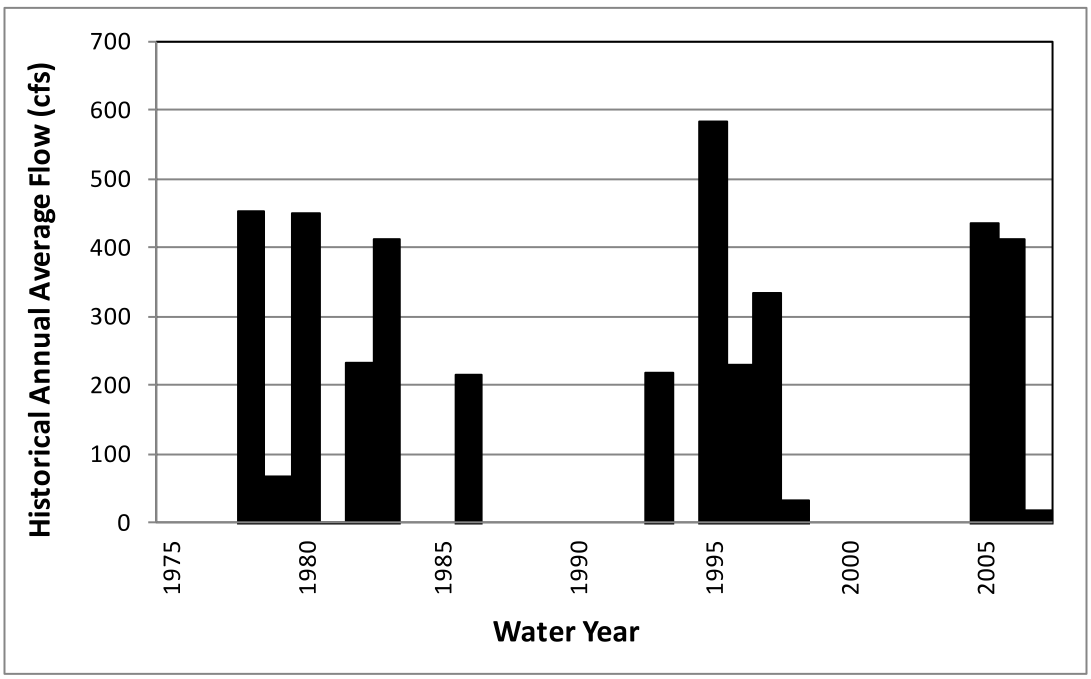
Source: CDEC 2008, Gage ID GRF
Notes:
[1] Period of record Water Years 1975 – 2007; some years may be missing data.
[2] Restoration Year Types are defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

Reach 2B. Reach 2B is a sandy channel extending into the Mendota Pool. The design conveyance capacity of this reach is 2,500 cfs, but significant seepage has been observed at flows above 1,300 cfs (RMC 2007). Agricultural return flows within this reach are minor. Reach 2B ends at Mendota Dam, and Mendota Pool backwater extends up a portion of this reach. Seepage in Reach 2B caused by high flows can be reduced by removal of a set of gates and flashboards at Mendota Dam. These gates and flashboards are manually opened or removed in advance of high-flow conditions. This process lowers the water level in the pool for passing high flows to reduce seepage impacts to adjacent lands, but hinders distribution of flows into the canals. Twenty-nine water diversions are located along this reach. One major road crossing in this reach can affect flow stage. The DMC typically conveys 2,500 to 3,000 cfs to the Mendota Pool during the irrigation season. Table 13-15 shows the gage located in this reach segment, its period of performance, and average and maximum daily average streamflow. Figure 13-12 shows historical annual average flow at the gage and demonstrates the dry conditions within Reach 2B. Table 13-16 shows historical average monthly flow at the gage. An exceedence curve and a rating table for the San Joaquin River below the Chowchilla Bypass Bifurcation Structure gage is shown in Appendix J, "Surface Water Supplies and Facilities Operations."

**Table 13-15.
Streamflow Gage in Reach 2B**

Gage Name	USGS Gage Station No. or CDEC ID	MP	Drainage Area (square miles)	Period of Record[1]	Average Streamflow (cfs)	Maximum Daily Average Streamflow (cfs) (date measured)
San Joaquin River below Chowchilla Bypass Bifurcation Structure	SJB	217.8	NA	1975 – 1986, 1989 – 1997, 2006 – 2007	159	2,660 (May 23, 1978)

Source: CDEC 2008
Note:
[1] Water year.
Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
ID = identification
MP = milepost
NA = not applicable/not available
No. = number
USGS = U.S. Geological Survey



Source: CDEC 2008, Gage ID SJB
Key:
cfs = cubic feet per second

**Figure 13-12.
Historical Annual Average Flow for San Joaquin River Below Chowchilla Bypass Bifurcation Structure**

Table 13-16.
Historical Average Monthly Flows for San Joaquin River Below Chowchilla Bypass Bifurcation Structure

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
All Years	11	4	6	81	164	285	328	348	327	230	60	54
Wet	9	2	17	205	439	675	638	690	686	589	174	153
Normal-Wet	15	5	0	18	140	396	257	157	55	0	0	0
Normal-Dry	5	0	0	0	0	0	0	0	0	0	0	0
Dry	0	0	0	0	0	0	0	0	0	0	0	0
Critical-High	0	0	0	0	0	0	0	0	0	0	0	0
Critical-Low	0	0	0	0	0	0	0	0	0	0	0	0

Source: CDEC 2008, Gage ID SJB
Notes:
[1] Period of record Water Years 1975 – 2007; some years may be missing data.
[2] Restoration Year Types are defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

Reach 3

Reach 3 flows 23 miles along a sandy channel from Mendota Dam to Sack Dam. The design capacity of Reach 3 is 4,500 cfs; however, anecdotal evidence suggests that seepage and associated flooding may begin at sustained flows above 800 cfs (RMC 2007). The estimated existing capacity of Reach 3 with 3 feet of freeboard is 1,300 cfs (see Appendix G, "Plan Formulation"). Significant bed lowering has been measured within Reach 3; however, the extent of this lowering that is due to subsidence from groundwater overdraft, or to human-induced sediment and hydrology modification within the channel, is unknown (McBain and Trush 2002). Flows within this reach predominantly consist of water conveyed from the Delta by the DMC and released from the Mendota Pool for diversion. Diversions for Reach 3 are listed in Appendix J, "Surface Water Supplies and Facilities Operations."

Sack Dam is a 5-foot-high concrete and wood diversion structure delivering water to the Arroyo Canal on the west side of the river (RMC, 2003). No operational storage for water supply exists within this reach. The existing fish passage at Sack Dam is inoperable. Flows of 500 to 600 cfs are typically released from the Mendota Pool for downstream diversions at Sack Dam. Flows greater than required for diversions (such as during flood events) spill over Sack Dam into the San Joaquin River downstream into Reach 4A. Seven water diversions are located in this reach. One major road crossing in this reach can affect flow stage.

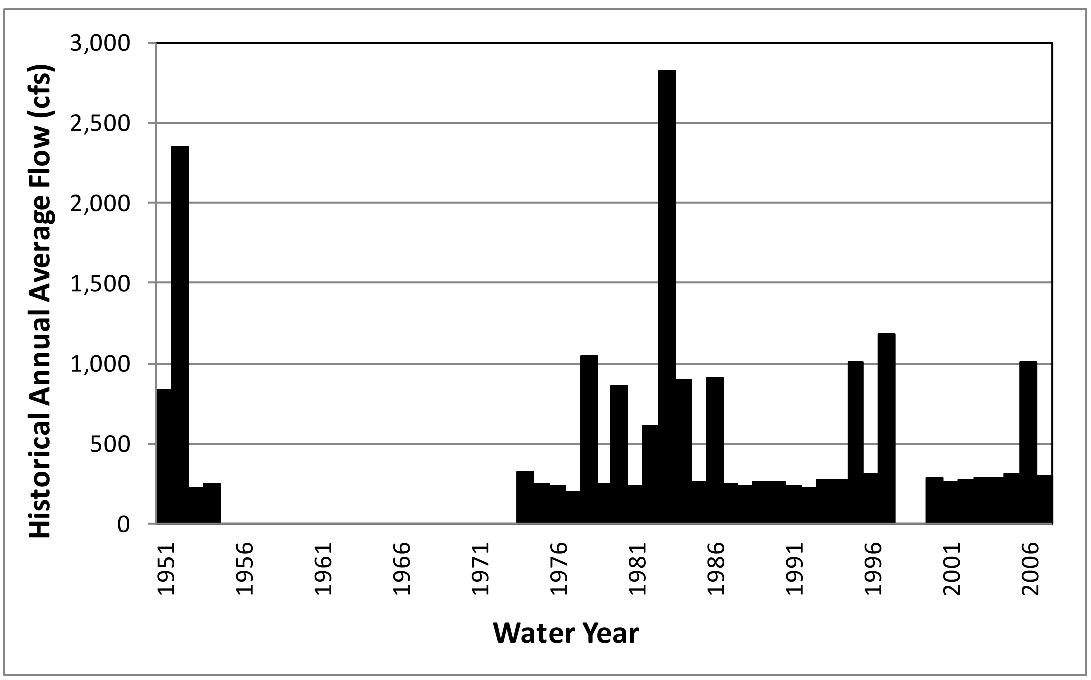
Table 13-17 lists the gage located in this reach segment, its period of record, and average and maximum daily average streamflow. Figure 13-13 shows historical annual average flow at the gage. Table 13-18 shows historical average monthly flow at the gage. An exceedence curve and rating table for the San Joaquin River near Mendota is shown in Appendix J, "Surface Water Supplies and Facilities Operations."

Table 13-17.
Streamflow Gage in Reach 3

Gage Name	USGS Gage Station No. or CDEC ID	MP	Drainage Area (square miles)	Period of Record[1]	Average Streamflow (cfs)	Maximum Daily Average Streamflow (cfs) (date measured)
San Joaquin River near Mendota	11254000	217.8	3,940	1951 – 1954, 1975 – 2007[2]	545	8,770 (May 29, 1952)

Source: USGS 2008

Notes:
[1] Water year.
[2] Period of record coincides with start of diversions from Friant Dam (1950).
Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
ID = identification
MP = milepost
NA = not applicable/not available
No. = number
USGS = U.S. Geological Survey



Source: USGS 2008, Gage Station No. 11254000
Key: cfs = cubic feet per second

Figure 13-13.
Historical Annual Average Flow for San Joaquin River near Mendota

Table 13-18.
Historical Average Monthly Flows for San Joaquin River near Mendota

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	203	221	306	444	661	732	920	979	839	613	439	275
Wet	160	234	488	1,019	1,770	2,274	2,646	2,534	1,820	939	483	311
Normal-Wet	292	530	746	654	495	278	223	364	463	497	433	274
Normal-Dry	175	101	67	86	208	190	240	328	491	522	406	247
Dry	218	115	61	56	175	230	209	245	445	526	445	275
Critical-High	133	67	1	87	146	157	231	345	479	486	459	312
Critical-Low	188	58	4	27	126	219	141	141	341	507	412	214

Source: USGS 2008, Gage Station No. 11254000
Notes:
[1] Period of record Water Years 1951 – 2007; some years may be missing data.
[2] Restoration Year Types are defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

Reach 4

Reach 4 runs approximately 46 miles from Sack Dam to the confluence of the Eastside Bypass. Flows within much of this reach are predominantly agricultural return flows, although large sections of this reach are dry. Diversions for Reach 4 are listed in Appendix J, "Surface Water Supplies and Facilities Operations."

Reach 4 is subdivided into three subreaches: 4A, 4B1, and 4B2. 4A begins at Sack Dam and extends to the Sand Slough Control Structure; 4B1 extends from the Sand Slough Control Structure to the Mariposa Bypass confluence; and 4B2 begins at the confluence of the Mariposa Bypass and extends to the confluence of the Eastside Bypass. The Sand Slough Control Structure controls the flow split between the mainstem San Joaquin River and Eastside Bypass. A headgate is also present at the entrance to Reach 4B1 of the San Joaquin River.

Reach 4 subreaches have different characteristics and design capacities, as discussed below. Several road crossings exist in Reach 4; however the dry conditions in this reach minimize the impact of the road crossings.

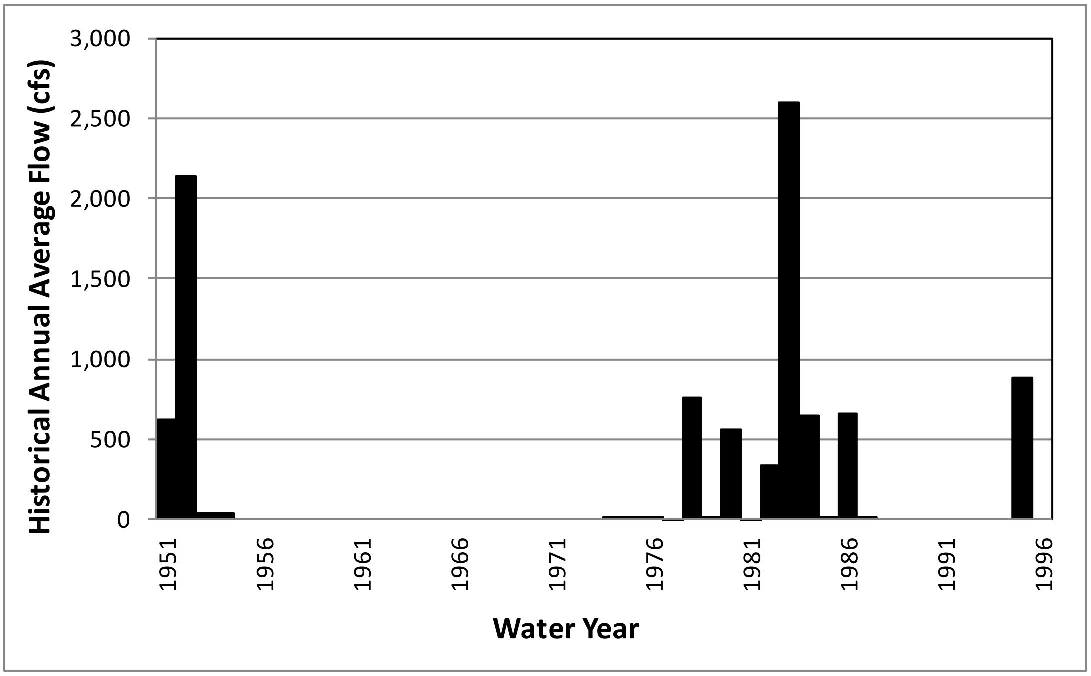
Reach 4A. The design channel capacity in this reach is approximately 4,500, beginning at Sack Dam and extending to the Sand Slough Control Structure. The channel below Sack Dam has flow during the agricultural season (agricultural return flows) and during upstream flood releases. Four water diversions are located along this reach. This subreach has experienced bed lowering similar to that discussed for Reach 3. Table 13-19 lists the gages located in this reach segment, their periods of record, and average and maximum daily average streamflows. Figures 13-14 and 13-15 show historical annual average flows at the gages. Tables 13-20 and 13-21 show historical average monthly flows at the gages. Exceedence curves for this reach are shown in Appendix J, "Surface Water Supplies and Facilities Operations." Rating curves are not available for this reach.

Table 13-19.
Streamflow Gages in Reach 4A

Gage Name	USGS Gage Station No. or CDEC ID	MP	Drainage Area (square miles)	Period of Record[1]	Average Streamflow (cfs)	Maximum Daily Average Streamflow (cfs) (date measured)
San Joaquin River near Dos Palos	11256000	NA	4,669	1951 – 1954, 1975 – 1987, 1996[2]	478	8,170 (June 5, 1952)
San Joaquin River near El Nido	11260000	NA	6,443	1940 – 1949[3]	705	3,700 (June 22, 1942)

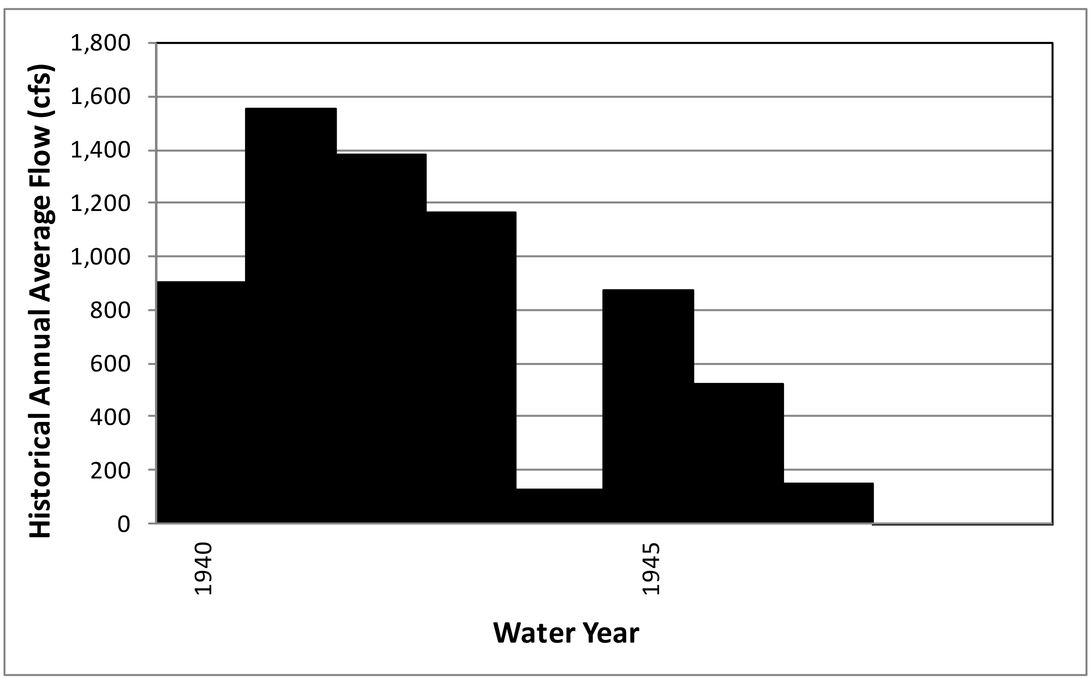
Source: USGS 2008
Notes:
[1] Water year.
[2] Period of record coincides with start of diversions from Friant Dam (1950).
[3] Period of record is during Friant Dam construction and filling. This gage has been discontinued.

Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
ID = identification
MP = milepost
NA = not applicable/not available
No. = number
USGS = U.S. Geological Survey



Source: USGS 2008, Gage Station No. 11256000
Key:
cfs = cubic feet per second

Figure 13-14.
Historical Annual Average Flow for San Joaquin River near Dos Palos



Source: USGS 2008, Gage Station No. 11260000
Key:
cfs = cubic feet per second

Figure 13-15.
Historical Annual Average Flow for San Joaquin River near El Nido

Table 13-20.
Historical Average Monthly Flows for San Joaquin River near Dos Palos

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	49	202	458	556	794	943	1,064	1,007	562	187	22	29
Wet	6	182	610	751	1,642	2,515	2879	2,726	1,512	469	45	68
Normal-Wet	154	501	873	995	585	55	4	3	6	6	7	3
Normal-Dry	5	4	52	62	154	6	8	7	8	6	6	7
Dry	0	0	0	41	23	15	3	8	10	Data not available		
Critical-High	58	6	6	51	1	2	1	3	7	12	8	0
Critical-Low	0	13	0	0	2	3	2	1	9	9	9	6

Source: USGS 2008, Gage Station No. 11256000
Notes:
[1] Period of record Water Years 1951 – 1996; some years may be missing data.
[2] Restoration Year Types are defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

Table 13-21.
Historical Average Monthly Flows for San Joaquin River near El Nido

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	27	106	399	934	1,248	1,112	1,201	1,538	1,489	473	17	13
Wet	0	0	630	1,842	2,521	2,805	2,600	3,096	3,429	1,779	26	8
Normal-Wet	54	199	594	1,303	1,840	1,540	1,629	2117	1,947	482	24	20
Normal-Dry	1	16	97	247	204	153	20	54	79	22	2	3
Dry	Data not available											
Critical-High	Data not available											
Critical-Low	Data not available											

Source: USGS 2008, Gage Station No. 11260000
Notes:
[1] Period of record Water Years 1940 – 1949; some years may be missing data.
[2] Restoration Year Types are defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

Reach 4B1. This reach has a design capacity of 1,500 cfs, and the Sand Slough Control Structure is designed to maintain this design discharge; although current operations recommend discharge past the control structure to be 300 to 400 cfs because of reduced capacity in the channel (see Appendix G, "Plan Formulation"). Thus, actual operations keep the gates of the San Joaquin River headgates closed, diverting all flow from Reach 4B1 to the Eastside Bypass (McBain and Trush 2002). Reach 4B1, therefore, is dry until downstream agricultural return flows contribute to its baseflow, although this flow is often pumped and reused for irrigation.

Reach 4B2. The design channel capacity of Reach 4B2 is 10,000 cfs. The channel carries tributary and flood flows from the Mariposa Bypass. No operational storage for water supply exists within this reach. Two water diversions are located along this reach.

Reach 5

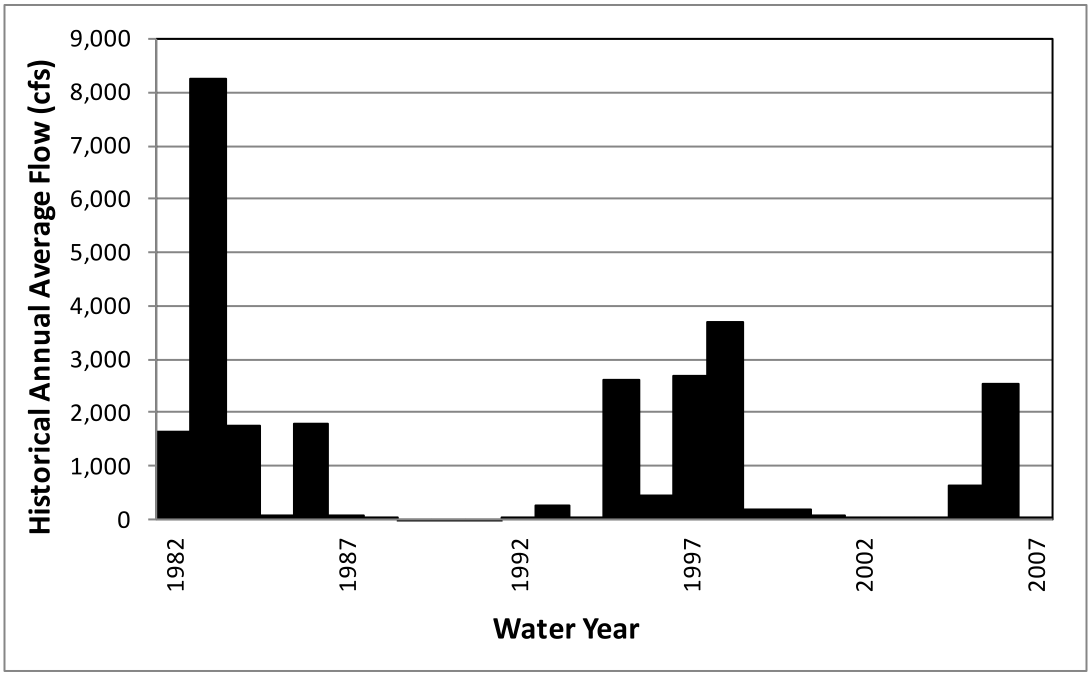
Reach 5 of the San Joaquin River extends from the confluence of the Eastside Bypass downstream to the Merced River confluence. The design capacity of Reach 5 is 26,000 cfs; no significant capacity constraints have been identified in this reach. Reach 5 receives flow from Reach 4B2 and the Eastside Bypass. Agricultural and wildlife management area return flows also enter Reach 5 via Mud and Salt sloughs, which drain the west side of the San Joaquin Valley. Three major road crossings within this reach can affect flow stage. Four water diversions are located in this reach and are listed in Appendix J, "Surface Water Supplies and Facilities Operations."

Table 13-22 lists the gages located in or near this reach segment, their periods of record, and average and maximum daily average streamflows. Figures 13-16, 13-17, 13-18, and 13-19 show historical annual average flows at the gages. Tables 13-23, 13-24, 13-25, and 13-26 show historical average monthly flows at the gages. Exceedence curves for this reach are shown in Appendix J, "Surface Water Supplies and Facilities Operations." Rating tables for the San Joaquin River near Stevinson and at Fremont Ford Bridge are shown in Appendix J, "Surface Water Supplies and Facilities Operations."

Table 13-22.
Streamflow Gages in Reach 5

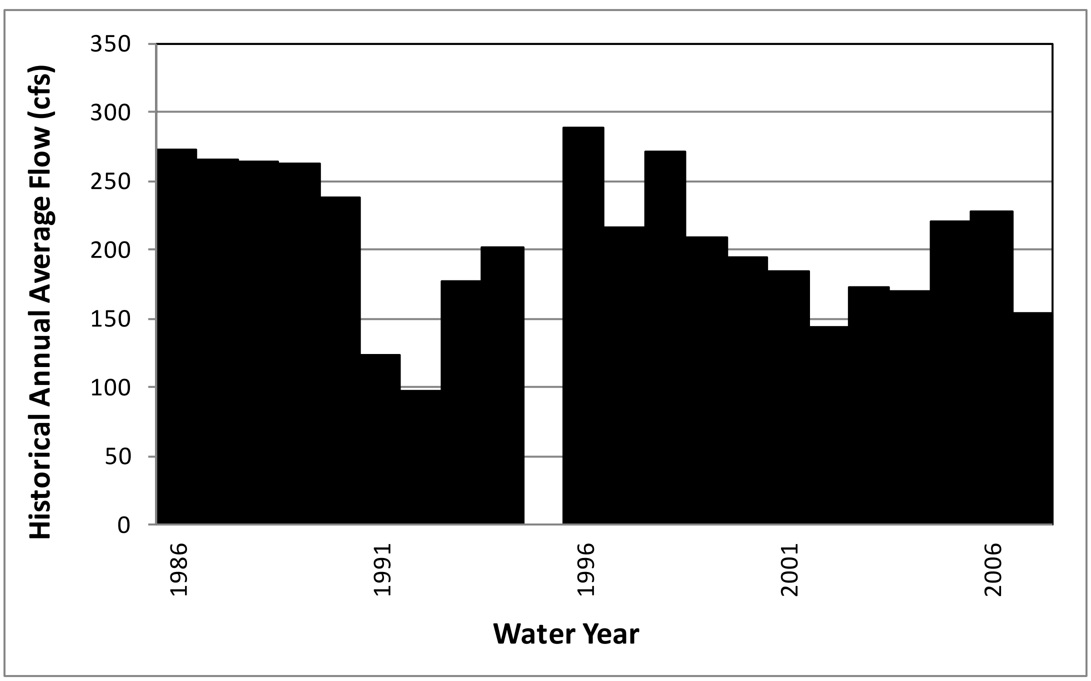
Gage Name	USGS Gage Station No. or CDEC ID	MP	Drainage Area (square miles)	Period of Record[1]	Average Streamflow (cfs)	Maximum Daily Average Streamflow (cfs) (date measured)
San Joaquin River near Stevinson	SJS	118.2	NA	1982 – 2007	1,042	23,900 (January 28, 1997)
Salt Slough at HW 165 near Stevinson	11261100	NA	NA	1986 – 2007	206	810 (February 20, 1986)
San Joaquin River at Fremont Ford Bridge	11261500	118.2	7,615	1951 – 1971, 1986 – 1989, 2002 – 2007[2]	640	22,500 (April 8, 2006)
Mud Slough near Gustine	11262900	NA	NA	1986 – 2007	101	1,060 (February 9, 1998)

Source: CDEC 2008; USGS 2008
Notes:
[1] Water year.
[2] Period of record coincides with start of diversions from Friant Dam (1950).
Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
HW = highway
ID = identification
MP = milepost
NA = not applicable/not available
No. = number
USGS = U.S. Geological Survey



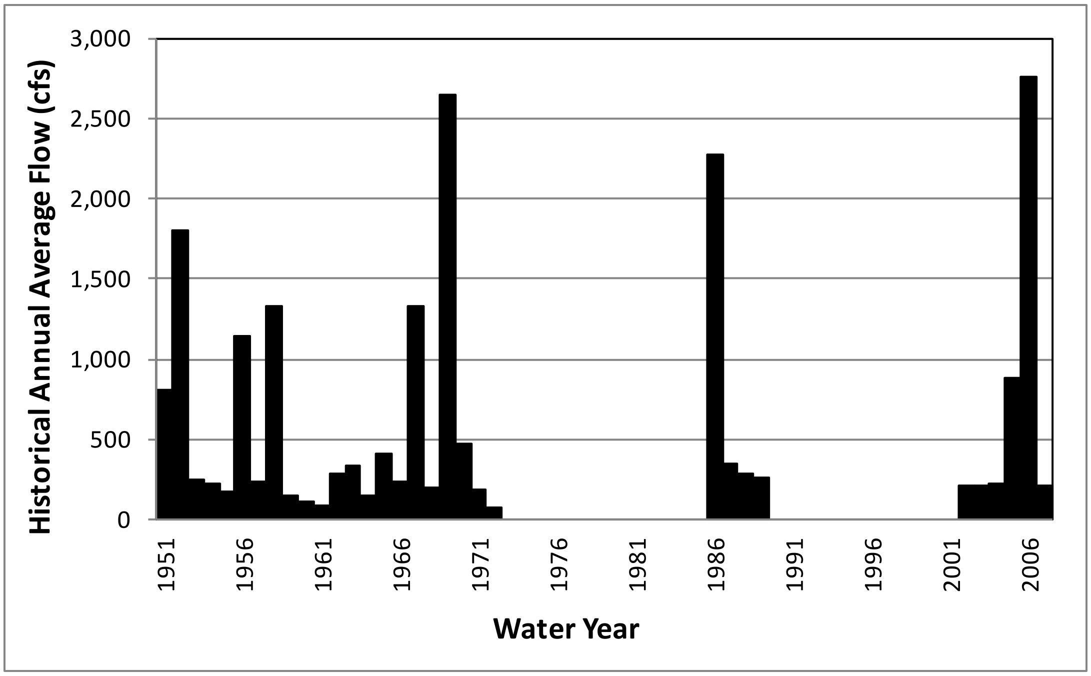
Source: CDEC 2008, Gage ID SJS
Key:
cfs = cubic feet per second

Figure 13-16.
Historical Annual Average Flow for San Joaquin River near Stevinson



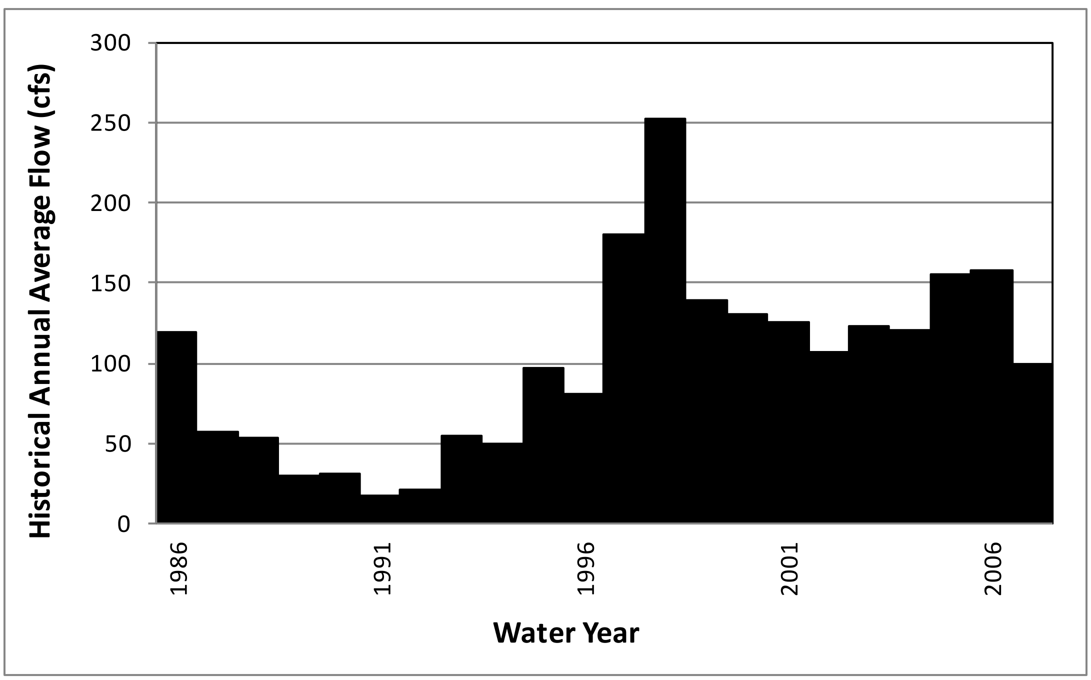
Source: USGS 2008, Gage Station No. 11261100
Key:
cfs = cubic feet per second

Figure 13-17.
Historical Annual Average Flow for Salt Slough at Highway 165 near Stevinson



Source: USGS 2008, Gage Station No. 11261500
Key:
cfs = cubic feet per second

Figure 13-18.
Historical Annual Average Flow for San Joaquin River at Fremont Ford Bridge



Source: USGS 2008, Gage Station No. 11262900
Key:
cfs = cubic feet per second

Figure 13-19.
Historical Annual Average Flow for Mud Slough near Gustine

Table 13-23.
Historical Average Monthly Flows for San Joaquin near Stevinson

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	188	229	705	1619	1,768	1,985	2,344	1,764	1,213	671	83	148
Wet	109	326	1,593	4,269	5,745	6,423	6,716	4,783	3,307	2,314	229	448
Normal-Wet	670	654	1,301	1,699	654	678	148	289	70	46	55	78
Normal-Dry	60	23	32	90	95	177	42	22	21	12	13	30
Dry	59	22	20	46	157	66	27	19	13	8	7	10
Critical-High	Data not available											
Critical-Low	Data not available											

Source: CDEC 2008, Gage ID SJS
Notes:
[1] Period of record Water Years 1982 – 2007; some years may be missing data.
[2] Restoration Year Types are defined in Appendix J, “Surface Water Supplies and Facilities Operations.”
Key:
cfs = cubic feet per second

Table 13-24.
Historical Average Monthly Flows for Salt Slough at Highway 165 near Stevinson

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	146	173	146	181	284	356	241	199	197	213	215	142
Wet	117	141	124	208	364	362	291	239	234	264	292	185
Normal-Wet	159	178	184	186	336	403	226	179	186	211	216	137
Normal-Dry	147	155	120	147	212	320	210	163	178	184	180	109
Dry	167	206	155	148	242	352	241	212	212	227	230	170
Critical-High	Data not available											
Critical-Low	Data not available											

Source: USGS 2008, Gage Station No. 11261100
Notes:
[1] Period of record Water Years 1986 – 2007; some years may be missing data.
[2] Restoration Year Types are defined in Appendix J, “Surface Water Supplies and Facilities Operations.”
Key:
cfs = cubic feet per second

Table 13-25.
Historical Average Monthly Flows for San Joaquin River at Fremont Ford Bridge

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
All Years	132	161	306	769	1,098	1,152	1,483	1,171	979	292	193	195
Wet	99	99	375	1,586	3,309	4,029	4,188	3,245	2,879	706	313	388
Normal-Wet	55	211	696	832	1213	512	523	274	210	156	157	160
Normal-Dry	149	159	180	503	422	371	236	243	207	147	144	137
Dry	211	170	174	199	267	316	241	249	219	183	203	182
Critical-High	24	36	60	131	139	95	125	144	103	66	80	66
Critical-Low	Data not available											

Source: USGS 2008, Gage Station No. 11261500
Notes:
[1] Period of record Water Years 1951 – 2007; some years may be missing data.
[2] Restoration Year Types are defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

Table 13-26.
Historical Average Monthly Flows for Mud Slough near Gustine

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
All Years	88	107	120	166	205	187	85	58	56	53	46	36
Wet	61	90	140	288	358	308	146	81	73	69	54	37
Normal-Wet	122	141	161	158	256	204	81	75	71	54	53	50
Normal-Dry	96	110	101	107	124	138	55	46	43	56	48	39
Dry	35	51	49	62	91	82	38	19	28	25	26	7
Critical-High	Data not available											
Critical-Low	Data not available											

Source: USGS 2008, Gage Station No. 11262900
Notes:
[1] Period of record Water Years 1986 – 2007; some years may be missing data.
[2] Restoration Year Types are defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

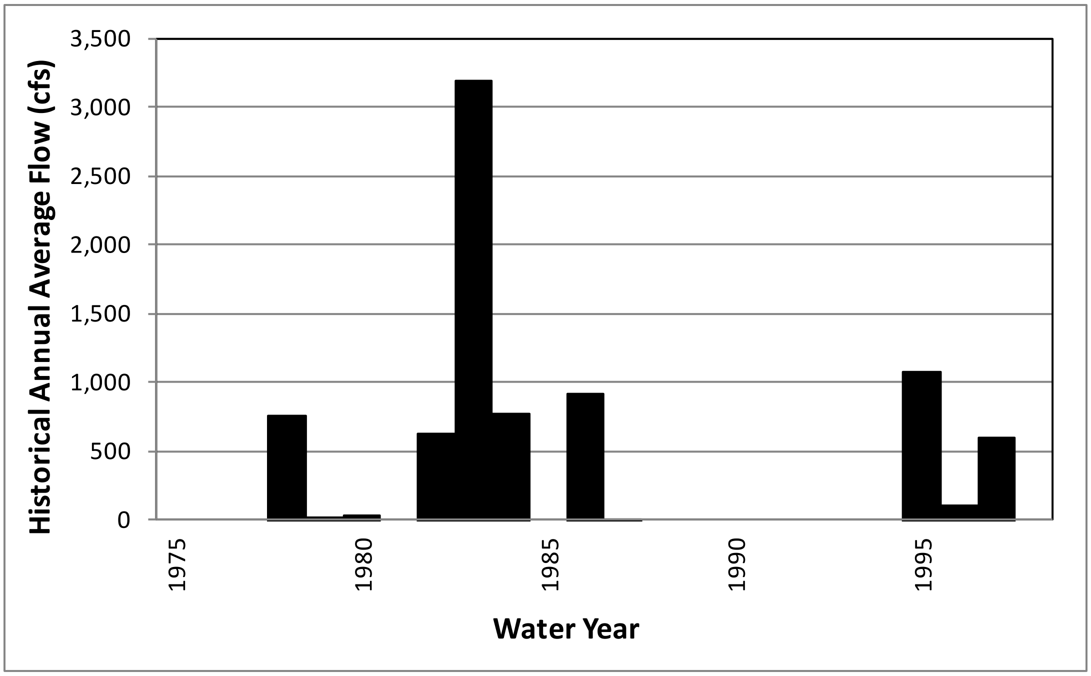
Fresno Slough/James Bypass

Under current operational requirements, Kings River flood flows can enter the Mendota Pool via the Fresno Slough/James Bypass. Flows from the Kings River are regulated by Pine Flat Dam releases and the Crescent Weir, which are operated by the Kings River Conservation District. Pine Flat Dam has routed surplus flows through the Fresno Slough/James Bypass in 20 of 53 years of operation (EPA 2007). More details regarding Fresno Slough/James Bypass effects on San Joaquin River flood operations can be found in the Chapter 11.0, "Hydrology – Flood Management." Reclamation supplements natural flow from the Fresno Slough/James Bypass and San Joaquin River into the Mendota Pool with deliveries from the DMC to satisfy water supply contracts. The "CVP and SWP Water Service Areas" section below describes Fresno Slough/James Bypass flow effects on water deliveries at the Mendota Pool. Table 13-27 lists the gage located at the head of this bypass, its period of record, and average and maximum daily average streamflow. Figure 13-20 shows historical annual average flow at the gage. Table 13-28 shows historical average monthly flow at the gage. Appendix J, "Surface Water Supplies and Facilities Operations," shows exceedence curves for the Fresno Slough/James Bypass.

Table 13-27.
Streamflow Gage at Fresno Slough/James Bypass

Gage Name	USGS Gage Station No. or CDEC ID	MP	Drainage Area (square miles)	Period of Record[1]	Average Streamflow (cfs)	Maximum Daily Average Streamflow (cfs) (date measured)
Fresno Slough/ James Bypass near San Joaquin	11253500	NA	NA	1975 – 1987, 1996 – 1997	495	5,355 (March 3, 1983)

Source: USGS 2008
Note:
[1] Water year.
Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
ID = identification
MP= milepost
NA = not applicable/not available
No. = number
USGS = U.S. Geological Survey



Source: USGS 2008, Gage Station No. 11253500
Key:
cfs = cubic feet per second

Figure 13-20.
Historical Annual Average Flow for Fresno Slough/James Bypass near San Joaquin River

Table 13-28.
Historical Average Monthly Flows for Fresno Slough/James Bypass near San Joaquin River

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	108	244	371	584	597	764	11,57	1261	653	330	74	54
Wet	0	220	533	901	1,283	1,620	2,478	2,524	1,396	707	159	117
Normal-Wet	431	591	550	752	6	31	4	313	5	1	0	0
Normal-Dry	0	0	0	0	0	0	0	0	0	0	0	0
Dry	0	0	11	22	Data not available							
Critical-High	0	0	0	0	0	0	0	0	0	0	0	0
Critical-Low	0	0	0	0	0	0	0	0	0	0	0	0

Source: USGS 2008, Gage Station No. 11253500
Notes:
[1] Period of record Water Years 1975 – 1998; some years may be missing data.
[2] Restoration Year Types are defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

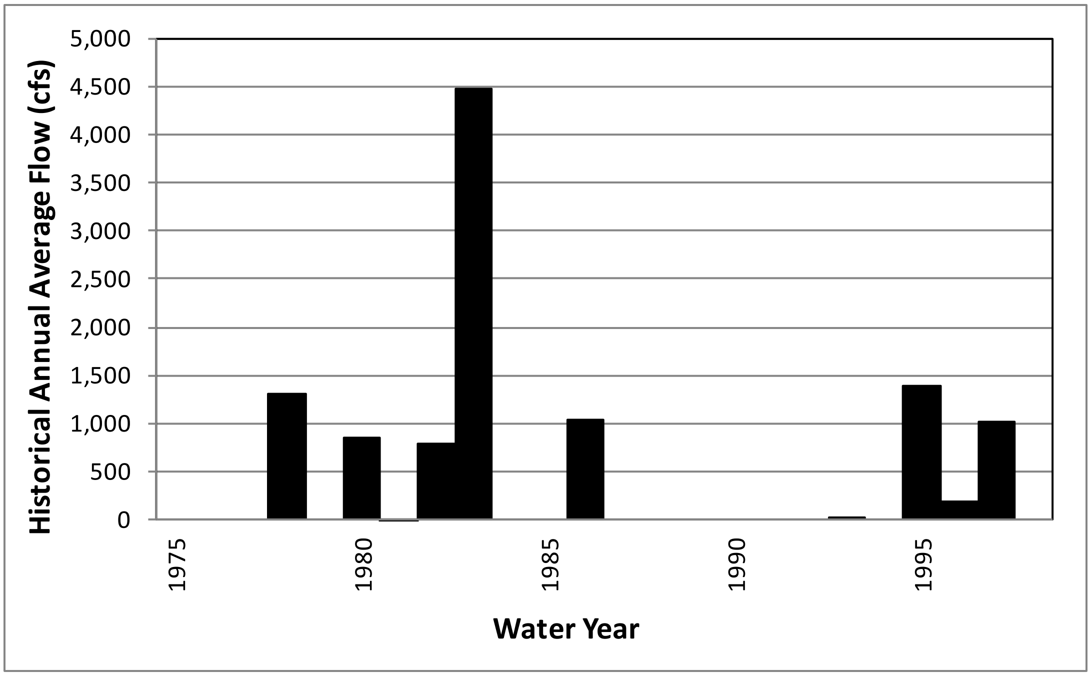
Chowchilla Bypass and Tributaries

The Chowchilla Bypass extends from the Chowchilla Bypass Bifurcation Structure to the Eastside Bypass at the confluence of the Fresno River. More details regarding flood control operations of Chowchilla Bypass are discussed in Chapter 11.0, “Hydrology – Flood Management.” The design channel capacity of the bypass is 5,500 cfs. The bypass is constructed in highly permeable soils, and much of the initial flood flows infiltrate and recharge groundwater. Records from one stream gage are available for this reach. Table 13-29 lists the gage located at the head of this bypass, its period of record, and average and maximum daily average streamflow. Figure 13-21 shows historical annual average flow at the gage. Table 13-30 shows historical average monthly flow at the gage. Appendix J, “Surface Water Supplies and Facilities Operations,” shows exceedence curves for the Chowchilla Bypass. A rating table for the head of the Chowchilla Bypass is also shown in Appendix J, “Surface Water Supplies and Facilities Operations.”

Table 13-29.
Streamflow Gage at Chowchilla Bypass near Head of Reach 2B

Gage Name	USGS Gage Station No. or CDEC ID	MP	Drainage Area (square miles)	Period of Record[1]	Average Streamflow (cfs)	Maximum Daily Average Streamflow (cfs) (date measured)
Chowchilla Bypass at Head	CBP	216.0	NA	1975 – 1986, 1989 – 1997	462	9,430 (February 19, 1986)

Source: CDEC 2008
Note:
[1] Water year.
Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
ID = identification
MP = milepost
NA = not applicable/not available
No. = number
USGS = U.S. Geological Survey



Source: CDEC 2008, Gage ID CBP
Key:
cfs = cubic feet per second

Figure 13-21.
Historical Annual Average Flow for Chowchilla Bypass near Head of Reach 2B

Table 13-30.
Historical Average Monthly Flows for Chowchilla Bypass near Head of Reach 2B

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	0	0	22	533	821	1,214	1,339	957	487	335	29	40
Wet	0	0	57	1,400	2,151	3,073	3,682	2,490	1,339	920	80	111
Normal-Wet	0	0	0	0	35	302	0	282	0	0	0	0
Normal-Dry	2	0	0	0	0	0	0	0	0	0	0	0
Dry	0	0	0	0	0	0	0	0	0	0	0	0
Critical-High	0	0	0	0	0	0	0	0	0	0	0	0
Critical-Low	0	0	0	0	0	0	0	0	0	0	0	0

Source: CDEC 2008, Gage ID CBP
Notes:
[1] Period of record Water Years 1975 – 1998; some years may be missing data.
[2] Restoration Year Types are defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

Eastside Bypass, Mariposa Bypass, and Tributaries

The three Eastside Bypass reaches have a design channel capacity of 17,000 cfs, 16,500 cfs, and 13,500 cfs, respectively. The channel capacity in Eastside Bypass Reach 3 increases to 18,500 cfs at the confluence of Bear Creek. Flow within Eastside Bypass Reach 3 is controlled by the Eastside Bypass Control Structure. The Mariposa Bypass has a design channel capacity of 8,500 cfs. Channel capacities may be less than design capacities because of subsidence of the Eastside Bypass levees. Flow within the Mariposa Bypass is controlled by the Mariposa Bypass Control Structure, which diverts water from the Eastside Bypass back to Reach 4 of the San Joaquin River.

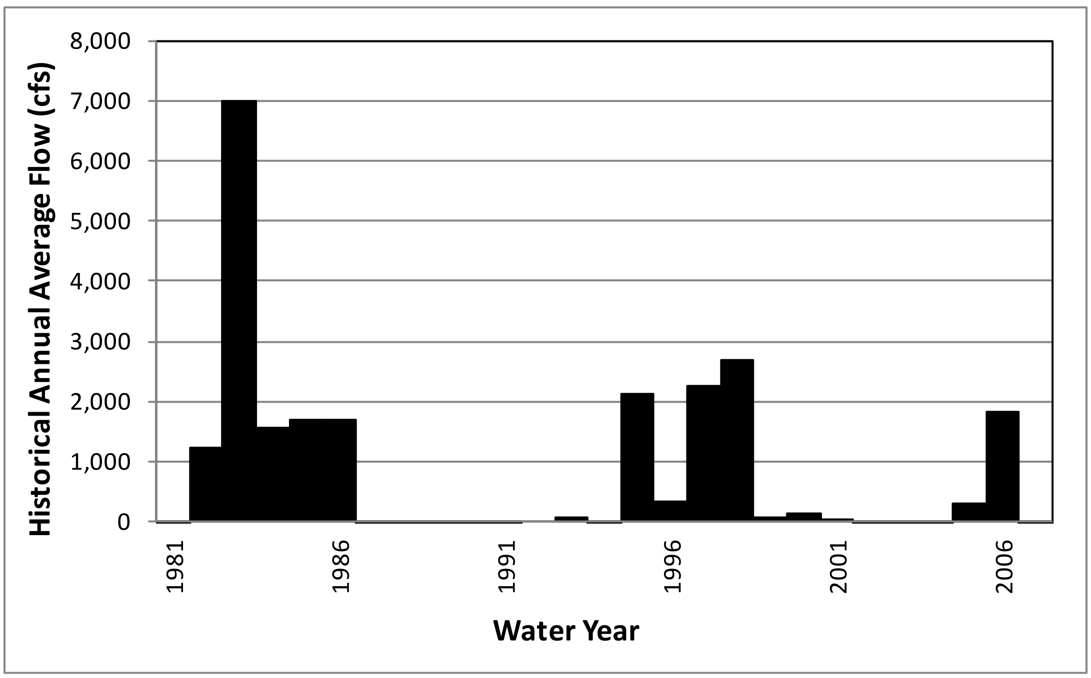
Flood control operations of the Eastside Bypass and Mariposa Bypass are discussed in the Chapter 11.0, "Hydrology – Flood Management." Storage on Eastside Bypass tributaries (e.g., Buchanan Dam, Hidden Dam) can be coordinated with CVP Friant Division operations to meet contract deliveries on the Madera Canal (Reclamation 1997). Hidden Dam forms Hensley Lake on the Fresno River upstream from the Eastside Bypass. USACE operates Hidden Dam for flood control; the total storage of Hensley Lake is 90,600 acre-feet. Buchanan Dam forms Eastman Lake on the Chowchilla River upstream from the Eastside Bypass. USACE operates Buchanan Dam for flood control; the total storage of Eastman Lake is 150,600 acre-feet.

Table 13-31 lists the gages located in or near this bypass, their periods of record, and average and maximum daily average streamflows. Figures 13-22, 13-23, and 13-24 show historical annual average flows at the gages. Tables 13-32, 13-33 and 13-34 show historical average monthly flows at the gages. Appendix J, "Surface Water Supplies and Facilities Operations," shows exceedence curves for the Eastside Bypass. A rating table for the Eastside Bypass near El Nido is given in Appendix J, "Surface Water Supplies and Facilities Operations." Table 13-35 lists the gage located in Mariposa Bypass, its period of record, and average and maximum daily average streamflow. Figures 13-25 shows historical annual average flows at the gage. Table 13-36 shows historical average monthly flow at the gage.

Table 13-31.
Streamflow Gages in Eastside Bypass

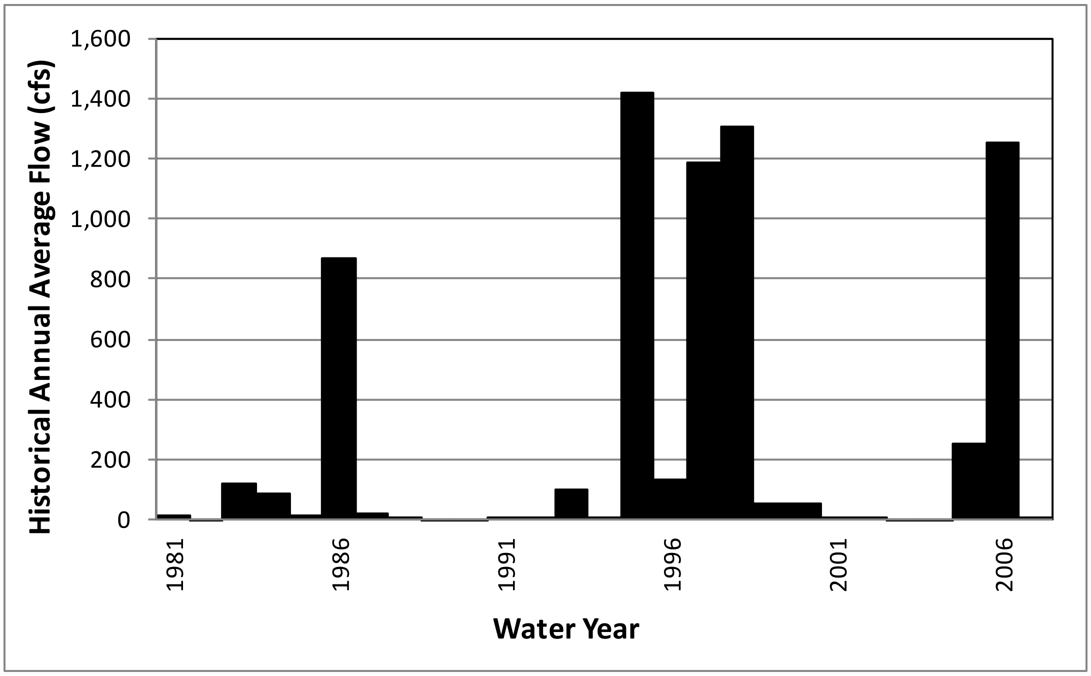
Gage Name	CDEC ID or DWR Station No.	Drainage Area (square miles)	Period of Record[1]	Average Streamflow (cfs)	Maximum Daily Average Streamflow (cfs) (date measured)
Eastside Bypass near El Nido	ELN	NA	1981 – 2007	840	20,400 (January 27, 1997)
Eastside Bypass below Mariposa Bypass	EBM	NA	1981 – 2007	257	11,400 (January 27, 1997)
Bear Creek below Eastside Bypass	B05516	NA	1981 – 2007	81	4,170 (April 6, 2006)

Source: CDEC 2008; Reclamation 2008a
Note:
[1] Water year.
Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
DWR = California Department of Water Resources
ID = identification
NA = not applicable/not available
No. = number



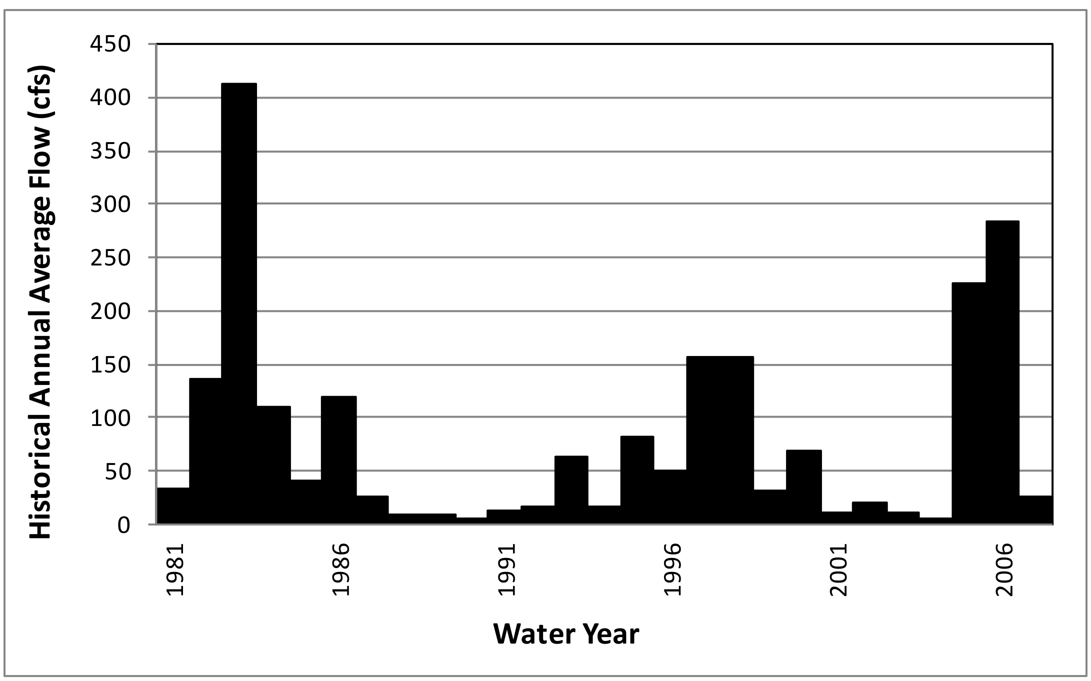
Source: CDEC 2008, Gage ID ELN
Key:
cfs = cubic feet per second

Figure 13-22.
Historical Annual Average Flow for Eastside Bypass near El Nido



Source: CDEC 2008, Gage ID EBM
Key:
cfs = cubic feet per second

Figure 13-23.
Historical Annual Average Flow for Eastside Bypass Below Mariposa Bypass



Source: Reclamation 2008a, DWR Gage Station No. B05516
Key:
cfs = cubic feet per second

Figure 13-24.
Historical Annual Average Flow for Bear Creek Below Eastside Bypass

Table 13-32.
Historical Average Monthly Flows for Eastside Bypass near El Nido

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
All Years	110	198	559	1,108	1,331	1,711	2,122	1,521	1,002	512	32	58
Wet	1	280	1,282	3,173	4,582	4,844	6,008	4,129	2,846	1,922	113	219
Normal-Wet	572	656	1191	1477	118	723	14	263	2	0	1	1
Normal-Dry	7	9	13	23	464	1,230	967	119	111	5	7	3
Dry	12	8	11	23	4	0	1	0	0	0	0	0
Critical-High	Data not available											
Critical-Low	Data not available											

Source: CDEC 2008, Gage ID ELN
Notes:
[1] Period of record Water Years 1981 – 2007; some years may be missing data.
[2] Restoration Year Types are defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

Table 13-33.
Historical Average Monthly Flows for Eastside Bypass Below Mariposa Bypass

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
All Years	23	16	50	338	424	376	634	602	410	206	17	10
Wet	22	27	102	1,217	1,427	1,262	1,539	1,331	906	727	51	20
Normal-Wet	58	36	98	23	191	131	22	157	22	19	20	20
Normal-Dry	14	3	8	21	9	46	3	1	1	0	0	0
Dry	10	4	9	21	45	1	3	2	1	1	1	1
Critical-High	Data not available											
Critical-Low	Data not available											

Source: CDEC 2008, Gage ID EBM
Notes:
[1] Period of record Water Years 1981 – 2007; some years may be missing data.
[2] Restoration Year Types are defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

Table 13-34.
Historical Average Monthly Flows for Bear Creek Below Eastside Bypass

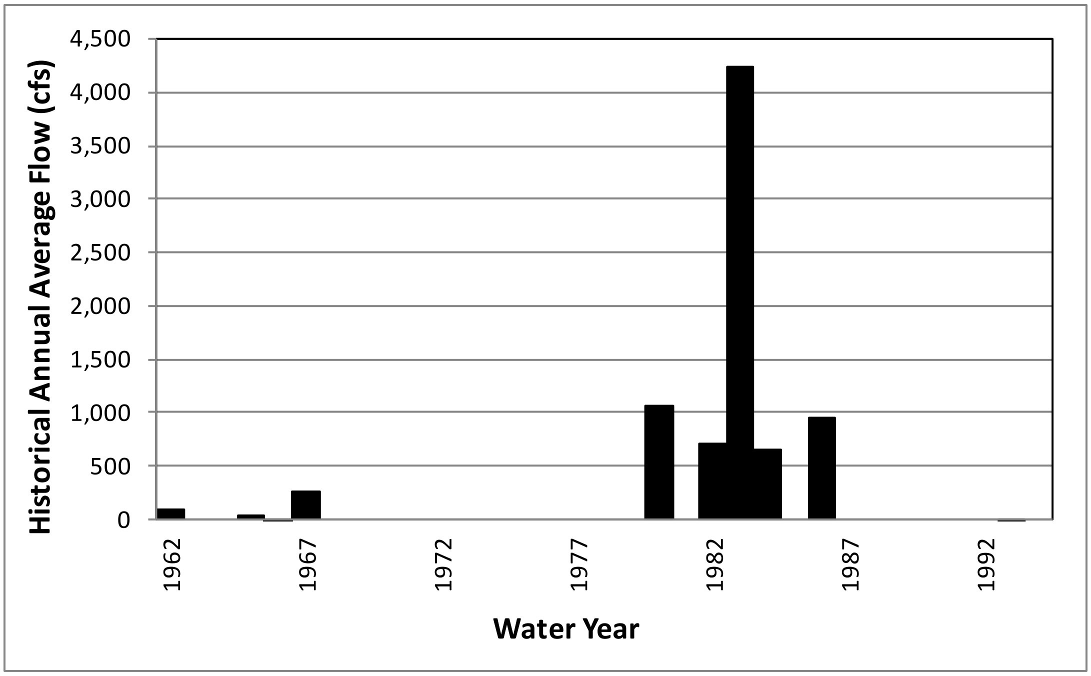
Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	50	23	57	186	172	184	121	43	29	22	25	47
Wet	59	39	108	434	416	390	159	75	56	40	52	122
Normal-Wet	51	27	86	48	167	88	50	33	40	28	21	27
Normal-Dry	44	7	12	29	22	70	10	8	4	1	2	20
Dry	49	6	3	9	58	21	7	5	3	1	2	13
Critical-High	Data not available											
Critical-Low	Data not available											

Source: Reclamation 2008a, DWR Gage Station No. B05516
Notes:
[1] Period of record Water Years 1981 – 2007; some years may be missing data.
[2] Restoration Year Types are defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

Table 13-35.
Streamflow Gage in Mariposa Bypass near Crane Ranch

Gage Name	DWR Station No.	Drainage Area (square miles)	Period of Record[1]	Average Streamflow (cfs)	Maximum Daily Average Streamflow (cfs) (date measured)
Mariposa Bypass near Crane Ranch	B00420	NA	1981 – 1994	456	9,960 (March 3, 1983)

Source: Reclamation 2008a
Note:
[1] Water year.
Key:
cfs = cubic feet per second
DWR = Department of Water Resources
NA = not applicable/not available
No. = number



Source: Reclamation 2008a, DWR Gage Station No. B00420
Key:
cfs = cubic feet per second

Figure 13-25.
Historical Annual Average Flow for Mariposa Bypass near Crane Ranch

Table 13-36.
Historical Average Monthly Flows for Mariposa Bypass near Crane Ranch

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	66	147	410	598	720	1,076	958	556	422	285	28	44
Wet	0	315	893	1,525	2,044	3,050	2,871	1,574	1,196	911	90	141
Normal-Wet	496	472	671	1,038	1	0	6	0	0	0	0	0
Normal-Dry	0	0	0	1	0	0	0	0	0	0	0	0
Dry	0	0	0	0	0	0	0	0	0	0	0	0
Critical-High	Data not available											
Critical-Low	Data not available											

Source: Reclamation 2008a, DWR Gage Station No. B00420
Notes:
[1] Period of record Water Years 1962 – 1994; some years may be missing data.
[2] Restoration Year Types are defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

13.1.3 San Joaquin River from Merced River to the Delta

Flows in the San Joaquin River below the Merced River confluence to the Delta are controlled in large part by releases from reservoirs, located on the tributary systems, including the Merced, Tuolumne, and Stanislaus rivers, to satisfy contract deliveries and instream flow requirements, as well as operational agreements such as the Vernalis Adaptive Management Program (VAMP).

VAMP, officially initiated in 2000, was an experimental-management program, under the jurisdiction of SWRCB (per Water Right Decision 1641 (D-1641)). VAMP was initiated in 2000 as a 12-year program to protect juvenile Chinook salmon emigrating through the San Joaquin River and Delta, and to evaluate how Chinook salmon survival rates change in response to alterations in San Joaquin River flows and exports at CVP and SWP facilities in the south Delta when the Head of Old River Barrier is installed. VAMP included a 31-day pulse flow period in April and May of up to 110 TAF, depending on the flow conditions. Water needed to create the pulse flow was obtained by Reclamation through performance-based agreements that require the release of water, or reduction of delivery from reservoirs on the Merced, Tuolumne, and Stanislaus rivers and from the Exchange Contractors at the Mendota Pool, to meet target flow requirements. Under the San Joaquin River Agreement, the San Joaquin River Group Authority (SJRGA) coordinated operations to meet VAMP requirements. Reclamation and DWR compensated SJRGA to make water supplies available for instream flows, as needed, up to prescribed limits. Though VAMP flows were discontinued in 2010, the recent NMFS 2009 BOs included continuation of VAMP-like flows in the reasonable and prudent alternatives.

The hydrology and hydraulics of the San Joaquin River downstream from the Restoration Area return to a more natural state because there is no extensive flood bypass system, and there is continuous tributary flow from the Merced, Tuolumne, and Stanislaus rivers. Table 13-37 lists gages in or near the San Joaquin River downstream from the Restoration Area, their periods of record, and average and maximum daily average streamflows. Figures 13-26, 13-27, and 13-28 show historical annual average flows at the gages. Tables 13-38, 13-39, and 13-40 show historical average monthly flows at the gages. Appendix J, “Surface Water Supplies and Facilities Operations,” shows exceedence curves for gages listed in Table 13-37.

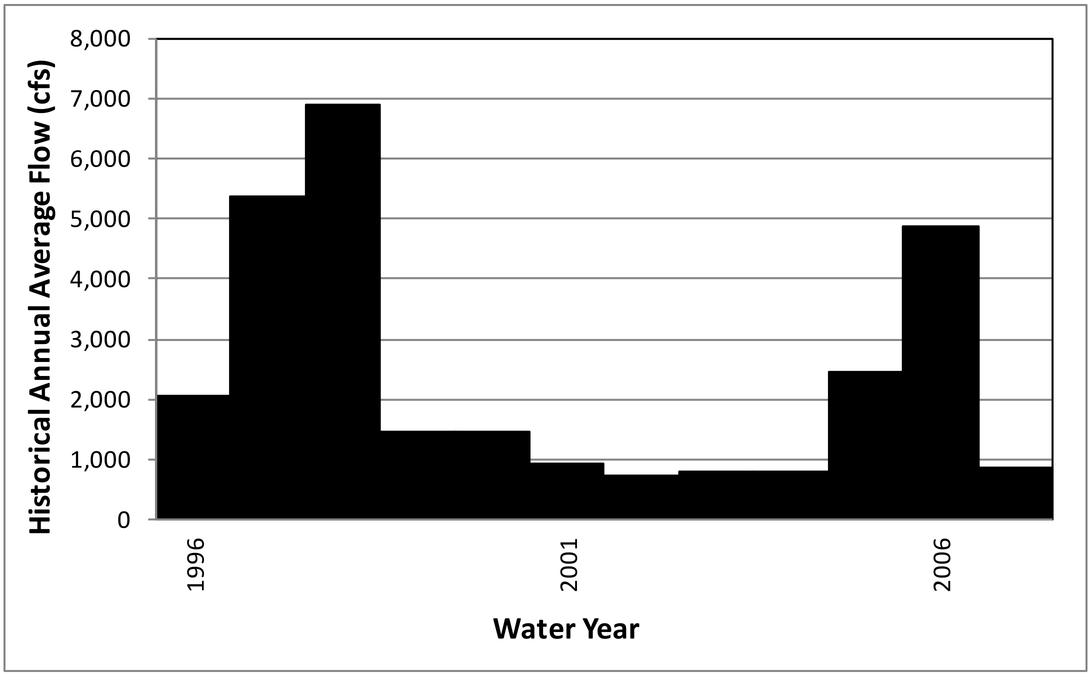
Table 13-37.
San Joaquin River Streamflow Gages Downstream from Restoration Area

Gage Name	USGS Gage Station No.	MP	Drainage Area (square miles)	Period of Record[1]	Average Streamflow (cfs)	Maximum Daily Average Streamflow (cfs) (date measured)
San Joaquin River near Crows Landing	11274550	118.2	9,694	1996 – 2007	2,329	37,600 (January 28, 1997)
San Joaquin River near Vernalis	11303500	NA	13,536	1951 – 2007[2]	4,446	70,000 (December 9, 1950)
Stanislaus River at Ripon	11303000	NA	1,075	1941 – 2007	976	47,000 (December 24, 1955)

Source: USGS 2008

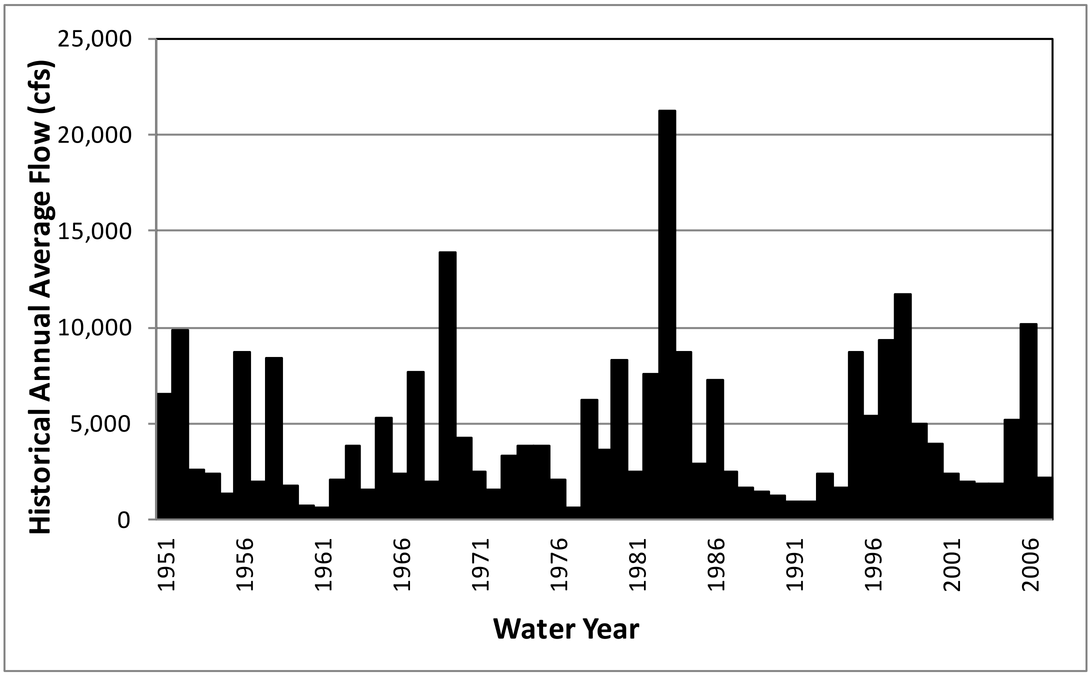
Notes:
[1] Water year.
[2] Period of record coincides with start of diversions from Friant Dam (1950).

Key:
CDEC = California Data Exchange Center
cfs = cubic feet per second
ID = identification
MP = milepost
NA = not applicable/not available
No. = number
USGS = U.S. Geological Survey



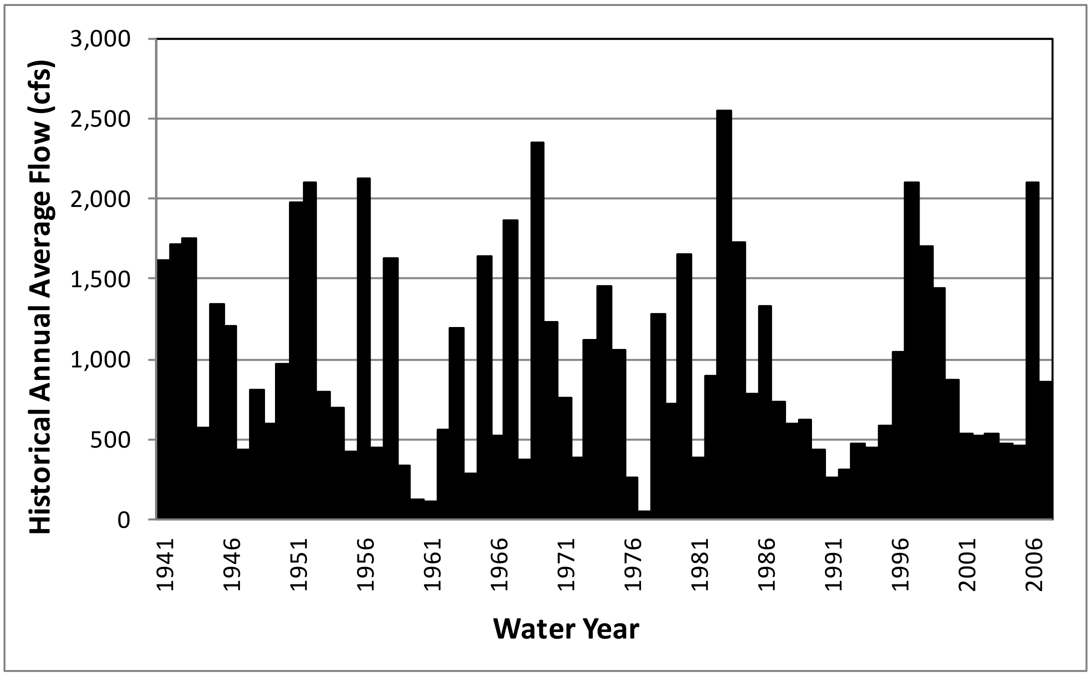
Source: USGS 2008, Gage Station No. 11274550
Key:
cfs = cubic feet per second

Figure 13-26.
Historical Annual Average Flow for San Joaquin River near Crows Landing



Source: USGS 2008, Gage Station No. 11303500
Key:
cfs = cubic feet per second

Figure 13-27.
Historical Annual Average Flow for San Joaquin River near Vernalis



Source: USGS 2008, Gage Station No. 11303000
Key:
cfs = cubic feet per second

Figure 13-28.
Historical Annual Average Flow for Stanislaus River at Ripon

Table 13-38.
Historical Average Monthly Flows for San Joaquin River near Crows Landing

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
All Years	1,135	962	1,273	3,700	5,207	3,443	3,899	3,574	2,721	1,465	788	737
Wet	1,352	942	2,093	9,680	15,392	7,173	5,882	5,480	4,598	3,281	1,096	1,081
Above-Normal	1,509	1,072	1,135	1,304	3,369	3,237	1,872	1,412	744	653	654	625
Below-Normal	656	834	1,111	1,012	890	1,110	966	1,055	531	475	452	344
Dry	848	974	843	1,022	1,012	1,278	935	1,080	519	464	470	383
Critical	Data not available											

Source: USGS 2008, Gage Station No. 11274550
Notes:
[1] Period of record Water Years 1996 – 2007; some years may be missing data.
[2] San Joaquin Valley Water Year Types as defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

Table 13-39.
Historical Average Monthly Flows for San Joaquin River near Vernalis

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	2,517	2,435	3,811	5,666	7,086	7,206	7,068	6,935	5,262	2,507	1,613	1,984
Wet	2,364	2,173	4,423	9,399	13,879	14,625	15,414	14,864	11,505	5,265	2,697	3,548
Above-Normal	4,320	4,526	7,754	8,118	9,176	7,719	4,548	4,665	3,202	1,542	1,467	1,808
Below-Normal	1,717	1,951	3,130	3,245	3,419	3044	2,229	2,900	2,626	958	773	1,017
Dry	2,625	2,553	2,786	2,844	2,600	2381	1,832	1,729	1,146	969	1,003	1,157
Critical	1,806	1,645	1,669	1,544	1,523	1,662	1,355	1,222	907	777	806	846

Source: USGS 2008, Gage Station No. 11303500
Notes:
[1] Period of record Water Years 1951 – 2007; some years may be missing data.
[2] San Joaquin Valley Water Year Types as defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

Table 13-40.
Historical Average Monthly Flows for Stanislaus River at Ripon

Year Type[2]	Average Monthly Flow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	422	468	864	1,210	1,244	1,386	1,500	1,981	1,380	527	385	364
Wet	353	362	1,019	1,859	2,157	2,451	2,736	3,394	2,487	913	583	571
Above-Normal	647	1,064	1,847	2,000	2,074	1,825	1,515	2,283	1,257	335	293	324
Below-Normal	262	344	543	660	644	707	955	1,800	1,391	267	184	186
Dry	453	384	583	585	427	444	575	623	429	358	310	219
Critical	376	338	298	235	253	544	485	446	402	352	300	269

Source: USGS 2008, Gage Station No. 11303000
Notes:
[1] Period of record Water Years 1941 – 2007; some years may be missing data.
[2] San Joaquin Valley Water Year Types as defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

Merced River

The Merced River flows west out of the Sierra Nevada to its confluence with the San Joaquin River at the end of Reach 5. Merced River stream flows are regulated primarily by New Exchequer and McSwain dams, which form Lake McClure and Lake McSwain, respectively. The Crocker-Hoffman Diversion Dam is located downstream from New Exchequer and McSwain dams. Lake McClure is a water supply, hydropower, and flood control reservoir and Lake McSwain is a regulating reservoir approximately 6 miles downstream from Lake McClure. Both reservoirs are owned and operated by the Merced ID. Minimum flow standards were established in 1964 (Project No. 2179) by a FERC license and, in addition, the Davis-Grunsky Contract No. D-GGR17 between Merced ID and DWR. During high-flow events, a portion of Merced River flows are conveyed to the San Joaquin River through Merced Slough.

Tuolumne River

The Tuolumne River enters the San Joaquin River downstream from the Merced River. The largest reservoir on the Tuolumne River is New Don Pedro Lake, owned and operated by the Turlock ID and Modesto ID for water supply, hydropower, and flood control purposes. La Grange Reservoir below New Don Pedro Lake is also jointly owned by the two irrigation districts and is operated as a diversion dam. The *1995 New Don Pedro Settlement Agreement* contains instream flow requirements on the Tuolumne River for the anadromous fishery downstream from the project (FERC 2009).

Stanislaus River

The Stanislaus River flows into the San Joaquin River just upstream from Vernalis. New Melones Reservoir is the largest reservoir on the Stanislaus River, operated as part of the CVP for water supply, hydropower, flood control, water quality, and environmental purposes. Downstream from New Melones Reservoir are the Tulloch and Goodwin reservoirs, operated as part of the Tri-Dam Project. A 1987 study agreement between DFG and Reclamation contains Stanislaus River instream flow standards (Reclamation and DWR 1987). The agreement specifies interim annual water allocations of 98,300 – 302,000 acre-feet, depending on New Melones Reservoir carryover storage and inflow. Annual flow schedules are determined by DFG. A SWRCB decision (D-1422) required New Melones Storage to be used for meeting a total dissolved solids objective of 500 parts per million at Vernalis on the San Joaquin River. The SWRCB decision also states water quality goals for dissolved oxygen in the Stanislaus River. A subsequent SWRCB decision (D-1641) revised water quality standards at Vernalis (via the *1995 Bay-Delta Plan*) to an average monthly conductivity of 0.7 µS/cm from April through August, and 1 µS/cm from September through March (SWRCB 2000).

13.1.4 Sacramento-San Joaquin Delta

The hydraulics of the Delta are complicated by tidal influences, a multitude of agricultural and M&I diversions for use within the Delta itself, and by CVP and SWP operations and exports. Principal factors affecting Delta hydrodynamics are (1) river inflow and outflow from the Sacramento River and San Joaquin River systems, (2) daily tidal inflow and outflow through San Francisco Bay, and (3) export pumping from the south Delta, primarily through the Banks and Jones pumping plants. Inflow to the Delta comes from the Sacramento, San Joaquin, Mokelumne, and Cosumnes rivers, and many smaller eastside tributaries. Historical average monthly total Delta inflow is shown in Table 13-41 by year type.

Table 13-41.
Historical Average Monthly Sacramento-San Joaquin Delta Inflow

Year Type[2]	Average Monthly Inflow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	16,089	19,540	36,435	58,429	67,358	59,327	43,370	32,925	24,811	19,658	17,934	18,187
Wet	19,135	25,634	61,875	99,536	110,506	91,466	76,891	54,024	38,873	25,251	21,683	23,436
Above-Normal	12,717	15,297	21,482	65,912	74,084	74,818	37,090	33,465	23,817	19,602	18,647	18,497
Below-Normal	15,822	16,655	22,077	31,460	48,980	41,330	23,488	21,723	17,247	16,189	15,846	15,536
Dry	14,083	16,884	21,290	21,799	27,137	27,989	17,840	15,070	13,606	16,559	15,616	14,105
Critical	13,927	13,465	16,750	16,651	16,553	17,348	13,072	10,413	10,278	12,123	12,212	11,743

Source: DWR 2009a
Notes:
[1] Period of record Water Years 1956 – 2007.
[2] Sacramento Valley Water Year Types as defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

Because tidal inflows are approximately equivalent to tidal outflows during each daily tidal cycle, tributary inflows and export pumping are the principal variables that define the range of hydrodynamic conditions in the Delta. Excess outflow occurs almost entirely during the winter and spring months. Average winter outflow is about 32,000 cfs, while the average summer outflow is 6,000 cfs. Because of tidal factors and changing channel geometry, Delta outflow is typically a calculated value rather than a directly measured one. Table 13-42 shows the calculated average monthly Delta outflow by year type. Appendix J, "Surface Water Supplies and Facilities Operations," shows the exceedence curve for the Delta outflow.

Table 13-42.
Calculated Average Monthly Sacramento-San Joaquin Delta Outflow

Year Type[2]	Average Monthly Outflow (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	9,726	15,063	32,049	54,724	64,021	54,942	38,282	27,133	16,071	8,451	6,698	9,402
Wet	12,939	22,120	59,197	97,478	108,005	88,897	73,229	48,241	30,115	14,024	10,424	15,123
Above-Normal	6,758	10,939	17,087	61,807	69,421	70,408	32,290	27,874	13,450	7,164	5,990	7,866
Below-Normal	10,684	13,066	18,778	28,662	47,909	36,353	17,719	15,488	7,433	5,045	5,121	7,296
Dry	7,260	11,265	14,837	16,982	22,595	22,784	11,114	9,183	5,449	4,273	3,469	4,936
Critical	5,942	6,731	9,198	9,189	11,292	9,649	6,737	5,038	3,614	3,675	3,180	3,376

Source: DWR 2009a
Notes:
[1] Period of record Water Years 1956 – 2007.
[2] Sacramento Valley Water Year Types as defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key: cfs = cubic feet per second

In the south Delta, decreases in water levels due to CVP and SWP export pumping are a concern for local agricultural diverters because during periods of low-water levels, sufficient pump draft cannot be maintained, and irrigation can be interrupted. Historically, the highest minimum stage in the Middle River typically occurs in February and is about 0.1 foot below msl. The lowest minimum stage typically occurs in August and is about 0.8 feet below msl. During dry and critical years, under existing conditions, the highest minimum stage in the Middle River typically occurs in April and is about 0.6 feet below msl.

The CVP pumping plant is the Jones Pumping Plant, formerly called the Tracy Pumping Plant. The Jones Pumping Plant consists of six pumps, with a nominal and permitted pumping capacity of 4,600 cfs during the irrigation season, and 4,200 cfs during the winter nonirrigation season. Limitations at the Jones Pumping Plant are the result of a DMC freeboard constriction near the O'Neill Forebay, and current water demand in the upper sections of the DMC. The Jones Pumping Plant is at the end of an earth-lined intake channel about 2.5 miles long.

The SWP pumping facility is the Banks Pumping Plant. The Banks Pumping Plant supplies water for the South Bay Aqueduct and the California Aqueduct, with an installed capacity of 10,300 cfs. Under current operational constraints, exports from the Banks Pumping Plant are generally limited to a daily average of 6,680 cfs, except between December 15 and March 15, when exports can be increased by 33 percent of San Joaquin River flow. Under the 2008 USFWS CVP/SWP Operations BO and the 2009 NMFS CVP/SWP Operations BO, delivery capacity is increased by 500 cfs in July, August, and September to reduce the impacts of export reductions made for fisheries during other months. The Banks Pumping Plant exports water from the Clifton Court Forebay, a 31,000- acre- foot reservoir that provides storage for off-peak pumping, and moderates the effect of the pumps on the fluctuation of flow and stage in adjacent Delta channels.

Recent historical average monthly pumping, by year type, at the Jones and Banks pumping plants are shown in Tables 13-43 and 13-44, respectively. Appendix J, “Surface Water Supplies and Facilities Operations,” shows the exceedence curves for Jones and Bank pumping.

Table 13-43.
Historical Average Monthly Exports from the C.W. “Bill” Jones Pumping Plant

Year Type[2]	Average Monthly Exports (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	3,707	3,550	3,258	3,577	3,576	3,234	2,070	1,506	3,157	3,976	4,008	4,075
Wet	3,965	3,575	3,377	3,545	3,325	2,797	2,067	2,104	3,746	4,365	4,391	4,335
Above-Normal	3,413	3,357	2,721	3,921	4,072	3,796	2,276	1,330	3,402	4,297	4,364	4,313
Below-Normal	4,296	4,316	4,142	4,350	3,961	4,133	1,952	960	3,625	4,367	4,422	4,385
Dry	3,914	3,906	3,790	3,438	3,558	3,029	2,159	856	2,764	4,241	4,230	4,176
Critical	3,023	3,124	2,999	2,736	3,166	3,180	1,638	984	1,059	1,705	1,714	2,567

Source: USGS 2008, Gage Station 11313000
Notes:
[1] Period of record Water Years 1992 – 2006.
[2] Sacramento Valley Water Year Types as defined in Appendix J, “Surface Water Supplies and Facilities Operations.”
Key:
cfs = cubic feet per second

Table 13-44.
Historical Average Monthly Exports from the Harvey O. Banks Pumping Plant

Year Type[2]	Average Monthly Exports (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	4,159	4,015	4,529	4,648	3,901	3,485	1,893	1,192	2,745	5,513	5,800	5,321
Wet	4,587	3,924	3,840	3,502	2,577	2,000	1,564	1,527	2,990	5,579	5,565	5,439
Above-Normal	3,140	4,076	4,104	6,680	6,203	5,139	3,043	1,482	5,240	6,472	6,756	6,761
Below-Normal	2,884	3,798	4,257	6,901	6,422	6,826	2,008	749	1,611	6,270	6,587	4,968
Dry	3,994	4,664	5,854	4,573	4,034	4,243	1,884	543	946	5,456	5,813	4,308
Critical	6,414	2,643	6,236	3,402	2,023	1,823	322	703	319	1,648	3,518	3,679

Source: CDEC 2008, Gage HRO
Notes:
[1] Period of record Water Years 1994 – 2007.
[2] Sacramento Valley Water Year Types as defined in Appendix J, “Surface Water Supplies and Facilities Operations.”
Key:
cfs = cubic feet per second

Contra Costa WD (CCWD) supplies CVP water to its users via a pumping plant at the end of Rock Slough. At Rock Slough, the water is lifted 127 feet into the Contra Costa Canal by a series of four pumping plants. The 47.5-mile-long canal terminates in Martinez Reservoir. The Rock Slough diversion capacity of 350 cfs gradually decreases to 22 cfs at the terminus. CCWD also constructed and operates the 100,000-acre-foot Los Vaqueros Reservoir, which has an intake and pumping plant on the Old River for diverting surplus Delta flows to reservoir storage, or contract water to CCWD users. CCWD completed construction of an alternative intake on Victoria Canal for this diversion in 2010. CCWD also has a third diversion facility in the Delta, at the southern end of a 3,000-foot-long channel running due south of Suisun Bay, near Mallard Slough. This facility has with a capacity of 39.3 cfs. Table 13-45 shows historical average monthly exports from the CCWD Rock Slough Pumping Plant by year type.

Table 13-45.
Historical Average Monthly Exports from the Contra Costa Water District Rock Slough Pumping Plant by Year Type

Year Type[2]	Average Monthly Exports (cfs)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	198	165	126	110	108	104	114	149	140	210	205	205
Wet	223	186	117	104	76	72	80	122	137	190	222	226
Above-Normal	115	152	145	123	186	175	186	229	152	281	240	228
Below-Normal	Data not available											
Dry	218	54	35	13	16	16	31	69	47	168	29	32
Critical	211	179	173	159	155	155	168	176	181	208	213	214

Source: USGS 2008, Gage Station 11337000
Notes:
[1] Period of record Water Years 1992 – 2001.
[2] Sacramento Valley Water Year Types as defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
cfs = cubic feet per second

A number of agreements exist between Reclamation and DWR regarding how the CVP and SWP will jointly operate to meet the goals and needs of the projects, and to meet shared responsibilities for in-basin flow and water quality requirements in the Delta. Both projects export water from the Delta for use in areas to the south. This has led to issues involving how the requirements would be met by the two projects, and which project could export any naturally occurring water in excess of the requirements. For example, the *Coordinated Operation Agreement* (COA), signed in November 1986, contains joint operations rules that the CVP and SWP have agreed to follow to allow operations while meeting in-basin flow and/or water quality standards in Delta (Reclamation and DWR 1987).

CVP and SWP operations are also constrained by a number of flow and quality regulations throughout the Sacramento River basin that have occurred since the COA was signed. These other operational agreements have been developed to define how the CVP and SWP will share these responsibilities. Many of these agreements restrict maximum allowable export from the Delta at any time and can be impacted by changes in Delta inflow. Typically, the CVP and SWP attempt to maximize their export pumping from the Delta within these operational constraints (see Appendix H, “Modeling,” for a description of operational constraints considered in this study).

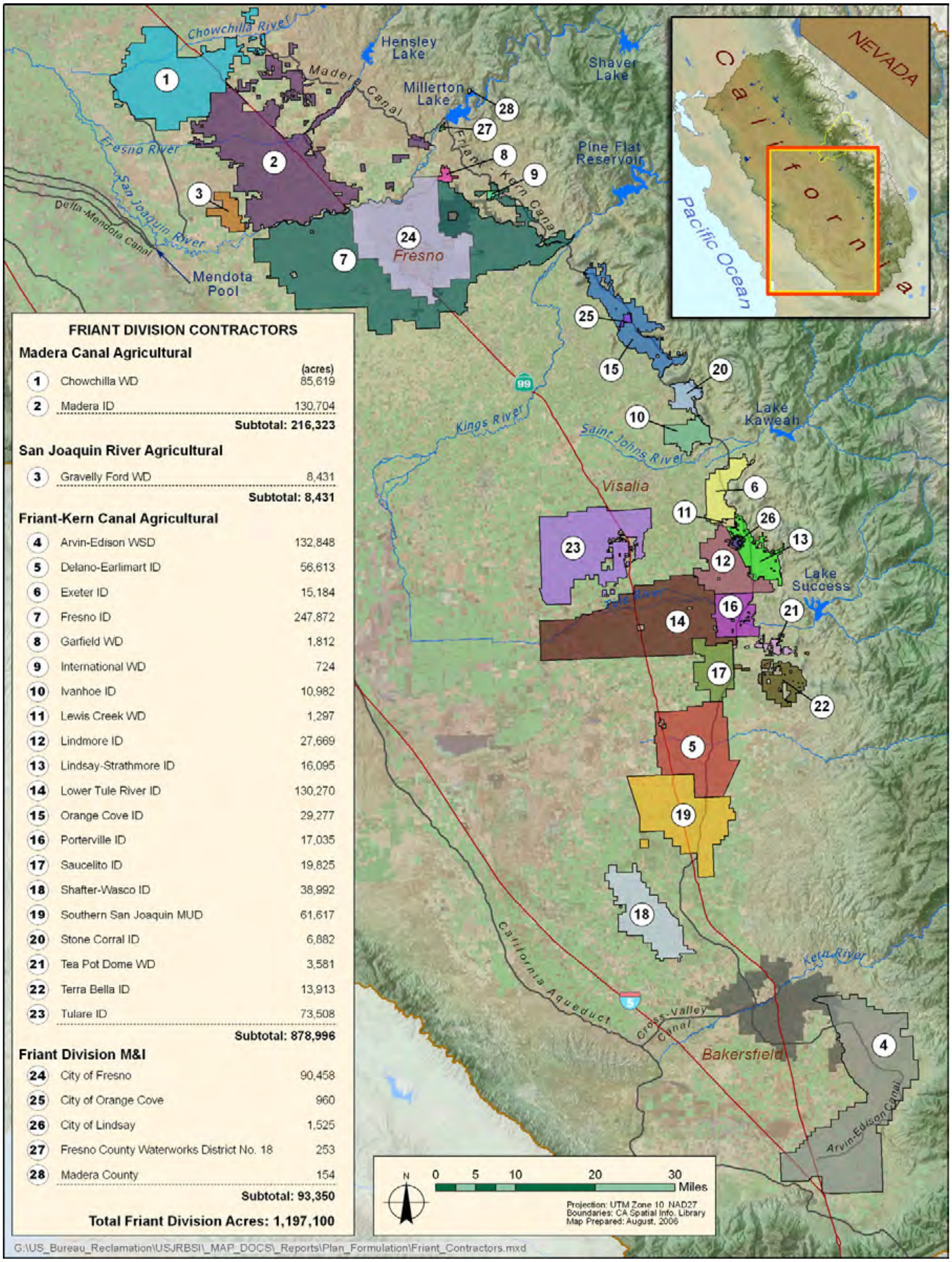
Los Vaqueros Reservoir is refilled by diversions only when source water chloride concentration is relatively low. Los Vaqueros water is used for water quality blending and delivery during low Delta outflow periods, when the chloride concentration at Rock Slough and the Old River is greater than 65 milligrams per liter. The Old River facility allows CCWD to divert up to 250 cfs to a blending facility with the Contra Costa Canal, and to divert up to 200 cfs of CVP and Los Vaqueros water rights water for storage in Los Vaqueros Reservoir. The Mallard Slough facility is only used during periods of very high Delta outflow.

13.1.5 Central Valley Project/State Water Project Water Service Areas

The following sections describe storage and diversion facilities for CVP and SWP water service areas that may be impacted by the Settlement.

Central Valley Project Friant Division Water Service Area and Facilities

Friant Division facilities include Friant Dam and Millerton Lake, and the Madera and Friant-Kern canals, which convey water north and south, respectively, to agricultural and urban water contractors. These facilities are described in the San Joaquin River System Upstream from Friant Dam section, above. Historically, the Friant Division has delivered an average of about 1,300 TAF of water annually. Figure 13-29 shows the locations and acreage of the 28 Friant Division long-term contractors.



Note*:* Includes Friant Division Long-Term Contractors as of 2007.

Figure 13-29.
Friant Division Long-Term Contractors

The Friant Division was designed and is operated to support conjunctive water management in an area that was subject to groundwater overdraft. Chapter 12, "Hydrology – Groundwater," discusses the current state of groundwater use and overdraft in the region. Reclamation employs a two-class system of water allocation to support conjunctive water management and take advantage of water during wetter years:

- Class 1 supplies, which are based on a firm water supply, are generally assigned to M&I and agricultural water users who have limited access to quality groundwater, although most Friant Division long - term contractors have contracted for a combination of Class 1 and Class 2 supplies. During project operations, the first 800 TAF of annual water supply are delivered as Class 1 water.

- Class 2 water is a supplemental supply and is delivered directly for agricultural use or for groundwater recharge, generally in areas that experience groundwater overdraft. Larger Class 2 contractors typically have access to good quality groundwater supplies and can use groundwater during periods of surface water deficiency. Many Class 2 contractors are in areas with high groundwater recharge capability and operate dedicated groundwater recharge facilities. Total Class 2 contracts equal 1.4 MAF.

- In addition to Class 1 and Class 2 water deliveries, water can be provided in accordance with Section 215 of the Reclamation Reform Act of 1982, which authorizes delivery of unstorable water that would otherwise be released in accordance with flood management criteria or unmanaged flood flows. Delivery of such water has enabled San Joaquin Valley groundwater to be replenished at levels higher than otherwise could be supported with Class 1 and Class 2 contract deliveries.

Appendix J, "Surface Water Supplies and Facilities Operations," lists total Friant Division contract amounts for each contractor. Figure 13-30 shows the historical allocation of water to Friant Division contractors. As shown, annual allocation of Class 1 and Class 2 water varies widely in response to hydrologic conditions.

From 1957 through 2007, annual allocations of Class 1 water were typically at or above 75 percent of contract amounts, except in 3 extremely dry years. In this same period, full allocation of Class 2 water supplies occurred in about one-fourth of the years. During the extended drought of 1987 through 1992, no Class 2 water was available and Class 1 allocations were below full contract amounts, except in 1 year. During this and other historical drought periods, water contractors relied heavily on groundwater to meet water demands.

In addition to the Class 1, Class 2, and conjunctive management aspects of Friant Division operations, a program of transfers between districts takes place annually. This program provides opportunities to improve water management within the Friant Division service area. In wet years, water surplus to one district's need can be transferred to other districts with the ability to recharge groundwater. Conversely, in dry years, water is returned to districts with little or no groundwater supply, thereby providing an ongoing informal groundwater banking program within the Friant Division.

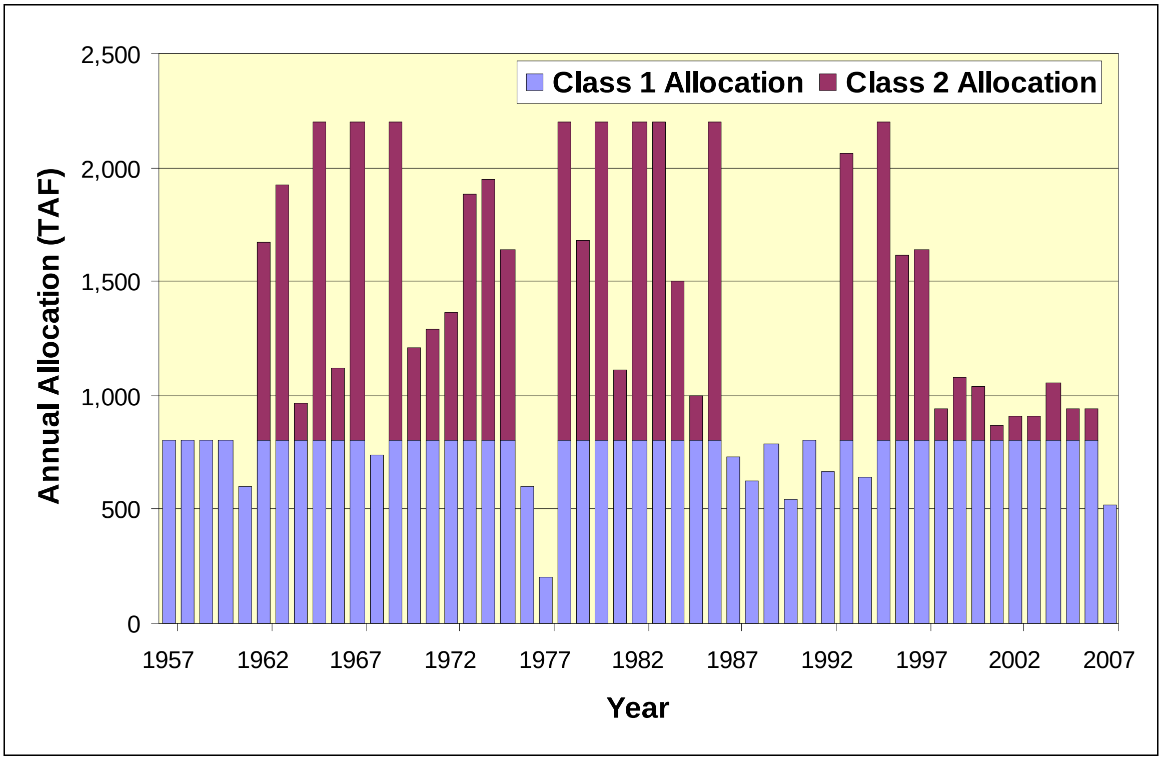


Figure 13-30.
Historical Water Allocation to Friant Division Contractors

The Cross Valley Canal is a privately owned canal that was constructed in the mid-1970s through a collaborative effort of several State and Federal water agencies. The Cross Valley Canal allows water to be conveyed between the California Aqueduct and the Friant Kern Canal, for delivery to seven CVP contractors located in the east side of the southern San Joaquin Valley. CVP water supply from the Delta was designed to be delivered to Arvin-Edison WSD in exchange for a portion of their Friant Division CVP water supply available through Millerton Lake. Recently, Pixley Irrigation District and Lower Tule River Irrigation District have discontinued the exchange with Arvin-Edison WSD and have transferred their CVP water to other CVP water districts and purchased local supplies.

Other Central Valley Project Service Areas and Facilities. The CVP provides water to Settlement Contractors in the Sacramento Valley, Exchange Contractors in the San Joaquin Valley, agricultural and M&I water service contractors in both the Sacramento and San Joaquin valleys, and wildlife refuges both north and south of the Delta. Through an Exchange Contract, Reclamation provides a substitute water supply to the Exchange Contractors (Central California ID, Columbia Canal Company, San Luis Canal Company, and the Firebaugh Canal WD), in exchange for the use of waters of the San Joaquin River within the Friant Division. The four Exchange Contractor entities each have separate conveyance and delivery systems operated independently, although their combined water supply is managed as one unit for performance under the Exchange Contract. The Exchange Contractors, along with eight additional water right contractors, have conveyance and delivery systems that generally divert water from the DMC or Mendota Pool, convey water to customer delivery turnouts, and at times discharge to tributaries of the San Joaquin River.

Because of water rights secured before construction of the CVP, San Joaquin Valley Exchange Contractors have a higher level of reliability for their supplies; except in extremely dry years, when the Shasta Hydrologic Index water year type is classified as critical, Exchange Contractors receive 100 percent of their contract amounts (840 TAF). In Shasta Hydrologic Index critical years, Exchange Contractors receive 75 percent of their contract amounts (not to exceed 650 TAF). The Exchange Contractors have historically been capable of diverting the full amount of the Exchange Contract. When water is available at the Mendota Pool from the San Joaquin River or Kings River (occurrences typically associated with wet conditions), the water is used to offset the need to provide the Exchange Contractors with water from the DMC. If the CVP cannot meet the exchange contracts, the Exchange Contractors can call upon water storage and diversion at Friant Dam.

In February of each year and monthly thereafter, Reclamation evaluates hydrologic conditions throughout California to forecast CVP operations and to estimate the amount of water to be made available to Federal water service contractors for the contract year. Allocations vary from year to year, and are based on unimpaired inflow to Shasta Lake. In general, allocations to CVP water service contractors south of the Delta are lower than allocations to service contractors in the Sacramento Valley.

A detailed summary of CVP annual contract amounts for service areas supplied from the Delta is presented in Appendix J, “Surface Water Supplies and Facilities Operations.” The CVP water service contracts have varying water shortage provisions. Since 1991, Reclamation has been developing an M&I Water Shortage Policy applicable to all CVP M&I contractors. This policy provides M&I water supplies with a 75 percent water supply reliability based on a contractor’s historical use, as defined by the last 3 years of water deliveries unconstrained by the availability of CVP water. Before M&I supplies are reduced, irrigation water supplies would be reduced below 75 percent of contract entitlement. The proposed policy also provides that when the allocation of irrigation water is reduced below 25 percent of contract entitlement, Reclamation will reassess the availability of CVP water and CVP water demand and, because of limited water supplies, M&I water supplies may be reduced below 75 percent of adjusted historical use. Table 13-46 shows historical CVP annual allocations since 1997.

Table 13-46.
Historical Central Valley Project Annual Allocations

Year	Year Type[1]	CVP Contract Allocation (%)						
		Agricultural		Urban		Wildlife Refuges		Settlement/ Exchange
		North of Delta	South of Delta	North of Delta	South of Delta	North of Delta	South of Delta	
1997	Wet	90	90	90 – 100	90 – 100	As scheduled	As scheduled	100
1998	Wet	100	100	100	100	100	100	100
1999	Wet	100	70	95	95	100	100	100
2000	Above-Normal	100	65	100	90	100	100	100
2001	Dry	60	49	85	77	100	100	100
2002	Dry	100	70	100	95	100	100	100
2003	Above-Normal	100	75	100	100	100	100	100
2004	Below-Normal	100	70	100	95	100	100	100
2005	Above-Normal	100	85	100	100	100	100	100
2006	Wet	100	100	100	100	100	100	100
2007	Dry	100	50	100	75	100	100	100

Source: Reclamation 2008b
Note:
[1] Sacramento Valley Water Year Types as defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta

The following subsections describe major south-of-Delta CVP facilities outside the Friant Division.

New Melones Reservoir. New Melones Dam, completed in 1979, is the newest major facility of the CVP. The reservoir is located on the Stanislaus River and has a storage capacity of 2.4 MAF. New Melones Reservoir is operated for flood control on the lower Stanislaus River and the Delta, irrigation and municipal supplies, hydropower, recreation, and fish and wildlife enhancement. Downstream from New Melones Reservoir are the Tulloch and Goodwin reservoirs, operated by the Oakdale and South San Joaquin irrigation districts as part of the Tri-Dam Project. Table 13-47 shows recent historical average monthly storage operations at New Melones Reservoir.

Table 13-47.
Historical Average End-of-Month New Melones Reservoir Storage

Year Type[2]	Average End-of-Month Storage (TAF)[1]											
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
All Years	1,078	1,093	1,120	1,163	1,213	1,255	1,262	1,287	1,300	1,241	1,165	1,126
Wet	917	941	988	1,112	1,218	1,304	1,343	1,448	1,568	1,542	1,447	1,399
Above-Normal	1,468	1,484	1,491	1,467	1,492	1,514	1,524	1,581	1,583	1,510	1,441	1,397
Below-Normal	1,288	1,304	1,358	1,405	1,427	1,425	1,427	1,459	1,447	1,369	1,304	1,280
Dry	1,330	1,351	1,382	1,406	1,433	1,473	1,452	1,405	1,325	1,221	1,138	1,100
Critical	716	716	722	725	737	738	709	660	607	546	496	472

Source: CDEC 2008, Gage ID NML
Notes:
[1] Period of record Water Years 1976 – 2007; some years may be missing data.
[2] Sacramento Valley Water Year Types as defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
TAF = thousand acre-feet

San Luis Reservoir/O'Neill Forebay. Downstream from the Jones Pumping Plant, CVP water flows in the DMC and can be either diverted by the O'Neill Pumping-Generating Plant into the O'Neill Forebay, or can continue down the DMC for delivery to CVP contractors. The O'Neill Pumping-Generating Plant generates power from releases from the O'Neill Forebay back to the DMC. The O'Neill Pumping-Generating Plant consists of six pump-generating units, each with a capacity of 700 cfs.

The O'Neill Forebay is a joint CVP and SWP facility, with a storage capacity of about 56,000 acre-feet. In addition to its interactions with the DMC via the O'Neill Pumping-Generating Plant, it is part of the SWP California Aqueduct. Also, several water districts receive diversions directly from the O'Neill Forebay.

The William R. Gianelli Pumping-Generating Plant (Gianelli Pumping-Generating Plant), also a joint CVP and SWP facility, can pump water from the O'Neill Forebay into San Luis Reservoir, and also generate power from releases from San Luis Reservoir to the O'Neill Forebay. The Gianelli Pumping-Generating Plant consists of eight units, each with a capacity of 1,375 cfs.

San Luis Reservoir lies at the base of foothills on the west side of the San Joaquin Valley. The reservoir provides offstream storage for excess winter and spring flows diverted from the Delta. It is sized to provide seasonal carryover storage, with a total capacity of 2.0 MAF.

Reclamation and DWR have the ability to use or exchange the diversion capacity capabilities of the CVP and SWP (i.e., Delta pumping into San Luis Reservoir) to enhance the beneficial uses of both projects. The Joint Point of Diversion capabilities are based on a staged implementation and conditional requirements for each stage of implementation. The stages of the Joint Point of Diversion are:

- **Stage 1 –** For water service to Cross Valley Canal contractors, Tracy Veterans Cemetery and Musco Olive, and to recover export reductions taken to benefit fish
- **Stage 2 –** For any purpose authorized under the current project water right permits
- **Stage 3 –** For any purpose authorized up to the physical capacity of the diversion facilities

Each stage has regulatory terms and conditions that must be satisfied to implement the Joint Point of Diversion.

The CVP share of the storage at San Luis Reservoir is 965,660 acre-feet; the remaining 1,062,180 acre-feet are the SWP share. During spring and summer, water demands and schedules are greater than the capability of Reclamation and DWR to pump water from the Jones and Banks pumping plants; water stored in San Luis Reservoir is used to make up the difference. Since San Luis Reservoir receives very little natural inflow, water must be stored during fall and winter when the two Delta pumping plants can pump more water from the Delta than is needed to meet water demands. The CVP share of San Luis Reservoir is typically at its lowest in August and September, and at its maximum in April.

The San Felipe Division of the CVP supplies water to customers in Santa Clara and San Benito counties from San Luis Reservoir. Operation of San Luis Reservoir has the potential to affect the water quality and reliability of these supplies if reservoir storage drops below 300 TAF. Low water levels can affect water quality and reliability by creating conditions for algae growth, or by exposing intake structures. Table 13-48 shows historical average monthly storage in the CVP share of San Luis Reservoir by year type.

Table 13-48.
Historical Average End-of-Month Central Valley Project San Luis Reservoir Storage

Year Type[2]	Average End-of-Month Storage (TAF)[1]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
All Years	390	531	658	794	864	929	889	727	545	330	230	289
Wet	442	573	702	827	900	942	915	797	635	418	295	329
Above-Normal	240	374	478	661	796	932	917	767	689	419	312	375
Below-Normal	354	509	700	855	906	950	829	539	285	123	90	156
Dry	491	651	792	900	892	898	828	587	316	204	172	267
Critical	403	549	661	770	829	925	879	742	461	178	31	94

Source: CDEC 2008, Gage SLF
Notes:
[1] Period of record Water Years 1992 – 2007.
[2] Sacramento Valley Water Year Types as defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
TAF = thousand acre-feet

Delta-Mendota Canal. The DMC, completed in 1951, carries water from the Jones Pumping Plant along the west side of the San Joaquin Valley, for use by the Delta Division, West San Joaquin Division, San Felipe Division, and wildlife refuges, and to replace San Joaquin River water stored at Friant Dam and diverted into the Friant-Kern and Madera canals. The canal is about 117 miles long and ends at the Mendota Pool. The initial diversion capacity is 4,600 cfs, which decreases to 3,211 cfs at the terminus.

Central Valley Project Contractor Facilities. The CVP has 273 water service contractors, Exchange Contractors, and Settlement Contractors. Several of the Federal water service contractors have service areas located south of the Delta; most of their supplies must be conveyed through the Delta before delivery.

Exchange Contractors (Figure 13-31) provide water deliveries to over 240,000 acres of irrigable land on the west side of the San Joaquin Valley, from roughly the town of Mendota in the south, to the town of Crows Landing in the north. Deliveries include conveying water to the San Luis Wildlife Refuge Complex and the State WMAs.

Although unique for each entity, operations generally consist of diverting sufficient flow from the DMC and Mendota Pool to the Exchange Contractors' main distribution systems. Depending on the particular Exchange Contractor entity, water is either directly delivered to community ditch systems of the customers from the main canal systems, or water is further conveyed through entity-owned and -maintained community ditch systems to ultimate points of delivery. Once delivered, the entities lose control of the water until the farmers' drainage, if any, is intercepted by district facilities. In certain circumstances, groundwater pumping is used to supplement the Exchange Contractors' CVP substitute water supply, and to provide delivery capacity. Groundwater pumping is also being used to improve operational control of the distribution systems.

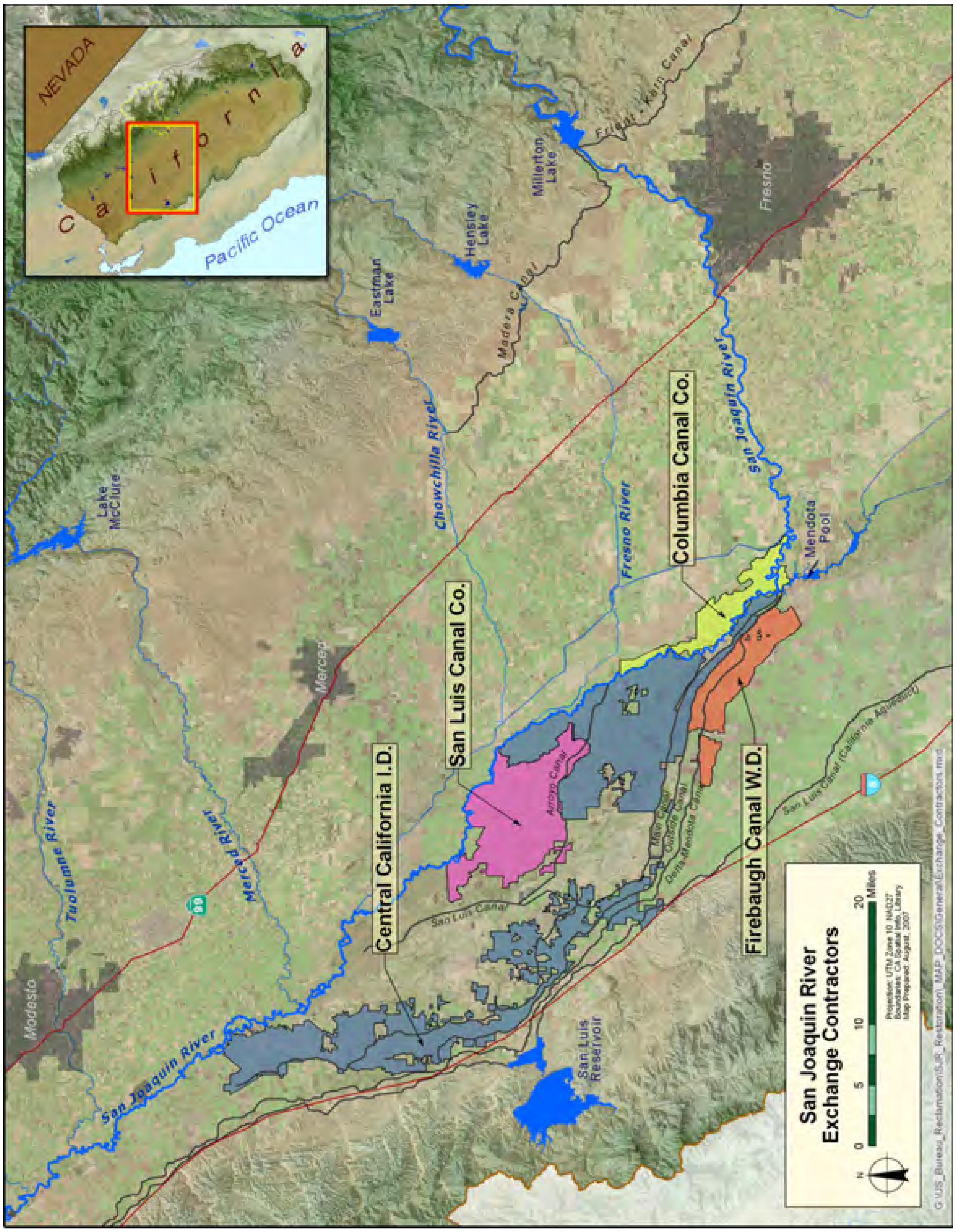


Figure 13-31.
San Joaquin River Exchange Contractors

State Water Project Service Areas and Facilities

The SWP operates under long-term contracts with public water agencies throughout California. These agencies, in turn, deliver water to wholesalers or retailers, or deliver it directly to agricultural and M&I water users (DWR 1999). The SWP contracts between DWR and individual State water contractors define several classifications of water available for delivery under specific circumstances. All classifications are considered "project water." Table A is an exhibit to the SWP long-term water supply contracts. Table A amounts are used to define each contractor's proportion of the available water supply that DWR will allocate and deliver to that contractor. Each year, each contractor may request an amount not to exceed its Table A amount. Table A amounts are used as a basis for allocations to contractors, but the actual annual supply to contractors varies, and depends on the amount of water available. Water delivery capabilities are frequently lower than Table A amounts. Table A water is water delivered according to this apportionment methodology and is given first priority for delivery (DWR 2005). The total Table A amount has increased since inception of the SWP, and is projected to reach a maximum amount of about 4.2 MAF per year by 2021. The current Table A amount is about 4.17 MAF (DWR 2009b). Maximum annual Table A amounts allocated to the 29 SWP contractors are presented in Appendix J, "Surface Water Supplies and Facilities Operations."

The *Monterey Agreement* (DWR 2003), signed by 27 of the 29 SWP water contractors in 1995, restructured the SWP contracts to allocate water based on contractual Table A amounts instead of the amount of water requested for a given year. In times of shortages, the water supply to SWP agricultural and M&I contractors are reduced equally.

Many contractors also make frequent use of additional contract water types to increase or decrease the amount of water available to the contractors under Table A. Other contract types of water include Article 21 Water (surplus water available after operational requirements of SWP water deliveries, water quality, and Delta requirements are met), turnback pool water (SWP accounting of SWP supplies is used early in the year for later purchase by other SWP contractors at a set price), and carryover water (unused SWP allocation from previous year).

The SWP allocation (proportion of Table A to be delivered) for any specific year is made based on a number of factors, including existing storage, current regulatory constraints, projected hydrologic conditions, and desired carryover storage. Since 1995, annual delivery of Table A water has varied between 1.691 MAF (in 2001) to 3.201 MAF (in 2000). Article 21 deliveries have varied between approximately 20 TAF (in 1998) to 309 TAF (in 2000) (DWR 2009b). Table 13-49 shows historical SWP deliveries since 1997 by year.

Table 13-49.
Historical Annual State Water Project Deliveries

Year	Year Type[1]	Table A Amounts		Article 21 (TAF)	Water Rights and Other Contractors (TAF)	Fish and Wildlife (TAF)
		Allocation (%)	Delivery (TAF)			
1997	Wet	-	2,324	21	1,315	4.15
1998	Wet	100	1,726	20	1,007	2.11
1999	Wet	100	2,739	158	1,194	4.32
2000	Above-Normal	90	3,201	309	1,419	4.03
2001	Dry	39	1,691	43	1,556	2.93
2002	Dry	70	2,573	37	1,440	3.69
2003	Above-Normal	90	2,901	60	1,260	2.85
2004	Below-Normal	65	2,600	218	1,533	2.87
2005	Above-Normal	90	2,826	731	1,172	1.51
2006	Wet	100	2,973	621	1,232	1.94
2007	Dry	60	2081	310	1,668	0.89

Source: DWR 2009b
Note:
[1] Sacramento Valley Water Year Types as defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
- = no data available
TAF = thousand acre-feet

The following subsections describe major south-of-Delta SWP facilities.

San Luis Reservoir/O'Neill Forebay. Downstream from the Banks Pumping Plant, SWP water flows in the California Aqueduct and into the O'Neill Forebay. The O'Neill Forebay and San Luis Reservoir are described in the "Other Central Valley Project Service Areas and Facilities" section of this chapter. The SWP share of the storage in San Luis Reservoir is 1,062,180 acre-feet. During spring and summer, water demands and schedules are greater than the capability of Reclamation and DWR to pump water from the Jones and Banks pumping plants; water stored in San Luis Reservoir is used to make up the difference. Since San Luis Reservoir receives very little natural inflow, water must be stored during fall and winter when the two Delta pumping plants can pump more water from the Delta than is needed to meet water demands. Table 13-50 shows historical average monthly storage in the SWP share of San Luis Reservoir by year type.

Table 13-50.
Historical Average End-of-Month State Water Project San Luis Reservoir Storage

Year Type[2]	Average End-of-Month Storage[1]											
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
All Years	655	696	780	930	1,016	1,046	977	826	671	592	565	640
Wet	820	903	984	1,093	1,105	1,078	1,019	925	822	768	698	781
Above-Normal	409	450	523	823	992	1,020	966	797	672	605	610	727
Below-Normal	607	613	615	809	971	1,060	938	674	434	369	408	513
Dry	599	651	799	876	976	1,029	945	719	489	425	454	451
Critical	760	679	735	798	883	1,021	944	829	608	404	324	390

Source: CDEC 2008, Gage LUS
Notes:
[1] Period of record Water Years 1992 – 2007.
[2] Sacramento Valley Water Year Types as defined in Appendix J, "Surface Water Supplies and Facilities Operations."
Key:
TAF = thousand acre-feet

California Aqueduct. The California Aqueduct carries water 443 miles from the Banks Pumping Plant to areas in Southern California. The concrete-lined canal includes several pumping plants and branches to enable delivery to various, predominantly urban locations. The initial physical diversion capacity is 10,670 cfs.

State Water Project Contractor Facilities. The SWP operates under long-term contracts with public water agencies throughout California. These agencies, in turn, deliver water to wholesalers or retailers, or deliver it directly to agricultural and M&I water users (DWR 1999).

13.2 Regulatory Setting

The regulatory setting related to surface water supplies and facility operations is described below.

13.2.1 Federal

This section presents the applicable Federal regulations associated with surface water supplies and facility operations.

Central Valley Project Improvement Act

Implementation of the CVPIA changed management of the CVP by making fish and wildlife protection a project purpose, equal to water supply for agricultural and urban uses. The CVPIA affects water exports from the Delta to San Luis Reservoir and increases operational pressures on the reservoir to meet south-of-Delta water demands. CVPIA Section 3406 (b)(2) authorized and directed the Secretary of the Interior, among other actions, to dedicate and manage 800 TAF of CVP yield annually for the primary purpose of implementing the fish, wildlife, and habitat restoration purposes and measures authorized in the CVPIA, to assist the State of California in its efforts to protect the waters of the San Francisco Bay-Delta Estuary, and to help meet obligations legally imposed on the CVP under Federal or State law following the date of enactment of the CVPIA. CVPIA Section 3406(d)(1) required that the Secretary immediately provide specific quantities of water to the refuges, referred to as “Level 2” supplies. The CVPIA requires delivery of Level 2 water in all year–types except critically dry water year conditions, when Level 2 water can be reduced by 25 percent. Section 3406(d)(2) of the CVPIA refers to “Level 4” refuge water supplies, which are the quantities required for optimum habitat management of the existing refuge lands. Level 4 water supplies amount to about 163 TAF above Level 2 water supplies. The availability of Level 4 refuge water supplies is influenced by the availability of water for transfer from willing sellers. CVPIA Section 3406(c)(1) mandated development of a comprehensive plan that is reasonably prudent and feasible to be presented to Congress to address fish, wildlife, and habitat concerns on the San Joaquin River. However, Public Law 111-11 declared “that the Settlement satisfies and discharges all of the obligations of the Secretary contained in section 3406(c)(1).”

Coordinated Operation Agreement

With the goal of using coordinated management of reservoir releases and surplus flows in the Delta to improve Delta export and conveyance capability, the COA received Congressional approval in 1986 and became Public Law 99-546. As modified by interim agreements, the COA coordinates operations between the CVP and SWP, and provides for equitable sharing of surplus water entering the Delta.

Central Valley Project Long-Term Water Service Contracts

In accordance with CVPIA Section 3404(c), Reclamation is renegotiating long-term water service contracts. As many as 113 CVP water service contracts located within the Central Valley of California may be renewed during this process.

San Joaquin River Agreement

The San Joaquin River Agreement (SJRA), adopted in 2000, is a water supply program to provide increased instream flows in the San Joaquin River. The water provides protective measures for fall-run Chinook salmon in the San Joaquin River under VAMP. Parties to the agreement include Reclamation, USFWS, DWR, DFG, SJRGA, and CVP and SWP Export Interests parties, which includes State Water Contractors, Kern County Water Agency, Tulare Lake Basin WSD, Santa Clara Valley WD, San Luis and Delta-Mendota Water Authority, Westlands WD , and MWD of Southern California.

U.S. Army Corps of Engineers — Reservoir Regulation for Flood Control at Friant Dam and Millerton Lake

Friant Dam and Millerton Lake are operated for flood control in accordance with rules and regulations prescribed by CFR Title 33, Part 208, and the *Report on Reservoir Regulation for Flood Control, Friant Dam and Millerton Lake, San Joaquin River, California* (USACE 1955 (revised 1980)). The regulations set limitations on storage space in Millerton Lake and flow releases from Friant Dam for flood control. (See the Chapter 11.0, “Hydrology – Flood Management for more information regarding flood operations at Friant Dam.)

13.2.2 State of California

This section describes State regulations and policies associated with surface water supplies and facility operations.

California Public Resources Code

Under the California PRC, agencies of the State government that regulate activities of private individuals, corporations, and public agencies found to affect the quality of the environment shall regulate such activities, with major consideration given to preventing environmental damage, while providing a satisfying living environment for every Californian.

California Fish and Game Code Section 1602 — Streambed Alteration

All diversions, obstructions, or changes to the natural flow or bed, channel, or bank of any river, stream, or lake in California that supports wildlife resources are subject to regulation by DFG under Section 1602 of the California Fish and Game Code.

Central Valley Flood Protection Board Encroachment Permit

Under the CCR, Title 23, the CVFPB of the State of California (previously known as The Reclamation Board) issues encroachment permits to maintain the integrity and safety of flood control project levees and floodways that were constructed according to flood control plans adopted by the CVFPB or the California Legislature.

California Water Rights

A water right is a legally protected right, granted by law, to take possession of water and put it to beneficial use. Under the CWC, SWRCB is responsible for allocating surface water rights and permitting the diversion and use of water throughout the State.

State Lands Commission Land Use Lease

The California State Lands Commission was given authority and responsibility to manage and protect important natural and cultural resources on certain public lands within the State, and the public's rights to access these lands. Public lands under the commission's jurisdiction are of two distinct types: sovereign lands and school lands. Sovereign lands encompass approximately 4 million acres. These lands include the beds of California's naturally navigable rivers, lakes, and streams, and the State's tidal and submerged lands along the coastline, extending from the shoreline out to 3 miles offshore. As a historic navigable river, the bed of the San Joaquin River is subject to the jurisdiction of the California State Lands Commission. California holds the fee ownership in the river bed between the two ordinary low water marks in Reach 1A. The California State Lands Commission initiated work in the fall of 2010 to develop an administrative decision on the ordinary low and high water marks in the remaining reaches of the Restoration Area. Land between the ordinary high water marks is subject to a Public Trust Easement. A lease is required for projects on State-owned lands under the jurisdiction of the California State Lands Commission.

Water Quality Control Plan for the San Francisco Bay – San Joaquin Delta Estuary

The 1995 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary WD (1995 Water Quality Control Plan (WQCP)) (SWRCB 1995) established water quality control objectives to protect beneficial uses in the Delta. The 1995 WQCP identified (1) beneficial uses of the Delta to be protected, (2) water quality objectives for the reasonable protection of beneficial uses, and (3) an implementation program to achieve the water quality objectives. Because these new beneficial objectives and water quality standards were more protective than those of the previous SWRCB D-1485, and required changes in CVP and SWP operations that affected their ability to store and divert water (D-1485), the new objectives were adopted in 1995 through a water right order for operation of the CVP and SWP. Key features of the 1995 WQCP include estuarine habitat objectives for Suisun Bay and the western Delta (consisting of salinity measurements at several locations), export/inflow (E/I) ratios intended to reduce entrainment of fish at the export pumps, Delta Cross-Channel gate closures, and San Joaquin River EC and flow standards. SWRCB adopted a new Bay-Delta WQCP on December 13, 2006. However, this new WQCP made only minor changes to the 1995 WQCP.

State Water Resources Control Board Water Right Decision 1641

SWRCB D-1641 (SWRCB 2000) and Water Right Order 2001-05 contain the current water right requirements to implement the 1995 Bay-Delta WQCP. D-1641 incorporates water right settlement agreements between Reclamation and DWR and certain water users in the Delta and upstream watersheds regarding contributions of flows to meet water quality objectives. However, SWRCB imposed terms and conditions on water rights held by Reclamation and DWR that require these two agencies, in some circumstances, to meet many of the water quality objectives established in the 1995 WQCP. D-1641 also authorizes the CVP and SWP to use joint points of diversion (JPOD) in the south Delta, and recognizes the CALFED Operations Coordination Group process for operational flexibility in applying or relaxing certain protective standards.

13.2.3 Regional and Local

Local surface water regulations can include water supply master plans, general plans, Integrated Regional Water Management Plans, habitat and conservation plans, and land use ordinances, with many of these regulations including goals, objectives, and policies pertaining to the primary and extended study areas. Examples of relevant local water supply master plans include Fresno’s Urban Water Management Plan (2008), Merced’s Water Supply Plan Update (2001), Modesto’s Joint Urban Water Management Plan (2007), and Stockton’s Water Master Plan (2008). Local water supply plans typically outline future water supply/demand and provide a framework for supply diversification and conservation.

Several county and city general plans cover lands within or near the Restoration Area, including general plans for Fresno (2000), Madera (1995), and Merced (1990) counties, and the Cities of Fresno (2002), Clovis (1993), Mendota, and Firebaugh. These county and city general plans have goals, objectives, and policies oriented toward the conservation, protection, and enhancement of streams, rivers, wetlands, and riparian areas. Development and land use ordinance decisions within these counties and cities are considered in view of their consequences to the general plan goals. General plans also have policies toward water supply protection and enhancement, and coordinate closely with their local water supply master plans. General plans are typically administered by local planning commissions or public utilities departments.

Integrated Regional Water Management Plans are state-wide voluntary initiatives to foster regional water management and are intended to "ensure sustainable water uses, reliable water supplies, better water quality, environmental stewardship, efficient urban development, protection of agriculture, and a strong economy" (DWR 2005). Applicable plans include Madera County (2008). Other plans are currently in development (e.g., Central California and Southern Sierra).

Local habitat and conservation plans can be county-wide initiatives or can be implemented in response to proposed development. The main objectives of these plans are to protect natural resources, including species and habitat, as well as enhance coordination and collaboration of development stakeholders.

13.3 Environmental Consequences and Mitigation Measures

This section describes the methodology, criteria for determining significance of effects, and effects of implementing the Settlement. Implementing the action alternatives would change surface water supplies and facilities operations of the San Joaquin River from Friant Dam to the Delta, in the Delta, and in CVP and SWP water service areas. Changes in operations at Friant Dam and the recapture and recirculation of water to the CVP and SWP water service areas have the potential to result in impacts to groundwater or socioeconomic conditions, as described in Chapters 12, "Hydrology – Groundwater," and 22, "Socioeconomics," respectively, and are not considered as independent impacts outside of those resource areas or described in this chapter. Accordingly, potential impacts to surface water supplies and facilities operations are described in the San Joaquin River from Friant Dam to the Delta and in the Delta. Additional information on potential changes in surface water supplies and facilities operations throughout the study is summarized at the end of this chapter, and provided in Appendix J, "Surface Water Supplies and Facilities Operations."

Specific effects discussed in this section include diversion structure capacities, water levels in the south Delta, and Delta excess water conditions. This section also summarizes modeling results related to flow, storage, and diversions. These results are used in impact analyses of various chapters, as described in this section.

The program alternatives evaluated in this chapter are described in detail in Chapter 2.0, "Description of Alternatives," and summarized in Table 13-51. The potential impacts to surface water supplies and facilities operations and associated mitigation measures are summarized in Table 13-52.

Table 13-51.
Actions Included Under Action Alternatives

Level of NEPA/CEQA Compliance	Actions[1]		Action Alternative					
			A1	A2	B1	B2	C1	C2
Project-Level	Reoperate Friant Dam and downstream flow control structures to route Interim and Restoration flows		✓	✓	✓	✓	✓	✓
	Recapture Interim and Restoration flows in the Restoration Area		✓	✓	✓	✓	✓	✓
	Recapture Interim and Restoration flows at existing CVP and SWP facilities in the Delta		✓	✓	✓	✓	✓	✓
Program-Level	Common Restoration actions[2]		✓	✓	✓	✓	✓	✓
	Actions in Reach 4B1 to provide at least:	475 cfs capacity	✓	✓	✓	✓	✓	✓
		4,500 cfs capacity with integrated floodplain habitat		✓		✓		✓
	Recapture Interim and Restoration flows on the San Joaquin River downstream from the Merced River at:	Existing facilities on the San Joaquin River			✓	✓	✓	✓
		New pumping infrastructure on the San Joaquin River					✓	✓
	Recirculation of recaptured Interim and Restoration flows		✓	✓	✓	✓	✓	✓

Notes:
[1] All alternatives also include the Physical Monitoring and Management Plan and the Conservation Strategy, which include both project- and program-level actions intended to guide implementation of the Settlement.
[2] Common Restoration actions are physical actions to achieve the Restoration Goal that are common to all action alternatives and are addressed at a program level of detail.

Key:
CEQA = California Environmental Quality Act
cfs = cubic feet per second
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
NEPA = National Environmental Policy Act
PEIS/R = Program Environmental Impact Statement/Report
SWP = State Water Project

Table 13-52.
Summary of Environmental Consequences and Mitigation Measures – Surface Water Supplies and Facilities Operations

Impacts	Alternative	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance After Mitigation
Hydrology – Surface Water Supplies and Facilities Operations: Program-Level				
SWS-1: Changes in Diversion Capacities	No-Action	No Impact	--	No Impact
	A1	PS	SWS-1: Provide Alternate Temporary or Permanent River Access to Avoid Diversion Losses	LTS
	A2	PS		LTS
	B1	PS		LTS
	B2	PS		LTS
	C1	PS		LTS
	C2	PS		LTS
Hydrology – Surface Water Supplies and Facilities Operations: Project-Level				
SWS-2: Change in Water Levels in the Old River near the Tracy Road Bridge	No-Action	LTS	--	LTS
	A1	LTS	--	LTS
	A2	LTS	--	LTS
	B1	LTS	--	LTS
	B2	LTS	--	LTS
	C1	LTS	--	LTS
	C2	LTS	--	LTS
SWS-3: Change in Water Levels in the Grant Line Canal near the Grant Line Canal Barrier	No-Action	LTS	--	LTS
	A1	LTS	--	LTS
	A2	LTS	--	LTS
	B1	LTS	--	LTS
	B2	LTS	--	LTS
	C1	LTS	--	LTS
	C2	LTS	--	LTS
SWS-4: Change in Water Levels in the Middle River near the Howard Road Bridge	No-Action	LTS	--	LTS
	A1	LTS	--	LTS
	A2	LTS	--	LTS
	B1	LTS	--	LTS
	B2	LTS	--	LTS
	C1	LTS	--	LTS
	C2	LTS	--	LTS

**Table 13-52.
Summary of Environmental Consequences and Mitigation Measures – Surface Water Supplies and Facilities Operations (contd.)**

Impacts	Alternative	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance After Mitigation
Hydrology – Surface Water Supplies and Facilities Operations: Project-Level (continued)				
SWS-5: Change in Recurrence of Delta Excess Conditions	No-Action	PS	--	PS
	A1	LTS	--	LTS
	A2	LTS	--	LTS
	B1	LTS	--	LTS
	B2	LTS	--	LTS
	C1	LTS	--	LTS
	C2	LTS	--	LTS

Key:
-- = not applicable
Delta = Sacramento – San Joaquin Delta
LTS = less than significant
PS = potentially significant

13.3.1 Impact Assessment Methodology

This section describes modeling, assumptions, and significance criteria used to assess impacts to surface water supply and facilities operations.

Modeling and Assumptions

A suite of modeling tools was used to evaluate the potential effects of Settlement implementation on surface water supplies and facilities operations, and to quantify potential benefits. CalSim-II was used to simulate CVP and SWP operations, determining the surface water flows, storages, and deliveries associated with each alternative. SJR5Q provides a method to evaluate the flows and temperatures in the San Joaquin River downstream from Millerton Lake to the Merced River confluence. DSM2 was used to simulate Delta hydrodynamics, providing the data used to evaluate the water-level-related impacts of each alternative. Analysis and modeling results are summarized below; more detailed explanations, assumptions, and results of these models are found in Appendix H, "Modeling."

CalSim-II. CalSim-II is the application to the CVP and SWP of the Water Resources Integrated Modeling System software. This application was jointly developed by Reclamation and DWR for planning studies relating to CVP and SWP operations. The primary purpose of CalSim-II is to evaluate the water supply reliability of the CVP and SWP at current and/or future levels of development (e.g., 2005, 2030), with and without various assumed future facilities, and with different modes of facility operations. Geographically, the model covers the drainage basin of the Delta, and CVP and SWP exports to the San Francisco Bay Area, San Joaquin Valley, Central Coast, and Southern

California. CalSim-II typically simulates system operations for an 83-year period using a monthly time step. The program alternatives assessed by CalSim all have similar structure and assumptions. All of the alternatives include the restoration minimum Friant Dam release requirements and 16(b) operations for capture of upper San Joaquin River surplus water supply, as defined in Appendix G, “Plan Formulation.”

The program alternatives CalSim evaluations differ in the implementation of 16(a) operations – recapture of San Joaquin Restoration Flows downstream from the Merced River confluence. These 16(a) water management actions are discussed in detail in Appendix G, “Plan Formulation.” The additional restoration inflows to the Delta are treated the same as any other Delta inflow within CalSim. This results in a reoperation of the CVP and SWP system under the physical and regulatory limits within the model. The actual results are a relatively small reoperation of the system north of the Delta, and increased Delta pumping and CVP and SWP delivery south of the Delta. For modeling purposes, the average annual increase in south of Delta deliveries is assumed to represent the upper limit of the potential return for Alternative A1. The potential return of recaptured water to Friant, however, pursuant to 16(a) is not explicitly modeled in CalSim.

Alternatives B1, B2, C1, and C2 each also include recapture upstream from the Delta via exchange or direct diversion, respectively, in the CalSim model. This water is not returned to Friant but it also is not delivered to other CVP and SWP contractors in the model. In these alternatives, the potential return is defined as the sum of the annual average of the internal recapture and the annual average increase in south of Delta deliveries.

These potential return values are assumed to represent the maximum potential return. No attempt was made to allocate the potential return to individual years or months because the mechanism and facilities required to implement the return, either existing or new, are unknown at this time. These results were post-processed to meet the needs of other resource impact analyses (e.g. socioeconomics, power and energy), and are described in corresponding chapters.

SJR5Q. SJR5Q covers the San Joaquin River downstream from Millerton Lake to the confluence with the Merced River. The model was developed using the USACE HEC-5Q modeling tool, which can be used for simulating water flow and quality of both reservoirs and streams. SJR5Q uses the river modeling capabilities of HEC-5Q to model both flow and temperature in the San Joaquin River from Millerton Lake to the Merced River confluence. The HEC-5Q users manual (USACE 1998) describes more completely the water quality relationships included in the model.

DSM2. DSM2 is a branched one-dimensional model used to simulate hydrodynamics, water quality, and particle tracking in a network of riverine or estuarine channels. The hydrodynamic module can simulate channel stage, flow, and water velocity. The water quality module can simulate the movement of both conservative and nonconservative constituents. Impact analysis for planning studies of the Delta is typically performed for an 82-year period (1922 to 2003).

Significance Criteria

The thresholds of significance for impacts to surface water supplies and facilities operations are based on the environmental checklist in Appendix G of the State CEQA Guidelines, as amended. These thresholds also encompass the factors taken into account under NEPA to determine the significance of an action in terms of its context and the intensity of its impacts. An alternative was determined to result in a significant impact related to surface water supply if it would adversely affect surface water supply facilities operations, as measured by the criteria in Table 13-53. Significance statements are relative to both existing conditions (2005) and future conditions (2030), unless stated otherwise.

Table 13-53.
Impact Indicators and Significance Criteria for Surface Water Supply Facilities Operations

Impact Indicator	Significance Criterion
Diversion capacities	Reduce the ability to satisfy downstream Holding Contract diversions in Reach 1, or reduce capacity of other existing operational diversion facilities.
Water levels in the south Delta[1]	Reduce water surface elevation, relative to the basis of comparison, with sufficient frequency and magnitude to adversely affect south Delta water users' abilities to divert water during the irrigation season.
Delta excess water conditions	Cause a reduction in the duration of Delta excess conditions from November to June that adversely affects Contra Costa WD's ability to fill Los Vaqueros Reservoir.

Note:
[1] Changes in south Delta water levels are estimated using the Delta Simulation Model 2..
Key:
Delta = Sacramento-San Joaquin Delta
WD = Water District

A summary of changes in flow, storage, and diversions resulting from each of the program alternatives is also included in this section. This information is used to assess impacts related to water delivery economics, flood management, water quality, groundwater, recreation, biology, etc., and is described in Appendix H, "Modeling." Impacts to Friant Division water supplies are presented in Chapter 22.0, "Socioeconomics." The following subsections describe the impact indicators listed in Table 13-53.

San Joaquin River Diversions. Releases are made at Friant Dam to comply with Holding Contract requirements along Reach 1. Diversions within this reach, many of which are small and not all of which are active on a regular basis, are listed in Appendix J, "Surface Water Supplies and Facilities Operations." Construction activities within this reach could adversely affect existing diversion facilities, including pumps, pipelines, and weirs. Other diversion facilities may be present within the study area that could be affected by construction activities associated with program-level actions.

South Delta Water Levels. Water levels in the south Delta are influenced to varying degrees by natural tidal fluctuations, San Joaquin River flows, barrier operations, Jones and Banks export pumping, local agricultural diversions and drainage return flows, channel capacities, siltation, and dredging. When the Jones and Banks pumping plants are exporting water, water levels in local channels can be drawn down, particularly during water years with low flow. The South Delta Water Agency (SDWA) and local farmers in the south and central Delta are interested in maintaining adequate water levels for their siphons and pumps, which are installed at fixed locations in the Delta, to continue to be used for irrigation diversions. The program alternatives could affect the ability of the SDWA to divert water if changes in Delta operations reduce Delta channel water levels during the irrigation season, from April to October.

The South Delta Temporary Barriers Program was initiated by DWR in 1991 to improve water conditions in the south Delta and to provide design data for permanent gates. Since 1991, DWR has seasonally installed four barriers. Three barriers, located on the Middle River, Grant Line Canal, and Old River, facilitate adequate water levels and water quality for agricultural diversions. The barriers are constructed from rock fill and incorporate overflow weirs and gated culverts. These barriers are installed in spring and removed in fall. A fourth barrier is seasonally installed at the Head of the Old River for fish control. The existing seasonal barriers (and proposed permanent tidal gates) significantly affect water levels in the south Delta. In October 2005, Reclamation and DWR released a Draft EIS/EIR for the South Delta Improvements Program (SDIP) (Reclamation and DWR 2005). This Draft EIS/EIR discusses the proposed operation, and evaluates the impacts of the proposed permanent tidal and fish control gates in the south Delta. The Final EIS/EIR for the SDIP was released and the EIR certified by DWR in December 2006 (Reclamation and DWR 2006).

To evaluate water level effects, modeling results were examined for sites near three monitoring locations. South Delta agricultural irrigation users are primarily concerned with the water level at low-low tide because this is the minimum water surface elevation they experience. The impact analysis considers the maximum change in water elevation at the low-low tide for each day of each month. Channel tidal levels at three south Delta locations have been selected to describe possible impacts of the program alternatives on south Delta tidal hydraulics:

- **Old River at Tracy Boulevard Bridge (Road Bridge) –** This station is a tidal level and EC monitoring location, and is upstream from the temporary barrier and proposed permanent barrier just east (upstream) from the DMC intake and fish facility.

- **Grant Line Canal above the Grant Line Canal Barrier –** This station is upstream from the temporary barrier on Grant Line Canal and upstream from the proposed permanent tidal gate.

- **Middle River near the Howard Road Bridge –** This station is located just upstream from the temporary barrier near Victoria Canal and the proposed permanent tidal gate.

Water levels in the south Delta are considered to adversely affect water users, as defined by DWR's *Water Level Response Plan*, if they are below 0.0 feet at msl at the Old River near Tracy Boulevard Bridge, and at locations above the Grant Line Canal Barrier, and 0.3 foot above msl at the Middle River near the Howard Road Bridge (Reclamation and DWR 2004; Reclamation et al., 2004). A change in water level is considered to be significant if the water level is below the identified limit, and the water level change between the alternative and baseline is greater than a 0.1-foot decrease during the irrigation season of April through October.

Delta Excess Water Conditions. Changes from Delta excess water conditions to balanced conditions could adversely affect CCWD's ability to fill Los Vaqueros Reservoir. Under SWRCB D-1629, filling Los Vaqueros Reservoir is restricted to when (during November 1 to June 30) the Delta is in excess water conditions. Changes in simulated Delta conditions are considered to be potentially significant if during this period the following conditions are met:

- Under the basis of comparison, the Delta is in excess conditions
- Under the program alternatives, the Delta is in balanced conditions

Environmental Consequences and Mitigation Measures Summary

The sections below describe the environmental consequences of the program alternatives, and proposed mitigation measures for any impacts determined to be significant or potentially significant. All alternatives are evaluated under existing and future conditions and compared to existing and future baselines. For the existing condition evaluation (2005 level of development), a CalSim-II simulation for the existing condition is used as the basis for comparison. Similarly, the future conditions evaluation (2030 level of development) uses a CalSim-II simulation of the No-Action Alternative as a basis of comparison. Each of the alternatives is simulated using the same levels of development so that any changes from the basis of comparison in surface water supply and facilities operations can be attributed to the alternative. Impacts and mitigation measures are summarized in Table 13-52.

13.3.2 Program-Level Impacts and Mitigation Measures

This section determines the significance of impacts related to program-level actions defined in Chapter 2.0, "Description of Alternatives," based on impact indicators previously described.

No-Action Alternative

Under the No-Action Alternative, the Settlement would not be implemented. The No-Action Alternative includes conditions in the study area in 2030, meaning those projects and programs considered reasonably foreseeable by that time. The San Joaquin River Basin has experienced numerous physical and institutional changes over the decades, and continues to experience change. The several changes addressed in the 2030 level of development that would lead to substantive change in hydrologic outcome, compared to the 2005 level of development simulation, include the following:

- Land-use conversion from agricultural demand to urban demand
- Source of water to meet the change in land use
- Drainage to the San Joaquin River

Operational assumptions that remain constant between the 2005 and 2030 levels of development include the following:

- All current tributary and San Joaquin River mainstem flow requirements and other regulatory requirements would remain in place for the 2030 level of development.
- All current water exchanges, transfers, and sales explicitly or implicitly modeled in the current level of development would remain in place for the 2030 level of development.
- Water use efficiency would remain the same between the current and 2030 level of development.
- Tributary inflow (rim flows) would remain the same.

Additional information regarding the differences between the 2005 and 2030 levels of development is found in Appendix H, "Modeling." Each of these changes could result in impacts, as determined by the various impact indicators and significance criteria defined in Table 13-53.

Impact SWS-1 (No-Action Alternative): ***Changes in Diversion Capacities – Program-Level.*** No program-level impacts are anticipated in the study area under the No-Action Alternative. There would be **no impact**.

Alternatives A1 through C2

At the program level, Alternatives A1 through C2 include a range of actions for achieving the Restoration and Water Management goals. Program-level actions included in Alternatives A1 through C2 with potential to affect surface water supplies and facilities operations are described in this subsection, based on the impact indicators and significance criteria defined in Table 13-53.

Impact SWS-1 (Alternatives A1 through C2): ***Changes in Diversion Capacities – Program-Level.*** Construction activities related to the Restoration Goal of the Settlement in Alternatives A1 through C2 have potential to impede existing diversion facilities or equipment. Therefore, this impact would be **potentially significant**.

Mitigation Measure SWS-1 (Alternatives A1 through C2): ***Provide Alternative Temporary or Permanent River Access to Avoid Diversion Losses – Program-Level.*** If the potential for significant impacts to existing operational diversion facilities due to construction activities is identified during site-specific studies, the project proponent would provide alternative equivalent pumping capacity. Permanent diversion facility relocations would be incorporated in the designs of any restoration action that would permanently impact existing facilities. With mitigation, this impact would be **less than significant**.

13.3.3 Project-Level Impacts and Mitigation Measures

This section determines the significance of project-level impacts related to the reoperation of Friant Dam based on the impact indicators and significance criteria defined in Table 13-53. Because sufficient information is available to do so, the potential impacts of program-level actions under Alternatives B1 through C2 associated with changes in water levels in the south Delta and excess water conditions in the Delta are evaluated at a project level of detail in this subsection, according to the significance criteria defined in Table 13-53. These program-level actions include actions for the recapture of Interim and Restoration flows in the San Joaquin River below the confluence of the Merced River using existing facilities with potential in-district modifications (Alternatives B1 through C2), and construction of new infrastructure to increase pumping capacity on the San Joaquin River below the confluence of the Merced River (Alternatives C1 and C2). Impacts related to these actions outside of the Delta, including changes in diversion capacities could occur under these alternatives, and are addressed at the program level in this and other chapters of the Draft PEIS/R. Reclamation would file petitions to change Permits 11885, 11886, and 11887 to implement the action alternatives.

No-Action Alternative

The several No-Action Alternative changes and assumptions addressed in the 2030 level of development compared to the 2005 level of development simulation are described in Section 13.3.2, "Program Level Impacts and Mitigation Measures." Each of these changes could result in different Delta conditions and could result in impacts, as determined by the various impact indicators and significance criteria defined in Table 13-53 and described below.

Impact SWS-2 (No-Action Alternative): ***Change in Water Levels in the Old River near the Tracy Road Bridge – Project-Level.*** Water levels in the Old River near Tracy Road Bridge could be lower under the No-Action Alternative than existing conditions, but changes in water level of this magnitude and frequency would not adversely affect agricultural users' ability to divert irrigation water. Therefore, this impact would be **less than significant**.

As shown in Table 13-54, some noticeable differences in water level could occur in the Old River near the Tracy Road Bridge. These differences would be due to the construction of permanent operable barriers rather than the temporary barriers currently in place. Specifically, the permanent barriers would use different gate operations than the temporary barriers, resulting in typically decreased water levels under the No-Action Alternative. These decreases in water level, however, would not go below the identified threshold of 0.0 feet at msl and thus would not adversely affect agricultural users' ability to divert irrigation water. Therefore, this impact would be less than significant.

Table 13-54.
Simulated Monthly Maximum 15-Minute Change in Water Levels at Old River near Tracy Road Bridge at Low-Low Tide

Month	Existing Level (2005)			Future Level (2030)			
	Alt A1 and A2 (ft msl)	Alt B1 and B2 (ft msl)	Alt C1 and C2 (ft msl)	No-Action Alt (ft msl)	Alt A1 and A2 (ft msl)	Alt B1 and B2 (ft msl)	Alt C1 and C2 (ft msl)
April	-0.09 (0%)	-0.09 (0%)	-0.09 (0%)	-0.38 (0%)	-0.08 (0%)	-0.08 (0%)	-0.08 (0%)
May	-0.37 (0%)	-0.37 (0%)	-0.37 (0%)	-1.67 (0%)	-0.31 (0%)	-0.31 (0%)	-0.31 (0%)
June	-0.53 (0%)	-0.53 (0%)	-0.53 (0%)	-3.06 (0%)	-0.58 (0%)	-0.58 (0%)	-0.58 (0%)
July	-0.20 (0%)	-0.20 (0%)	-0.20 (0%)	-3.08 (0%)	-0.19 (0%)	-0.19 (0%)	-0.19 (0%)
August	-0.07 (0%)	-0.07 (0%)	-0.07 (0%)	-2.58 (0%)	-0.05 (0%)	-0.05 (0%)	-0.06 (0%)
September	-0.02 (0%)	-0.02 (0%)	-0.02 (0%)	-1.95 (0%)	-0.89 (0%)	-0.89 (0%)	-0.89 (0%)
October	-0.03 (0%)	-0.03 (0%)	-0.03 (0%)	-1.47 (0%)	-0.15 (0%)	-0.15 (0%)	-0.15 (0%)

Source: DSM2 simulations (Node 071_3116)

Notes:

Simulation period: October 1921 – September 2003.

(%) indicates percent of months with a maximum decrease in water level exceeding 0.1 feet resulting in a water level below the identified limit.

Key:
Alt = Alternative
ft msl = feet mean sea level

Impact SWS-3 (No-Action Alternative): *Change in Water Levels in the Grant Line Canal near the Grant Line Canal Barrier – Project-Level.* Water levels in the Grant Line Canal near the Grant Line Canal Barrier, as shown in Table 13-55, could be lower under the No-Action Alternative than the existing conditions because of differences in operation of south Delta barriers, but would not adversely affect agricultural users' ability to divert irrigation water. Therefore, this impact would be **less than significant**.

Table 13-55.
Simulated Monthly Maximum 15-Minute Change in Water Levels at Grant Line Canal near Grant Line Canal Barrier at Low-Low Tide

Month	Existing Level (2005)			Future Level (2030)			
	Alt A1 and A2 (ft msl)	Alt B1 and B2 (ft msl)	Alt C1 and C2 (ft msl)	No-Action Alt (ft msl)	Alt A1 and A2 (ft msl)	Alt B1 and B2 (ft msl)	Alt C1 and C2 (ft msl)
April	-0.08 (0%)	-0.08 (0%)	-0.08 (0%)	0.00 (0%)	-0.08 (0%)	-0.08 (0%)	-0.08 (0%)
May	-0.36 (0%)	-0.36 (0%)	-0.36 (0%)	-1.12 (0%)	-0.32 (0%)	-0.32 (0%)	-0.32 (0%)
June	-0.58 (0%)	-0.58 (0%)	-0.58 (0%)	-2.84 (0%)	-0.57 (0%)	-0.57 (0%)	-0.57 (0%)
July	-0.21 (0%)	-0.21 (0%)	-0.21 (0%)	-2.79 (0%)	-0.20 (0%)	-0.20 (0%)	-0.20 (0%)
August	-0.07 (0%)	-0.07 (0%)	-0.07 (0%)	-2.31 (0%)	-0.05 (0%)	-0.05 (0%)	-0.05 (0%)
September	-0.02 (0%)	-0.02 (0%)	-0.02 (0%)	-1.39 (0%)	-0.27 (0%)	-0.27 (0%)	-0.27 (0%)
October	-0.03 (0%)	-0.03 (0%)	-0.03 (0%)	-1.52 (0%)	-0.14 (0%)	-0.14 (0%)	-0.14 (0%)

Source: DSM2 simulations (Node 206_5533)

Notes:

Simulation period: October 1921 – September 2003.

(%) indicates percent of months with a maximum decrease in water level exceeding 0.1 feet resulting in a water level below the identified limit.

Key:
Alt = Alternative
ft msl = feet mean sea level

Impact SWS-4 (No-Action Alternative): ***Change in Water Levels in the Middle River near the Howard Road Bridge – Project-Level.*** Water levels in the Middle River near the Howard Road Bridge, as shown in Table 13-56, could be lower under the No-Action Alternative than the existing conditions because of differences in operation of south Delta barriers, but would not adversely affect agricultural users' ability to divert irrigation water. Therefore, this impact would be **less than significant**.

Table 13-56.
Simulated Monthly Maximum 15-Minute Change in Water Levels at Middle River near Howard Road Bridge at Low-Low Tide

Month	Existing Level (2005)			Future Level (2030)			
	Alt A1 and A2 (ft msl)	Alt B1 and B2 (ft msl)	Alt C1 and C2 (ft msl)	No-Action Alt (ft msl)	Alt A1 and A2 (ft msl)	Alt B1 and B2 (ft msl)	Alt C1 and C2 (ft msl)
April	-0.06 (0%)	-0.06 (0%)	-0.06 (0%)	-0.26 (0%)	-0.08 (0%)	-0.08 (0%)	-0.08 (0%)
May	-0.28 (0%)	-0.28 (0%)	-0.28 (0%)	-0.68 (0%)	-0.37 (0%)	-0.37 (0%)	-0.37 (0%)
June	-0.45 (0%)	-0.45 (0%)	-0.45 (0%)	-1.35 (0%)	-0.53 (0%)	-0.53 (0%)	-0.53 (0%)
July	-0.16 (0%)	-0.16 (0%)	-0.16 (0%)	-0.96 (0%)	-0.54 (0%)	-0.55 (0%)	-0.55 (0%)
August	-0.03 (0%)	-0.04 (0%)	-0.04 (0%)	-1.02 (0%)	-0.05 (0%)	-0.05 (0%)	-0.05 (0%)
September	-0.01 (0%)	-0.01 (0%)	-0.01 (0%)	-1.01 (0%)	-0.32 (0%)	-0.33 (0%)	-0.32 (0%)
October	-0.02 (0%)	-0.02 (0%)	-0.02 (0%)	-0.66 (0%)	-0.15 (0%)	-0.15 (0%)	-0.15 (0%)

Source: DSM2 simulations (Node 129_5691)

Notes:

Simulation period: October 1921 – September 2003.

(%) indicates percent of months with a maximum decrease in water level exceeding 0.1 feet resulting in a water level below the identified limit.

Key:
Alt = Alternative
ft msl = feet mean sea level

Impact SWS-5 (No-Action Alternative): ***Change in Recurrence of Delta Excess Conditions – Project-Level.*** The No-Action Alternative could result in a change of recurrence of Delta excess conditions at a frequency potentially impacting CCWD's ability to fill Los Vaqueros Reservoir. Therefore, this impact would be **potentially significant**.

As shown in Table 13-57, the No-Action Alternative would cause several changes from excess to balanced conditions compared to the existing conditions. This reduction in Delta excess conditions would be caused by increased water supply demand. Based on the frequency of these changes, this could adversely affect Los Vaqueros Reservoir filling operations and this impact would be potentially significant. Since this potentially significant impact results from the No-Action Alternative, no mitigation is required.

Table 13-57.
Simulated Number of Years the Delta Changes from Excess to Balanced Condition for the No-Action Alternative

Comparison Level	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Existing Conditions	12 (15%)	4 (5%)	2 (2%)	1 (1%)	1 (1%)	0 (0%)	0 (0%)	4 (5%)

Source: Summarized from CalSim-II 2005 and 2030 simulations

Notes:

Simulation period: 1922 – 2003.

Significance criteria apply for period between November 1 and June 30.

(%) indicates percentage of months Delta condition change occurs.

Alternatives A1 and A2

Alternatives A1 and A2 include reoperating Friant Dam, and the potential for incidental recapture of Interim and Restoration flows in the Delta using existing facilities, operated under existing operating criteria. The actions included in Alternatives A1 and A2 with potential to affect Delta surface water supplies and facilities operations, based on the impact indicators and significance criteria defined in Table 13-53, are project-specific in nature and are described in this subsection.

Impact SWS-2 (Alternatives A1 and A2): ***Change in Water Levels in the Old River near the Tracy Road Bridge – Project-Level.*** Alternatives A1 and A2 would not directly change Delta operations, but instead would change Delta conditions because of indirect effects of Interim and Restoration flows from the San Joaquin River reaching the Delta. These changed conditions could alter the quantity and timing of Jones and Banks pumping in the south Delta, which could impact south Delta water levels. This impact would be **less than significant**.

As shown in Table 13-54, water level decreases greater than 0.1 feet in the Old River near the Tracy Road Bridge that also result in water levels below the identified threshold rarely occurred in the simulated irrigation months during the late spring. The greatest decreases were 0.53 feet and 0.89 feet compared to the existing conditions and No-Action Alternative, respectively, yet these maximum decreases would not violate the threshold and would not adversely affect agricultural users' ability to divert irrigation water. This impact would be less than significant.

Impact SWS-3 (Alternatives A1 and A2): ***Change in Water Levels in the Grant Line Canal near the Grant Line Canal – Project-Level.*** Alternatives Al and A2 would not directly change Delta operations, but instead would change Delta conditions because of indirect effects of Interim and Restoration flows from the San Joaquin River reaching the Delta. These changed conditions could alter the quantity and timing of Jones and Banks pumping in the south Delta, which could impact south Delta water levels. This impact would be **less than significant**.

As shown in Table 13-55, water level decreases greater than 0.1 feet in the Grant Line Canal near the Grant Line Canal Barrier that also result in water levels below the identified limit rarely occurred in the simulated irrigation months during the late spring. The greatest decreases were 0.58 feet and 0.57 feet compared to the existing conditions and No-Action Alternative, respectively, yet these maximum decreases do not violate the threshold and would not adversely affect agricultural users' ability to divert irrigation water. This impact would be less than significant.

Impact SWS-4 (Alternatives A1 and A2): ***Change in Water Levels in the Middle River near the Howard Road Bridge – Project-Level.*** Alternatives A1 and A2 would not directly change Delta operations, but instead would change Delta conditions because of indirect effects of Interim and Restoration flows from the San Joaquin River reaching the Delta. These changed conditions could alter the quantity and timing of Jones and Banks pumping in the south Delta, which could impact south Delta water levels. This impact would be **less than significant**.

As shown in Table 13-56, water level decreases greater than 0.1 feet in the Middle River near the Howard Road Bridge that also result in water levels below the identified limit rarely occurred in the simulated irrigation months during the late spring. The greatest decreases were 0.45 feet and 0.55 feet compared to the existing conditions and No-Action Alternative, respectively, yet these maximum decreases would not violate the threshold and would not adversely affect agricultural users' ability to divert irrigation water. This impact would be less than significant.

Impact SWS-5 (Alternatives A1 and A2): ***Change in Recurrence of Delta Excess Conditions – Project-Level.*** Alternatives A1 and A2 would not result in a change of recurrence of Delta excess conditions at a frequency potentially impacting CCWD's ability to fill Los Vaqueros Reservoir. Therefore, this impact would be **less than significant**.

As shown in Table 13-58, Alternatives A1 and A2 would cause very few changes from excess to balanced conditions compared to the existing conditions and No-Action Alternative during the critical months of November through June. February was most impacted, but even this frequency of change in the simulation record is relatively small. A major factor resulting in these infrequent impacts is a periodic reduction of San Joaquin River flood flows due to changes in Millerton Lake storages. These changes in Millerton Lake storages result in changing flood operations. The impacted months, however, were scattered throughout the simulation record and were not clustered in one season such that CCWD's ability to fill Los Vaqueros Reservoir would be substantially affected. This impact would be less than significant.

Table 13-58.
Simulated Number of Years the Delta Changes from Excess to Balanced Condition for Alternatives A1 and A2

Comparison Level	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Existing Conditions	2 (2%)	3 (4%)	2 (2%)	3 (4%)	1 (1%)	1 (1%)	0 (0%)	0 (0%)
No-Action Alternative	1 (1%)	2 (2%)	2 (2%)	6 (7%)	0 (0%)	0 (0%)	2 (2%)	3 (4%)

Source: Summarized from CalSim-II 2005 and 2030 simulations.

Notes:

Simulation period: 1922 – 2003.

Significance criteria apply for period between November 1 and June 30.

(%) indicates percentage of months Delta condition change occurs.

Alternatives B1 and B2

Alternatives B1 and B2 include the same actions for achieving the Restoration and Water Management goals as Alternatives A1 and A2. Alternatives B1 and B2 also include additional, program-level recapture and exchange of Interim and Restoration flows in the San Joaquin River below the confluence of the Merced River using existing facilities. As previously described, the actions included in Alternatives B1 and B2 with potential to affect Delta surface water supplies and facilities operations (based on the impact indicators and significance criteria defined in Table 13-53) are sufficiently defined at this time to allow a project-level evaluation as described in this subsection.

Impact SWS-2 (Alternatives B1 and B2): ***Change in Water Levels in the Old River near the Tracy Road Bridge – Project-Specific.*** Settlement implementation would not directly change Delta operations, but instead would change Delta conditions because of indirect effects of Interim and Restoration flows from the San Joaquin River reaching the Delta. These changed conditions could alter the quantity and timing of Jones and Banks pumping in the south Delta, which could impact south Delta water levels. This impact would be **less than significant**.

This impact would be similar to Impact SWS-2 for Alternatives A1 and A2.

Impact SWS-3 (Alternatives B1 and B2): ***Change in Water Levels in the Grant Line Canal near the Grant Line Canal Barrier – Project-Specific.*** Settlement implementation would not directly change Delta operations, but instead would change Delta conditions because of indirect effects of Interim and Restoration flows from the San Joaquin River reaching the Delta. These changed conditions could alter the quantity and timing of Jones and Banks pumping in the south Delta, which could impact south Delta water levels. This impact would be **less than significant**.

This impact would be similar to Impact SWS-3 for Alternatives A1 and A2.

Impact SWS-4 (Alternatives B1 and B2): ***Change in Water Levels in the Middle River near the Howard Road Bridge – Project-Specific.*** Settlement implementation would not directly change Delta operations, but instead would change Delta conditions because of indirect effects of Interim and Restoration flows from the San Joaquin River reaching the Delta. These changed conditions could alter the quantity and timing of Jones and Banks pumping in the South Delta, which could impact south Delta water levels. This impact would be **less than significant**.

This impact would be similar to Impact SWS-4 for Alternatives A1 and A2.

Impact SWS-5 (Alternatives B1 and B2): ***Change in Recurrence of Delta Excess Conditions – Project-Specific.*** Alternatives B1 and B2 would not result in a change of recurrence of Delta excess conditions at a frequency potentially impacting CCWD's ability to fill Los Vaqueros Reservoir. Therefore, this impact would be **less than significant**.

As shown in Table 13-59, Alternatives B1 and B2 would cause very few changes from excess to balanced conditions compared to the existing conditions and No-Action Alternative during the critical months of November through June. February was most impacted, but even this frequency of change in the simulation record is relatively small. A major factor resulting in these infrequent impacts is a periodic reduction of San Joaquin River flood flows due to changes in Millerton Lake storages. Changes in Millerton Lake storages result in changing flood operations. The impacted months, however, were scattered throughout the simulation record and were not clustered in one season such that CCWD's ability to fill Los Vaqueros Reservoir would be substantially affected. This impact would be less than significant.

Table 13-59.
Simulated Number of Years the Delta Changes from Excess to Balanced Conditions for Alternatives B1 and B2

Comparison Level	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Existing Conditions	2 (2%)	4 (5%)	2 (2%)	3 (4%)	2 (2%)	1 (1%)	0 (0%)	0 (0%)
No-Action Alternative	1 (1%)	3 (4%)	2 (2%)	6 (7%)	0 (0%)	0 (0%)	2 (2%)	5 (6%)

Source: Summarized from CalSim-II 2005 and 2030 simulations
Notes:
Simulation period: 1922 – 2003.
Significance criteria apply for period between November 1 and June 30.
(%) indicates percentage of months Delta condition change occurs.

Alternatives C1 and C2

Alternatives C1 and C2 include the same actions for achieving the Restoration and Water Management goals as in Alternatives A1, A2, B1, and B2. In addition, Alternatives C1 and C2 include additional recapture and exchange of Interim and Restoration flows through construction of new infrastructure to increase pumping capacity on the San Joaquin River below the confluence of the Merced River. As previously described, the actions included in Alternatives C1 and C2 with potential to affect Delta surface water supplies and facilities operations (based on the impact indicators and significance criteria defined in Table 13-53) are sufficiently defined at this time to allow a project-level evaluation as described in this subsection.

Impact SWS-2 (Alternatives C1 and C2): ***Change in Water Levels in the Old River near the Tracy Road Bridge – Project-Specific.*** Settlement implementation would not directly change Delta operations, but instead would change Delta conditions because of indirect effects of Interim and Restoration flows from the San Joaquin River reaching the Delta. These changed conditions could alter the quantity and timing of Jones and Banks pumping in the South Delta, which could impact south Delta water levels. This impact would be **less than significant**.

This impact would be similar to Impact SWS-2 for Alternatives A1 and A2.

Impact SWS-3 (Alternatives C1 and C2): ***Change in Water Levels in the Grant Line Canal near the Grant Line Canal Barrier – Project-Specific.*** Settlement implementation would not directly change Delta operations, but instead would change Delta conditions because of indirect effects of Interim and Restoration flows from the San Joaquin River reaching the Delta. These changed conditions could alter the quantity and timing of Jones and Banks pumping in the south Delta, which could impact south Delta water levels. This impact would be **less than significant**.

This impact would be similar to Impact SWS-3 for Alternatives A1 and A2.

Impact SWS-4 (Alternatives C1 and C2): ***Change in Water Levels in the Middle River near the Howard Road Bridge – Project-Specific.*** Settlement implementation would not directly change Delta operations, but instead would change Delta conditions because of indirect effects of Interim and Restoration flows from the San Joaquin River reaching the Delta. These changed conditions could alter the quantity and timing of Jones and Banks pumping in the south Delta, which could impact south Delta water levels. This impact would be **less than significant**.

This impact would be similar to Impact SWS-4 for Alternatives A1 and A2.

Impact SWS-5 (Alternatives C1 and C2): ***Change in Recurrence of Delta Excess Conditions – Project-Specific.*** Alternatives C1 and C2 would not result in a change of recurrence of Delta excess conditions at a frequency potentially impacting CCWD's ability to fill Los Vaqueros Reservoir. Therefore, this impact would be **less than significant**.

As shown in Table 13-60, Alternatives C1 and C2 would cause very few changes from excess to balanced conditions compared to the existing conditions and No-Action Alternative during the critical months of November through June. February was most impacted, but even this frequency of change in the simulation record is relatively small. A major factor resulting in these infrequent impacts is a periodic reduction of San Joaquin River flood flows due to changes in Millerton Lake storages. Changes in Millerton Lake storages result in changing flood operations. The impacted months, however, were scattered throughout the simulation record and were not clustered in one season such that CCWD's ability to fill Los Vaqueros Reservoir would be substantially affected. This impact would be less than significant.

Table 13-60.
Simulated Number of Years the Delta Changes from Excess to Balanced Conditions for Alternatives C1 and C2

Comparison Level	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Existing Conditions	4 (5%)	4 (5%)	2 (2%)	2 (2%)	1 (1%)	1 (1%)	0 (0%)	0 (0%)
No-Action Alternative	1 (1%)	2 (2%)	2 (2%)	6 (7%)	0 (0%)	1 (1%)	2 (2%)	5 (6%)

Source: Summarized from CalSim-II 2005 and 2030 simulations

Notes:

Simulation period: 1922 – 2003.

Significance criteria apply for period between November 1 and June 30.

(%) indicates percentage of months Delta condition change occurs.

13.3.4 Changes to Restoration Area Flows and CVP and SWP Operations

Each of the program alternatives would have similar effects on San Joaquin River flows and CVP and SWP operations compared to either the existing conditions or the No-Action Alternative. However, the magnitude of the changes may vary according to the alternative. Results are summarized below and represent changes to flows, storages, and diversions. These results are presented in more detail (e.g., year type tables) in Appendix H, “Modeling.” While these results do not directly affect the analysis of impacts in this chapter (see Table 13-53), these results may be post-processed to meet the needs for analysis of significant impacts of Interim and Restoration flows in additional resource areas (e.g., impacts to Friant Division water supply in Chapter 22.0, “Socioeconomics”). These processes are described in corresponding sections of the PEIS/R.

San Joaquin River Upstream from Friant Dam

Under the No-Action Alternative, releases and diversions are made from Millerton Lake to satisfy downstream Holding Contract requirements, Friant Division demands, and flood management requirements. Interim and Restoration flows in the program alternatives would affect average end-of-month storages in Millerton Lake, as seen in Tables 13-61 and 13-62 and Figures 13-32 and 13-33. Larger decreases in wetter months (October to May) would be due to the release of Interim and Restoration flows and the diversion of 16(b) water. Millerton Lake levels fluctuate greatly in most years due to large water supply demands on a reservoir undersized for the annual inflow. This condition would not change under the program alternatives, and fluctuations in reservoir levels would remain within historical operational levels. Interim and Restoration flows and operations of Friant Dam would be similar for each alternative, as seen in Tables 13-61 and 13-62 and Figures 13-32 and 13-33.

Table 13-61.
Average Simulated End-of-Month Millerton Lake Storage

Month	Existing Level (2005)[1]				Future Level (2030)[1]			
	Existing Conditions (TAF)	Alt A1 and A2 (TAF)[2]	Alt B1 and B2 (TAF)[2]	Alt C1 and C2 (TAF)[2]	No-Action Alt (TAF)[2]	Alt A1 and A2 (TAF)[3]	Alt B1 and B2 (TAF)[3]	Alt C1 and C2 (TAF)[3]
Oct	241	217 (-10%)	217 (-10%)	217 (-10%)	241 (0%)	217 (-10%)	217 (-10%)	217 (-10%)
Nov	280	239 (-15%)	239 (-15%)	239 (-15%)	280 (0%)	238 (-15%)	238 (-15%)	238 (-15%)
Dec	325	277 (-15%)	277 (-15%)	277 (-15%)	325 (0%)	277 (-15%)	277 (-15%)	277 (-15%)
Jan	369	323 (-12%)	323 (-12%)	323 (-12%)	369 (0%)	323 (-12%)	323 (-12%)	323 (-12%)
Feb	387	356 (-8%)	356 (-8%)	356 (-8%)	387 (0%)	356 (-8%)	356 (-8%)	356 (-8%)
Mar	418	368 (-12%)	368 (-12%)	368 (-12%)	418 (0%)	367 (-12%)	367 (-12%)	367 (-12%)
Apr	444	333 (-25%)	333 (-25%)	333 (-25%)	444 (0%)	333 (-25%)	333 (-25%)	333 (-25%)
May	452	375 (-17%)	375 (-17%)	375 (-17%)	452 (0%)	375 (-17%)	375 (-17%)	375 (-17%)
Jun	446	399 (-10%)	399 (-10%)	399 (-10%)	446 (0%)	399 (-11%)	399 (-11%)	399 (-11%)
Jul	348	317 (-9%)	317 (-9%)	317 (-9%)	348 (0%)	317 (-9%)	317 (-9%)	317 (-9%)
Aug	245	227 (-8%)	227 (-8%)	227 (-8%)	245 (0%)	227 (-8%)	227 (-8%)	227 (-8%)
Sep	230	214 (-7%)	214 (-7%)	214 (-7%)	230 (0%)	214 (-7%)	214 (-7%)	214 (-7%)

Source: Summarized from CALSIM II 2005 and 2030 simulations (Node S18)

Notes:
[1] Simulation period: January 1980 – September 2003.
[2] (%) indicates percent change from existing conditions.
[3] (%) indicates percent change from No-Action Alternative.

Key:
Alt = Alternative
TAF = thousand acre-feet

**Table 13-62.
Average Simulated End-of-Month Millerton Lake Storage
in Dry and Critical Years[1]**

Month	Existing Level (2005)[2]				Future Level (2030)[2]			
	Existing Conditions (TAF)	Alt A1 and A2 (TAF)[3]	Alt B1 and B2 (TAF)[3]	Alt C1 and C2 (TAF)[3]	No-Action Alt (TAF)[3]	Alt A1 and A2 (TAF)[4]	Alt B1 and B2 (TAF)[4]	Alt C1 and C2 (TAF)[4]
Oct	175	163 (-7%)	163 (-7%)	163 (-7%)	175 (0%)	161 (-8%)	161 (-8%)	161 (-8%)
Nov	191	164 (-14%)	164 (-14%)	164 (-14%)	191 (0%)	163 (-15%)	163 (-15%)	163 (-15%)
Dec	231	195 (-16%)	195 (-16%)	195 (-16%)	231 (0%)	194 (-16%)	194 (-16%)	194 (-16%)
Jan	300	266 (-12%)	266 (-12%)	266 (-12%)	300 (0%)	264 (-12%)	264 (-12%)	264 (-12%)
Feb	331	307 (-7%)	307 (-7%)	307 (-7%)	331 (0%)	306 (-7%)	306 (-7%)	306 (-7%)
Mar	372	270 (-28%)	270 (-28%)	270 (-28%)	372 (0%)	268 (-28%)	268 (-28%)	268 (-28%)
Apr	424	322 (-24%)	322 (-24%)	322 (-24%)	424 (0%)	321 (-24%)	321 (-24%)	321 (-24%)
May	419	334 (-20%)	334 (-20%)	334 (-20%)	419 (0%)	332 (-21%)	332 (-21%)	332 (-21%)
Jun	334	272 (-19%)	272 (-19%)	272 (-19%)	334 (0%)	270 (-19%)	270 (-19%)	270 (-19%)
Jul	222	184 (-17%)	184 (-17%)	184 (-17%)	222 (0%)	182 (-18%)	182 (-18%)	182 (-18%)
Aug	159	148 (-7%)	148 (-7%)	148 (-7%)	159 (0%)	147 (-8%)	147 (-8%)	147 (-8%)
Sep	174	169 (-3%)	169 (-3%)	169 (-3%)	174 (0%)	168 (-3%)	168 (-3%)	168 (-3%)

Source: Summarized from CALSIM II 2005 and 2030 simulations (Node S18)

Notes:
[1] Dry and critical years as defined by the Restoration Year Type.
[2] Simulation period: January 1980 – September 2003.
[3] (%) indicates percent change from existing conditions.
[4] (%) indicates percent change from No-Action Alternative.

Key:
Alt = Alternative
TAF = thousand acre-feet

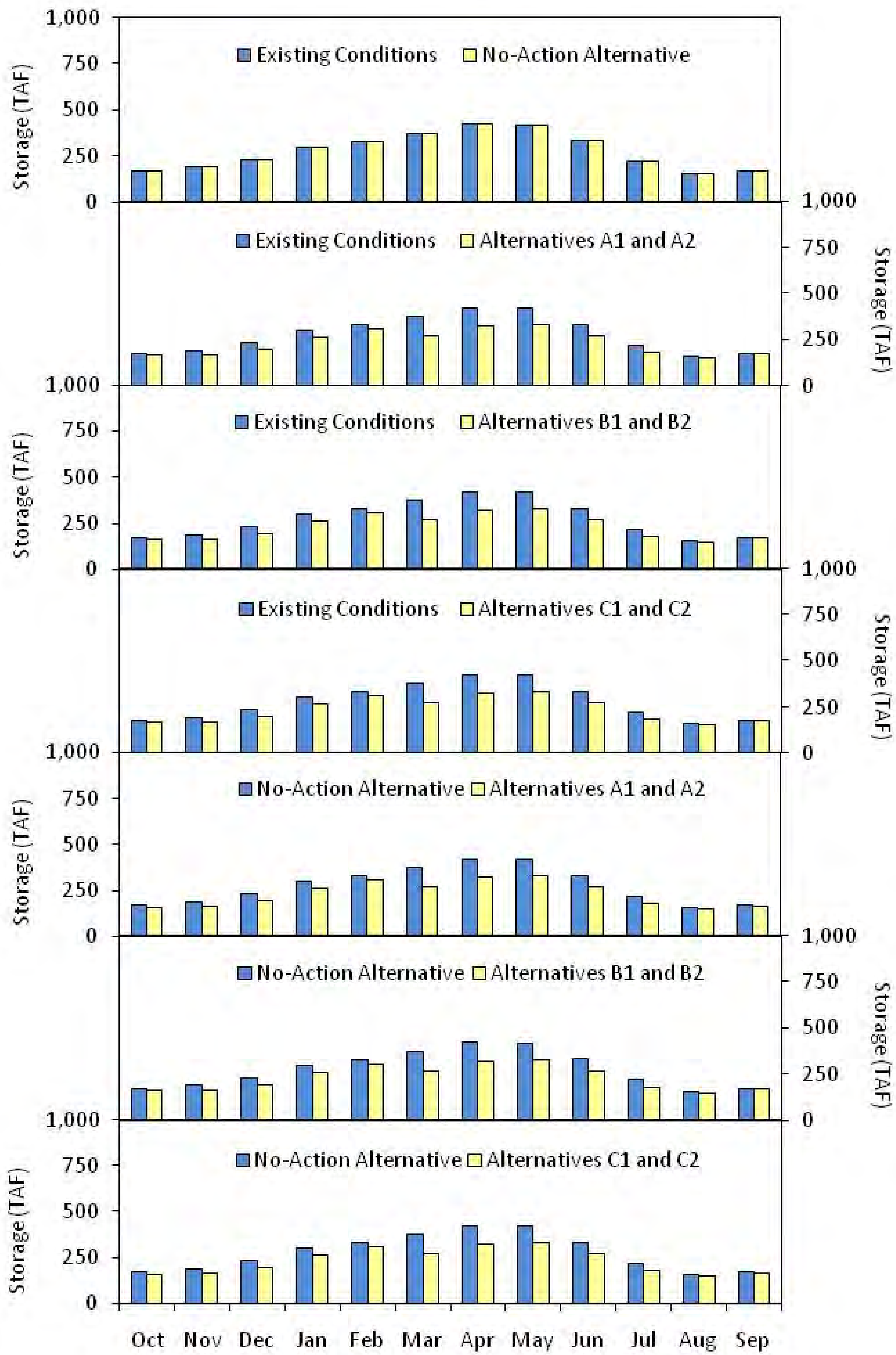


Figure 13-33.
Average Simulated End-of-Month Millerton Lake Storage in Dry and Critical Years

San Joaquin River from Friant Dam to the Merced River – Restoration Area

Flow changes within the Restoration Area reaches and flood bypasses would be similar for all alternatives, as the releases from Friant Dam and potential restoration actions would be similar across alternatives. The maximum nonflood releases common to all program alternatives are shown in Tables 13-63 through 13-68. These tables also show the maximum amount of water that could be available for recapture if there are no physical or institutional constraints on recapture and conveyance. Current constraints would reduce this maximum recapture amount.

Table 13-63.
Maximum Nonflood Friant Dam Releases to San Joaquin River and Maximum Potential Water Recapture in Wet Years[1]

Begin Date	End Date	Friant Dam Releases According to Settlement[2] (cfs)	Reach 1 Holding Contract Diversions Estimated as in Exhibit B[3] (cfs)	Friant Dam Releases Eligible for Recapture[3] (cfs)
March 1	March 15	500	130	370
March 16	March 31	1,500	130	1,370
April 1	April 15	2,500	150	2,350
April 16	April 30	4,000	150	3,850
May 1	June 30	2,000	190	1,810
July 1	August 31	350	230	120
September 1	September 30	350	210	140
October 1	October 31	350	160	190
November 1	November 10	700	130	570
November 11	December 31	350	120	230
January 1	February 28	350	100	250
Total Flows Released (TAF)		**673**	**Total Available for Transfer[4] (TAF)**	**556**
Potential Buffer Flows (TAF)		**67**	**Potential Buffer Flows (TAF)**	**67**
Potential additional releases pursuant to paragraph 13(c) (TAF)		**60**	**Potential additional releases pursuant to paragraph 13(c), minus seepage[5] (TAF)**	**0**
Maximum total volume released (TAF)		**800**	**Maximum total volume available for transfer (TAF)**	**623**

Notes:
1 Wet years as defined by the Restoration Year Type.
2 Nonflood conditions.
3 Under existing conditions, Reclamation makes deliveries to riparian water right holders in Reach 1 under "holding contracts." The amounts in the table are approximate based on recent historical deliveries (1922 through 2004), as provided in Exhibit B of the Settlement. Water delivered to riparian water right holders would not be eligible for recapture.
4 Total eligible for recapture is a maximum potential total, and does not account for anticipated losses to seepage or other unanticipated losses.
5 Paragraph 13(c) requires the acquisition of purchased water to overcome seepage losses not anticipated in Exhibit B. Because these potential releases would only be made to overcome seepage, this water would not be available for transfer.

Key:
cfs = cubic feet per second TAF = thousand acre-feet

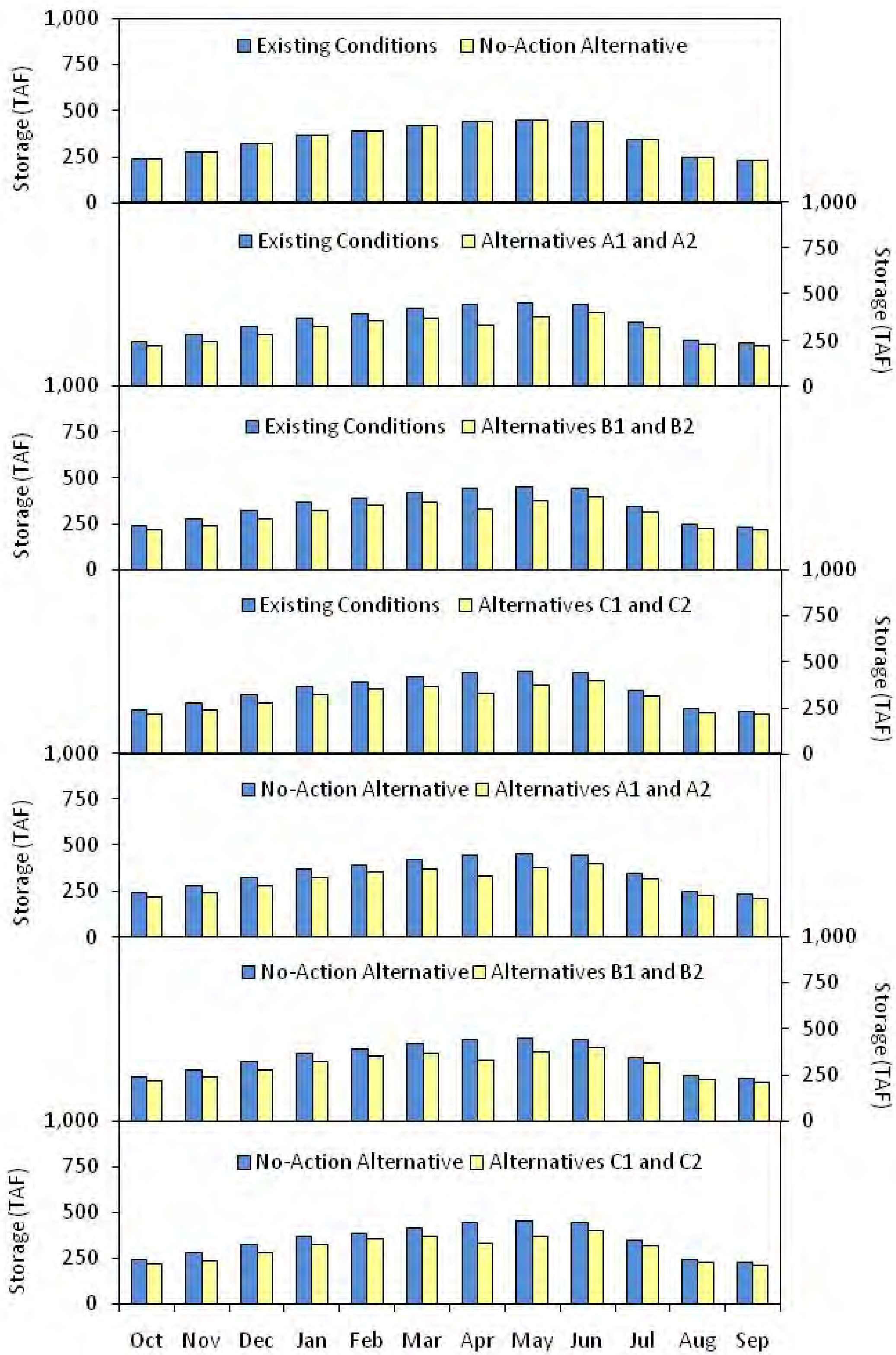


Figure 13-32.
Average Simulated End-of-Month Millerton Lake Storage

Table 13-64.
Maximum Nonflood Friant Dam Releases to San Joaquin River and Maximum Potential Water Recapture in Normal-Wet Years[1]

Begin Date	End Date	Maximum Releases from Friant Dam[2] (cfs)	Reach 1 Holding Contract Releases[3] (cfs)	Friant Release Minus Holding Contract Releases[3] (cfs)
March 1	March 15	500	130	370
March 16	March 31	1,500	130	1,370
April 1	April 15	2,500	150	2,350
April 16	April 30	4,000	150	3,850
May 1	June 30	350	190	160
July 1	August 31	350	230	120
September 1	September 30	350	210	140
October 1	October 31	350	160	190
November 1	November 10	700	130	570
November 11	December 31	350	120	230
January 1	February 28	350	100	250
Total Flows Released (TAF)		**473**	**Total Available for Transfer4 (TAF)**	**356**
Potential Buffer Flows (TAF)		**47**	**Potential Buffer Flows (TAF)**	**47**
Potential additional releases pursuant to paragraph 13(c) (TAF)		**60**	**Potential additional releases pursuant to paragraph 13(c), minus seepage5 (TAF)**	**0**
Maximum total volume released (TAF)		**580**	**Maximum total volume available for transfer (TAF)**	**403**

Notes:
[1] Normal-Wet years as defined by the Restoration Year-Type.
[2] Nonflood conditions.
[3] Under existing conditions, Reclamation makes deliveries to riparian water right holders in Reach 1 under “holding contracts.” The amounts in the table are approximate based on recent historical deliveries (1922 through 2004), as provided in Exhibit B of the Settlement. Water delivered to riparian water right holders would not be eligible for recapture.
[4] Total eligible for recapture is a maximum potential total, and does not account for anticipated losses to seepage or other unanticipated losses.
[5] Paragraph 13(c) requires the acquisition of purchased water to overcome seepage losses not anticipated in Exhibit B. Because these potential releases would only be made to overcome seepage, this water would not be available for transfer.

Key:
cfs = cubic feet per second
TAF = thousand acre-feet

Table 13-65.
Maximum Nonflood Friant Dam Releases to San Joaquin River and Maximum Potential Water Recapture in Normal-Dry Years[1]

Begin Date	End Date	Maximum Releases from Friant Dam[2] (cfs)	Reach 1 Holding Contract Releases[3] (cfs)	Friant Release Minus Holding Contract Releases[3] (cfs)
March 1	March 15	500	130	370
March 16	March 31	1,500	130	1,370
April 1	April 15	2,500	150	2,350
April 16	April 30	350	150	200
May 1	June 30	350	190	160
July 1	August 31	350	230	120
September 1	September 30	350	210	140
October 1	October 31	350	160	190
November 1	November 10	700	130	570
November 11	December 31	350	120	230
January 1	February 28	350	100	250
Total Flows Released (TAF)		**365**	**Total Available for Transfer[4] (TAF)**	**248**
Potential Buffer Flows (TAF)		**36**	**Potential Buffer Flows (TAF)**	**36**
Potential additional releases pursuant to paragraph 13(c) (TAF)		**60**	**Potential additional releases pursuant to paragraph 13(c), minus seepage[5] (TAF)**	**0**
Maximum total volume released (TAF)		**461**	**Maximum total volume available for transfer (TAF)**	**284**

Notes:
1 Normal-Dry years as defined by the Restoration Year Type.
2 Nonflood conditions.
3 Under existing conditions, Reclamation makes deliveries to riparian water right holders in Reach 1 under “holding contracts.” The amounts in the table are approximate based on recent historical deliveries (1922 through 2004), as provided in Exhibit B of the Settlement. Water delivered to riparian water right holders would not be eligible for recapture.
4 Total eligible for recapture is a maximum potential total, and does not account for anticipated losses to seepage or other unanticipated losses.
5 Paragraph 13(c) requires the acquisition of purchased water to overcome seepage losses not anticipated in Exhibit B. Because these potential releases would only be made to overcome seepage, this water would not be available for transfer.

Key:
cfs = cubic feet per second
TAF = thousand acre-feet

**Table 13-66.
Maximum Nonflood Friant Dam Releases to San Joaquin River and Maximum Potential Water Recapture in Dry Years[1]**

Begin Date	End Date	Maximum Releases from Friant Dam[2] (cfs)	Reach 1 Holding Contract Releases[3] (cfs)	Friant Release Minus Holding Contract Releases[3] (cfs)
March 1	March 15	500	130	370
March 16	March 31	1,500	130	1,370
April 1	April 15	350	150	200
April 16	April 30	350	150	200
May 1	June 30	350	190	160
July 1	August 31	350	230	120
September 1	September 30	350	210	140
October 1	October 31	350	160	190
November 1	November 10	700	130	570
November 11	December 31	350	120	230
January 1	February 28	350	100	250
Total Flows Released (TAF)		**301**	**Total Available for Transfer[4] (TAF)**	**184**
Potential Buffer Flows (TAF)		**30**	**Potential Buffer Flows (TAF)**	**30**
Potential additional releases pursuant to paragraph 13(c) (TAF)		**60**	**Potential additional releases pursuant to paragraph 13(c), minus seepage[5] (TAF)**	**0**
Maximum total volume released (TAF)		**391**	**Maximum total volume available for transfer (TAF)**	**214**

Notes:
1 Dry years as defined by the Restoration Year Type.
2 Nonflood conditions.
3 Under existing conditions, Reclamation makes deliveries to riparian water right holders in Reach 1 under “holding contracts.” The amounts in the table are approximate based on recent historical deliveries (1922 through 2004), as provided in Exhibit B of the Settlement. Water delivered to riparian water right holders would not be eligible for recapture.
4 Total eligible for recapture is a maximum potential total, and does not account for anticipated losses to seepage or other unanticipated losses.
5 Paragraph 13(c) requires the acquisition of purchased water to overcome seepage losses not anticipated in Exhibit B. Because these potential releases would only be made to overcome seepage, this water would not be available for transfer.

Key:
cfs = cubic feet per second
TAF = thousand acre-feet

Table 13-67.
Maximum Nonflood Friant Dam Releases to San Joaquin River and Maximum Potential Water Recapture in Critical-High Years[1]

Begin Date	End Date	Maximum Releases from Friant Dam[2] (cfs)	Reach 1 Holding Contract Releases[3] (cfs)	Friant Release Minus Holding Contract Releases[3] (cfs)
March 1	March 15	500	130	370
March 16	March 31	1,500	130	1,370
April 1	April 15	200	150	50
April 16	April 30	200	150	50
May 1	June 30	215	190	25
July 1	August 31	255	230	25
September 1	September 30	260	210	50
October 1	October 31	160	160	0
November 1	November 10	400	130	270
November 11	December 31	120	120	0
January 1	February 28	110	100	10
Total Flows Released (TAF)		**187**	**Total Available for Transfer[4] (TAF)**	**71**
Potential Buffer Flows (TAF)		**19**	**Potential Buffer Flows (TAF)**	**19**
Potential additional releases pursuant to paragraph 13(c) (TAF)		**60**	**Potential additional releases pursuant to paragraph 13(c), minus seepage[5] (TAF)**	**0**
Maximum total volume released (TAF)		**266**	**Maximum total volume available for transfer (TAF)**	**90**

Notes:
[1] Critical-High years as defined by the Restoration Year Type.
[2] Nonflood conditions.
[3] Under existing conditions, Reclamation makes deliveries to riparian water right holders in Reach 1 under "holding contracts." The amounts in the table are approximate based on recent historical deliveries (1922 through 2004), as provided in Exhibit B of the Settlement. Water delivered to riparian water right holders would not be eligible for recapture.
[4] Total eligible for recapture is a maximum potential total, and does not account for anticipated losses to seepage or other unanticipated losses.
[5] Paragraph 13(c) requires the acquisition of purchased water to overcome seepage losses not anticipated in Exhibit B. Because these potential releases would only be made to overcome seepage, this water would not be available for transfer.

Key:
cfs = cubic feet per second
TAF = thousand acre-feet

**Table 13-68.
Maximum Nonflood Friant Dam Releases to San Joaquin River and Maximum Potential Water Recapture in Critical-Low Years[1]**

Begin Date	End Date	Maximum Releases from Friant Dam[2] (cfs)	Reach 1 Holding Contract Releases[3] (cfs)	Friant Release Minus Holding Contract Releases[3] (cfs)
March 1	March 15	130	130	0
March 16	March 31	130	130	0
April 1	April 15	150	150	0
April 16	April 30	150	150	0
May 1	June 30	190	190	0
July 1	August 31	230	230	0
September 1	September 30	210	210	0
October 1	October 31	160	160	0
November 1	November 10	130	130	0
November 11	December 31	120	120	0
January 1	February 28	100	100	0
Total Flows Released (TAF)		**117**	**Total Available for Transfer[4] (TAF)**	**0**
Potential Buffer Flows (TAF)		**0**	**Potential Buffer Flows (TAF)**	**0**
Potential additional releases pursuant to paragraph 13(c) (TAF)		**0**	**Potential additional releases pursuant to paragraph 13(c), minus seepage[5] (TAF)**	**0**
Maximum total volume released (TAF)		**117**	**Maximum total volume available for transfer (TAF)**	**0**

Notes:
[1] Critical-Low years as defined by the Restoration Year Type.
[2] Nonflood conditions.
[3] Under existing conditions, Reclamation makes deliveries to riparian water right holders in Reach 1 under "holding contracts." The amounts in the table are approximate based on recent historical deliveries (1922 through 2004), as provided in Exhibit B of the Settlement. Water delivered to riparian water right holders would not be eligible for recapture.
[4] Total eligible for recapture is a maximum potential total, and does not account for anticipated losses to seepage or other unanticipated losses.
[5] Paragraph 13(c) requires the acquisition of purchased water to overcome seepage losses not anticipated in Exhibit B. Because these potential releases would only be made to overcome seepage, this water would not be available for transfer.

Key:
cfs = cubic feet per second
TAF = thousand acre-feet

The main difference in reach flows between program alternatives exists in the level of flows in Reach 4B, which distinguishes Alternative A1 from A2. Thus, Restoration Area reach flows for Alternatives B1 and C1 would be identical to Alternative A1, and Alternatives B2 and C2 would be identical to Alternative A2. Changes in Reach 1 flow due to Interim and Restoration flow releases from Friant Dam are shown in Tables 13-69 and 13-70 and Figures 13-34 and 13-35. The reduction of flow in some months would be due to changes in Millerton Lake storage, resulting from the effects of program alternatives on flood operations.

Table 13-69.
Average Simulated Flow at Head of Reach 1

Dates of Flow Release	Existing Level1 (2005)			Future Level[1] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1[2] (cfs)	Alt A2, B2, C2[2] (cfs)	No-Action Alt[2] (cfs)	Alt A1, B1, C1[3] (cfs)	Alt A2, B2, C2[3] (cfs)
Oct 1-31	182	363 (99%)	363 (99%)	183 (0%)	363 (99%)	363 (99%)
Nov 1-11	143	425 (198%)	425 (198%)	143 (0%)	425 (198%)	425 (198%)
Nov 12-30	160	437 (173%)	437 (173%)	162 (1%)	437 (169%)	437 (169%)
Dec 1-31	454	533 (17%)	533 (17%)	454 (0%)	533 (17%)	533 (17%)
Jan 1-31	792	882 (11%)	882 (11%)	792 (0%)	882 (11%)	882 (11%)
Feb 1-28	1,085	897 (-17%)	897 (-17%)	1,086 (0%)	897 (-17%)	897 (-17%)
Mar 1-15	996	1,260 (26%)	1,260 (26%)	998 (0%)	1,261 (26%)	1,261 (26%)
Mar 16-31	915	1,570 (72%)	1,570 (72%)	915 (0%)	1,570 (72%)	1,570 (72%)
Apr 1-15	1,044	2,138 (105%)	2,138 (105%)	1,044 (0%)	2,138 (105%)	2,138 (105%)
Apr 16-30	1,160	2,122 (83%)	2,122 (83%)	1,160 (0%)	2,122 (83%)	2,122 (83%)
May 1-31	1,283	1,309 (2%)	1,309 (2%)	1,284 (0%)	1,309 (2%)	1,309 (2%)
Jun 1-30	1,306	1,284 (-2%)	1,284 (-2%)	1,309 (0%)	1,285 (-2%)	1,285 (-2%)
Jul 1-31	910	976 (7%)	976 (7%)	910 (0%)	976 (7%)	976 (7%)
Aug 1-31	237	357 (51%)	357 (51%)	237 (0%)	357 (51%)	357 (51%)
Sep 1-30	207	350 (69%)	350 (69%)	207 (0%)	350 (69%)	350 (69%)

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Simulation period: January 1980 – September 2003.
[2] (%) indicates percent change from existing conditions.
[3] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternatives
cfs = cubic feet per second

Table 13-70.
Average Simulated Flow in Dry Years at Head of Reach 1[1]

Dates of Flow Release	Existing Level[2] (2005)			Future Level[2] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1[3] (cfs)	Alt A2, B2, C2[3] (cfs)	No-Action Alt[3] (cfs)	Alt A1, B1, C1[4] (cfs)	Alt A2, B2, C2[4] (cfs)
Oct 1-31	161	362 (124%)	362 (124%)	161 (0%)	362 (124%)	362 (124%)
Nov 1-11	134	417 (210%)	417 (210%)	134 (0%)	417 (210%)	417 (210%)
Nov 12-30	123	427 (248%)	427 (248%)	123 (0%)	427 (248%)	427 (248%)
Dec 1-31	118	362 (206%)	362 (206%)	118 (0%)	362 (206%)	362 (206%)
Jan 1-31	102	351 (244%)	351 (244%)	102 (0%)	351 (244%)	351 (244%)
Feb 1-28	103	436 (321%)	436 (321%)	103 (0%)	436 (321%)	436 (321%)
Mar 1-15	124	857 (588%)	857 (588%)	124 (0%)	857 (589%)	857 (589%)
Mar 16-31	135	884 (556%)	884 (556%)	135 (0%)	884 (556%)	884 (556%)
Apr 1-15	145	566 (290%)	566 (290%)	145 (0%)	566 (290%)	566 (290%)
Apr 16-30	160	403 (153%)	403 (153%)	160 (0%)	403 (153%)	403 (153%)
May 1-31	186	351 (89%)	351 (89%)	186 (0%)	351 (89%)	351 (89%)
Jun 1-30	195	342 (75%)	342 (75%)	195 (0%)	342 (75%)	342 (75%)
Jul 1-31	225	344 (53%)	344 (53%)	225 (0%)	344 (53%)	344 (53%)
Aug 1-31	227	345 (52%)	345 (52%)	227 (0%)	345 (52%)	345 (52%)
Sep 1-30	207	350 (69%)	350 (69%)	207 (0%)	350 (69%)	350 (69%)

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Year type as defined by the Restoration Year Type.
[2] Simulation period: January 1980 – September 2003.
[3] (%) indicates percent change from existing conditions.
[4] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

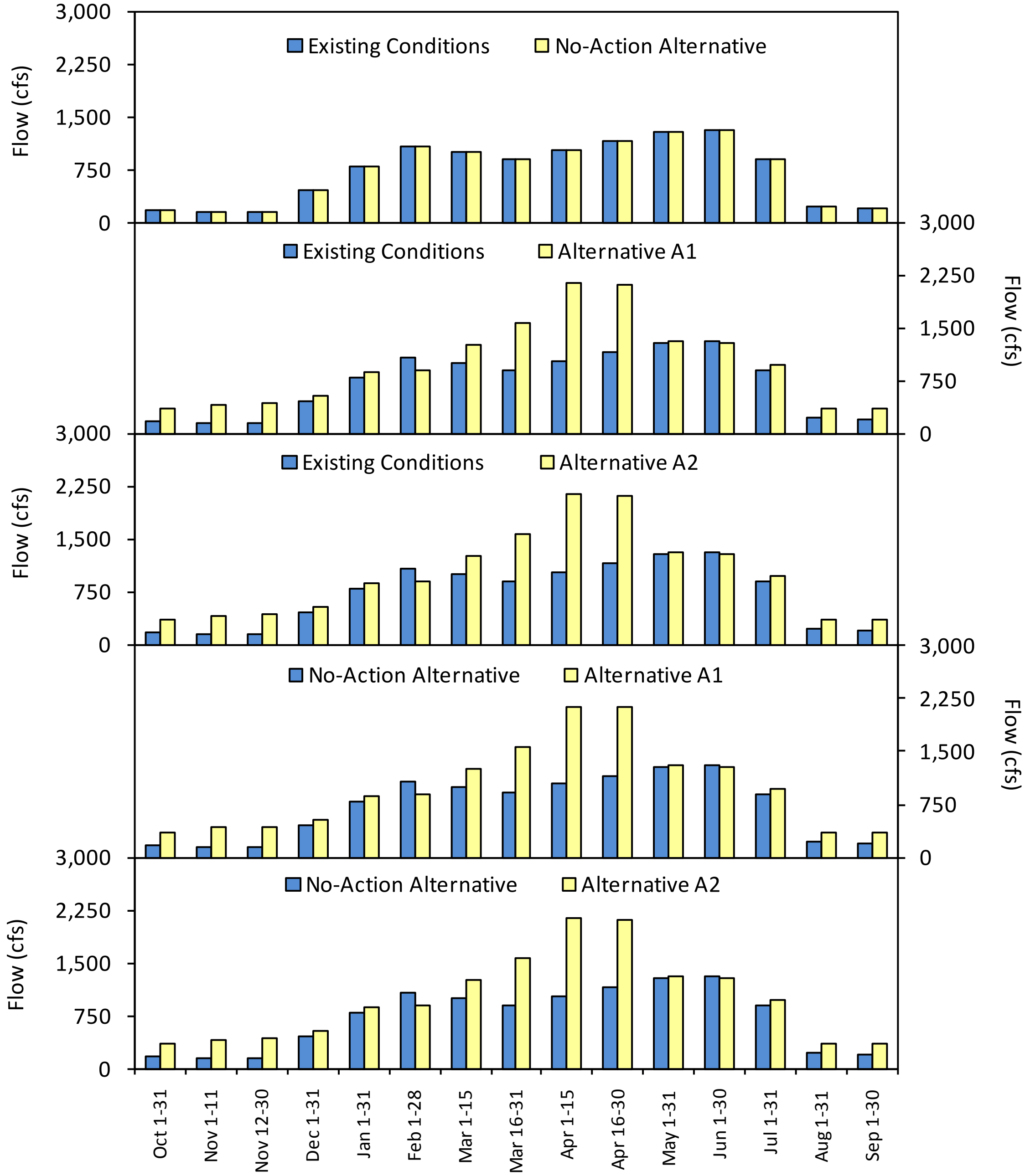


Figure 13-34.
Average Simulated Flow at Head of Reach 1

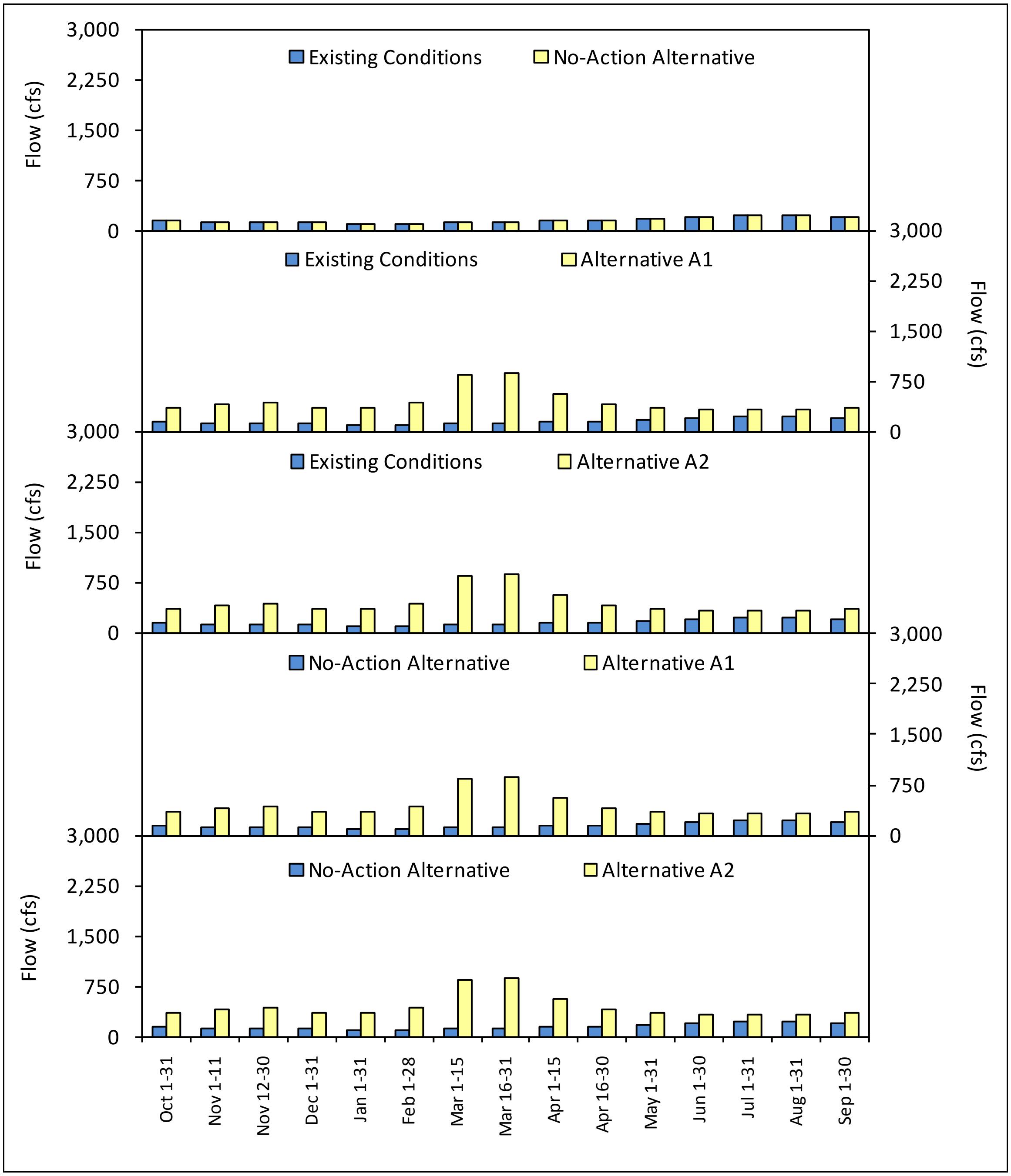


Figure 13-35.
Average Simulated Flow in Dry Years at Head of Reach 1

Flow changes in Reach 2A due to Interim and Restoration flows are shown in Tables 13-71 and 13-72 and Figures 13-36 and 13-37. Large increases in flow reflect dry existing conditions because of the practice of not maintaining flow below Gravelly Ford. The reduction of flow in some months would be due to changes in Millerton Lake storage, resulting from the effects of program alternatives on flood operations.

Table 13-71.
Average Simulated Flow at Head of Reach 2A

Dates of Flow Release	Existing Level[1] (2005)			Future Level[1] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1[2] (cfs)	Alt A2, B2, C2[2] (cfs)	No-Action Alt[2] (cfs)	Alt A1, B1, C1[3] (cfs)	Alt A2, B2, C2[3] (cfs)
Oct 1-31	49	229 (364%)	229 (364%)	50 (1%)	229 (361%)	229 (361%)
Nov 1-11	44	317 (624%)	317 (624%)	44 (0%)	317 (623%)	317 (623%)
Nov 12-30	60	347 (478%)	347 (478%)	62 (4%)	347 (456%)	347 (456%)
Dec 1-31	391	471 (20%)	471 (20%)	391 (0%)	471 (20%)	471 (20%)
Jan 1-31	831	924 (11%)	924 (11%)	831 (0%)	924 (11%)	924 (11%)
Feb 1-28	1,178	988 (-16%)	988 (-16%)	1,178 (0%)	988 (-16%)	988 (-16%)
Mar 1-15	1,068	1,315 (23%)	1,315 (23%)	1,070 (0%)	1,316 (23%)	1,316 (23%)
Mar 16-31	980	1,608 (64%)	1,608 (64%)	981 (0%)	1,609 (64%)	1,609 (64%)
Apr 1-15	989	2,061 (108%)	2,061 (108%)	990 (0%)	2,061 (108%)	2,061 (108%)
Apr 16-30	1,042	2,040 (96%)	2,040 (96%)	1,042 (0%)	2,040 (96%)	2,040 (96%)
May 1-31	1,148	1,192 (4%)	1,192 (4%)	1,149 (0%)	1,192 (4%)	1,192 (4%)
Jun 1-30	1,109	1,101 (-1%)	1,101 (-1%)	1,111 (0%)	1,101 (-1%)	1,101 (-1%)
Jul 1-31	758	806 (6%)	806 (6%)	758 (0%)	807 (6%)	807 (6%)
Aug 1-31	51	171 (235%)	171 (235%)	51 (0%)	171 (235%)	171 (235%)
Sep 1-30	42	184 (339%)	184 (339%)	42 (0%)	184 (339%)	184 (339%)

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Simulation period: January 1980 – September 2003.
[2] (%) indicates percent change from existing conditions.
[3] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

Table 13-72.
Average Simulated Flow in Dry Years at Head of Reach 2A[1]

Dates of Flow Release	Existing Level[2] (2005)			Future Level[2] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1[3] (cfs)	Alt A2, B2, C2[3] (cfs)	No-Action Alt[3] (cfs)	Alt A1, B1, C1[4] (cfs)	Alt A2, B2, C2[4] (cfs)
Oct 1-31	39	237 (508%)	237 (508%)	39 (0%)	237 (508%)	237 (508%)
Nov 1-11	36	315 (768%)	315 (768%)	36 (0%)	315 (768%)	315 (768%)
Nov 12-30	30	336 (1,011%)	336 (1,011%)	30 (0%)	336 (1,011%)	336 (1,011%)
Dec 1-31	41	285 (603%)	285 (603%)	41 (0%)	285 (603%)	285 (603%)
Jan 1-31	47	296 (524%)	296 (524%)	47 (0%)	296 (524%)	296 (524%)
Feb 1-28	49	372 (655%)	372 (655%)	49 (0%)	372 (655%)	372 (655%)
Mar 1-15	53	766 (1,357%)	766 (1,357%)	53 (0%)	766 (1,358%)	766 (1,358%)
Mar 16-31	60	824 (1,273%)	824 (1,273%)	60 (0%)	824 (1,273%)	824 (1,273%)
Apr 1-15	38	477 (1,156%)	477 (1,156%)	38 (0%)	477 (1,156%)	477 (1,156%)
Apr 16-30	32	279 (784%)	279 (784%)	32 (0%)	279 (784%)	279 (784%)
May 1-31	39	206 (426%)	206 (426%)	39 (0%)	206 (426%)	206 (426%)
Jun 1-30	22	168 (667%)	168 (667%)	22 (0%)	168 (667%)	168 (667%)
Jul 1-31	26	145 (455%)	145 (455%)	26 (0%)	145 (455%)	145 (455%)
Aug 1-31	33	150 (353%)	150 (353%)	33 (0%)	150 (353%)	150 (353%)
Sep 1-30	38	180 (371%)	180 (371%)	38 (0%)	180 (371%)	180 (371%)

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Year type as defined by the Restoration Year Type.
[2] Simulation period: January 1980 – September 2003.
[3] (%) indicates percent change from existing conditions.
[4] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

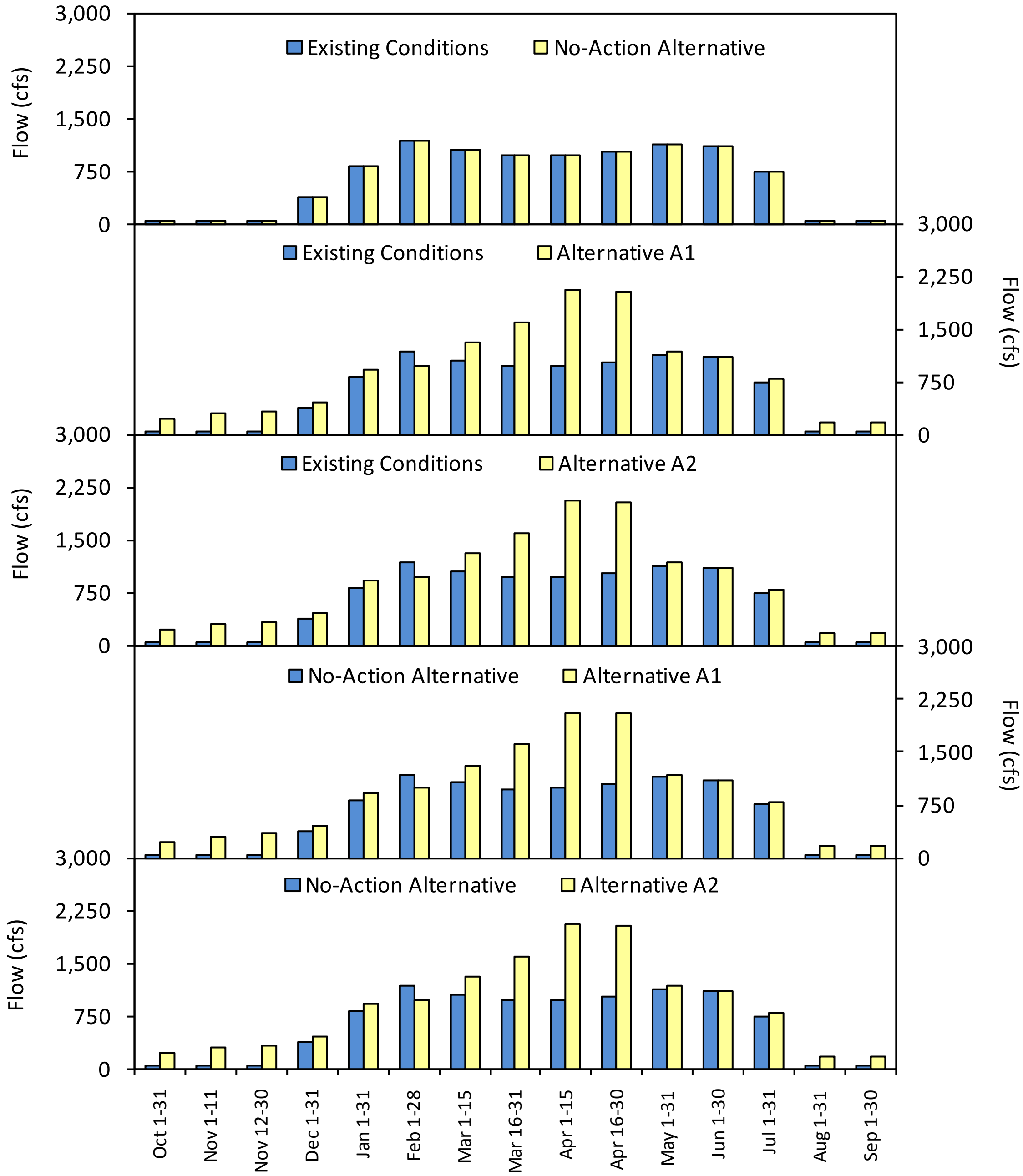


Figure 13-36.
Average Simulated Flow at Head of Reach 2A

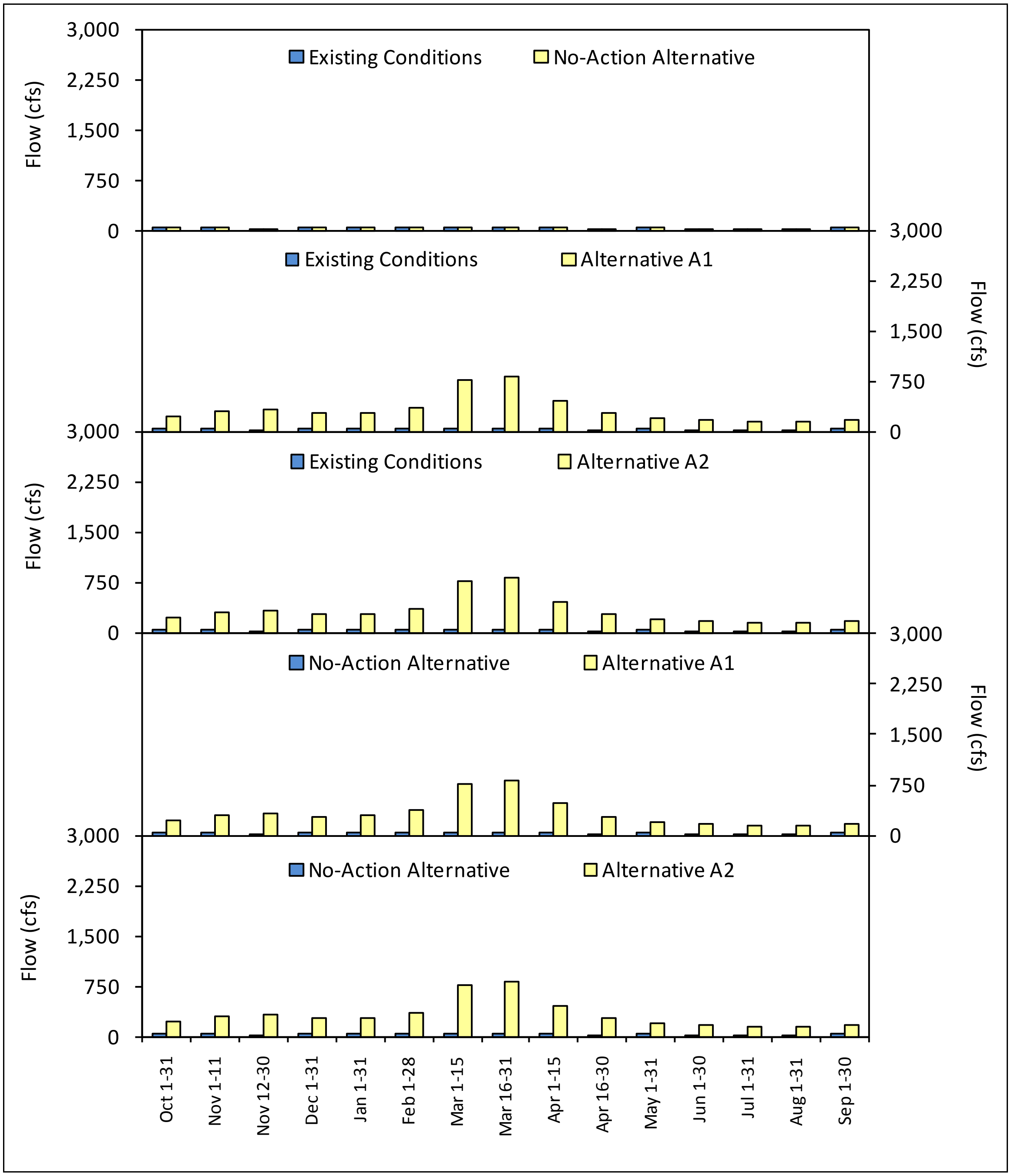


Figure 13-37.
Average Simulated Flow in Dry Years at Head of Reach 2A

Reach 2B flow changes due to Interim and Restoration flows are shown in Tables 13-73 and 13-74 and Figures 13-38 and 13-39. Flows changes within this reach would be large enough to maintain flow year-round.

Table 13-73.
Average Simulated Flow at Head of Reach 2B

Dates of Flow Release	Existing Level[1] (2005)			Future Level[1] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1[2] (cfs)	Alt A2, B2, C2[2] (cfs)	No-Action Alt[2] (cfs)	Alt A1, B1, C1[2] (cfs)	Alt A2, B2, C2[2] (cfs)
Oct 1-31	17	174	174	17	174	174
Nov 1-11	17	261	261	17	261	261
Nov 12-30	5	292	292	5	292	292
Dec 1-31	63	303	303	63	303	303
Jan 1-31	143	472	472	143	472	472
Feb 1-28	314	579	579	314	579	579
Mar 1-15	279	921	921	280	922	922
Mar 16-31	206	1,272	1,272	207	1,273	1,273
Apr 1-15	131	1,677	1,677	131	1,677	1,677
Apr 16-30	119	1,646	1,646	119	1,646	1,646
May 1-31	205	933	933	205	933	933
Jun 1-30	297	761	761	297	761	761
Jul 1-31	190	478	478	190	478	478
Aug 1-31	22	117	117	22	117	117
Sep 1-30	10	129	129	10	129	129

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Simulation period: January 1980 – September 2003.
[2] Percent changes are not shown because this reach is typically dry during all or part of the year in the existing conditions or No-Action Alternative simulations.
Key:
Alt = Alternative
cfs = cubic feet per second

Table 13-74.
Average Simulated Flow in Dry Years at Head of Reach 2B[1]

Dates of Flow Release	Existing Level[2] (2005)			Future Level[2] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1[3] (cfs)	Alt A2, B2, C2[3] (cfs)	No-Action Alt[3] (cfs)	Alt A1, B1, C1[3] (cfs)	Alt A2, B2, C2[3] (cfs)
Oct 1-31	9	182	182	9	182	182
Nov 1-11	3	259	259	3	259	259
Nov 12-30	1	281	281	1	281	281
Dec 1-31	6	231	231	6	231	231
Jan 1-31	5	241	241	5	241	241
Feb 1-28	8	315	315	8	315	315
Mar 1-15	8	705	705	7	705	705
Mar 16-31	13	773	773	13	773	773
Apr 1-15	6	428	428	6	428	428
Apr 16-30	3	225	225	3	225	225
May 1-31	4	152	152	4	152	152
Jun 1-30	1	114	114	1	114	114
Jul 1-31	1	91	91	1	91	91
Aug 1-31	4	95	95	4	95	95
Sep 1-30	5	125	125	5	125	125

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Year type as defined by the Restoration Year Type.
[2] Simulation period: January 1980 – September 2003.
[3] Percent changes are not shown because this reach is typically dry during all or part of the year in the existing conditions or No-Action Alternative simulations.
Key:
Alt = Alternative
cfs = cubic feet per second

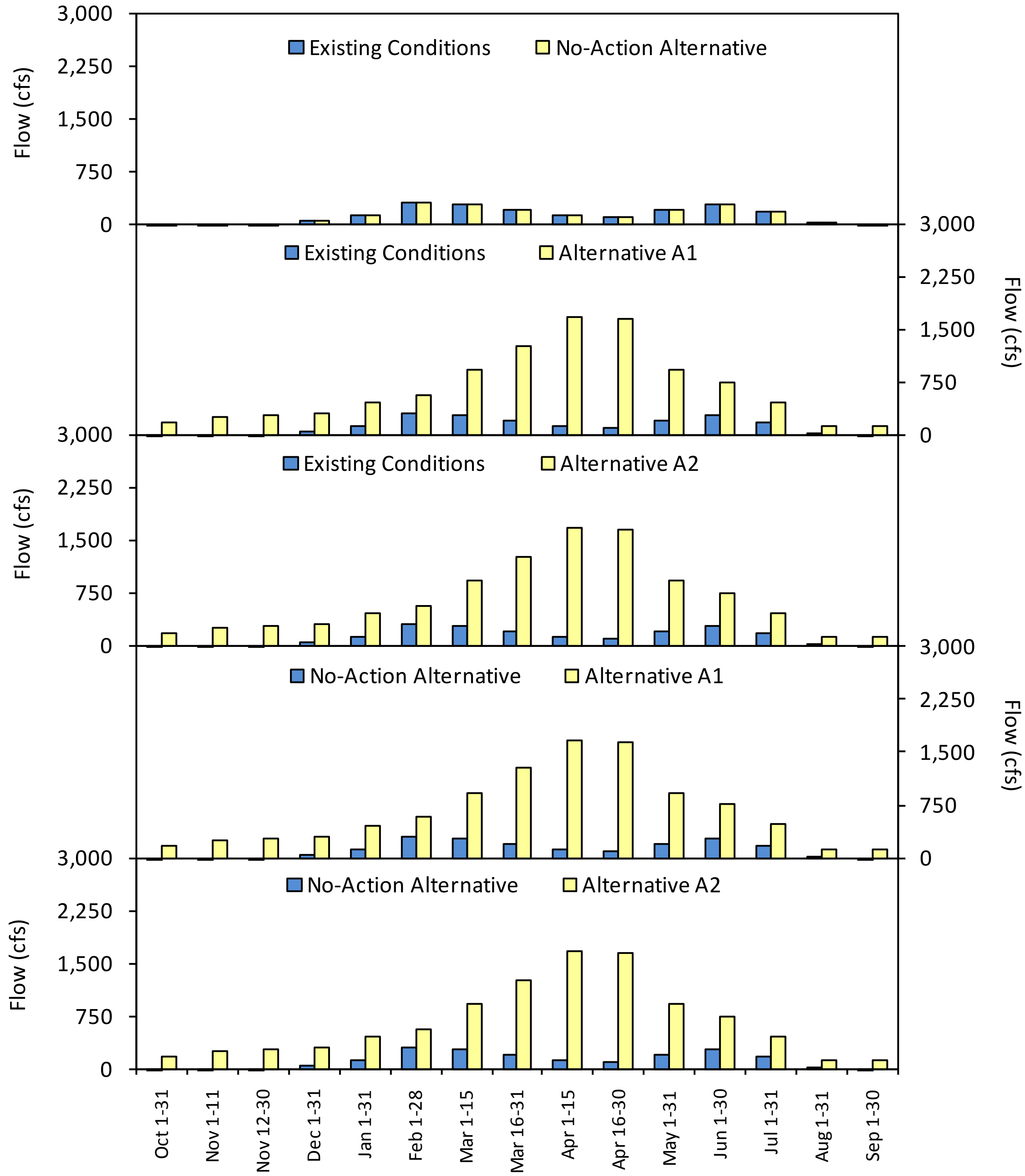


Figure 13-38.
Average Simulated Flow at Head of Reach 2B

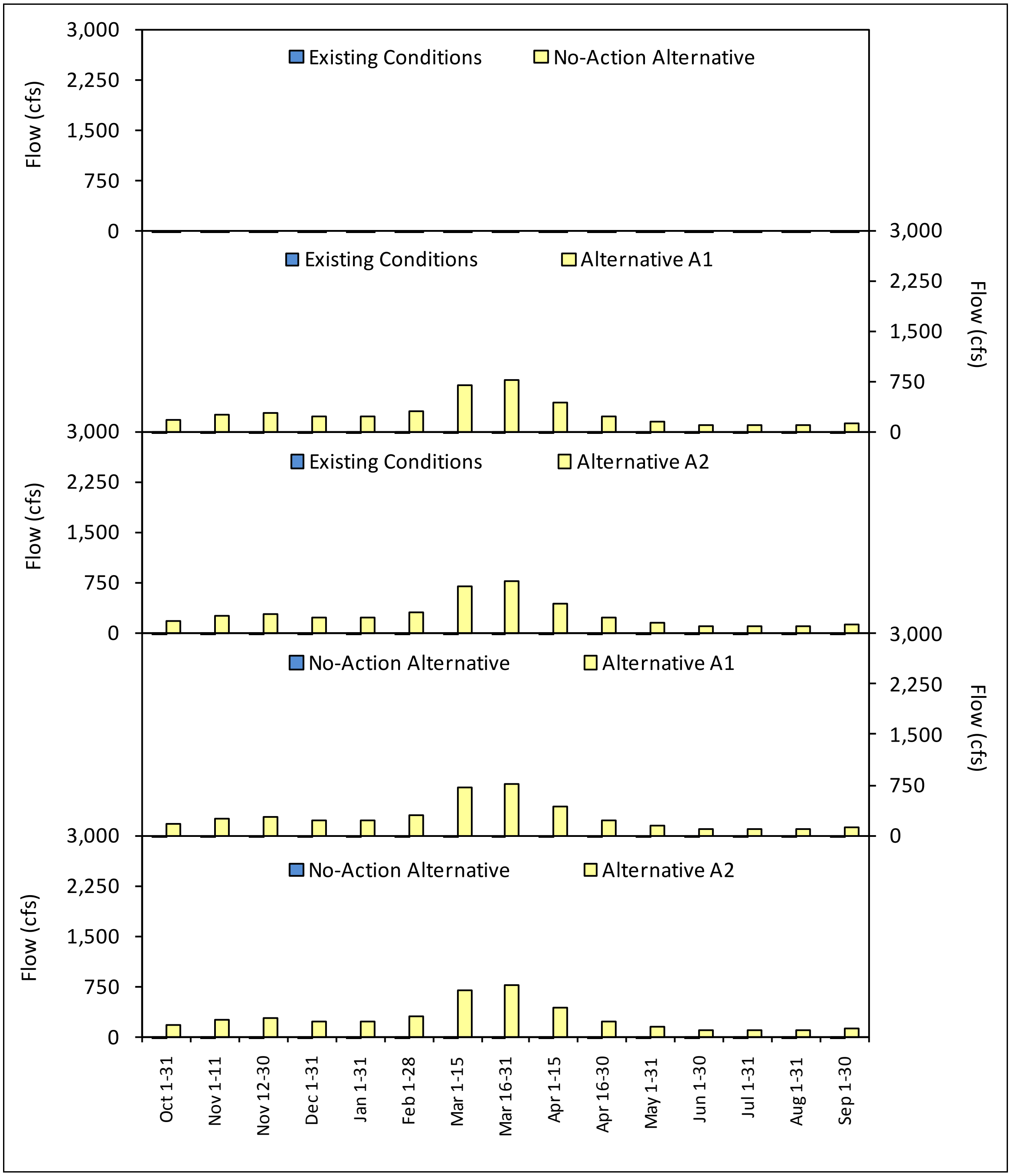


Figure 13-39.
Average Simulated Flow in Dry Years at Head of Reach 2B Flow

Changes to Reach 3 flow below Mendota Dam due to Interim and Restoration flows are shown in Tables 13-75 and 13-76 and Figures 13-40 and 13-41. These flows would include flow for both Arroyo Canal diversions and Interim and Restoration flows.

Table 13-75.
Average Simulated Flow at Head of Reach 3

Dates of Flow Release	Existing Level[1] (2005)			Future Level1 (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1[2] (cfs)	Alt A2, B2, C2[2] (cfs)	No-Action Alt[2] (cfs)	Alt A1, B1, C1[3] (cfs)	Alt A2, B2, C2[3] (cfs)
Oct 1-31	281	415 (48%)	415 (48%)	281 (0%)	415 (48%)	415 (48%)
Nov 1-11	218	436 (100%)	436 (100%)	218 (0%)	436 (100%)	436 (100%)
Nov 12-30	266	529 (99%)	529 (99%)	266 (0%)	529 (99%)	529 (99%)
Dec 1-31	489	707 (45%)	707 (45%)	489 (0%)	707 (45%)	707 (45%)
Jan 1-31	600	918 (53%)	918 (53%)	600 (0%)	918 (53%)	918 (53%)
Feb 1-28	829	1,083 (31%)	1,083 (31%)	829 (0%)	1,083 (31%)	1,083 (31%)
Mar 1-15	906	1,549 (71%)	1,549 (71%)	907 (0%)	1,549 (71%)	1,549 (71%)
Mar 16-31	857	1,908 (123%)	1,908 (123%)	857 (0%)	1,909 (123%)	1,909 (123%)
Apr 1-15	840	2,377 (183%)	2,377 (183%)	840 (0%)	2,377 (183%)	2,377 (183%)
Apr 16-30	919	2,452 (167%)	2,452 (167%)	919 (0%)	2,452 (167%)	2,452 (167%)
May 1-31	832	1,561 (88%)	1,561 (88%)	832 (0%)	1,561 (88%)	1,561 (88%)
Jun 1-30	818	1,288 (57%)	1,288 (57%)	818 (0%)	1,288 (57%)	1,288 (57%)
Jul 1-31	697	984 (41%)	984 (41%)	697 (0%)	984 (41%)	984 (41%)
Aug 1-31	464	534 (15%)	534 (15%)	464 (0%)	534 (15%)	534 (15%)
Sep 1-30	293	392 (33%)	392 (33%)	293 (0%)	392 (33%)	392 (33%)

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Simulation period: January 1980 – September 2003.
[2] (%) indicates percent change from existing conditions.
[3] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

Table 13-76.
Average Simulated Flow in Dry Years at Head of Reach 3[1]

Dates of Flow Release	Existing Level2 (2005)			Future Level[2] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1[3] (cfs)	Alt A2, B2, C2[3] (cfs)	No-Action Alt[3] (cfs)	Alt A1, B1, C1[4] (cfs)	Alt A2, B2, C2[4] (cfs)
Oct 1-31	241	392 (63%)	392 (63%)	241 (0%)	392 (63%)	392 (63%)
Nov 1-11	146	377 (158%)	377 (158%)	146 (0%)	377 (158%)	377 (158%)
Nov 12-30	100	354 (255%)	354 (255%)	100 (0%)	354 (255%)	354 (255%)
Dec 1-31	167	370 (121%)	370 (121%)	167 (0%)	370 (121%)	370 (121%)
Jan 1-31	49	263 (433%)	263 (433%)	49 (0%)	263 (433%)	263 (433%)
Feb 1-28	160	441 (176%)	441 (176%)	160 (0%)	441 (176%)	441 (176%)
Mar 1-15	264	932 (253%)	932 (253%)	264 (0%)	932 (254%)	932 (254%)
Mar 16-31	184	929 (405%)	929 (405%)	184 (0%)	929 (405%)	929 (405%)
Apr 1-15	200	606 (202%)	606 (202%)	200 (0%)	606 (202%)	606 (202%)
Apr 16-30	211	411 (94%)	411 (94%)	211 (0%)	411 (94%)	411 (94%)
May 1-31	219	345 (57%)	345 (57%)	219 (0%)	345 (57%)	345 (57%)
Jun 1-30	420	507 (21%)	507 (21%)	420 (0%)	507 (21%)	507 (21%)
Jul 1-31	536	600 (12%)	600 (12%)	536 (0%)	600 (12%)	600 (12%)
Aug 1-31	474	541 (14%)	541 (14%)	474 (0%)	541 (14%)	541 (14%)
Sep 1-30	307	405 (32%)	405 (32%)	307 (0%)	405 (32%)	405 (32%)

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Year type as defined by the Restoration Year Type.
[2] Simulation period: January 1980 – September 2003.
[3] (%) indicates percent change from existing conditions.
[4] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

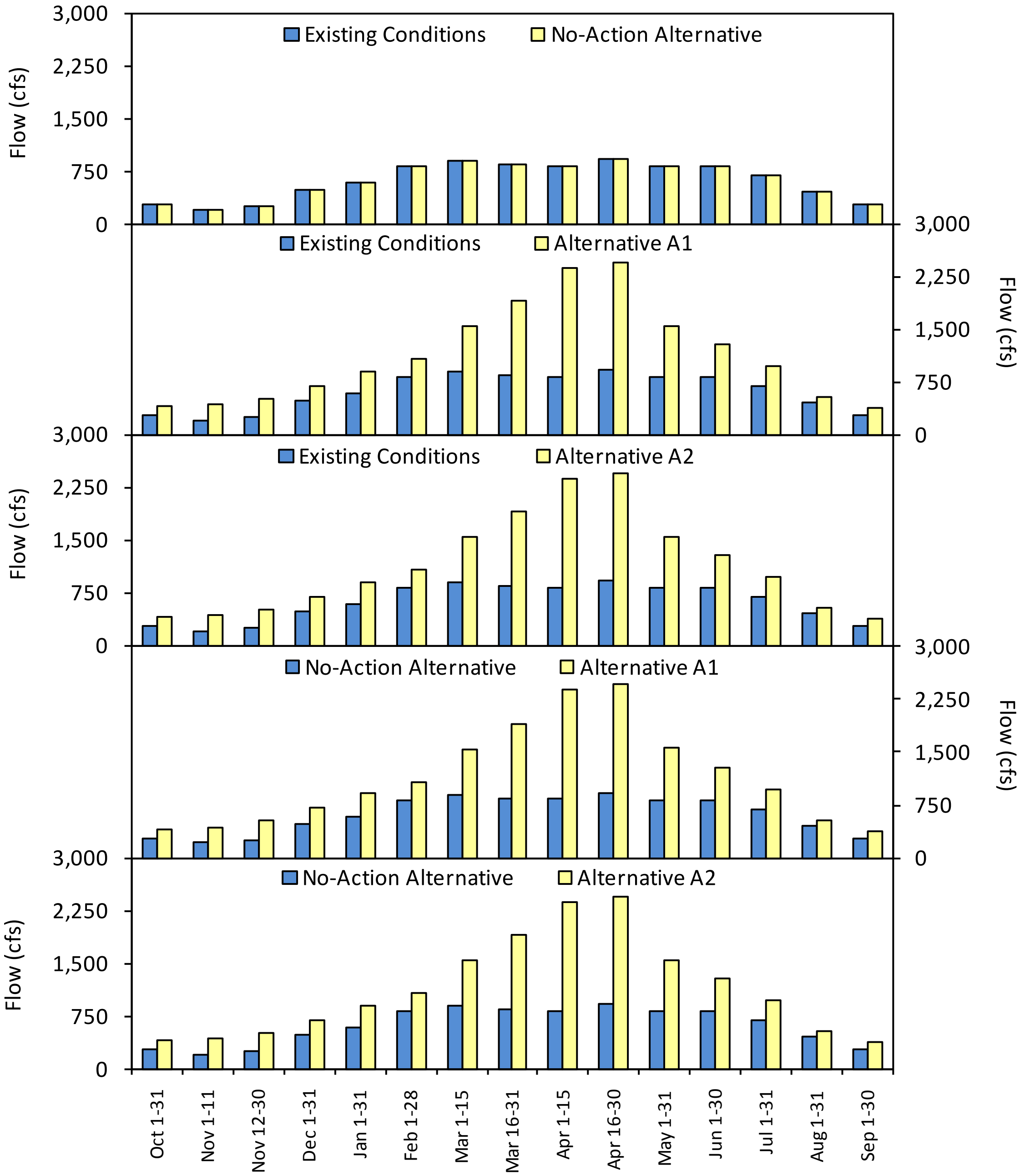


Figure 13-40.
Average Simulated Flow at Head of Reach 3

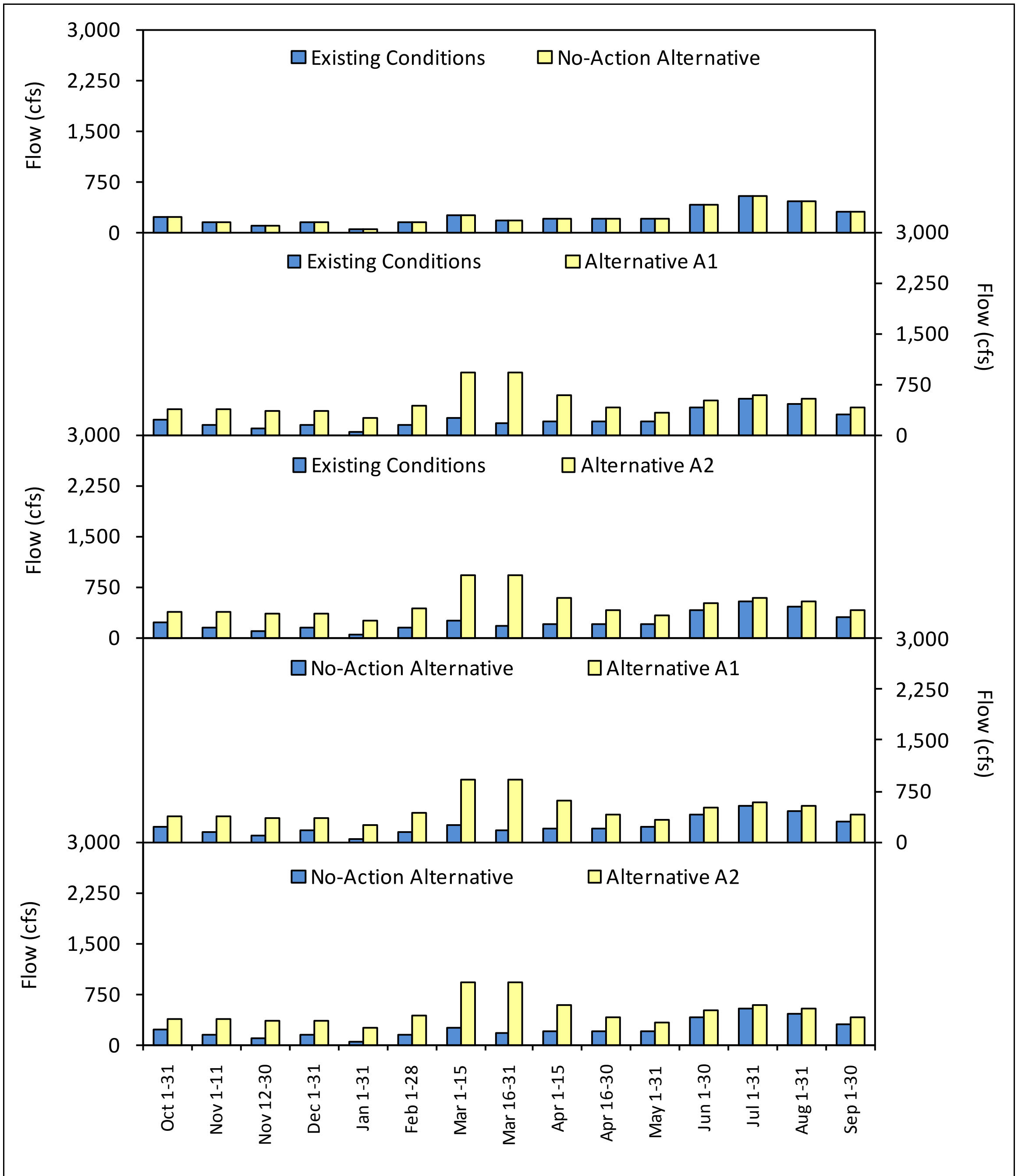


Figure 13-41.
Average Simulated Flow in Dry Years at Head of Reach 3

Flow changes in Reach 4A below Sack Dam due to Interim and Restoration flows are shown in Tables 13-77 and 13-78 and Figures 13-42 and 13-43. In Dry years, this reach receives little flow under existing conditions and the No-Action Alternative because most flow is diverted at Sack Dam. Interim and Restoration flows would greatly increase average monthly flow in these years.

Table 13-77.
Average Simulated Flow at Head of Reach 4A

Dates of Flow Release	Existing Level[1] (2005)			Future Level[1] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1[2] (cfs)	Alt A2, B2, C2[2] (cfs)	No-Action Alt[2] (cfs)	Alt A1, B1, C1[3] (cfs)	Alt A2, B2, C2[3] (cfs)
Oct 1-31	133	266 (100%)	266 (100%)	133 (0%)	266 (100%)	266 (100%)
Nov 1-11	98	302 (207%)	302 (207%)	98 (0%)	302 (207%)	302 (207%)
Nov 12-30	189	452 (139%)	452 (139%)	189 (0%)	452 (139%)	452 (139%)
Dec 1-31	357	574 (61%)	574 (61%)	357 (0%)	574 (61%)	574 (61%)
Jan 1-31	561	879 (57%)	879 (57%)	561 (0%)	879 (57%)	879 (57%)
Feb 1-28	696	934 (34%)	934 (34%)	696 (0%)	934 (34%)	934 (34%)
Mar 1-15	693	1,299 (87%)	1,299 (87%)	693 (0%)	1,299 (87%)	1,299 (87%)
Mar 16-31	721	1,720 (139%)	1,720 (139%)	721 (0%)	1,721 (139%)	1,721 (139%)
Apr 1-15	674	2,156 (220%)	2,156 (220%)	674 (0%)	2,156 (220%)	2,156 (220%)
Apr 16-30	726	2,277 (214%)	2,277 (214%)	726 (0%)	2,277 (214%)	2,277 (214%)
May 1-31	635	1,388 (119%)	1,388 (119%)	635 (0%)	1,388 (118%)	1,388 (118%)
Jun 1-30	453	932 (106%)	932 (106%)	453 (0%)	932 (106%)	932 (106%)
Jul 1-31	313	603 (93%)	603 (93%)	313 (0%)	604 (93%)	604 (93%)
Aug 1-31	152	224 (48%)	224 (48%)	152 (0%)	224 (48%)	224 (48%)
Sep 1-30	145	242 (66%)	242 (66%)	145 (0%)	242 (66%)	242 (66%)

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Simulation period: January 1980 – September 2003.
[2] (%) indicates percent change from existing conditions.
[3] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

Table 13-78.
Average Simulated Flow in Dry Years at Head of Reach 4A[1]

Dates of Flow Release	Existing Level[2] (2005)			Future Level[2] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1[3] (cfs)	Alt A2, B2, C2[3] (cfs)	No-Action Alt[3] (cfs)	Alt A1, B1, C1[4] (cfs)	Alt A2, B2, C2[4] (cfs)
Oct 1-31	68	216 (218%)	216 (218%)	68 (0%)	216 (218%)	216 (218%)
Nov 1-11	20	245 (1,142%)	245 (1,142%)	20 (0%)	245 (1,142%)	245 (1,142%)
Nov 12-30	20	275 (1,290%)	275 (1,290%)	20 (0%)	275 (1,290%)	275 (1,290%)
Dec 1-31	36	239 (571%)	239 (571%)	36 (0%)	239 (571%)	239 (571%)
Jan 1-31	17	230 (1,240%)	230 (1,240%)	17 (0%)	230 (1,240%)	230 (1,240%)
Feb 1-28	9	272 (2,817%)	272 (2,817%)	9 (0%)	272 (2,817%)	272 (2,817%)
Mar 1-15	17	644 (3,726%)	644 (3,726%)	17 (0%)	644 (3,733%)	644 (3,733%)
Mar 16-31	31	792 (2,443%)	792 (2,443%)	31 (0%)	792 (2,443%)	792 (2,443%)
Apr 1-15	34	462 (1,254%)	462 (1,254%)	34 (0%)	462 (1,254%)	462 (1,254%)
Apr 16-30	34	237 (589%)	237 (589%)	34 (0%)	237 (589%)	237 (589%)
May 1-31	35	160 (354%)	160 (354%)	35 (0%)	160 (354%)	160 (354%)
Jun 1-30	73	160 (120%)	160 (120%)	73 (0%)	160 (120%)	160 (120%)
Jul 1-31	124	189 (52%)	189 (52%)	124 (0%)	189 (52%)	189 (52%)
Aug 1-31	153	220 (43%)	220 (43%)	153 (0%)	220 (43%)	220 (43%)
Sep 1-30	135	231 (71%)	231 (71%)	135 (0%)	231 (71%)	231 (71%)

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Year type as defined by the Restoration Year Type.
[2] Simulation period: January 1980 – September 2003.
[3] (%) indicates percent change from existing conditions.
[4] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

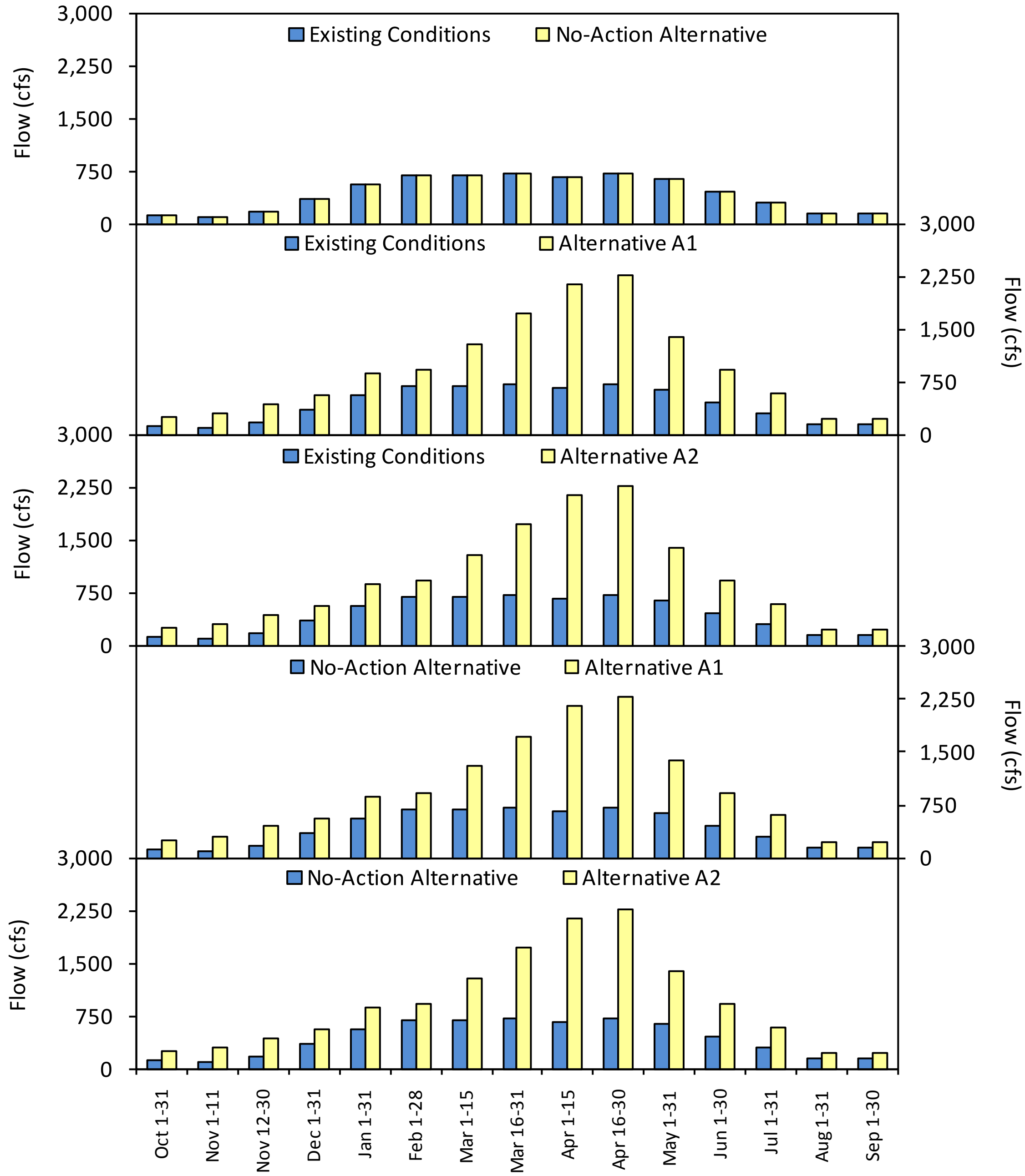


Figure 13-42.
Average Simulated Flow at Head of Reach 4A

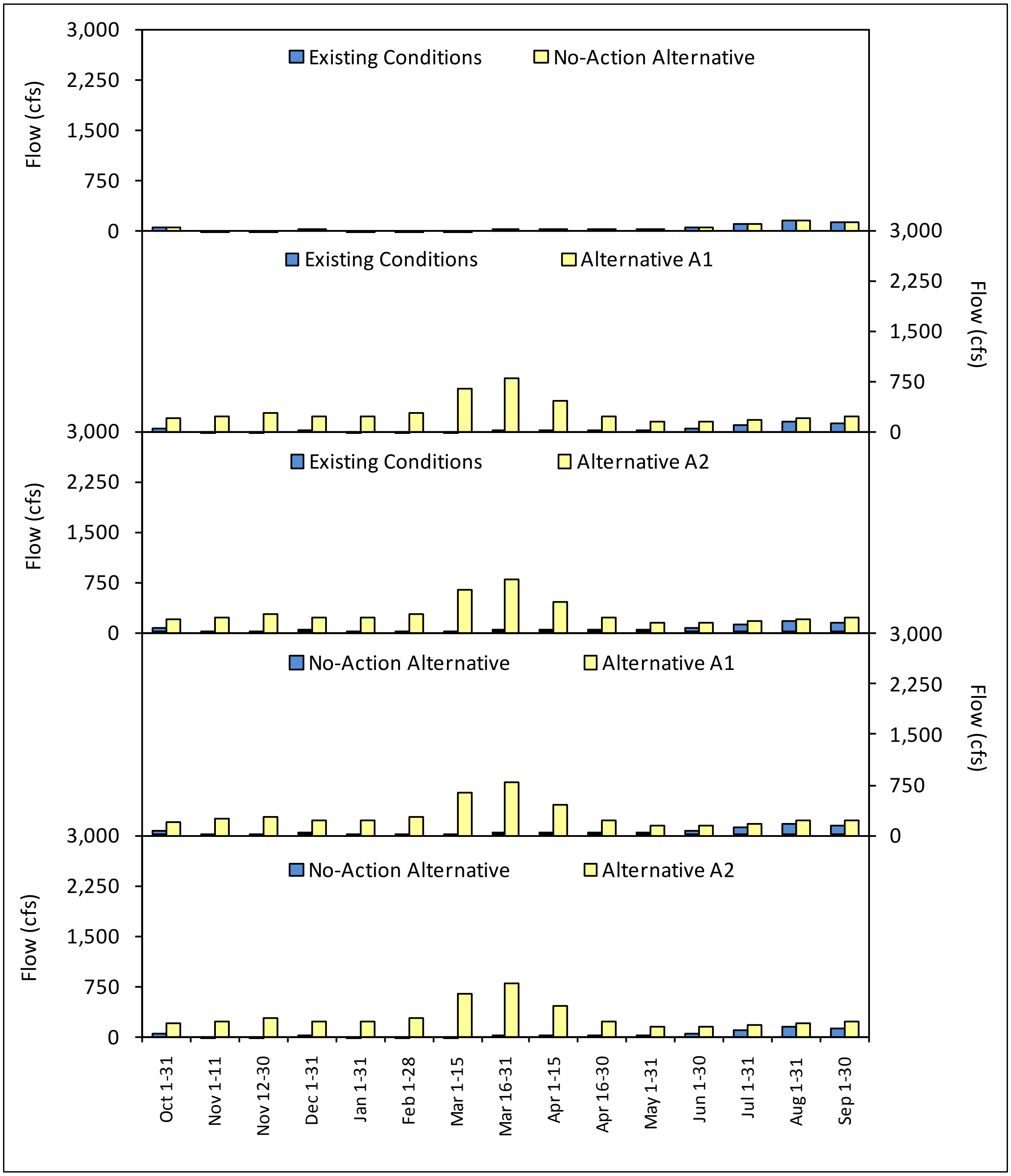


Figure 13-43.
Average Simulated Flow in Dry Years at Head of Reach 4A

Flow changes in Reach 4B1 below the Sand Slough split due to Interim and Restoration flows are shown in Tables 13-79 and 13-80 and Figures 13-44 and 13-45. This reach would have different capacities under Alternatives A1 and A2, resulting in more flow being diverted to the Eastside Bypass via the Sand Slough Control Structure. Any flow sent to Reach 4B1 would have a sizeable effect because this reach has been historically dry.

Table 13-79.
Average Simulated Flow at Head of Reach 4B1

Dates of Flow Release	Existing Level[1] (2005)			Future Level[1] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1[2] (cfs)	Alt A2, B2, C2[2] (cfs)	No-Action Alt[2] (cfs)	Alt A1, B1, C1[3] (cfs)	Alt A2, B2, C2[3] (cfs)
Oct 1-31	1	241	265	1	241	265
Nov 1-11	0	251	295	0	251	295
Nov 12-30	0	305	440	0	305	440
Dec 1-31	1	282	562	1	282	562
Jan 1-31	1	285	824	1	285	824
Feb 1-28	1	329	868	1	329	868
Mar 1-15	1	469	1,220	1	469	1,220
Mar 16-31	1	475	1,594	1	475	1,595
Apr 1-15	1	467	1,921	1	467	1,921
Apr 16-30	1	427	1,975	1	427	1,975
May 1-31	1	331	1,315	1	331	1,315
Jun 1-30	1	283	909	1	283	909
Jul 1-31	1	247	604	1	247	605
Aug 1-31	1	216	222	1	216	222
Sep 1-30	1	239	241	1	239	241

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Simulation period: January 1980 – September 2003.
[2] Percent changes are not shown because this reach is typically dry during all or part of the year in the existing conditions or No-Action Alternative simulations.
Key:
Alt = Alternative
cfs = cubic feet per second

Table 13-80.
Average Simulated Flow in Dry Years at Head of Reach 4B1[1]

Dates of Flow Release	Existing Level2[3] (2005)			Future Level[2 3] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1 (cfs)	Alt A2, B2, C2 (cfs)	No-Action Alt (cfs)	Alt A1, B1, C1 (cfs)	Alt A2, B2, C2 (cfs)
Oct 1-31	1	215	216	1	215	216
Nov 1-11	0	237	239	0	237	239
Nov 12-30	0	273	275	0	273	275
Dec 1-31	0	238	240	0	238	240
Jan 1-31	0	229	230	0	229	230
Feb 1-28	0	260	262	0	260	262
Mar 1-15	0	468	621	0	468	621
Mar 16-31	0	475	802	0	475	802
Apr 1-15	0	436	480	0	436	480
Apr 16-30	0	243	245	0	243	245
May 1-31	0	160	161	0	160	161
Jun 1-30	1	156	157	1	156	157
Jul 1-31	1	188	189	1	188	189
Aug 1-31	1	216	217	1	216	217
Sep 1-30	1	228	229	1	228	229

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Year type as defined by the Restoration Year Type.
[2] Simulation period: January 1980 – September 2003.
[3] Percent changes are not shown because this reach is typically dry during all or part of the year in the existing conditions or No-Action Alternative simulations.
Key:
Alt = Alternative
cfs = cubic feet per second

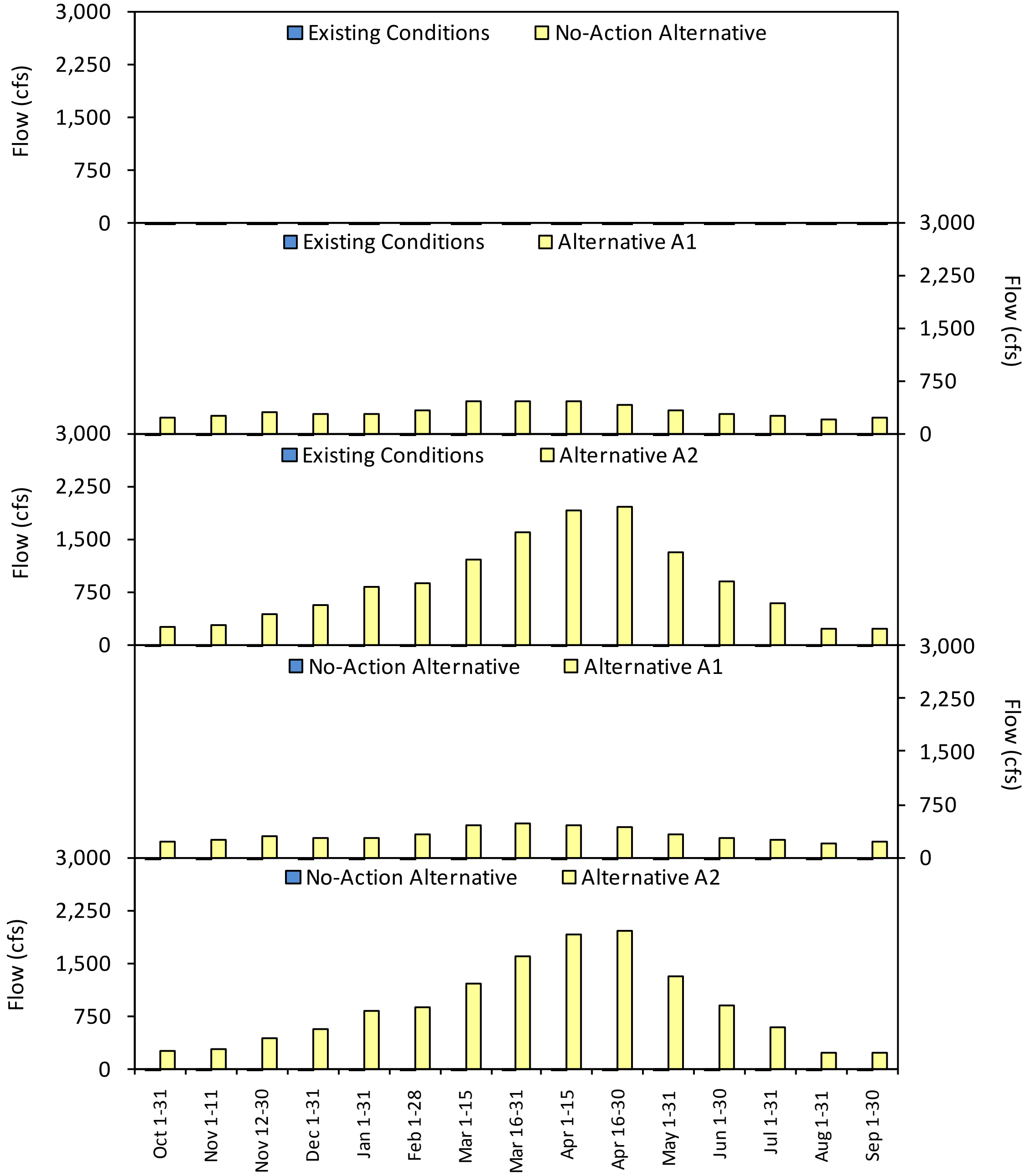


Figure 13-44.
Average Simulated Flow at Head of Reach 4B1

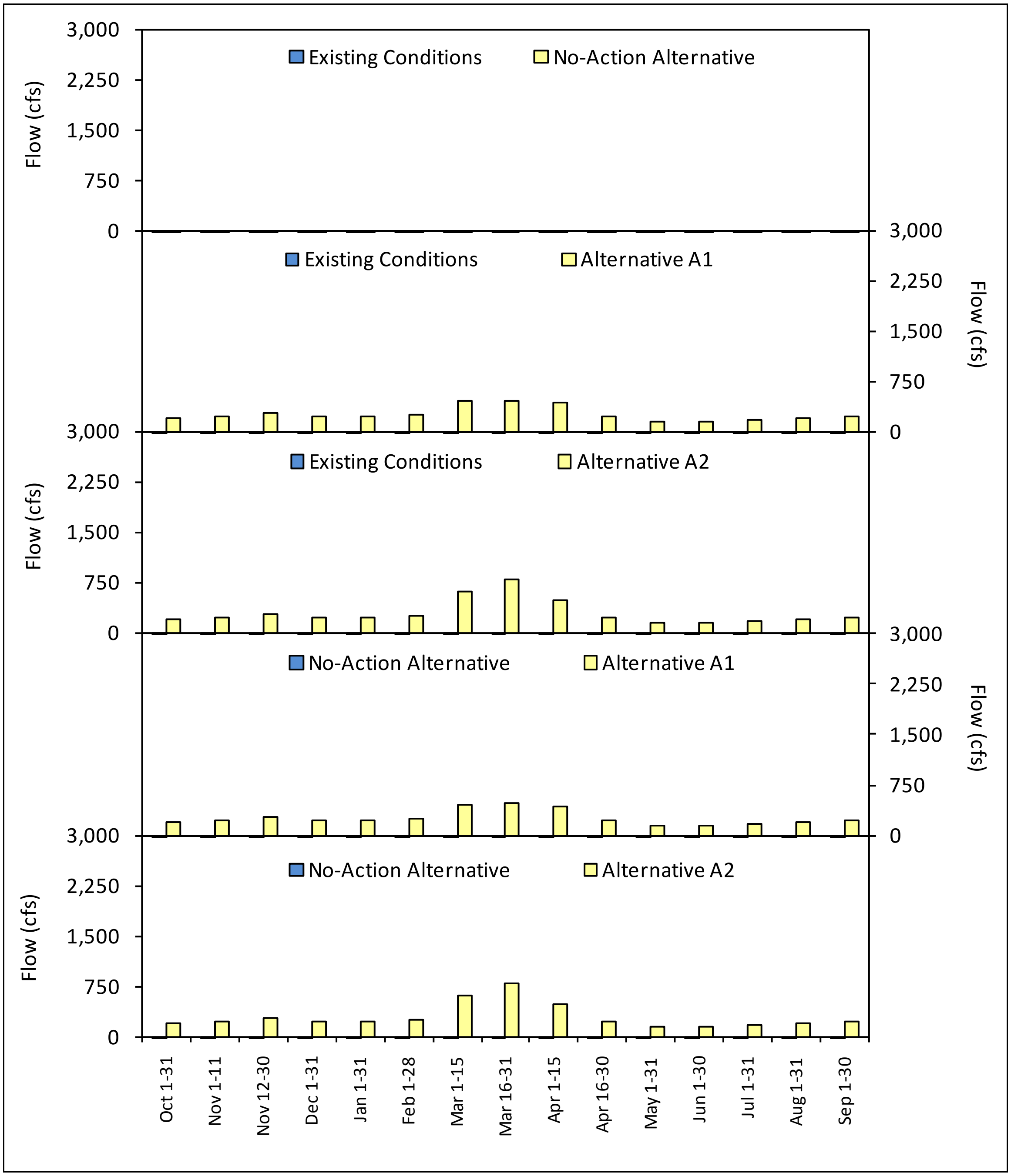


Figure 13-45.
Average Simulated Flow in Dry Years at Head of Reach 4B1

Flow changes in Reach 4B2 below the Mariposa Bypass confluence due to Interim and Restoration flows are shown in Tables 13-81 and 13-82 and Figures 13-46 and 13-47. Differences between Alternatives A1 and A2 would be due to capacity differences in Reach 4B1 and the resulting flow routing between the Eastside and Mariposa Bypasses. This reach also would also experience large flow increases during dry months and years compared to existing conditions.

Table 13-81.
Average Simulated Flow at Head of Reach 4B2

Dates of Flow Release	Existing Level[1 2] (2005)			Future Level[1 2] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1 (cfs)	Alt A2, B2, C2 (cfs)	No-Action Alt (cfs)	Alt A1, B1, C1 (cfs)	Alt A2, B2, C2 (cfs)
Oct 1-31	2	241	264	2	241	264
Nov 1-11	1	250	290	1	250	290
Nov 12-30	5	305	431	6	305	431
Dec 1-31	87	337	573	87	337	573
Jan 1-31	229	469	903	229	469	903
Feb 1-28	252	504	920	252	504	920
Mar 1-15	211	622	1,248	211	622	1,248
Mar 16-31	233	665	1,628	233	665	1,629
Apr 1-15	239	705	1,964	239	705	1,964
Apr 16-30	286	731	2,068	286	731	2,068
May 1-31	255	506	1,351	255	506	1,351
Jun 1-30	171	406	969	172	406	969
Jul 1-31	169	375	670	169	375	670
Aug 1-31	2	214	222	2	214	222
Sep 1-30	2	239	240	2	239	240

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Simulation period: January 1980 – September 2003.
[2] Percent changes are not shown because this reach is typically dry during all or part of the year in the existing conditions or No-Action Alternative simulations.
Key:
Alt = Alternative
cfs = cubic feet per second

Table 13-82.
Average Simulated Flow in Dry Years at Head of Reach 4B2[1]

Dates of Flow Release	Existing Level[2 3] (2005)			Future Level[2 3] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1 (cfs)	Alt A2, B2, C2 (cfs)	No-Action Alt (cfs)	Alt A1, B1, C1 (cfs)	Alt A2, B2, C2 (cfs)
Oct 1-31	2	215	216	2	215	216
Nov 1-11	1	235	236	1	235	236
Nov 12-30	1	273	275	1	273	275
Dec 1-31	1	240	242	1	240	242
Jan 1-31	1	230	231	1	230	231
Feb 1-28	1	254	255	1	254	255
Mar 1-15	1	468	603	1	468	603
Mar 16-31	1	477	808	1	477	808
Apr 1-15	1	444	497	1	444	497
Apr 16-30	1	251	252	1	251	252
May 1-31	1	161	162	1	161	162
Jun 1-30	2	155	155	2	155	155
Jul 1-31	2	190	190	2	190	190
Aug 1-31	2	214	215	2	214	215
Sep 1-30	2	228	229	2	228	229

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Year type as defined by the Restoration Year Type.
[2] Simulation period: January 1980 – September 2003.
[3] Percent changes are not shown because this bypass is typically dry during all or part of the year in the existing conditions or No-Action Alternative simulations.
Key:
Alt = Alternative
cfs = cubic feet per second

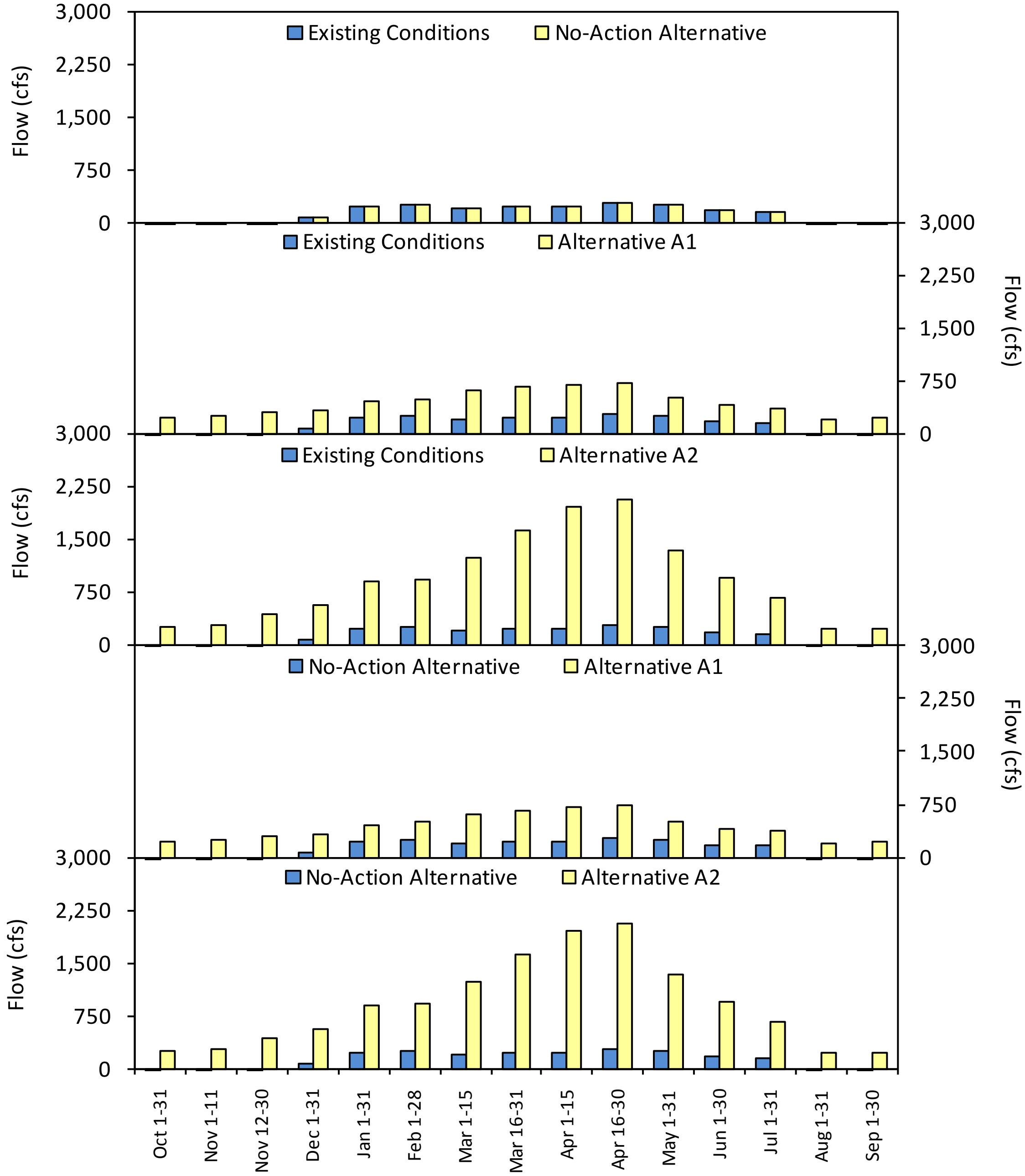


Figure 13-46.
Average Simulated Flow at Head of Reach 4B2

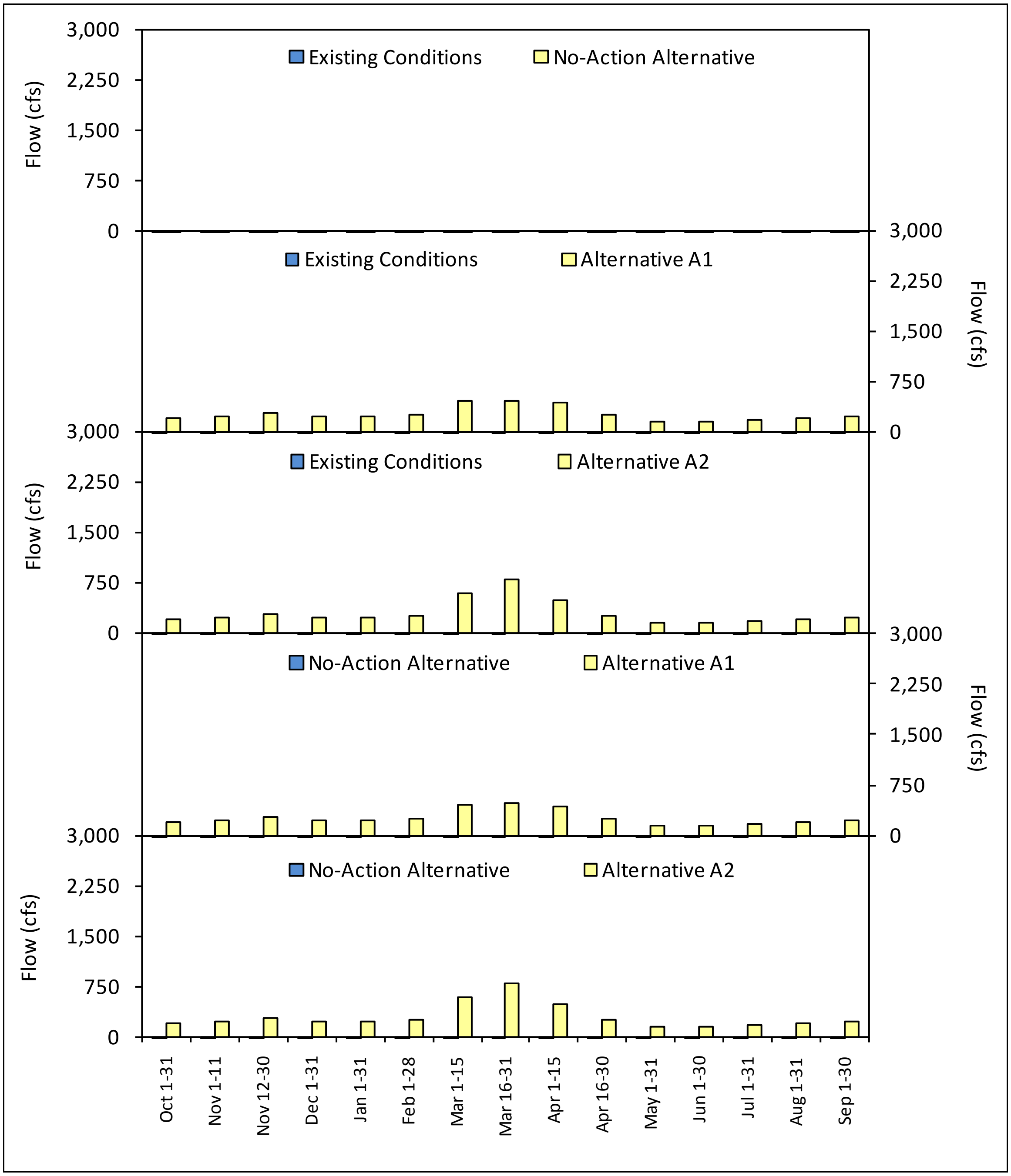


Figure 13-47.
Average Simulated Flow in Dry Years at Head of Reach 4B2

Flow changes in Reach 5 due to Interim and Restoration flows are shown in Tables 13-83 and 13-84 and Figures 13-48 and 13-49. This reach typically receives substantial agriculture return, stream inflow, and flood bypass flow. Flow changes, therefore, would not be as great as in Reach 4, and could even be negative because of changes in Millerton Lake storage and resulting flood operations.

Table 13-83.
Average Simulated Flow at Head of Reach 5

Dates of Flow Release	Existing Level[1] (2005)			Future Level[1] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1[2] (cfs)	Alt A2, B2, C2[2] (cfs)	No-Action Alt[2] (cfs)	Alt A1, B1, C1[3] (cfs)	Alt A2, B2, C2[3] (cfs)
Oct 1-31	234	362 (55%)	362 (54%)	235 (0%)	362 (54%)	362 (54%)
Nov 1-11	195	364 (87%)	363 (86%)	195 (0%)	364 (87%)	363 (86%)
Nov 12-30	246	491 (100%)	489 (99%)	247 (1%)	491 (99%)	489 (98%)
Dec 1-31	690	754 (9%)	754 (9%)	691 (0%)	753 (9%)	753 (9%)
Jan 1-31	1,406	1,487 (6%)	1,487 (6%)	1,406 (0%)	1,487 (6%)	1,487 (6%)
Feb 1-28	1,818	1,620 (-11%)	1,618 (-11%)	1,818 (0%)	1,620 (-11%)	1,618 (-11%)
Mar 1-15	1,711	1,834 (7%)	1,831 (7%)	1,712 (0%)	1,834 (7%)	1,831 (7%)
Mar 16-31	1,782	2,271 (27%)	2,267 (27%)	1,783 (0%)	2,272 (27%)	2,268 (27%)
Apr 1-15	1,650	2,576 (56%)	2,573 (56%)	1,650 (0%)	2,576 (56%)	2,573 (56%)
Apr 16-30	1,675	2,755 (64%)	2,758 (65%)	1,676 (0%)	2,755 (64%)	2,758 (65%)
May 1-31	1,635	1,760 (8%)	1,763 (8%)	1,636 (0%)	1,760 (8%)	1,763 (8%)
Jun 1-30	1,245	1,289 (3%)	1,291 (4%)	1,247 (0%)	1,289 (3%)	1,291 (4%)
Jul 1-31	1,081	1,033 (-5%)	1,035 (-4%)	1,083 (0%)	1,034 (-4%)	1,036 (-4%)
Aug 1-31	246	316 (29%)	316 (29%)	246 (0%)	316 (29%)	316 (29%)
Sep 1-30	245	339 (39%)	339 (39%)	245 (0%)	339 (39%)	339 (39%)

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Simulation period: January 1980 – September 2003.
[2] (%) indicates percent change from existing conditions.
[3] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

Table 13-84.
Average Simulated Flow in Dry Years at Head of Reach 5[1]

Dates of Flow Release	Existing Level[2] (2005)			Future Level[2] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1[3] (cfs)	Alt A2, B2, C2[3] (cfs)	No-Action Alt[3] (cfs)	Alt A1, B1, C1[4] (cfs)	Alt A2, B2, C2[4] (cfs)
Oct 1-31	140	284 (103%)	284 (103%)	140 (0%)	284 (103%)	284 (103%)
Nov 1-11	78	291 (273%)	291 (273%)	78 (0%)	291 (273%)	291 (273%)
Nov 12-30	68	325 (377%)	325 (377%)	68 (0%)	325 (377%)	325 (377%)
Dec 1-31	88	295 (235%)	295 (235%)	88 (0%)	295 (235%)	295 (235%)
Jan 1-31	96	310 (221%)	310 (221%)	96 (0%)	310 (221%)	310 (221%)
Feb 1-28	118	362 (207%)	362 (207%)	118 (0%)	362 (207%)	362 (207%)
Mar 1-15	116	691 (496%)	687 (492%)	116 (0%)	691 (496%)	687 (492%)
Mar 16-31	110	892 (714%)	894 (716%)	110 (0%)	892 (714%)	894 (716%)
Apr 1-15	83	566 (583%)	568 (586%)	83 (0%)	566 (583%)	568 (586%)
Apr 16-30	104	326 (214%)	326 (214%)	104 (0%)	326 (214%)	326 (214%)
May 1-31	67	199 (196%)	199 (196%)	67 (0%)	199 (196%)	199 (196%)
Jun 1-30	109	197 (81%)	197 (81%)	109 (0%)	197 (81%)	197 (81%)
Jul 1-31	164	232 (41%)	232 (41%)	164 (0%)	232 (41%)	232 (41%)
Aug 1-31	198	263 (33%)	263 (33%)	198 (0%)	263 (33%)	263 (33%)
Sep 1-30	175	268 (53%)	268 (53%)	175 (0%)	268 (53%)	268 (53%)

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Year type as defined by the Restoration Year Type.
[2] Simulation period: January 1980 – September 2003.
[3] (%) indicates percent change from existing conditions.
[4] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

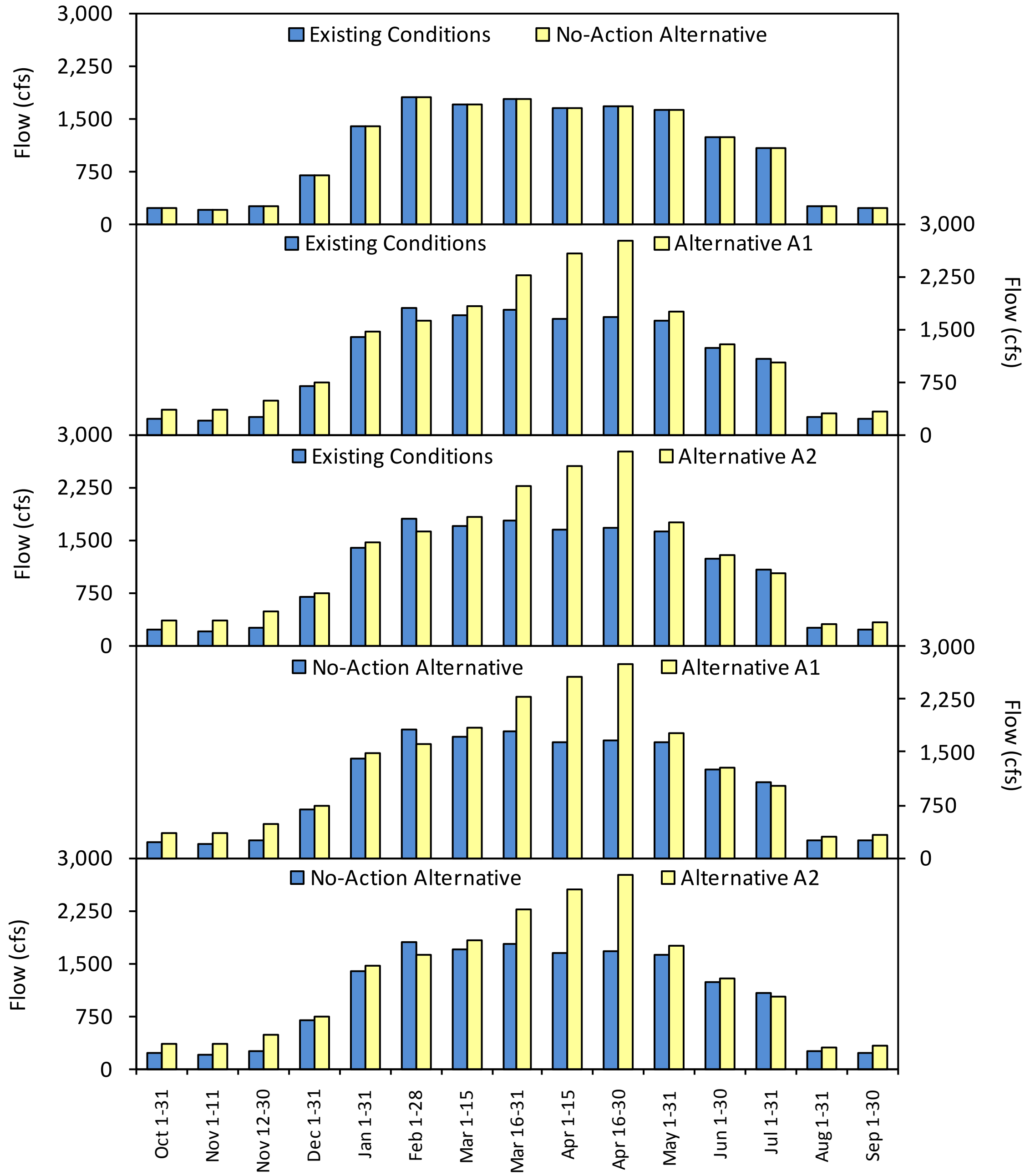


Figure 13-48.
Average Simulated Flow at Head of Reach 5

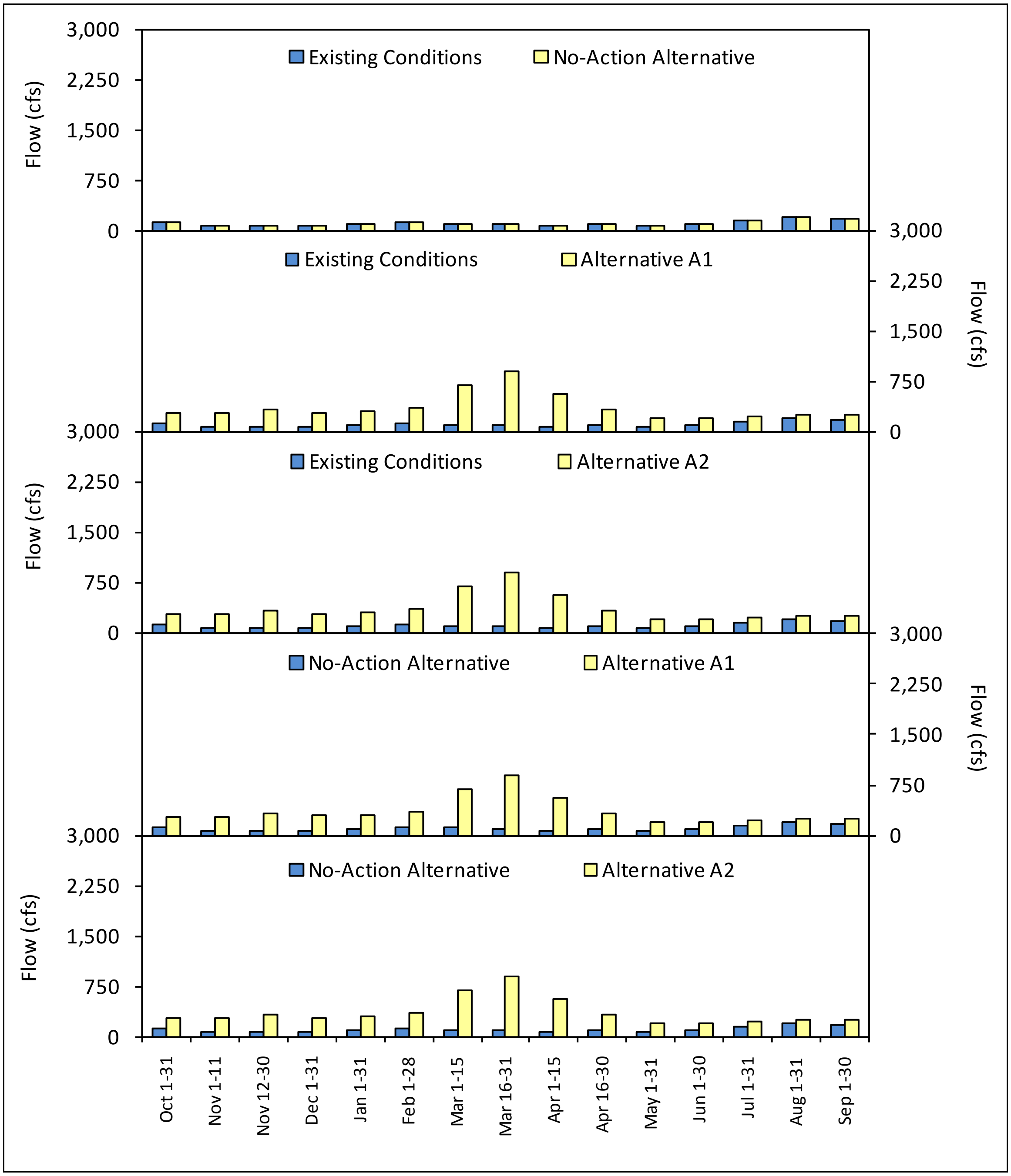


Figure 13-49.
Average Simulated Flow in Dry Years at Head of Reach 5

Flow changes in the flood bypass system due to Interim and Restoration flows are shown in Tables 13-85 through 13-94 and Figures 13-50 through 13-59. These changes would be typically negative because of less flood flows being released from Friant Dam. Flow increases in the Sand Slough and Eastside Bypasses (e.g., April) would occur in Alternative A1 because of increased Interim and Restoration flows being routed around Reach 4B1.

Table 13-85.
Average Simulated Flow at Chowchilla Bypass Below Bifurcation Structure

Dates of Flow Release	Existing Level[1] (2005)			Future Level[1] (2030)		
	Existing Condition (cfs)	Alt A1, B1, C1[2] (cfs)	Alt A2, B2, C2[2] (cfs)	No-Action Alt[2] (cfs)	Alt A1, B1, C1[2] (cfs)	Alt A2, B2, C2[2] (cfs)
Oct 1-31	8	1	1	9	1	1
Nov 1-11	1	1	1	1	1	1
Nov 12-30	28	1	1	30	1	1
Dec 1-31	288	112	112	288	111	111
Jan 1-31	642	396	396	642	396	396
Feb 1-28	818	354	354	818	354	354
Mar 1-15	738	333	333	739	334	334
Mar 16-31	726	277	277	726	277	277
Apr 1-15	815	322	322	815	322	322
Apr 16-30	881	349	349	882	349	349
May 1-31	898	211	211	899	211	211
Jun 1-30	774	285	285	775	285	285
Jul 1-31	552	282	282	552	283	283
Aug 1-31	1	1	1	1	1	1
Sep 1-30	0	1	1	0	1	1

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Simulation period: January 1980 – September 2003.
[2] Percent changes are not shown because this bypass is typically dry during all or part of the year in the existing conditions or No-Action Alternative simulations.
Key:
Alt = Alternative
cfs = cubic feet per second

Table 13-86.
Average Simulated Flow in Dry Years at Chowchilla Bypass Below Bifurcation Structure[1]

Dates of Flow Release	Existing Level[2 3] (2005)			Future Level[2 3] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1 (cfs)	Alt A2, B2, C2 (cfs)	No-Action Alt (cfs)	Alt A1, B1, C1 (cfs)	Alt A2, B2, C2 (cfs)
Oct 1-31	0	1	1	0	1	1
Nov 1-11	0	1	1	0	1	1
Nov 12-30	0	1	1	0	1	1
Dec 1-31	0	1	1	0	1	1
Jan 1-31	0	1	1	0	1	1
Feb 1-28	0	1	1	0	1	1
Mar 1-15	0	1	1	0	1	1
Mar 16-31	0	1	1	0	1	1
Apr 1-15	0	1	1	0	1	1
Apr 16-30	0	1	1	0	1	1
May 1-31	0	1	1	0	1	1
Jun 1-30	0	1	1	0	1	1
Jul 1-31	0	1	1	0	1	1
Aug 1-31	0	1	1	0	1	1
Sep 1-30	0	1	1	0	1	1

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Year type as defined by the Restoration Year Type.
[2] Simulation period: January 1980 – September 2003.
[3] Percent changes are not shown because this bypass is typically dry during all or part of the year in the existing conditions or No-Action Alternative simulations.
Key:
Alt = Alternative
cfs = cubic feet per second

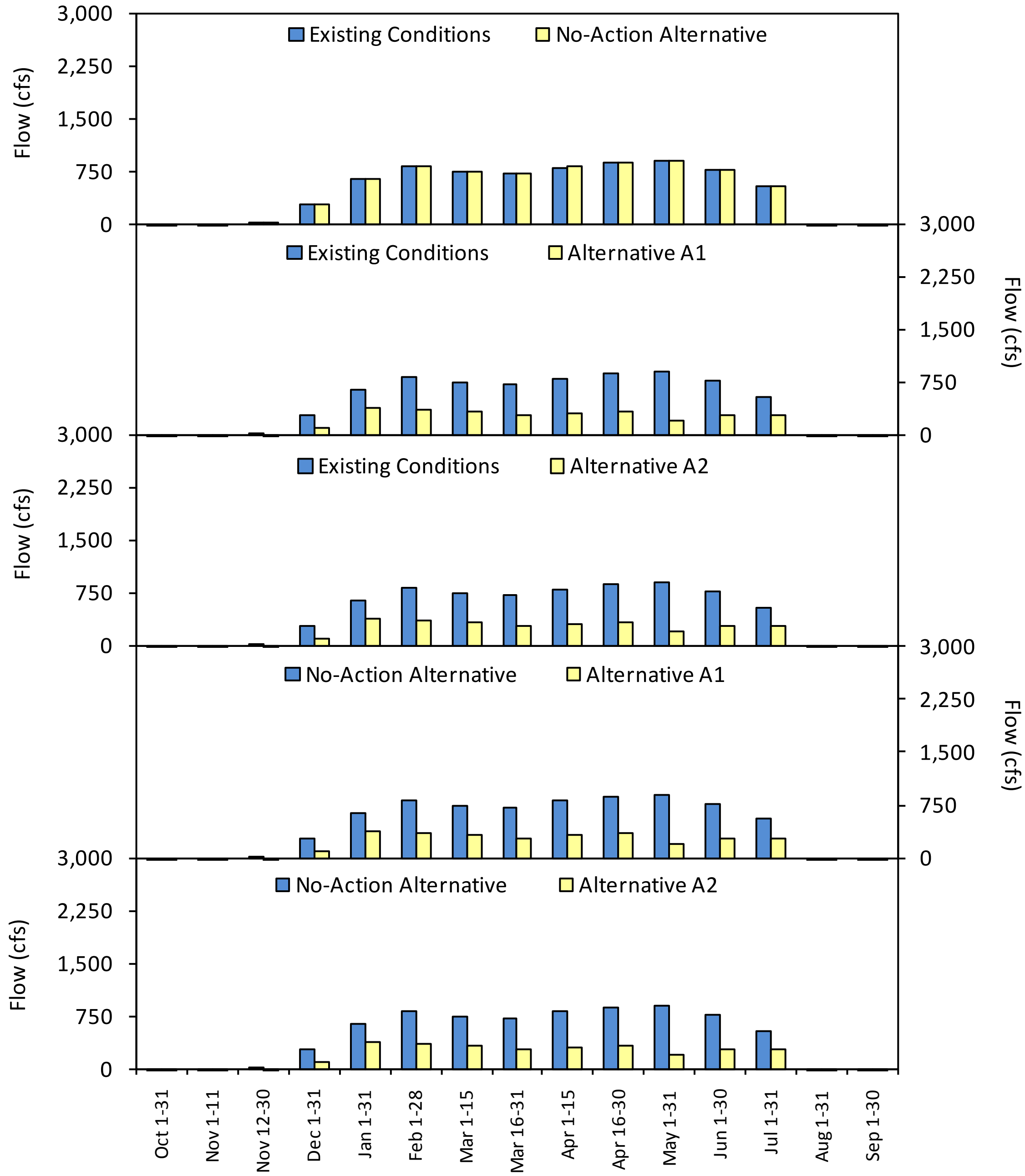


Figure 13-50.
Average Simulated Flow at Chowchilla Bypass Below Bifurcation Structure

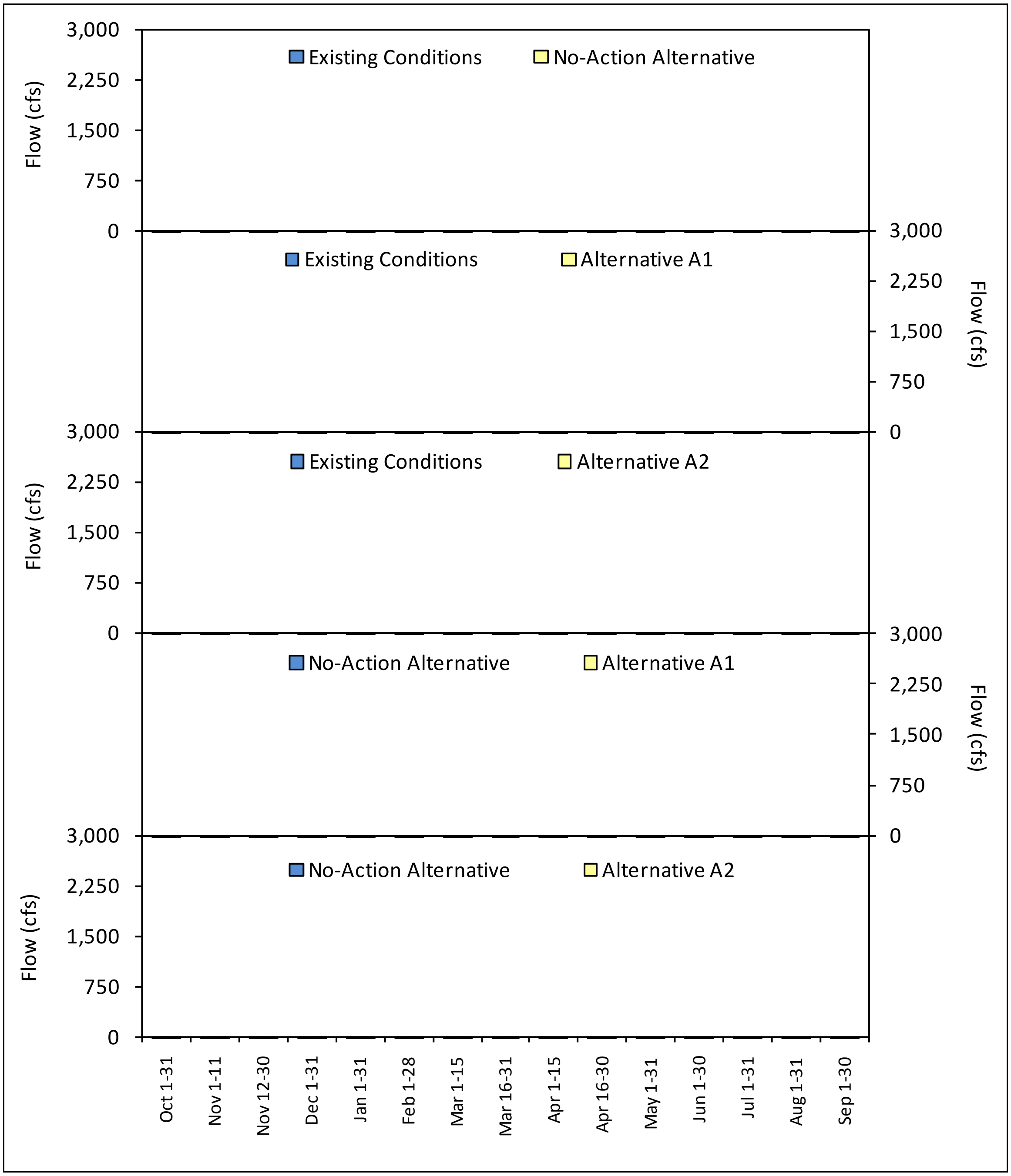


Figure 13-51.
Average Simulated Flow in Dry Years at Chowchilla Bypass Below Bifurcation Structure

Table 13-87.
Average Simulated Flow at Eastside Bypass Below Sand Slough

Dates of Flow Release	Existing Level[1] (2005)			Future Level[1] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1[2] (cfs)	Alt A2, B2, C2[2] (cfs)	No-Action Alt[2] (cfs)	Alt A1, B1, C1[3] (cfs)	Alt A2, B2, C2[3] (cfs)
Oct 1-31	133	25 (-82%)	1 (-99%)	133 (0%)	25 (-82%)	1 (-99%)
Nov 1-11	101	44 (-56%)	1 (-99%)	101 (0%)	44 (-56%)	1 (-99%)
Nov 12-30	178	136 (-24%)	1 (-99%)	178 (0%)	136 (-24%)	1 (-99%)
Dec 1-31	353	289 (-18%)	9 (-98%)	353 (0%)	289 (-18%)	9 (-98%)
Jan 1-31	555	590 (6%)	51 (-91%)	555 (0%)	590 (6%)	51 (-91%)
Feb 1-28	692	595 (-14%)	56 (-92%)	692 (0%)	595 (-14%)	56 (-92%)
Mar 1-15	691	806 (17%)	55 (-92%)	692 (0%)	806 (16%)	55 (-92%)
Mar 16-31	724	1,218 (68%)	99 (-86%)	724 (0%)	1,219 (68%)	99 (-86%)
Apr 1-15	672	1,661 (147%)	206 (-69%)	672 (0%)	1,661 (147%)	206 (-69%)
Apr 16-30	725	1,876 (159%)	327 (-55%)	725 (0%)	1,876 (159%)	327 (-55%)
May 1-31	640	1,087 (70%)	103 (-84%)	640 (0%)	1,087 (70%)	103 (-84%)
Jun 1-30	450	659 (46%)	33 (-93%)	451 (0%)	659 (46%)	33 (-93%)
Jul 1-31	326	374 (15%)	17 (-95%)	326 (0%)	374 (15%)	17 (-95%)
Aug 1-31	150	8 (-95%)	1 (-99%)	150 (0%)	8 (-95%)	1 (-99%)
Sep 1-30	145	2 (-98%)	1 (-99%)	145 (0%)	2 (-98%)	1 (-99%)

Source: Summarized from SJR5Q flow and temperature model.

Notes:
1 Simulation period: January 1980 – September 2003.
2 (%) indicates percent change from existing conditions.
3 (%) indicates percent change from No-Action Alternative.

Key:
Alt = Alternative
cfs = cubic feet per second

Table 13-88.
Average Simulated Flow in Dry Years at Eastside Bypass Below Sand Slough[1]

Dates of Flow Release	Existing Level[2] (2005)			Future Level[2] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1[3] (cfs)	Alt A2, B2, C2[3] (cfs)	No-Action Alt[3] (cfs)	Alt A1, B1, C1[4] (cfs)	Alt A2, B2, C2[4] (cfs)
Oct 1-31	70	2 (-97%)	1 (-98%)	70 (0%)	2 (-97%)	1 (-98%)
Nov 1-11	20	2 (-87%)	1 (-94%)	20 (0%)	2 (-87%)	1 (-94%)
Nov 12-30	19	3 (-85%)	1 (-94%)	19 (0%)	3 (-85%)	1 (-94%)
Dec 1-31	36	3 (-93%)	1 (-97%)	36 (0%)	3 (-93%)	1 (-97%)
Jan 1-31	18	2 (-87%)	1 (-94%)	18 (0%)	2 (-87%)	1 (-94%)
Feb 1-28	8	3 (-66%)	1 (-86%)	8 (0%)	3 (-66%)	1 (-86%)
Mar 1-15	18	154 (763%)	1 (-92%)	18 (0%)	154 (765%)	1 (-92%)
Mar 16-31	31	328 (958%)	2 (-95%)	31 (0%)	328 (958%)	2 (-95%)
Apr 1-15	31	46 (48%)	1 (-96%)	31 (0%)	46 (48%)	1 (-96%)
Apr 16-30	36	3 (-93%)	1 (-97%)	36 (0%)	3 (-93%)	1 (-97%)
May 1-31	34	2 (-95%)	1 (-97%)	34 (0%)	2 (-95%)	1 (-97%)
Jun 1-30	70	2 (-98%)	1 (-98%)	70 (0%)	2 (-98%)	1 (-98%)
Jul 1-31	124	2 (-98%)	1 (-99%)	124 (0%)	2 (-98%)	1 (-99%)
Aug 1-31	151	2 (-99%)	1 (-99%)	151 (0%)	2 (-99%)	1 (-99%)
Sep 1-30	135	2 (-98%)	1 (-99%)	135 (0%)	2 (-98%)	1 (-99%)

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Year type as defined by the Restoration Year Type.
[2] Simulation period: January 1980 – September 2003.
[3] (%) indicates percent change from existing conditions.
[4] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

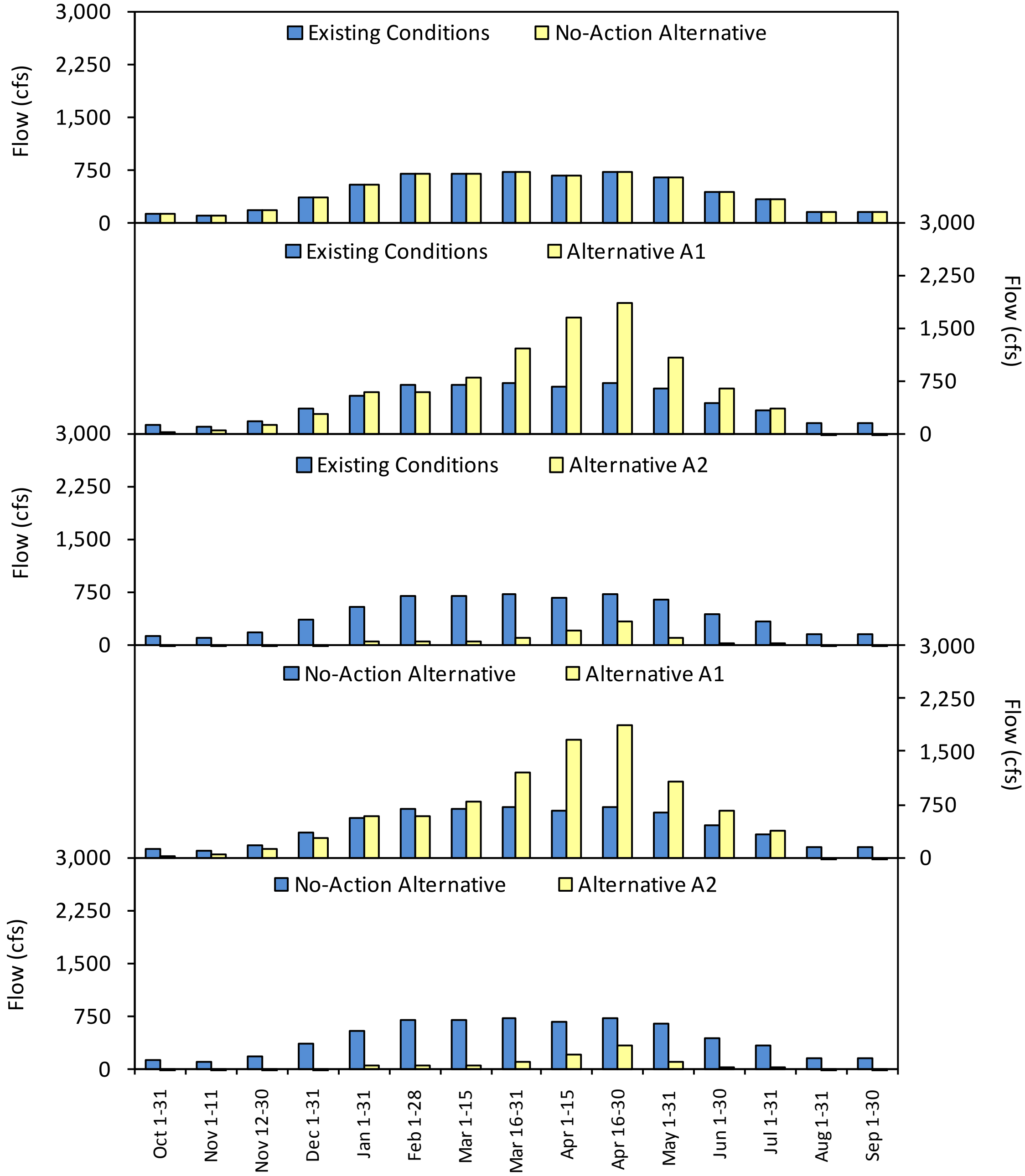


Figure 13-52.
Average Simulated Flow at Eastside Bypass Below Sand Slough

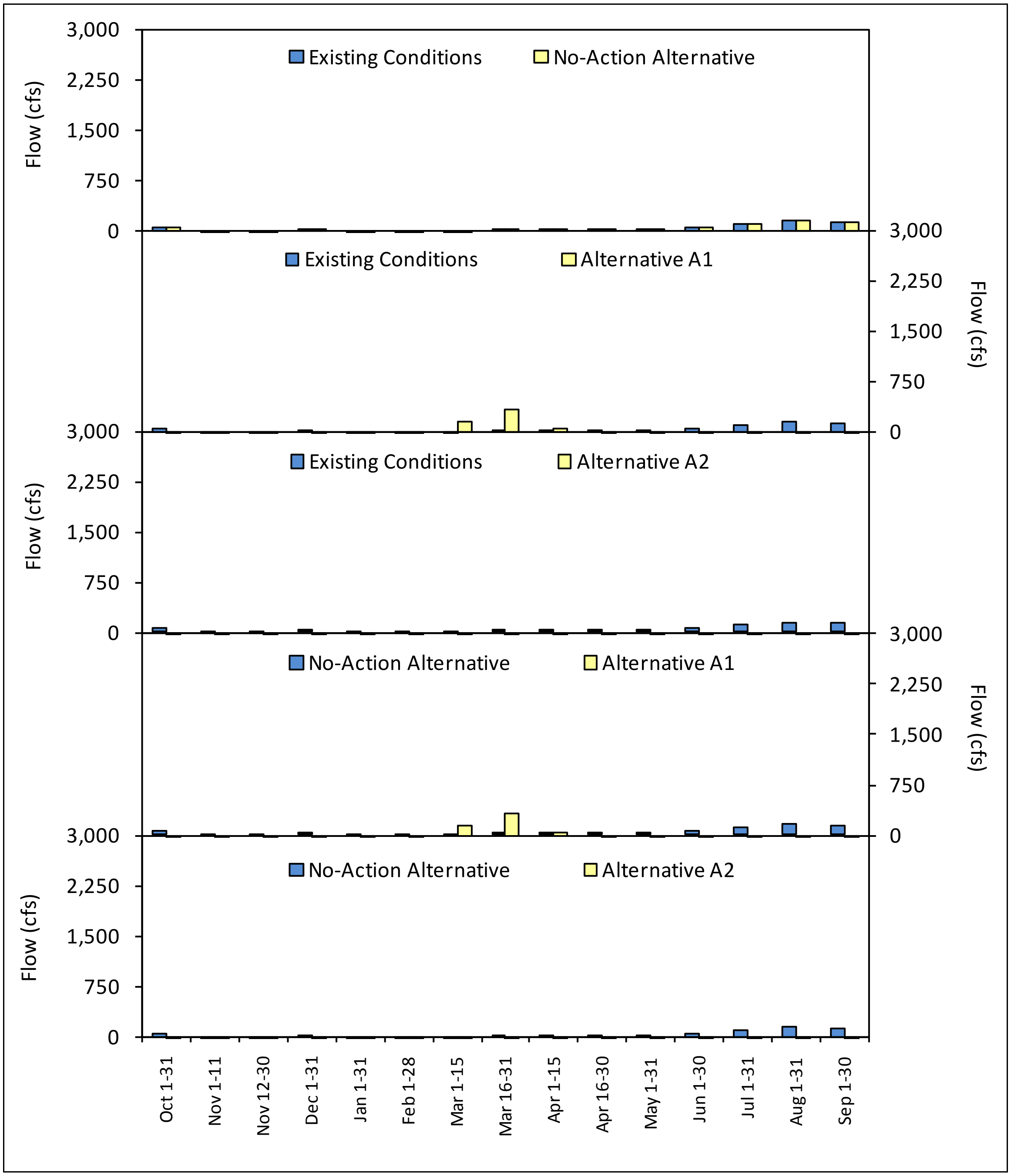


Figure 13-53.
Average Simulated Flow in Dry Years at Eastside Bypass Below Sand Slough

Table 13-89.
Average Simulated Flow at Eastside Bypass Before San Joaquin River Confluence

Dates of Flow Release	Existing Level[1] (2005)			Future Level[1] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1[2] (cfs)	Alt A2, B2, C2[2] (cfs)	No-Action Alt[2] (cfs)	Alt A1, B1, C1[3] (cfs)	Alt A2, B2, C2[3] (cfs)
Oct 1-31	135	24 (-82%)	2 (-99%)	135 (0%)	24 (-83%)	2 (-99%)
Nov 1-11	119	40 (-66%)	2 (-99%)	119 (0%)	40 (-66%)	2 (-99%)
Nov 12-30	177	123 (-30%)	2 (-99%)	178 (1%)	123 (-31%)	2 (-99%)
Dec 1-31	503	315 (-37%)	79 (-84%)	503 (0%)	315 (-38%)	78 (-84%)
Jan 1-31	940	780 (-17%)	347 (-63%)	940 (0%)	780 (-17%)	347 (-63%)
Feb 1-28	1,245	796 (-36%)	384 (-69%)	1,245 (0%)	796 (-36%)	384 (-69%)
Mar 1-15	1,201	919 (-24%)	301 (-75%)	1,203 (0%)	919 (-24%)	301 (-75%)
Mar 16-31	1,248	1,306 (5%)	354 (-72%)	1,249 (0%)	1,307 (5%)	354 (-72%)
Apr 1-15	1,233	1,694 (37%)	442 (-64%)	1,233 (0%)	1,694 (37%)	442 (-64%)
Apr 16-30	1,313	1,945 (48%)	601 (-54%)	1,313 (0%)	1,945 (48%)	601 (-54%)
May 1-31	1,306	1,175 (-10%)	322 (-75%)	1,307 (0%)	1,175 (-10%)	322 (-75%)
Jun 1-30	1,004	811 (-19%)	243 (-76%)	1,005 (0%)	811 (-19%)	243 (-76%)
Jul 1-31	841	587 (-30%)	286 (-66%)	842 (0%)	588 (-30%)	287 (-66%)
Aug 1-31	150	9 (-94%)	2 (-99%)	150 (0%)	9 (-94%)	2 (-99%)
Sep 1-30	145	3 (-98%)	2 (-99%)	145 (0%)	3 (-98%)	2 (-99%)

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Simulation period: January 1980 – September 2003.
[2] (%) indicates percent change from existing conditions.
[3] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

Table 13-90.
Average Simulated Flow in Dry Years at Eastside Bypass Before San Joaquin River Confluence[1]

Dates of Flow Release	Existing Level[2] (2005)			Future Level[2] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1[3] (cfs)	Alt A2, B2, C2[3] (cfs)	No-Action Alt[3] (cfs)	Alt A1, B1, C1[4] (cfs)	Alt A2, B2, C2[4] (cfs)
Oct 1-31	71	3 (-96%)	2 (-98%)	71 (0%)	3 (-96%)	2 (-98%)
Nov 1-11	21	3 (-86%)	2 (-92%)	21 (0%)	3 (-86%)	2 (-92%)
Nov 12-30	18	3 (-82%)	2 (-90%)	18 (0%)	3 (-82%)	2 (-90%)
Dec 1-31	36	3 (-91%)	2 (-95%)	36 (0%)	3 (-91%)	2 (-95%)
Jan 1-31	20	3 (-86%)	2 (-91%)	20 (0%)	3 (-86%)	2 (-91%)
Feb 1-28	8	3 (-59%)	2 (-77%)	8 (0%)	3 (-59%)	2 (-77%)
Mar 1-15	18	128 (625%)	2 (-87%)	18 (0%)	128 (626%)	2 (-87%)
Mar 16-31	29	337 (1,051%)	3 (-91%)	29 (0%)	337 (1,051%)	3 (-91%)
Apr 1-15	27	63 (129%)	2 (-92%)	27 (0%)	63 (129%)	2 (-92%)
Apr 16-30	38	3 (-92%)	2 (-95%)	38 (0%)	3 (-92%)	2 (-95%)
May 1-31	31	2 (-93%)	2 (-95%)	31 (0%)	2 (-93%)	2 (-95%)
Jun 1-30	66	2 (-97%)	2 (-98%)	66 (0%)	2 (-97%)	2 (-98%)
Jul 1-31	123	2 (-98%)	2 (-99%)	123 (0%)	2 (-98%)	2 (-99%)
Aug 1-31	148	3 (-98%)	2 (-99%)	148 (0%)	3 (-98%)	2 (-99%)
Sep 1-30	136	3 (-98%)	2 (-99%)	136 (0%)	3 (-98%)	2 (-99%)

Source: Summarized from SJR5Q flow and temperature model
Notes:
[1] Year type as defined by the Restoration Year Type.
[2] Simulation period: January 1980 – September 2003.
[3] (%) indicates percent change from existing conditions.
[4] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

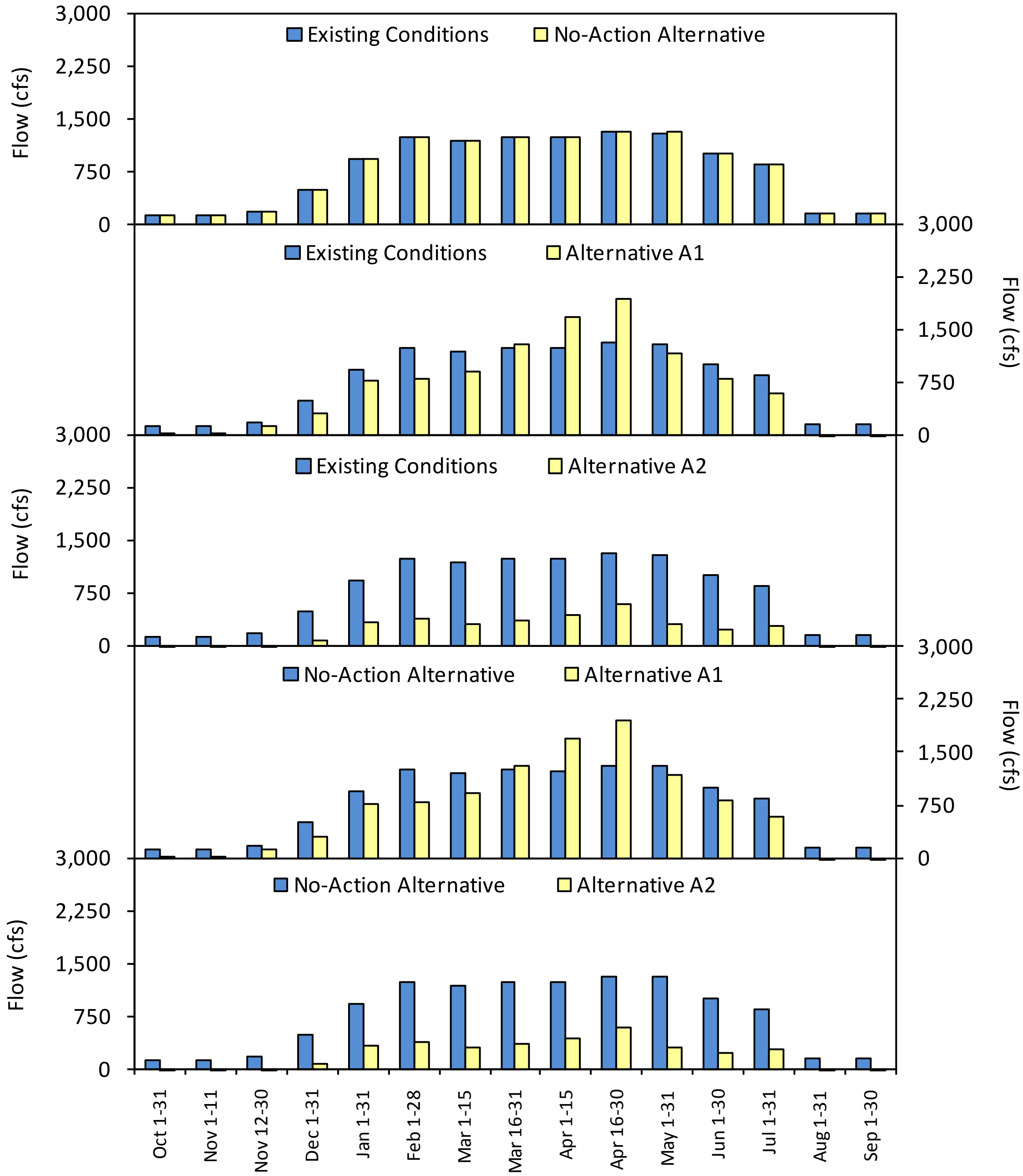


Figure 13-54.
Average Simulated Flow at Eastside Bypass Before San Joaquin River Confluence

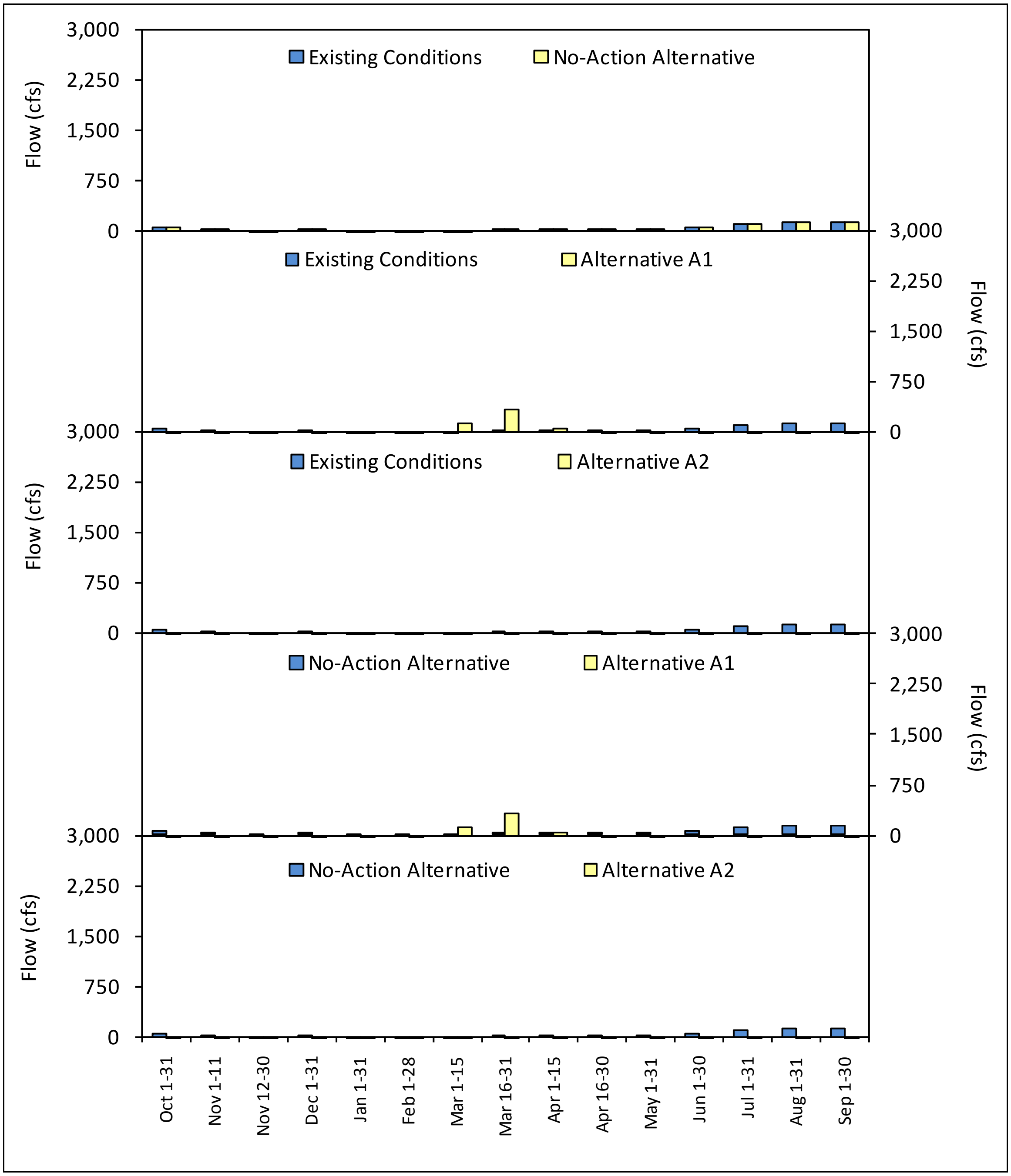


Figure 13-55.
Average Simulated Flow in Dry Years at Eastside Bypass Before San Joaquin River Confluence

Table 13-91.
Average Simulated Flow at Sand Slough Bypass

Dates of Flow Release	Existing Level[1] (2005)			Future Level[1] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1[2] (cfs)	Alt A2, B2, C2[2] (cfs)	No-Action Alt[2] (cfs)	Alt A1, B1, C1[3] (cfs)	Alt A2, B2, C2[3] (cfs)
Oct 1-31	133	25 (-82%)	1 (-99%)	133 (0%)	25 (-82%)	1 (-99%)
Nov 1-11	101	44 (-56%)	1 (-99%)	101 (0%)	44 (-56%)	1 (-99%)
Nov 12-30	178	136 (-24%)	1 (-99%)	178 (0%)	136 (-24%)	1 (-99%)
Dec 1-31	353	289 (-18%)	9 (-98%)	353 (0%)	289 (-18%)	9 (-98%)
Jan 1-31	555	590 (6%)	51 (-91%)	555 (0%)	590 (6%)	51 (-91%)
Feb 1-28	692	595 (-14%)	56 (-92%)	692 (0%)	595 (-14%)	56 (-92%)
Mar 1-15	691	806 (17%)	55 (-92%)	692 (0%)	806 (16%)	55 (-92%)
Mar 16-31	724	1,218 (68%)	99 (-86%)	724 (0%)	1,219 (68%)	99 (-86%)
Apr 1-15	672	1,661 (147%)	206 (-69%)	672 (0%)	1,661 (147%)	206 (-69%)
Apr 16-30	725	1,876 (159%)	327 (-55%)	725 (0%)	1,876 (159%)	327 (-55%)
May 1-31	640	1,087 (70%)	103 (-84%)	640 (0%)	1,087 (70%)	103 (-84%)
Jun 1-30	450	659 (46%)	33 (-93%)	451 (0%)	659 (46%)	33 (-93%)
Jul 1-31	326	374 (15%)	17 (-95%)	326 (0%)	374 (15%)	17 (-95%)
Aug 1-31	150	8 (-95%)	1 (-99%)	150 (0%)	8 (-95%)	1 (-99%)
Sep 1-30	145	2 (-98%)	1 (-99%)	145 (0%)	2 (-98%)	1 (-99%)

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Simulation period: January 1980 – September 2003.
[2] (%) indicates percent change from existing conditions.
[3] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

Table 13-92.
Average Simulated Flow in Dry Years at Sand Slough Bypass[1]

Dates of Flow Release	Existing Level[2] (2005)			Future Level[2] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1[3] (cfs)	Alt A2, B2, C2[3] (cfs)	No-Action Alt[3] (cfs)	Alt A1, B1, C1[4] (cfs)	Alt A2, B2, C2[4] (cfs)
Oct 1-31	70	2 (-97%)	1 (-98%)	70 (0%)	2 (-97%)	1 (-98%)
Nov 1-11	20	2 (-87%)	1 (-94%)	20 (0%)	2 (-87%)	1 (-94%)
Nov 12-30	19	3 (-85%)	1 (-94%)	19 (0%)	3 (-85%)	1 (-94%)
Dec 1-31	36	3 (-93%)	1 (-97%)	36 (0%)	3 (-93%)	1 (-97%)
Jan 1-31	18	2 (-87%)	1 (-94%)	18 (0%)	2 (-87%)	1 (-94%)
Feb 1-28	8	3 (-66%)	1 (-86%)	8 (0%)	3 (-66%)	1 (-86%)
Mar 1-15	18	154 (763%)	1 (-92%)	18 (0%)	154 (765%)	1 (-92%)
Mar 16-31	31	328 (958%)	2 (-95%)	31 (0%)	328 (958%)	2 (-95%)
Apr 1-15	31	46 (48%)	1 (-96%)	31 (0%)	46 (48%)	1 (-96%)
Apr 16-30	36	3 (-93%)	1 (-97%)	36 (0%)	3 (-93%)	1 (-97%)
May 1-31	34	2 (-95%)	1 (-97%)	34 (0%)	2 (-95%)	1 (-97%)
Jun 1-30	70	2 (-98%)	1 (-98%)	70 (0%)	2 (-98%)	1 (-98%)
Jul 1-31	124	2 (-98%)	1 (-99%)	124 (0%)	2 (-98%)	1 (-99%)
Aug 1-31	151	2 (-99%)	1 (-99%)	151 (0%)	2 (-99%)	1 (-99%)
Sep 1-30	135	2 (-98%)	1 (-99%)	135 (0%)	2 (-98%)	1 (-99%)

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Year type as defined by the Restoration Year Type.
[2] Simulation period: January 1980 – September 2003.
[3] (%) indicates percent change from existing conditions.
[4] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

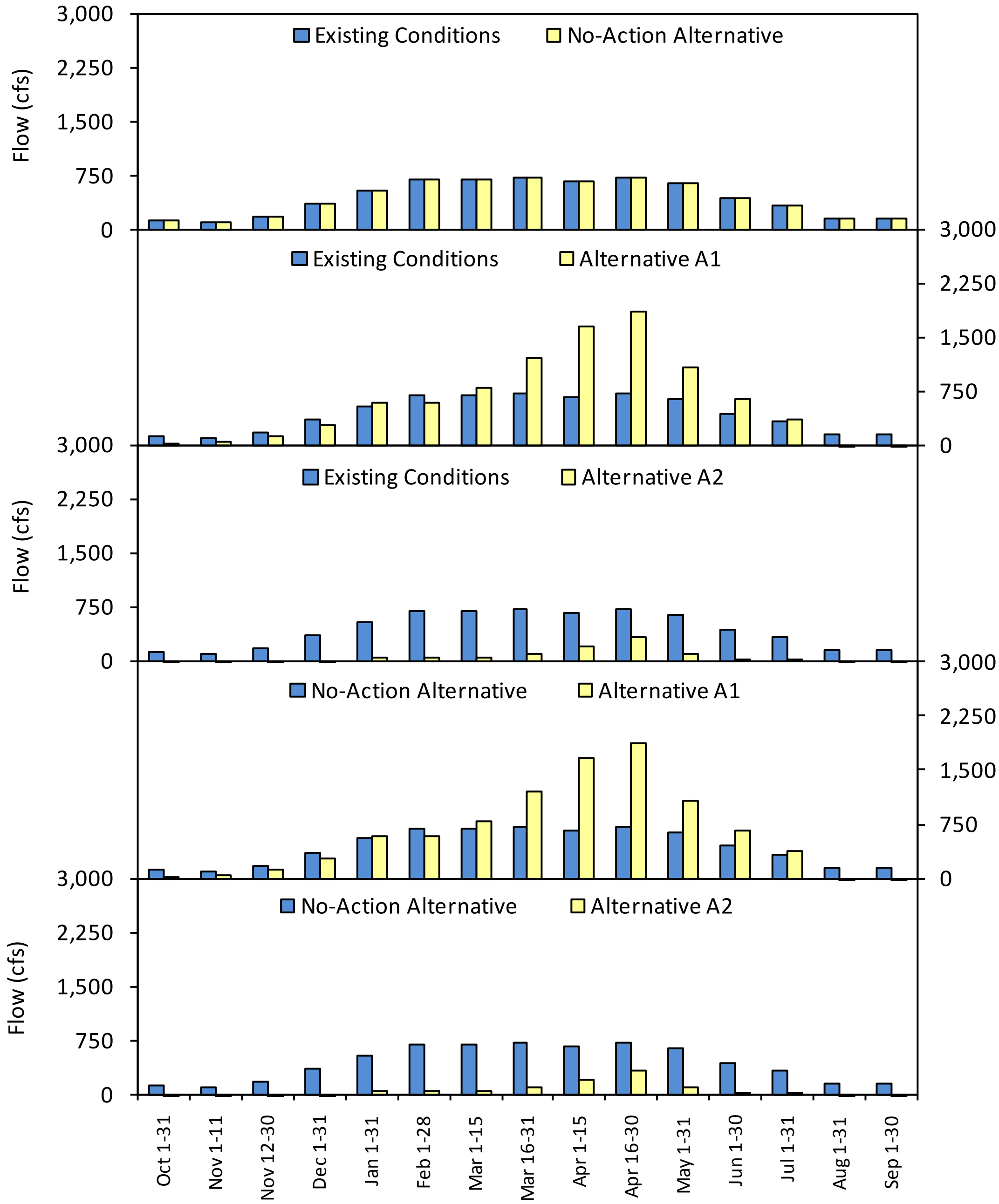


Figure 13-56.
Average Simulated Flow at Sand Slough Bypass

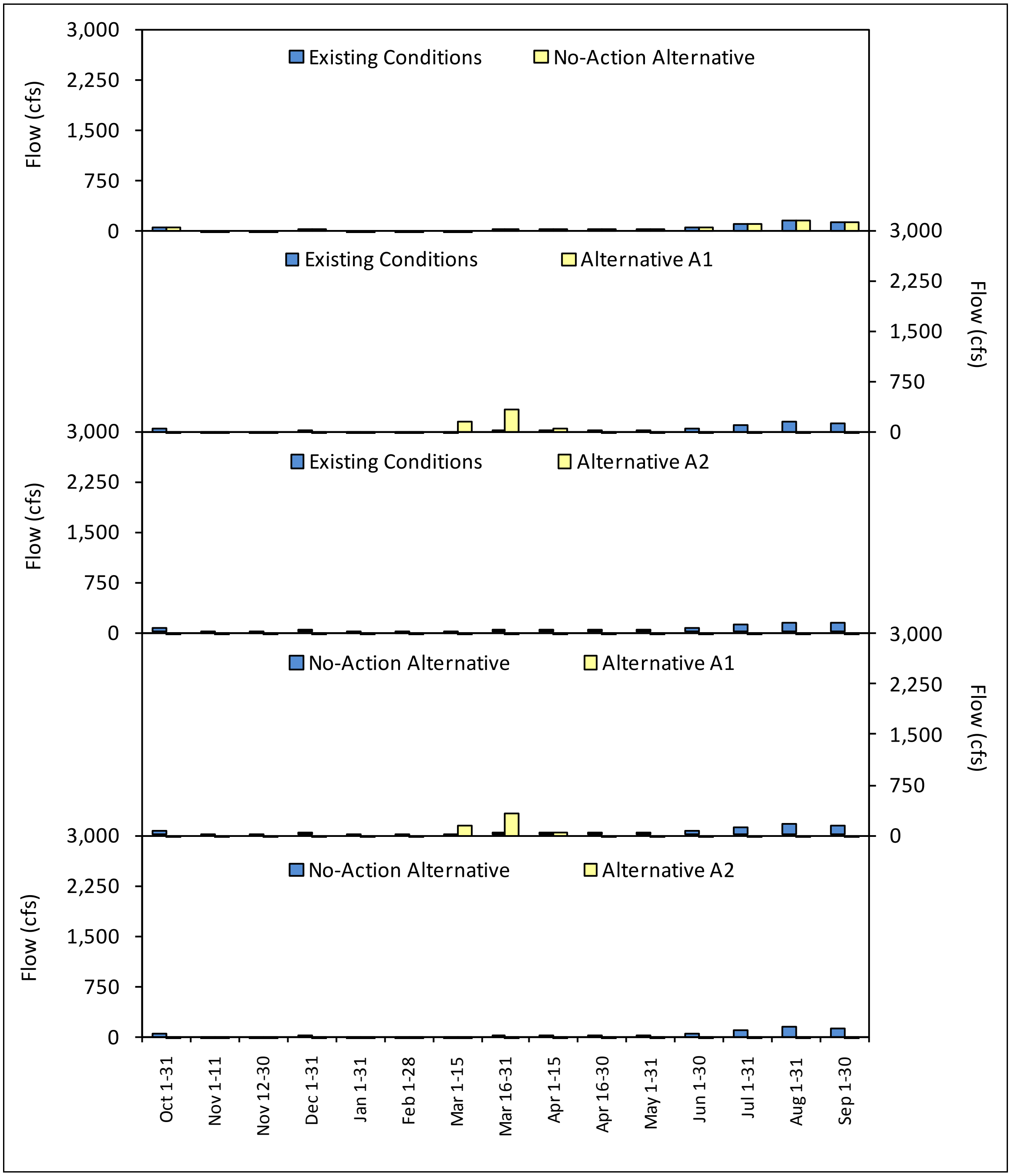


Figure 13-57.
Average Simulated Flow in Dry Years at Sand Slough Bypass

Table 13-93.
Average Simulated Flow at Mariposa Bypass

Dates of Flow Release	Existing Level[1 2] (2005)			Future Level[1 2] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1 (cfs)	Alt A2, B2, C2 (cfs)	No-Action Alt (cfs)	Alt A1, B1, C1 (cfs)	Alt A2, B2, C2 (cfs)
Oct 1-31	1	0	0	1	0	0
Nov 1-11	1	0	0	1	0	0
Nov 12-30	5	1	0	6	1	0
Dec 1-31	87	54	13	87	54	13
Jan 1-31	229	184	80	229	184	80
Feb 1-28	251	178	61	251	178	61
Mar 1-15	211	155	46	211	155	46
Mar 16-31	231	189	51	232	189	51
Apr 1-15	239	238	57	239	238	57
Apr 16-30	286	303	77	286	303	77
May 1-31	253	170	17	253	170	17
Jun 1-30	171	125	52	172	125	52
Jul 1-31	166	123	52	166	123	52
Aug 1-31	1	0	0	1	0	0
Sep 1-30	1	0	0	1	0	0

Source: Summarized from SJR5Q flow and temperature model.

Notes:

[1] Simulation period: January 1980 – September 2003.

[2] Percent changes are not shown because this bypass is typically dry during all or part of the year in the existing conditions or No-Action Alternative simulations.

Key:

Alt = Alternative

cfs = cubic feet per second

Table 13-94.
Average Simulated Flow in Dry Years at Mariposa Bypass[1]

Dates of Flow Release	Existing Level[2 3] (2005)			Future Level[2 3] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1 (cfs)	Alt A2, B2, C2 (cfs)	No-Action Alt (cfs)	Alt A1, B1, C1 (cfs)	Alt A2, B2, C2 (cfs)
Oct 1-31	1	0	0	1	0	0
Nov 1-11	1	0	0	1	0	0
Nov 12-30	1	0	0	1	0	0
Dec 1-31	1	0	0	1	0	0
Jan 1-31	1	0	0	1	0	0
Feb 1-28	1	0	0	1	0	0
Mar 1-15	1	1	0	1	1	0
Mar 16-31	1	2	0	1	2	0
Apr 1-15	1	1	0	1	1	0
Apr 16-30	1	0	0	1	0	0
May 1-31	1	0	0	1	0	0
Jun 1-30	1	0	0	1	0	0
Jul 1-31	1	0	0	1	0	0
Aug 1-31	1	0	0	1	0	0
Sep 1-30	1	0	0	1	0	0

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Year type as defined by the Restoration Year Type.
[2] Simulation period: January 1980 – September 2003.
[3] Percent changes are not shown because this bypass is typically dry during all or part of the year in the existing conditions or No-Action Alternative simulations.
Key:
Alt = Alternative
cfs = cubic feet per second

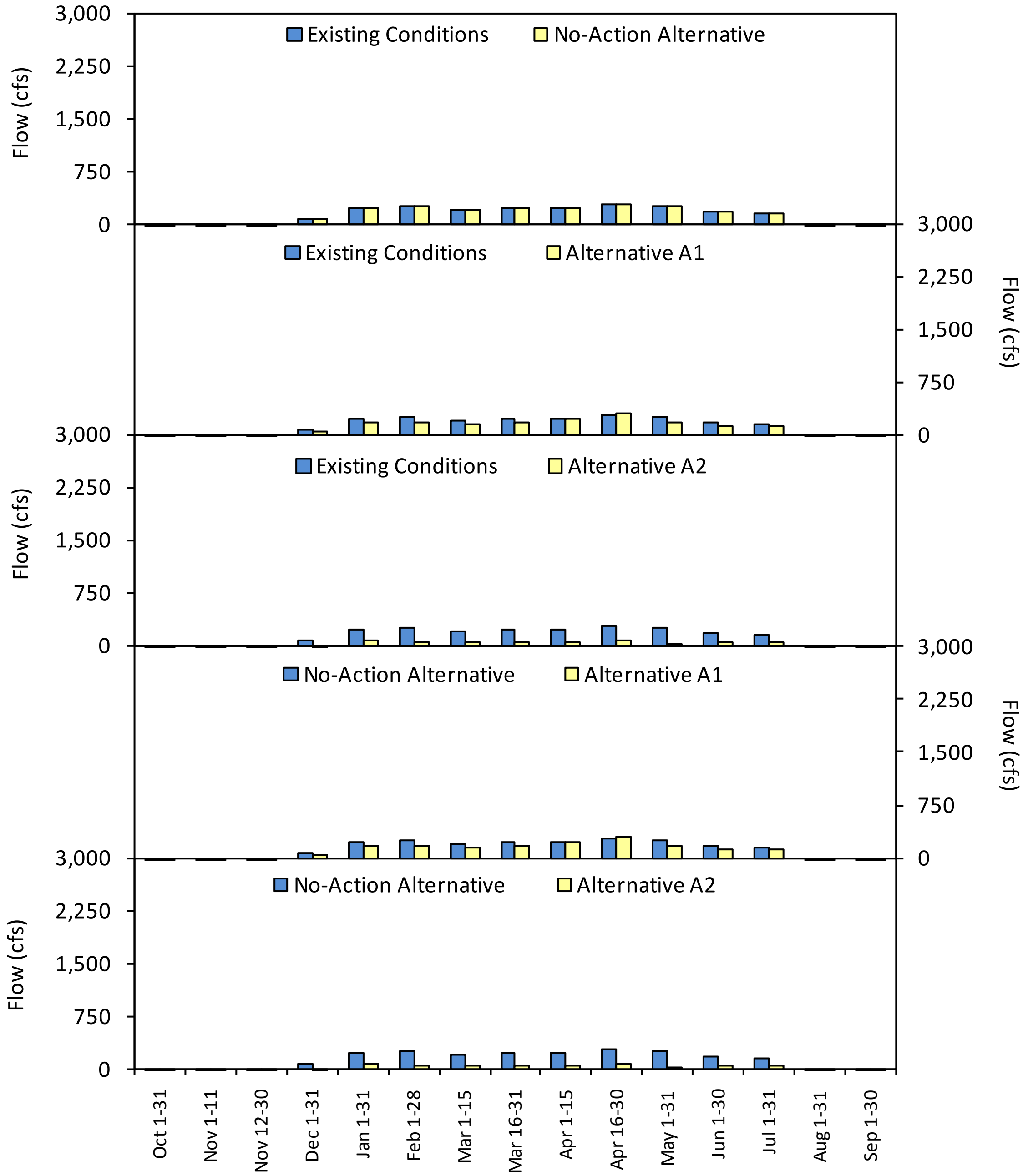


Figure 13-58.
Average Simulated Flow at Mariposa Bypass

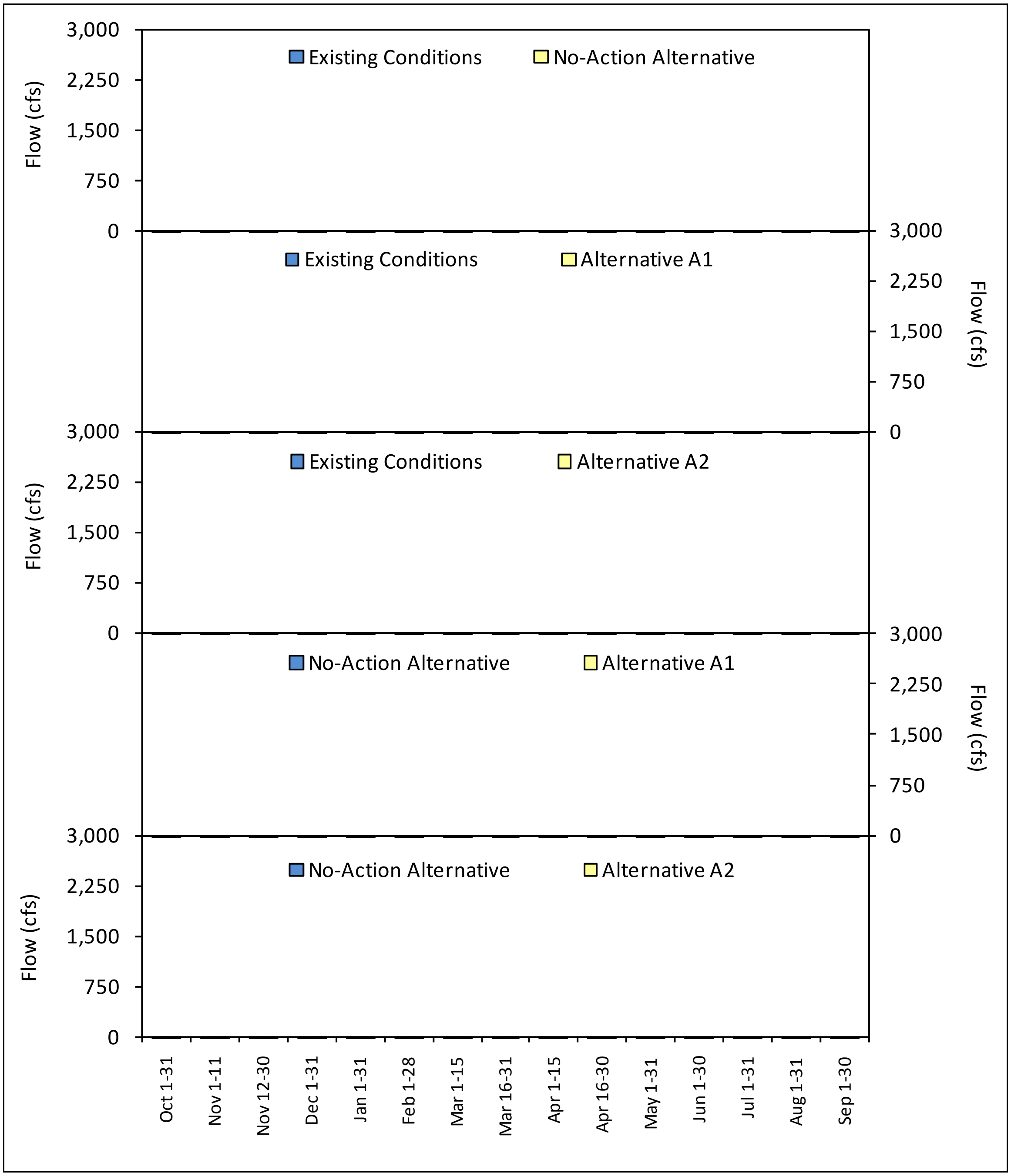


Figure 13-59.
Average Simulated Flow in Dry Years at Mariposa Bypass

Changes in flow leaving the Restoration Area due to Interim and Restoration flows are described in Tables 13-95 and 13-96 and Figures 13-60 and 13-61. At this point in the Restoration Area, Interim and Restoration flows would have less influence on total river flow because of agriculture return flows and tributaries such as Bear Creek.

Table 13-95.
Average Simulated Flow at San Joaquin River Above Merced River Confluence

Dates of Flow Release	Existing Level[1] (2005)			Future Level[1] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1[2] (cfs)	Alt A2, B2, C2[2] (cfs)	No-Action Alt[2] (cfs)	Alt A1, B1, C1[3] (cfs)	Alt A2, B2, C2[3] (cfs)
Oct 1-31	553	682 (23%)	681 (23%)	553 (0%)	682 (23%)	681 (23%)
Nov 1-11	537	697 (30%)	696 (29%)	538 (0%)	697 (30%)	696 (29%)
Nov 12-30	566	811 (43%)	809 (43%)	566 (0%)	811 (43%)	809 (43%)
Dec 1-31	1,089	1,158 (6%)	1,158 (6%)	1,090 (0%)	1,158 (6%)	1,158 (6%)
Jan 1-31	2,042	2,125 (4%)	2,125 (4%)	2,042 (0%)	2,125 (4%)	2,125 (4%)
Feb 1-28	2,692	2,504 (-7%)	2,502 (-7%)	2,693 (0%)	2,504 (-7%)	2,503 (-7%)
Mar 1-15	2,663	2,757 (4%)	2,753 (3%)	2,664 (0%)	2,757 (3%)	2,753 (3%)
Mar 16-31	2,732	3,203 (17%)	3,198 (17%)	2,733 (0%)	3,204 (17%)	3,199 (17%)
Apr 1-15	2,336	3,242 (39%)	3,239 (39%)	2,336 (0%)	3,242 (39%)	3,239 (39%)
Apr 16-30	2,227	3,319 (49%)	3,322 (49%)	2,227 (0%)	3,319 (49%)	3,322 (49%)
May 1-31	2,098	2,242 (7%)	2,246 (7%)	2,099 (0%)	2,243 (7%)	2,246 (7%)
Jun 1-30	1,631	1,683 (3%)	1,685 (3%)	1,633 (0%)	1,683 (3%)	1,685 (3%)
Jul 1-31	1,480	1,421 (-4%)	1,424 (-4%)	1,481 (0%)	1,423 (-4%)	1,425 (-4%)
Aug 1-31	588	658 (12%)	659 (12%)	588 (0%)	658 (12%)	659 (12%)
Sep 1-30	548	642 (17%)	642 (17%)	548 (0%)	642 (17%)	642 (17%)

Source: Summarized from SJR5Q flow and temperature model.
Notes:
[1] Simulation period: January 1980 – September 2003.
[2] (%) indicates percent change from existing conditions.
[3] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

Table 13-96.
Average Simulated Flow in Dry Years at San Joaquin River Above Merced River Confluence[1]

Dates of Flow Release	Existing Level[2] (2005)			Future Level[2] (2030)		
	Existing Conditions (cfs)	Alt A1, B1, C1[3] (cfs)	Alt A2, B2, C2[3] (cfs)	No-Action Alt[3] (cfs)	Alt A1, B1, C1[4] (cfs)	Alt A2, B2, C2[4] (cfs)
Oct 1-31	368	511 (39%)	511 (39%)	368 (0%)	511 (39%)	511 (39%)
Nov 1-11	369	578 (57%)	578 (57%)	369 (0%)	578 (57%)	578 (57%)
Nov 12-30	327	584 (79%)	584 (79%)	327 (0%)	584 (79%)	584 (79%)
Dec 1-31	322	531 (65%)	531 (65%)	322 (0%)	531 (65%)	531 (65%)
Jan 1-31	373	586 (57%)	586 (57%)	373 (0%)	586 (57%)	586 (57%)
Feb 1-28	529	768 (45%)	768 (45%)	529 (0%)	768 (45%)	768 (45%)
Mar 1-15	581	1,139 (96%)	1,135 (95%)	581 (0%)	1,139 (96%)	1,135 (95%)
Mar 16-31	571	1,357 (138%)	1,358 (138%)	571 (0%)	1,357 (138%)	1,358 (138%)
Apr 1-15	411	911 (122%)	914 (122%)	411 (0%)	911 (122%)	914 (122%)
Apr 16-30	400	629 (57%)	629 (57%)	400 (0%)	629 (57%)	629 (57%)
May 1-31	292	427 (46%)	427 (46%)	292 (0%)	427 (46%)	427 (46%)
Jun 1-30	331	419 (27%)	419 (27%)	331 (0%)	419 (27%)	419 (27%)
Jul 1-31	383	451 (18%)	451 (18%)	383 (0%)	451 (18%)	451 (18%)
Aug 1-31	436	500 (15%)	500 (15%)	436 (0%)	500 (15%)	500 (15%)
Sep 1-30	354	446 (26%)	446 (26%)	354 (0%)	446 (26%)	446 (26%)

Source: Summarized from SJR5Q flow and temperature model.

Notes:
[1] Year type as defined by the Restoration Year Type.
[2] Simulation period: January 1980 – September 2003.
[3] (%) indicates percent change from existing conditions.
[4] (%) indicates percent change from No-Action Alternative.

Key:
Alt = Alternative
cfs = cubic feet per second

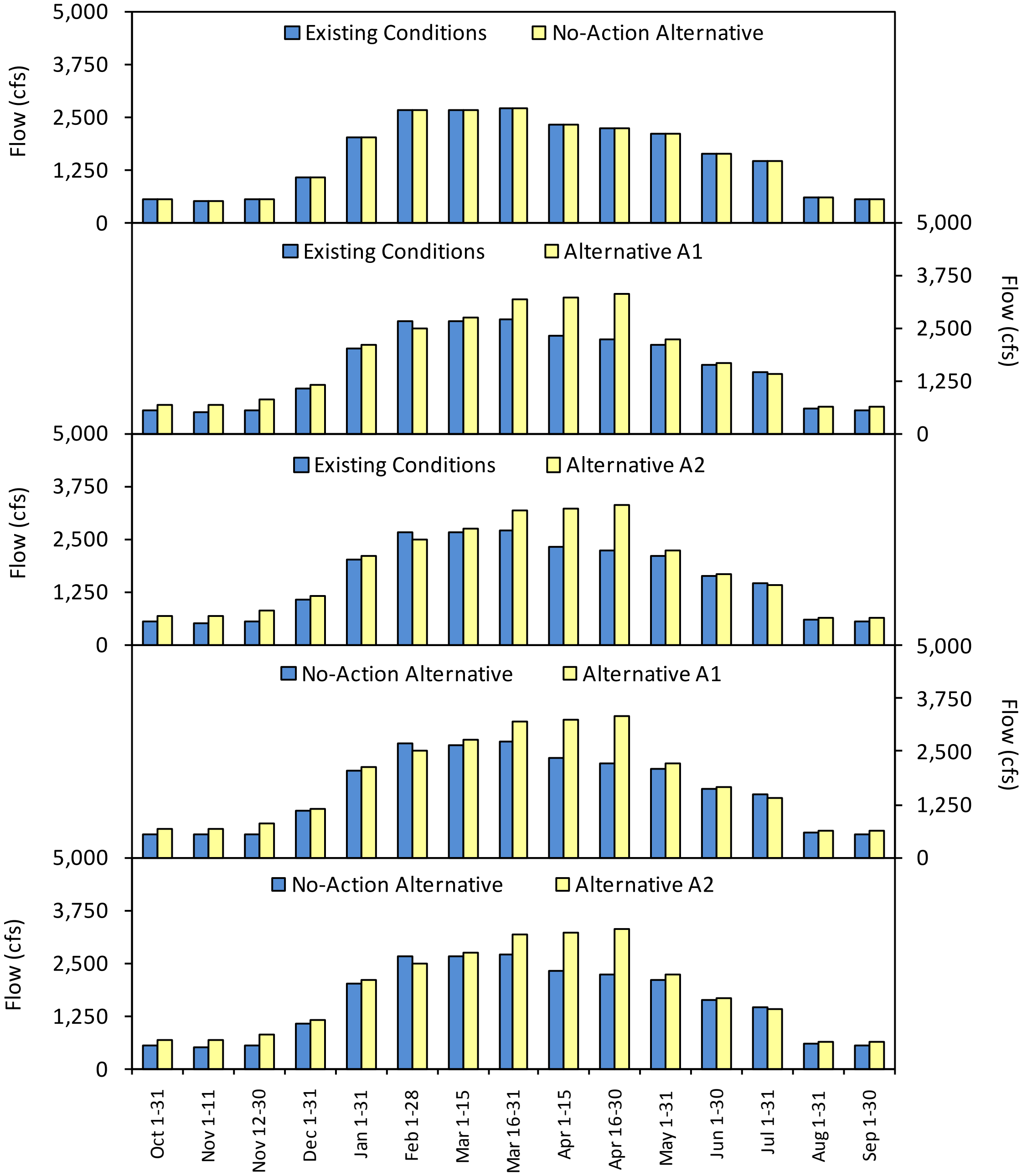


Figure 13-60.
Average Simulated Flow at San Joaquin River Above Merced River Confluence

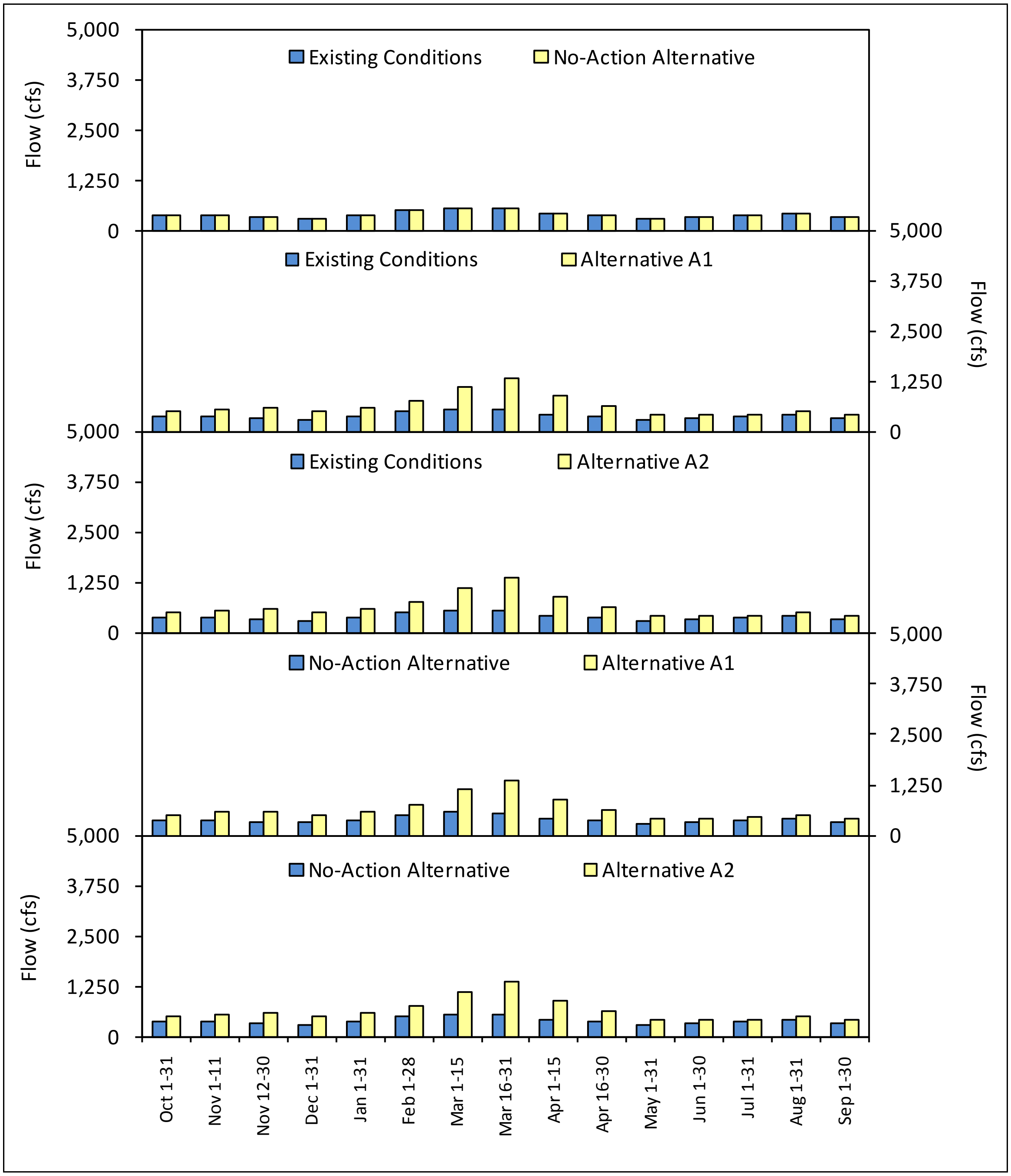


Figure 13-61.
Average Simulated Flow in Dry Years at San Joaquin River Above Merced River Confluence

San Joaquin River from the Merced River to Delta

Flows changes in the San Joaquin River below the Restoration Area, and in its associated tributaries, would be less than changes seen in the Restoration Area (Tables 13-97 through 13-106 and Figures 13-62 through 13-71). Percent changes in river flow would be smaller because the basis-of-comparison flow in the San Joaquin River increases considerably as it nears the Delta. Any positive changes would be associated with Interim and Restoration flows during key periods, but even these changes would diminish as the river nears the Delta. Negative percent changes would be due to changes in Millerton Lake storage, resulting from effects of the program alternatives on flood operations.

The largest changes in tributary and San Joaquin River flow downstream from the Merced River would occur in the spring. These changes in the tributaries would result from reservoir operations reacting to the addition of flows in the San Joaquin River, which can benefit water quality and also affect VAMP conditions in the river. When water quality levels at Vernalis increase due to relatively large spring Restoration Flows, for example, less water would be needed from New Melones Reservoir to meet river water quality targets, resulting in less water being released from the reservoir. This can result in decreases in tributary flows during April, as seen in the following tables. This effect, however, results in average changes to tributary storage facilities of less than 5 percent. Appendix H, “Modeling,” contains more detail regarding changes to these storage facilities.

Table 13-97.
Average Simulated Merced River Inflow to San Joaquin River

Month	Existing Level[1] (2005)				Future Level[1] (2030)			
	Existing Conditions (cfs)	Alt A1 and A2[2] (cfs)	Alt B1 and B2[2] (cfs)	Alt C1 and C2[2] (cfs)	No-Action Alt[2] (cfs)	Alt A1 and A2[2] (cfs)	Alt B1 and B2[3] (cfs)	Alt C1 and C2[3] (cfs)
Oct	453	457 (1%)	457 (1%)	457 (1%)	459 (1%)	461 (0%)	461 (0%)	461 (0%)
Nov	437	437 (0%)	437 (0%)	437 (0%)	437 (0%)	437 (0%)	437 (0%)	437 (0%)
Dec	595	593 (0%)	592 (-1%)	592 (-1%)	599 (1%)	603 (1%)	601 (0%)	601 (0%)
Jan	900	898 (0%)	896 (0%)	896 (0%)	910 (1%)	907 (0%)	906 (0%)	906 (0%)
Feb	1,157	1,164 (1%)	1,163 (1%)	1,163 (1%)	1,171 (1%)	1,178 (1%)	1,177 (1%)	1,177 (1%)
Mar	834	837 (0%)	836 (0%)	836 (0%)	843 (1%)	847 (0%)	846 (0%)	846 (0%)
Apr	746	640 (-14%)	645 (-13%)	645 (-13%)	761 (2%)	649 (-15%)	653 (-14%)	653 (-14%)
May	892	965 (8%)	969 (9%)	968 (8%)	900 (1%)	979 (9%)	983 (9%)	981 (9%)
Jun	924	923 (0%)	921 (0%)	922 (0%)	945 (2%)	939 (-1%)	938 (-1%)	939 (-1%)
Jul	701	705 (1%)	705 (1%)	705 (1%)	736 (5%)	739 (0%)	739 (0%)	739 (0%)
Aug	473	477 (1%)	477 (1%)	477 (1%)	491 (4%)	496 (1%)	496 (1%)	496 (1%)
Sep	271	280 (3%)	279 (3%)	280 (3%)	276 (2%)	283 (3%)	283 (3%)	283 (3%)

Source: Summarized from CalSim-II 2005 and 2030 simulations (Node C566).
Notes:
1 Simulation period: October 1921 – September 2003.
2 (%) indicates percent change from existing conditions.
3 (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

Table 13-98.
Average Simulated Merced River Inflow in Dry and Critical Years to San Joaquin River[1]

Month	Existing Level[2] (2005)				Future Level[2] (2030)			
	Existing Conditions (cfs)	Alt A1 and A2[3] (cfs)	Alt B1 and B2[3] (cfs)	Alt C1 and C2[3] (cfs)	No-Action Alt[3] (cfs)	Alt A1 and A2[4] (cfs)	Alt B1 and B2[4] (cfs)	Alt C1 and C2[4] (cfs)
Oct	445	454 (2%)	454 (2%)	454 (2%)	457 (3%)	464 (1%)	464 (1%)	464 (1%)
Nov	374	374 (0%)	374 (0%)	374 (0%)	374 (0%)	374 (0%)	374 (0%)	374 (0%)
Dec	390	390 (0%)	390 (0%)	390 (0%)	390 (0%)	390 (0%)	390 (0%)	390 (0%)
Jan	396	396 (0%)	396 (0%)	396 (0%)	396 (0%)	396 (0%)	396 (0%)	396 (0%)
Feb	411	411 (0%)	411 (0%)	411 (0%)	412 (0%)	412 (0%)	412 (0%)	412 (0%)
Mar	317	317 (0%)	317 (0%)	317 (0%)	319 (1%)	319 (0%)	319 (0%)	319 (0%)
Apr	479	475 (-1%)	481 (1%)	481 (1%)	501 (5%)	484 (-3%)	490 (-2%)	490 (-2%)
May	296	301 (2%)	305 (3%)	304 (3%)	308 (4%)	305 (-1%)	308 (0%)	308 (0%)
Jun	159	159 (0%)	159 (0%)	159 (0%)	167 (5%)	166 (0%)	167 (0%)	167 (0%)
Jul	102	102 (0%)	102 (0%)	102 (0%)	120 (17%)	118 (-2%)	118 (-2%)	117 (-2%)
Aug	92	92 (0%)	92 (0%)	92 (0%)	101 (9%)	101 (0%)	100 (-1%)	100 (-1%)
Sep	58	58 (0%)	58 (0%)	58 (0%)	58 (1%)	58 (0%)	58 (0%)	58 (0%)

Source: Summarized from CalSim-II 2005 and 2030 simulations (Node C566).
Notes:
[1] Year type as defined by the San Joaquin Valley Index Year Type.
[2] Simulation period: October 1921 – September 2003.
[3] (%) indicates percent change from existing conditions.
[4] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

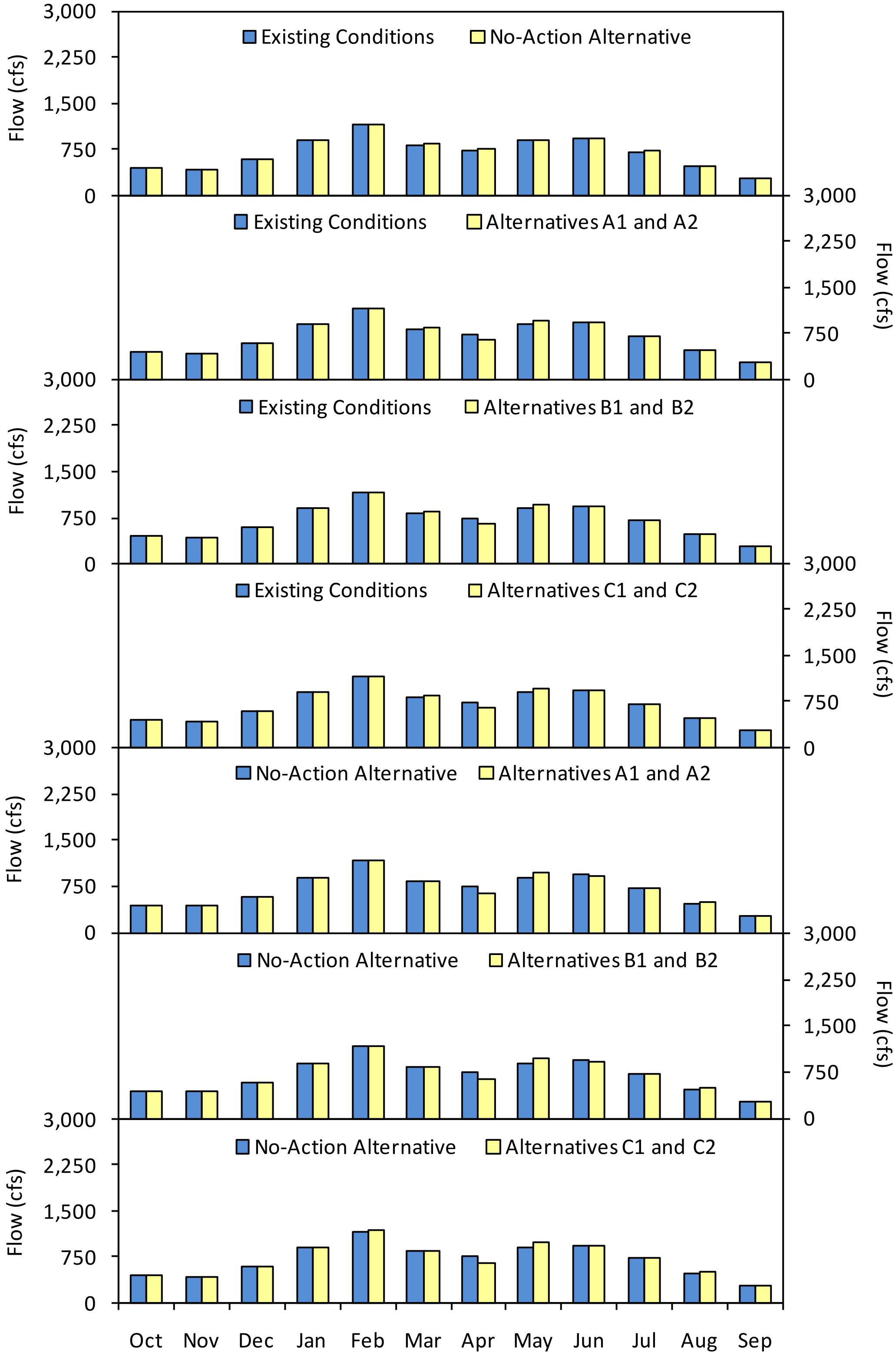


Figure 13-62.
Average Simulated Merced River Inflow to San Joaquin River

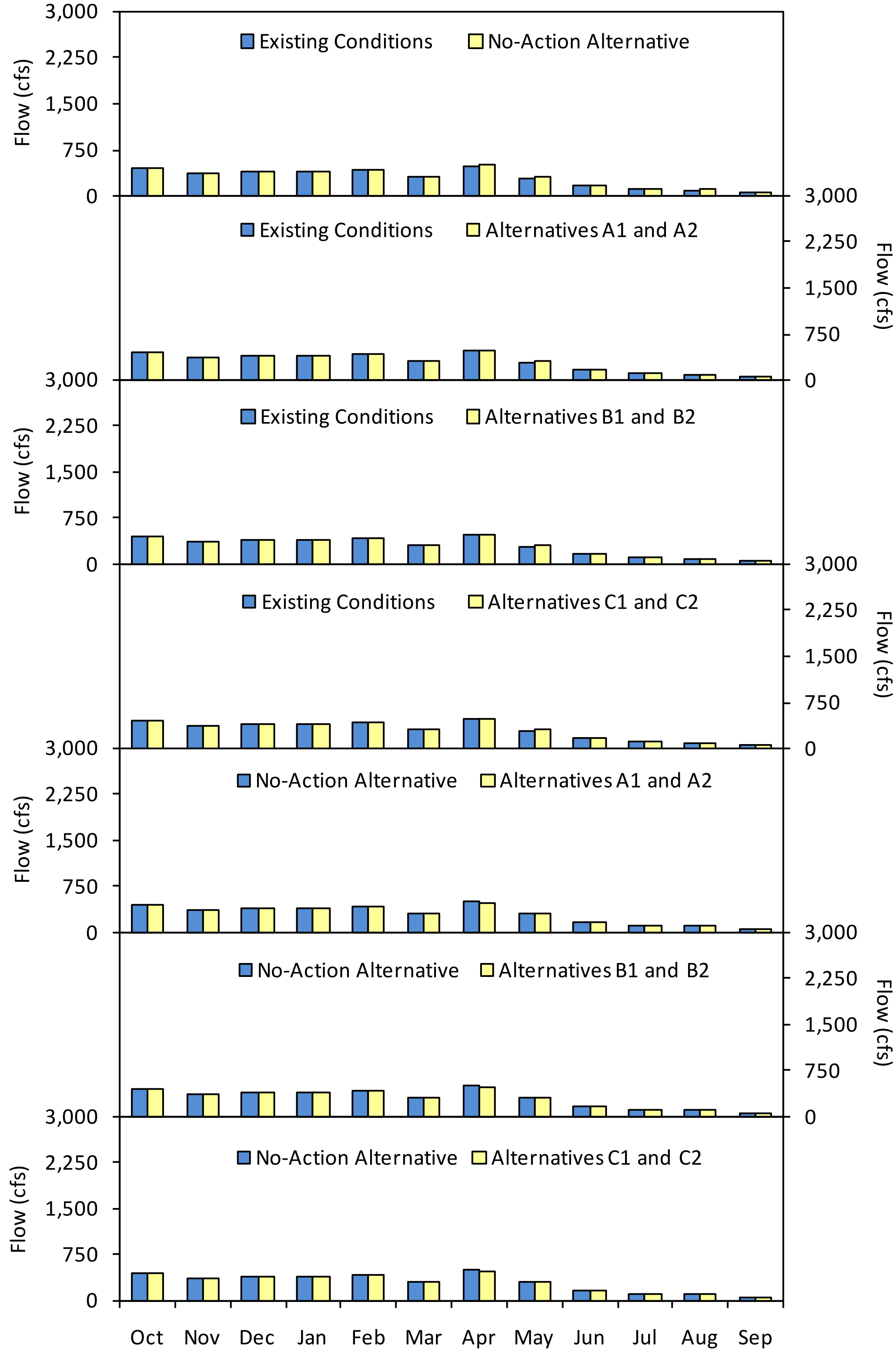


Figure 13-63.
Average Simulated Merced River Inflow in Dry and Critical Years to San Joaquin River

Table 13-99.
Average Simulated Flow at San Joaquin River Below Merced River

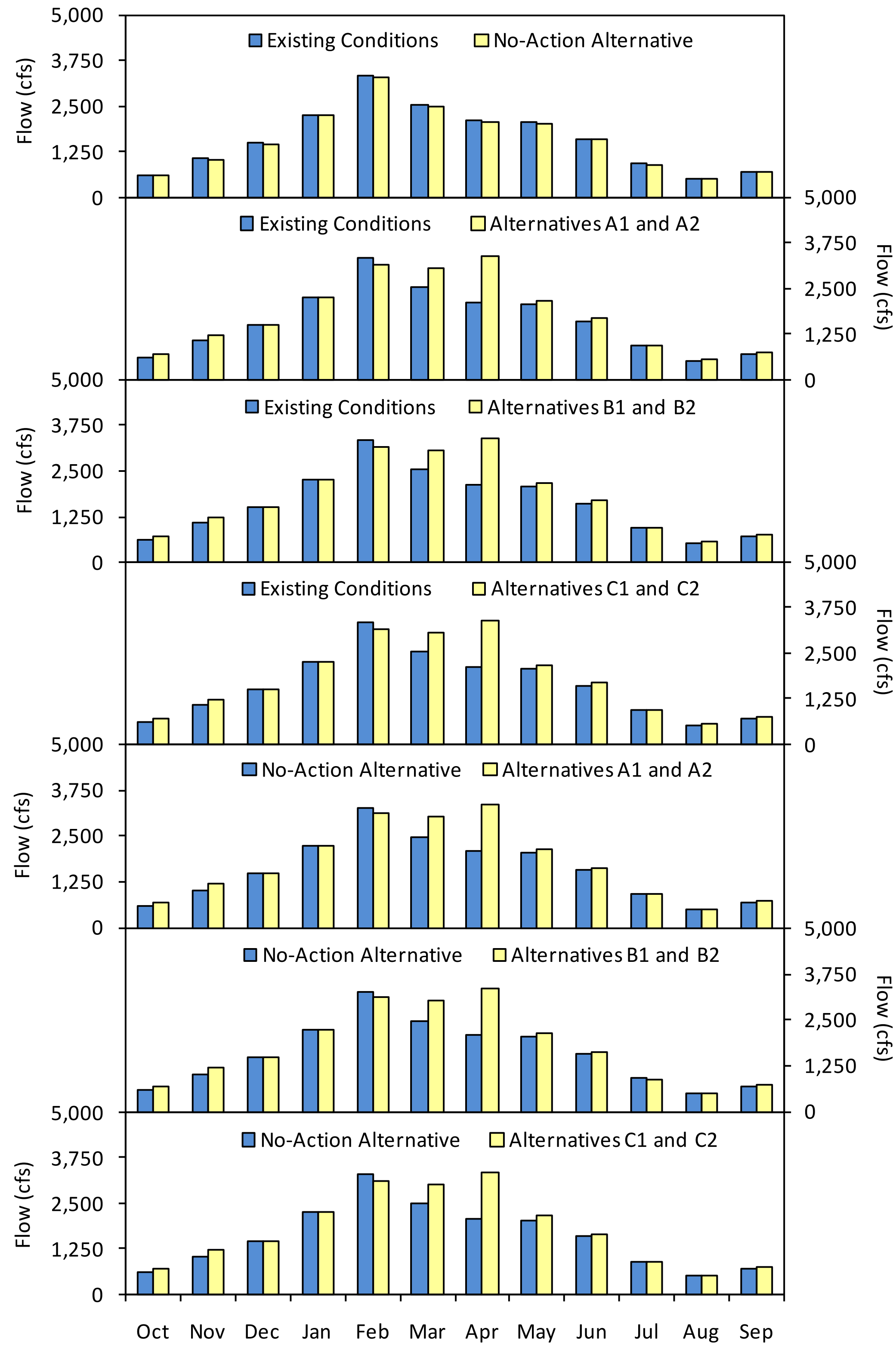
Month	Existing Level[1] (2005)				Future Level[1] (2030)			
	Existing Condition (cfs)	Alt A1 and A2[2] (cfs)	Alt B1 and B2[2] (cfs)	Alt C1 and C2[2] (cfs)	No-Action Alt[2] (cfs)	Alt A1 and A2[3] (cfs)	Alt B1 and B2[3] (cfs)	Alt C1 and C2[3] (cfs)
Oct	632	704 (11%)	704 (11%)	704 (11%)	614 (-3%)	685 (12%)	685 (12%)	685 (12%)
Nov	1,062	1,244 (17%)	1,244 (17%)	1,244 (17%)	1,037 (-2%)	1,219 (18%)	1,219 (18%)	1,219 (18%)
Dec	1,506	1,501 (0%)	1,499 (0%)	1,500 (0%)	1,486 (-1%)	1,486 (0%)	1,485 (0%)	1,485 (0%)
Jan	2,283	2,263 (-1%)	2,261 (-1%)	2,261 (-1%)	2,266 (-1%)	2,245 (-1%)	2,244 (-1%)	2,244 (-1%)
Feb	3,334	3,162 (-5%)	3,161 (-5%)	3,161 (-5%)	3,293 (-1%)	3,121 (-5%)	3,120 (-5%)	3,120 (-5%)
Mar	2,543	3,067 (21%)	3,067 (21%)	3,067 (21%)	2,499 (-2%)	3,023 (21%)	3,022 (21%)	3,022 (21%)
Apr	2,114	3,395 (61%)	3,401 (61%)	3,401 (61%)	2,091 (-1%)	3,364 (61%)	3,369 (61%)	3,369 (61%)
May	2,069	2,170 (5%)	2,174 (5%)	2,174 (5%)	2,039 (-1%)	2,144 (5%)	2,148 (5%)	2,147 (5%)
Jun	1,623	1,683 (4%)	1,682 (4%)	1,683 (4%)	1,588 (-2%)	1,642 (3%)	1,641 (3%)	1,642 (3%)
Jul	941	935 (-1%)	935 (-1%)	935 (-1%)	918 (-2%)	912 (-1%)	911 (-1%)	911 (-1%)
Aug	537	547 (2%)	547 (2%)	547 (2%)	498 (-7%)	510 (2%)	510 (2%)	510 (2%)
Sep	720	753 (4%)	752 (4%)	753 (4%)	703 (-2%)	734 (4%)	734 (4%)	734 (4%)

Source: Summarized from CalSim-II 2005 and 2030 simulations (Node C620).
Notes:
[1] Simulation period: October 1921 – September 2003.
[2] (%) indicates percent change from existing conditions.
[3] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

Table 13-100.
Average Simulated Flow in Dry and Critical Years at San Joaquin River Below Merced River[1]

Month	Existing Level[2] (2005)				Future Level[2] (2030)			
	Existing Conditions (cfs)	Alt A1 and A2[3] (cfs)	Alt B1 and B2[3] (cfs)	Alt C1 and C2[3] (cfs)	No-Action Alt[3] (cfs)	Alt A1 and A2[4] (cfs)	Alt B1 and B2[4] (cfs)	Alt C1 and C2[4] (cfs)
Oct	615	695 (13%)	695 (13%)	695 (13%)	604 (-2%)	681 (13%)	681 (13%)	681 (13%)
Nov	877	1,082 (23%)	1,082 (23%)	1,082 (23%)	851 (-3%)	1,056 (24%)	1,056 (24%)	1,056 (24%)
Dec	827	933 (13%)	933 (13%)	933 (13%)	803 (-3%)	909 (13%)	909 (13%)	909 (13%)
Jan	753	879 (17%)	879 (17%)	879 (17%)	726 (-4%)	852 (17%)	852 (17%)	852 (17%)
Feb	1,078	1,203 (12%)	1,203 (12%)	1,203 (12%)	1,023 (-5%)	1,148 (12%)	1,148 (12%)	1,148 (12%)
Mar	709	1,417 (100%)	1,417 (100%)	1,417 (100%)	657 (-7%)	1,365 (108%)	1,365 (108%)	1,365 (108%)
Apr	604	1,060 (75%)	1,068 (77%)	1,067 (77%)	589 (-3%)	1,028 (75%)	1,035 (76%)	1,035 (76%)
May	452	490 (8%)	494 (9%)	494 (9%)	424 (-6%)	453 (7%)	458 (8%)	458 (8%)
Jun	210	243 (16%)	243 (16%)	243 (16%)	159 (-24%)	193 (21%)	193 (21%)	193 (21%)
Jul	95	99 (5%)	99 (5%)	99 (5%)	54 (-43%)	58 (6%)	58 (6%)	58 (6%)
Aug	125	130 (4%)	130 (4%)	130 (4%)	77 (-38%)	82 (6%)	82 (6%)	82 (6%)
Sep	475	495 (4%)	495 (4%)	495 (4%)	452 (-5%)	473 (5%)	473 (5%)	473 (5%)

Source: Summarized from CalSim-II 2005 and 2030 simulations (Node C620).
Notes:
[1] Year type as defined by the San Joaquin Valley Index Year Type.
[2] Simulation period: October 1921 – September 2003.
[3] (%) indicates percent change from existing conditions.
[4] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second



1
2 **Figure 13-64.**
3 **Average Simulated Flow at San Joaquin River Below Merced River**

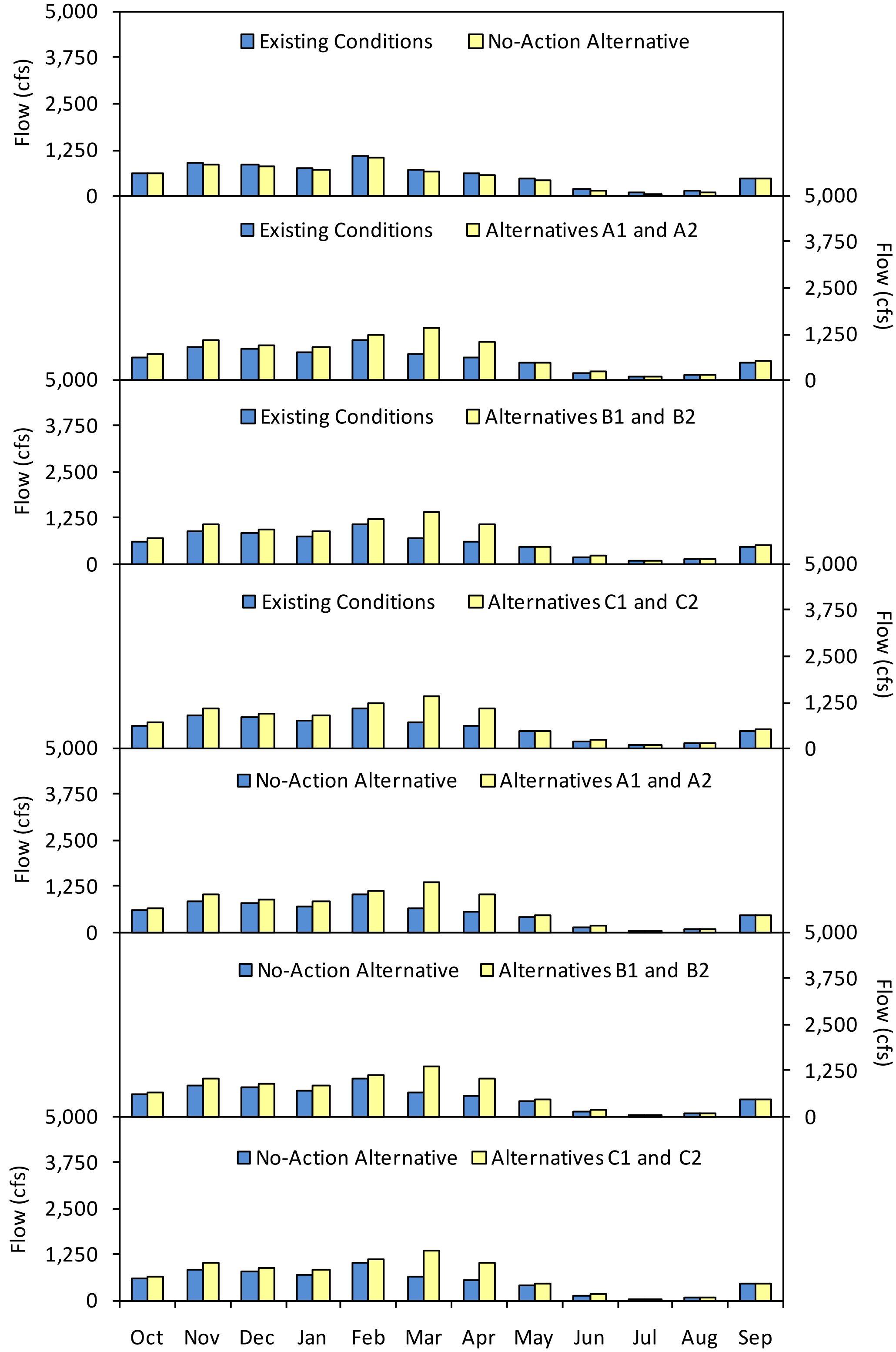


Figure 13-65.
Average Simulated Flow in Dry and Critical Years at San Joaquin River Below Merced River

Table 13-101.
Average Simulated Tuolumne River Inflow to San Joaquin River

Month	Existing Level[1] (2005)				Future Level[1] (2030)			
	Existing Conditions (cfs)	Alt A1 and A2[2] (cfs)	Alt B1 and B2[2] (cfs)	Alt C1 and C2[2] (cfs)	No-Action Alt[2] (cfs)	Alt A1 and A2[3] (cfs)	Alt B1 and B2[3] (cfs)	Alt C1 and C2[3] (cfs)
Oct	597	597 (0%)	597 (0%)	597 (0%)	594 (0%)	594 (0%)	594 (0%)	594 (0%)
Nov	574	575 (0%)	575 (0%)	575 (0%)	569 (-1%)	569 (0%)	569 (0%)	569 (0%)
Dec	830	835 (1%)	834 (1%)	834 (1%)	803 (-3%)	810 (1%)	809 (1%)	809 (1%)
Jan	1,265	1,264 (0%)	1,264 (0%)	1,264 (0%)	1,246 (-2%)	1,244 (0%)	1,244 (0%)	1,244 (0%)
Feb	1,688	1,697 (1%)	1,696 (0%)	1,696 (0%)	1,641 (-3%)	1,650 (1%)	1,650 (1%)	1,650 (1%)
Mar	2,119	2,122 (0%)	2,121 (0%)	2,121 (0%)	2,061 (-3%)	2,063 (0%)	2,063 (0%)	2,063 (0%)
Apr	2,036	1,983 (-3%)	1,987 (-2%)	1,987 (-2%)	2,027 (0%)	1,972 (-3%)	1,977 (-2%)	1,977 (-2%)
May	1,859	1,859 (0%)	1,861 (0%)	1,861 (0%)	1,858 (0%)	1,853 (0%)	1,855 (0%)	1,854 (0%)
Jun	1,430	1,441 (1%)	1,439 (1%)	1,440 (1%)	1,406 (-2%)	1,419 (1%)	1,418 (1%)	1,419 (1%)
Jul	1,103	1,103 (0%)	1,103 (0%)	1,103 (0%)	1,104 (0%)	1,104 (0%)	1,104 (0%)	1,104 (0%)
Aug	476	476 (0%)	476 (0%)	476 (0%)	475 (0%)	475 (0%)	475 (0%)	475 (0%)
Sep	482	483 (0%)	483 (0%)	483 (0%)	479 (-1%)	480 (0%)	480 (0%)	480 (0%)

Source: Summarized from CalSim-II 2005 and 2030 simulations (Node C545).
Notes:
[1] Simulation period: October 1921 – September 2003.
[2] (%) indicates percent change from existing conditions.
[3] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

Table 13-102.
Average Simulated Tuolumne River Inflow in Dry and Critical Years to San Joaquin River[1]

Month	Existing Level[2] (2005)				Future Level[2] (2030)			
	Existing Conditions (cfs)	Alt A1 and A2[3] (cfs)	Alt B1 and B2[3] (cfs)	Alt C1 and C2[3] (cfs)	No-Action Alt[3] (cfs)	Alt A1 and A2[4] (cfs)	Alt B1 and B2[4] (cfs)	Alt C1 and C2[4] (cfs)
Oct	559	559 (0%)	559 (0%)	559 (0%)	556 (-1%)	556 (0%)	556 (0%)	556 (0%)
Nov	487	487 (0%)	487 (0%)	487 (0%)	487 (0%)	487 (0%)	487 (0%)	487 (0%)
Dec	433	433 (0%)	433 (0%)	433 (0%)	433 (0%)	433 (0%)	433 (0%)	433 (0%)
Jan	456	456 (0%)	456 (0%)	456 (0%)	456 (0%)	456 (0%)	456 (0%)	456 (0%)
Feb	474	474 (0%)	474 (0%)	474 (0%)	463 (-2%)	463 (0%)	463 (0%)	463 (0%)
Mar	576	570 (-1%)	571 (-1%)	570 (-1%)	558 (-3%)	552 (-1%)	552 (-1%)	552 (-1%)
Apr	727	723 (-1%)	728 (0%)	728 (0%)	731 (1%)	725 (-1%)	731 (0%)	731 (0%)
May	734	742 (1%)	740 (1%)	740 (1%)	743 (1%)	742 (0%)	741 (0%)	741 (0%)
Jun	298	298 (0%)	298 (0%)	298 (0%)	299 (0%)	299 (0%)	299 (0%)	299 (0%)
Jul	284	284 (0%)	284 (0%)	284 (0%)	284 (0%)	284 (0%)	284 (0%)	284 (0%)
Aug	298	298 (0%)	298 (0%)	298 (0%)	298 (0%)	298 (0%)	298 (0%)	298 (0%)
Sep	299	299 (0%)	299 (0%)	299 (0%)	299 (0%)	299 (0%)	299 (0%)	299 (0%)

Source: Summarized from CalSim-II 2005 and 2030 simulations (Node C545).
Notes:
[1] Year type as defined by the San Joaquin Valley Index Year Type.
[2] Simulation period: October 1921 – September 2003.
[3] (%) indicates percent change from existing conditions.
[4] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

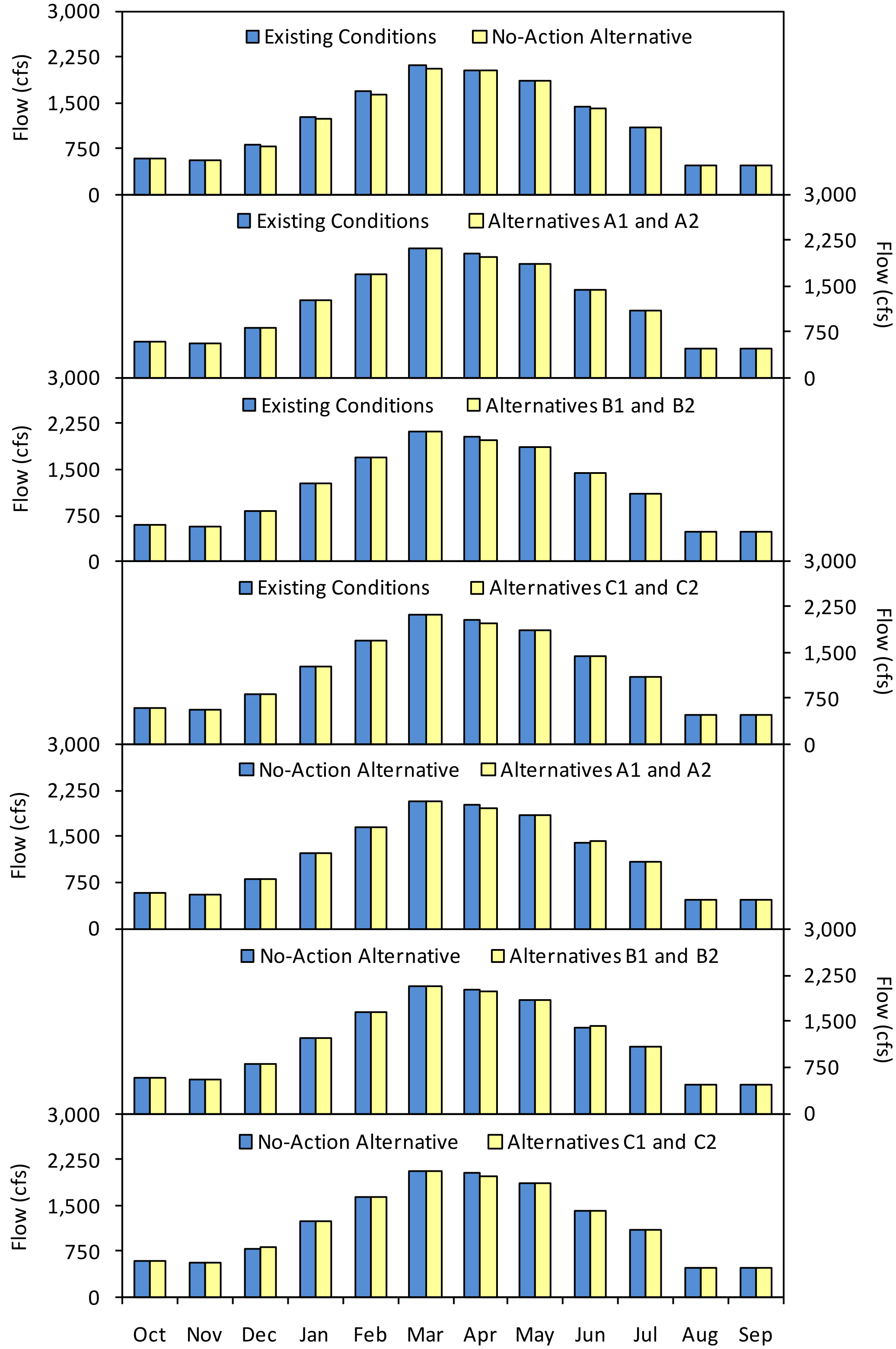


Figure 13-66.
Average Simulated Tuolumne River Inflow to San Joaquin River

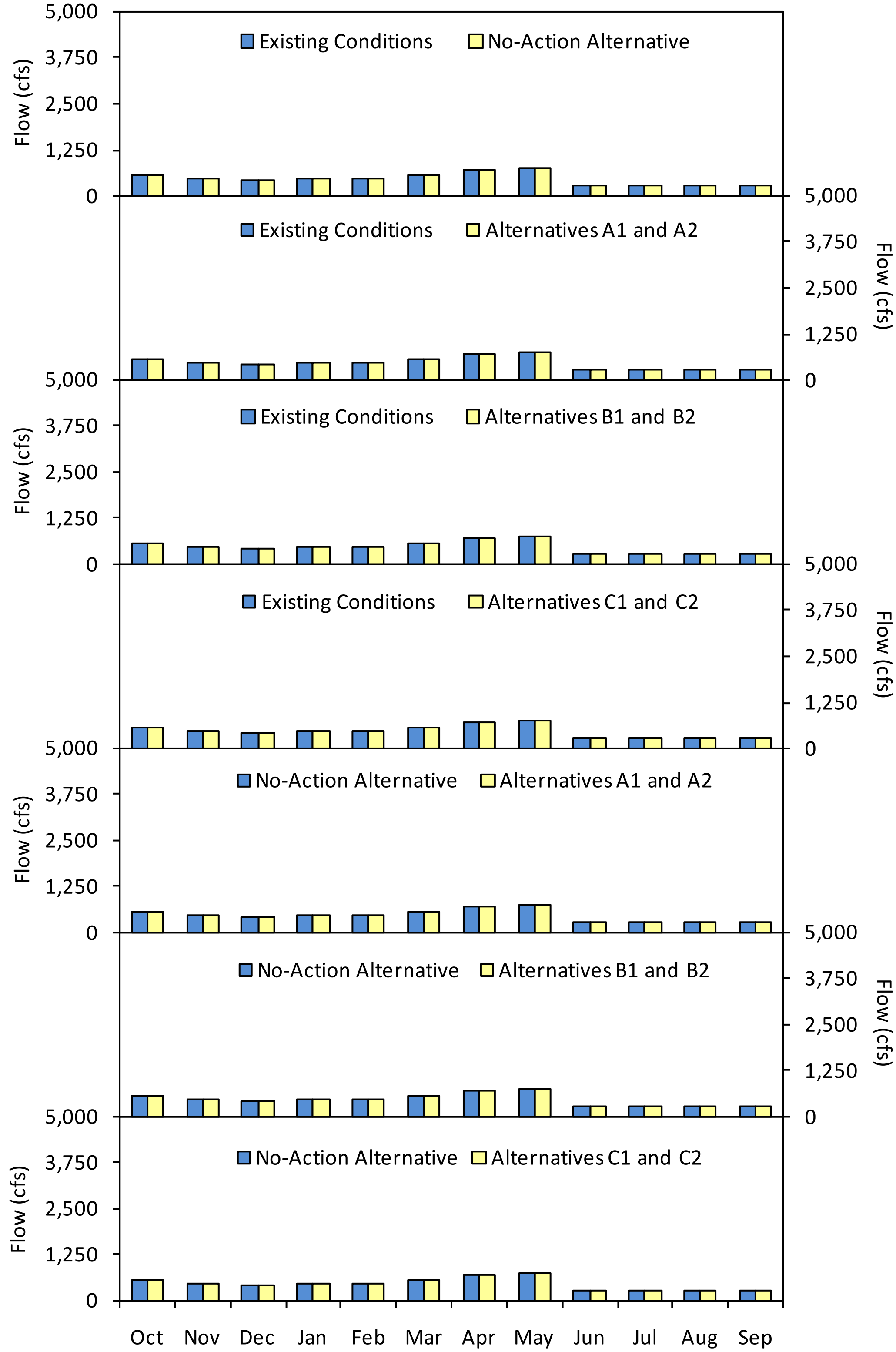


Figure 13-67.
Average Simulated Tuolumne River Inflow in Dry and Critical Years to San Joaquin River

Table 13-103.
Average Simulated Flow at San Joaquin River Below Tuolumne River

Month	Existing Level[1] (2005)				Future Level[1] (2030)			
	Existing Conditions (cfs)	Alt A1 and A2[2] (cfs)	Alt B1 and B2[2] (cfs)	Alt C1 and C2[2] (cfs)	No-Action Alt[2] (cfs)	Alt A1 and A2[3] (cfs)	Alt B1 and B2[3] (cfs)	Alt C1 and C2[3] (cfs)
Oct	1,326	1,398 (5%)	1,394 (5%)	1,397 (5%)	1,306 (-2%)	1,377 (5%)	1,368 (5%)	1,371 (5%)
Nov	1,648	1,832 (11%)	1,831 (11%)	1,832 (11%)	1,619 (-2%)	1,801 (11%)	1,798 (11%)	1,799 (11%)
Dec	2,336	2,336 (0%)	2,334 (0%)	2,334 (0%)	2,289 (-2%)	2,297 (0%)	2,294 (0%)	2,295 (0%)
Jan	3,549	3,527 (-1%)	3,525 (-1%)	3,525 (-1%)	3,513 (-1%)	3,490 (-1%)	3,488 (-1%)	3,488 (-1%)
Feb	5,031	4,867 (-3%)	4,865 (-3%)	4,865 (-3%)	4,942 (-2%)	4,780 (-3%)	4,777 (-3%)	4,777 (-3%)
Mar	4,679	5,206 (11%)	5,201 (11%)	5,201 (11%)	4,578 (-2%)	5,105 (11%)	5,097 (11%)	5,098 (11%)
Apr	4,223	5,452 (29%)	5,441 (29%)	5,448 (29%)	4,192 (-1%)	5,410 (29%)	5,394 (29%)	5,404 (29%)
May	4,003	4,104 (3%)	4,087 (2%)	4,093 (2%)	3,974 (-1%)	4,075 (3%)	4,054 (2%)	4,060 (2%)
Jun	3,089	3,160 (2%)	3,136 (2%)	3,142 (2%)	3,035 (-2%)	3,103 (2%)	3,077 (1%)	3,083 (2%)
Jul	2,079	2,074 (0%)	2,071 (0%)	2,071 (0%)	2,062 (-1%)	2,056 (0%)	2,052 (0%)	2,052 (0%)
Aug	1,080	1,091 (1%)	1,088 (1%)	1,088 (1%)	1,044 (-3%)	1,056 (1%)	1,053 (1%)	1,054 (1%)
Sep	1,289	1,322 (3%)	1,317 (2%)	1,319 (2%)	1,269 (-2%)	1,301 (3%)	1,293 (2%)	1,295 (2%)

Source: Summarized from CalSim-II 2005 and 2030 simulations (Node C630).
Notes:
[1] Simulation period: October 1921 – September 2003.
[2] (%) indicates percent change from existing conditions.
[3] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

Table 13-104.
Average Simulated Flow in Dry and Critical Years at San Joaquin River Below Tuolumne River[1]

Month	Existing Level[2] (2005)				Future Level[2] (2030)			
	Existing Conditions (cfs)	Alt A1 and A2[3] (cfs)	Alt B1 and B2[3] (cfs)	Alt C1 and C2[3] (cfs)	No-Action Alt[3] (cfs)	Alt A1 and A2[4] (cfs)	Alt B1 and B2[4] (cfs)	Alt C1 and C2[4] (cfs)
Oct	1,258	1,337 (6%)	1,332 (6%)	1,337 (6%)	1,243 (-1%)	1,320 (6%)	1,309 (5%)	1,314 (6%)
Nov	1,382	1,586 (15%)	1,585 (15%)	1,586 (15%)	1,355 (-2%)	1,560 (15%)	1,557 (15%)	1,558 (15%)
Dec	1,260	1,367 (8%)	1,366 (8%)	1,366 (8%)	1,236 (-2%)	1,342 (9%)	1,341 (9%)	1,342 (9%)
Jan	1,210	1,335 (10%)	1,335 (10%)	1,335 (10%)	1,182 (-2%)	1,308 (11%)	1,307 (11%)	1,307 (11%)
Feb	1,569	1,694 (8%)	1,693 (8%)	1,693 (8%)	1,502 (-4%)	1,627 (8%)	1,626 (8%)	1,626 (8%)
Mar	1,297	1,999 (54%)	1,995 (54%)	1,995 (54%)	1,228 (-5%)	1,930 (57%)	1,925 (57%)	1,925 (57%)
Apr	1,364	1,816 (33%)	1,809 (33%)	1,815 (33%)	1,355 (-1%)	1,788 (32%)	1,779 (31%)	1,791 (32%)
May	1,216	1,263 (4%)	1,242 (2%)	1,242 (2%)	1,201 (-1%)	1,230 (2%)	1,207 (0%)	1,207 (0%)
Jun	507	540 (7%)	519 (3%)	521 (3%)	460 (-9%)	494 (7%)	471 (2%)	471 (2%)
Jul	376	381 (1%)	377 (0%)	377 (0%)	338 (-10%)	342 (1%)	337 (0%)	337 (0%)
Aug	456	461 (1%)	457 (0%)	457 (0%)	411 (-10%)	416 (1%)	412 (0%)	412 (0%)
Sep	829	850 (2%)	848 (2%)	848 (2%)	808 (-3%)	828 (3%)	823 (2%)	825 (2%)

Source: Summarized from CalSim-II 2005 and 2030 simulations (Node C630).
Notes:
[1] Year type as defined by the San Joaquin Valley Index Year Type.
[2] Simulation period: October 1921 – September 2003.
[3] (%) indicates percent change from existing conditions.
[4] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

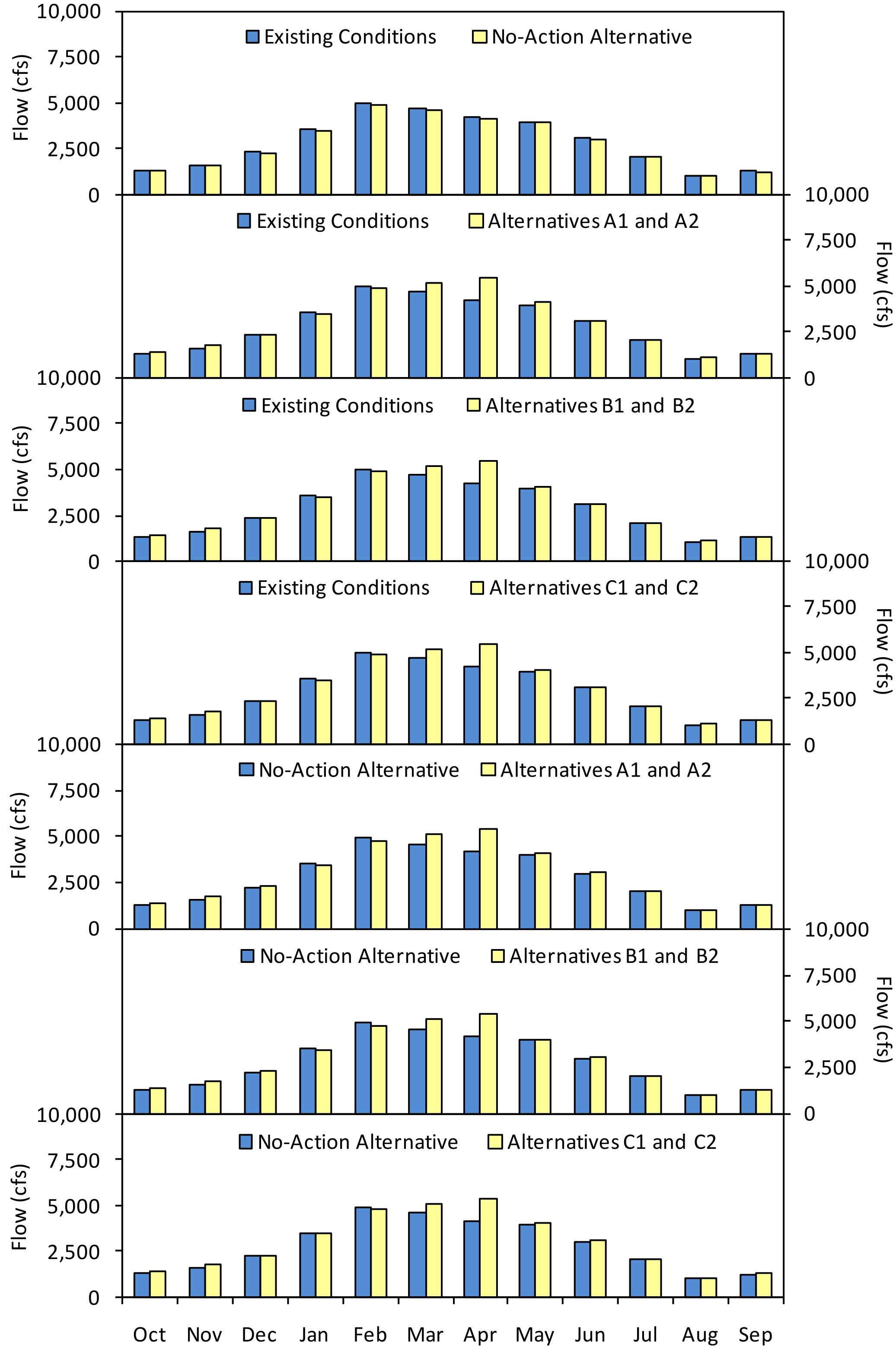


Figure 13-68.
Average Simulated Flow at San Joaquin River Below Tuolumne River

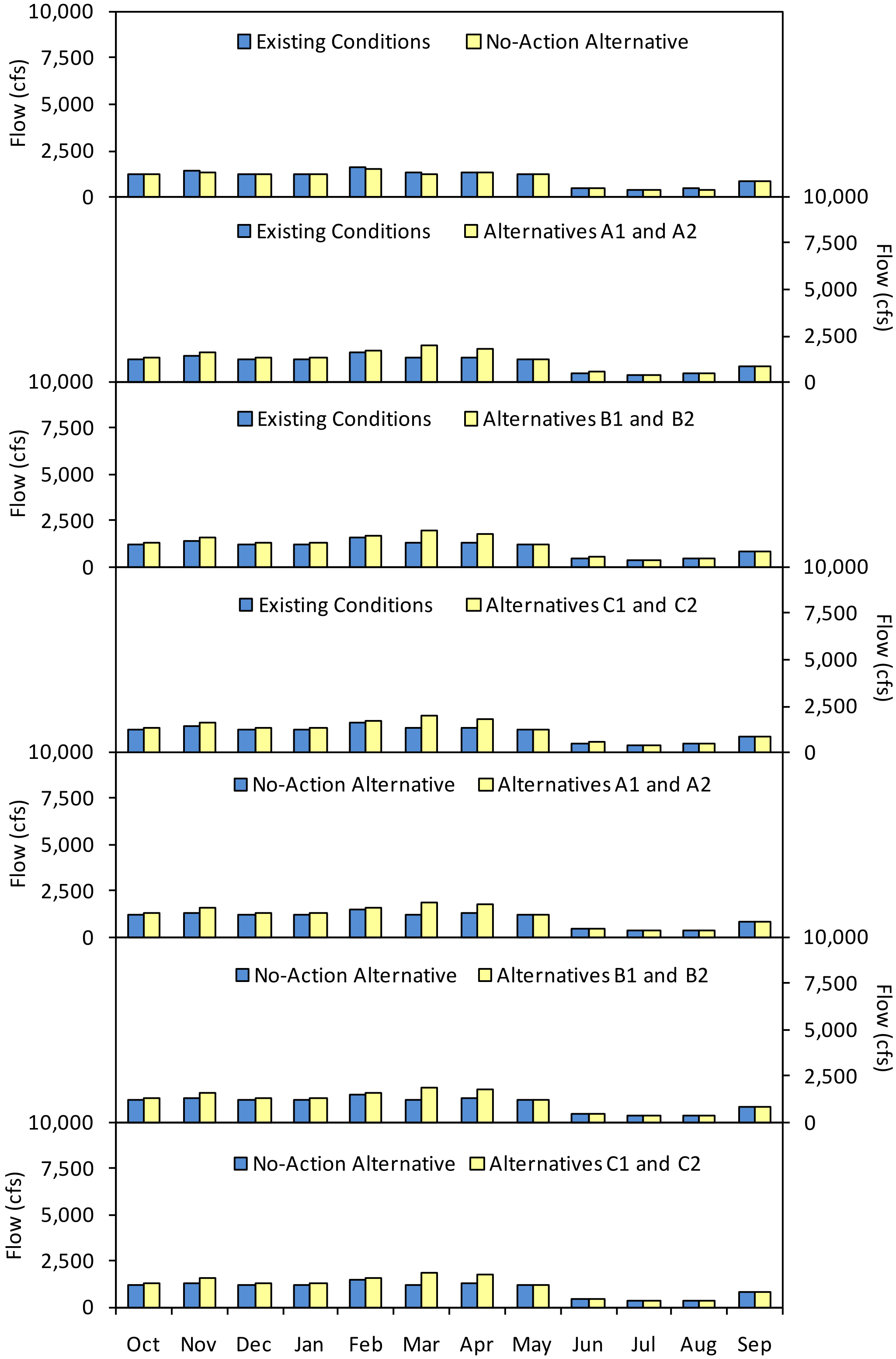


Figure 13-69.
Average Simulated Flow in Dry and Critical Years at San Joaquin River Below Tuolumne River

Table 13-105.
Average Simulated Stanislaus River Inflow to San Joaquin River

Month	Existing Level[1] (2005)				Future Level[1] (2030)			
	Existing Conditions (cfs)	Alt A1 and A2[2] (cfs)	Alt B1 and B2[2] (cfs)	Alt C1 and C2[2] (cfs)	No-Action Alt[2] (cfs)	Alt A1 and A2[3] (cfs)	Alt B1 and B2[3] (cfs)	Alt C1 and C2[3] (cfs)
Oct	711	715 (0%)	715 (0%)	715 (0%)	717 (1%)	719 (0%)	719 (0%)	719 (0%)
Nov	519	529 (2%)	527 (2%)	528 (2%)	521 (0%)	531 (2%)	530 (2%)	530 (2%)
Dec	587	602 (3%)	601 (3%)	602 (3%)	593 (1%)	604 (2%)	603 (2%)	603 (2%)
Jan	669	671 (0%)	671 (0%)	671 (0%)	669 (0%)	671 (0%)	671 (0%)	671 (0%)
Feb	894	893 (0%)	896 (0%)	896 (0%)	886 (-1%)	891 (1%)	892 (1%)	892 (1%)
Mar	835	757 (-9%)	756 (-9%)	756 (-9%)	808 (-3%)	763 (-6%)	761 (-6%)	761 (-6%)
Apr	1,200	1,200 (0%)	1,200 (0%)	1,200 (0%)	1,198 (0%)	1,202 (0%)	1,203 (0%)	1,203 (0%)
May	1,148	1,168 (2%)	1,167 (2%)	1,167 (2%)	1,152 (0%)	1,163 (1%)	1,162 (1%)	1,162 (1%)
Jun	969	968 (0%)	966 (0%)	966 (0%)	969 (0%)	965 (0%)	968 (0%)	968 (0%)
Jul	606	612 (1%)	612 (1%)	612 (1%)	620 (2%)	622 (0%)	622 (0%)	622 (0%)
Aug	581	582 (0%)	581 (0%)	581 (0%)	586 (1%)	586 (0%)	586 (0%)	586 (0%)
Sep	624	631 (1%)	631 (1%)	631 (1%)	637 (2%)	641 (1%)	641 (1%)	641 (1%)

Source: Summarized from CalSim-II 2005 and 2030 simulations (Node C528).
Notes:
[1] Simulation period: October 1921 – September 2003.
[2] (%) indicates percent change from existing conditions.
[3] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

Table 13-106.
Average Simulated Stanislaus River Inflow in Dry and Critical Years to San Joaquin River[1]

Month	Existing Level[2] (2005)				Future Level[2] (2030)			
	Existing Conditions (cfs)	Alt A1 and A2[3] (cfs)	Alt B1 and B2[3] (cfs)	Alt C1 and C2[3] (cfs)	No-Action Alt[3] (cfs)	Alt A1 and A2[4] (cfs)	Alt B1 and B2[4] (cfs)	Alt C1 and C2[4] (cfs)
Oct	633	635 (0%)	635 (0%)	636 (0%)	640 (1%)	641 (0%)	641 (0%)	641 (0%)
Nov	437	447 (2%)	445 (2%)	445 (2%)	438 (0%)	447 (2%)	446 (2%)	446 (2%)
Dec	408	418 (2%)	416 (2%)	416 (2%)	410 (0%)	419 (2%)	417 (2%)	417 (2%)
Jan	331	334 (1%)	334 (1%)	334 (1%)	333 (1%)	335 (1%)	335 (1%)	335 (1%)
Feb	393	370 (-6%)	372 (-5%)	372 (-5%)	328 (-17%)	318 (-3%)	318 (-3%)	318 (-3%)
Mar	465	273 (-41%)	273 (-41%)	273 (-41%)	354 (-24%)	261 (-26%)	261 (-26%)	261 (-26%)
Apr	726	698 (-4%)	698 (-4%)	698 (-4%)	694 (-4%)	684 (-2%)	685 (-1%)	685 (-1%)
May	712	735 (3%)	729 (2%)	729 (2%)	685 (-4%)	697 (2%)	694 (1%)	693 (1%)
Jun	325	341 (5%)	327 (1%)	327 (1%)	301 (-7%)	302 (0%)	301 (0%)	301 (0%)
Jul	334	335 (0%)	334 (0%)	334 (0%)	330 (-1%)	330 (0%)	330 (0%)	330 (0%)
Aug	360	361 (0%)	361 (0%)	361 (0%)	361 (0%)	361 (0%)	361 (0%)	361 (0%)
Sep	364	364 (0%)	364 (0%)	364 (0%)	365 (0%)	365 (0%)	365 (0%)	365 (0%)

Source: Summarized from CalSim-II 2005 and 2030 simulations (Node C528).
Notes:
[1] Year type as defined by the Sacramento Valley Index Year Type.
[2] Simulation period: October 1921 – September 2003.
[3] (%) indicates percent change from existing conditions.
[4] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

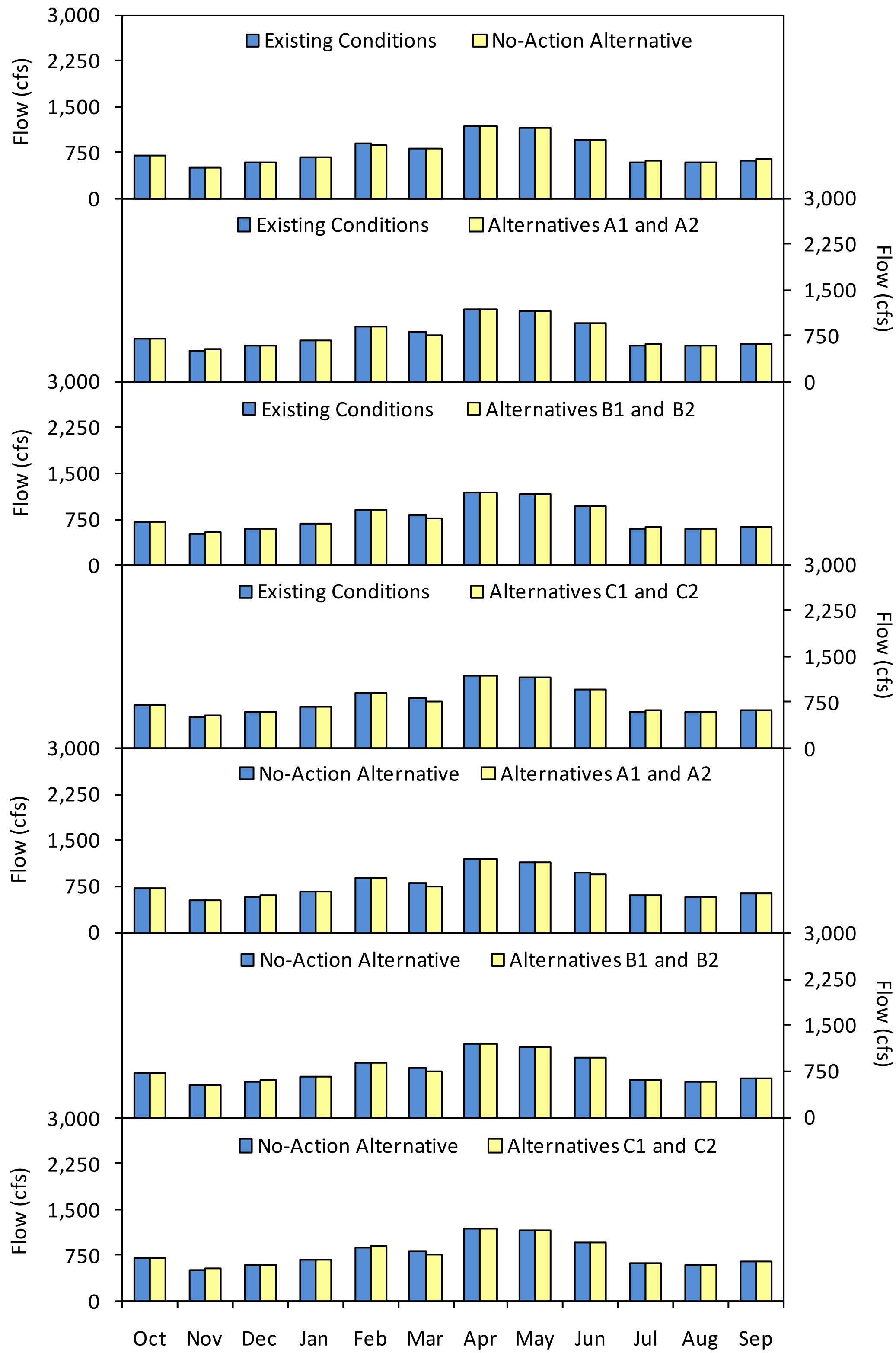
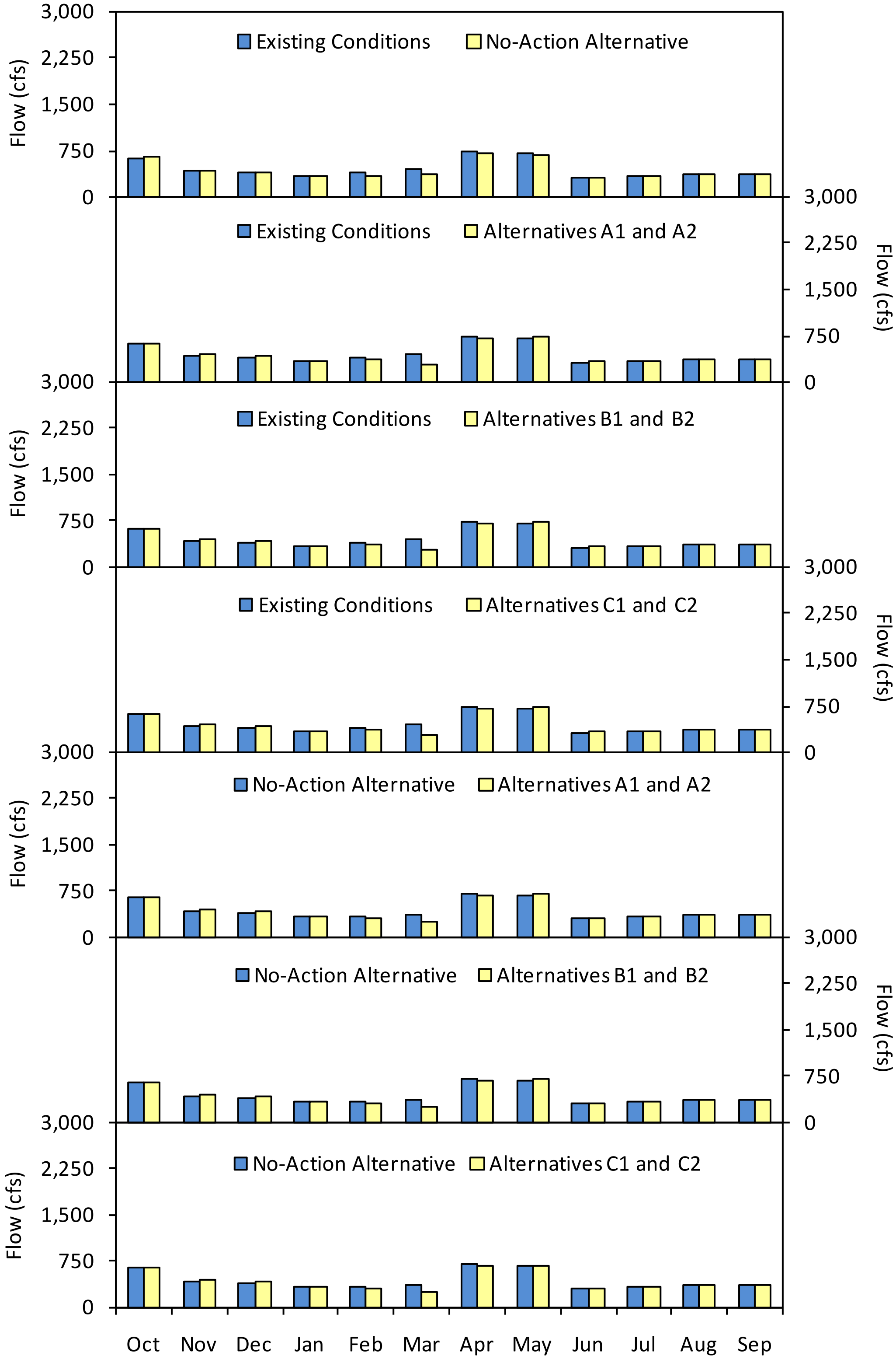


Figure 13-70.
Average Simulated Stanislaus River Inflow to San Joaquin River



1
2 **Figure 13-71.**
3 **Average Simulated Stanislaus River Inflow in Dry and Critical Years to San**
4 **Joaquin River**

San Francisco Bay/Sacramento-San Joaquin Delta

Delta inflows from the San Joaquin River would increase slightly overall because of Interim and Restoration flows leaving Reach 5 (Tables 13-107 and 13-108 and Figures 13-72 and 13-73). Percent changes would be small because the basis-of-comparison flow in the San Joaquin River would increase considerably as it enters the Delta. Negative percent changes would be due to changes in Millerton Lake storage, resulting from the effects of the program alternatives on flood operations.

Table 13-107.
Average Simulated Flow at San Joaquin River Upstream from Vernalis

Month	Existing Level[1] (2005)				Future Level[1] (2030)			
	Existing Conditions (cfs)	Alt A1 and A2[2] (cfs)	Alt B1 and B2[2] (cfs)	Alt C1 and C2[2] (cfs)	No-Action Alt[2] (cfs)	Alt A1 and A2[3] (cfs)	Alt B1 and B2[3] (cfs)	Alt C1 and C2[3] (cfs)
Oct	2,498	2,574 (3%)	2,570 (3%)	2,573 (3%)	2,484 (-1%)	2,557 (3%)	2,548 (3%)	2,551 (3%)
Nov	2,556	2,751 (8%)	2,749 (8%)	2,750 (8%)	2,530 (-1%)	2,722 (8%)	2,718 (7%)	2,720 (8%)
Dec	3,366	3,382 (0%)	3,379 (0%)	3,379 (0%)	3,324 (-1%)	3,344 (1%)	3,340 (0%)	3,341 (0%)
Jan	4,793	4,773 (0%)	4,772 (0%)	4,772 (0%)	4,758 (-1%)	4,736 (0%)	4,734 (0%)	4,734 (0%)
Feb	6,459	6,294 (-3%)	6,295 (-3%)	6,295 (-3%)	6,362 (-1%)	6,204 (-2%)	6,202 (-3%)	6,203 (-3%)
Mar	6,343	6,793 (7%)	6,786 (7%)	6,786 (7%)	6,215 (-2%)	6,697 (8%)	6,687 (8%)	6,688 (8%)
Apr	6,101	7,329 (20%)	7,319 (20%)	7,326 (20%)	6,069 (-1%)	7,291 (20%)	7,275 (20%)	7,285 (20%)
May	6,076	6,197 (2%)	6,179 (2%)	6,185 (2%)	6,051 (0%)	6,163 (2%)	6,141 (1%)	6,146 (2%)
Jun	4,696	4,766 (1%)	4,740 (1%)	4,745 (1%)	4,640 (-1%)	4,704 (1%)	4,682 (1%)	4,687 (1%)
Jul	3,349	3,349 (0%)	3,345 (0%)	3,345 (0%)	3,344 (0%)	3,341 (0%)	3,336 (0%)	3,336 (0%)
Aug	2,198	2,209 (1%)	2,206 (0%)	2,206 (0%)	2,166 (-1%)	2,179 (1%)	2,175 (0%)	2,176 (0%)
Sep	2,412	2,452 (2%)	2,447 (1%)	2,449 (2%)	2,407 (0%)	2,442 (1%)	2,435 (1%)	2,437 (1%)

Source: Summarized from CalSim-II 2005 and 2030 simulations (Node C637).
Notes:
[1] Simulation period: October 1921 – September 2003.
[2] (%) indicates percent change from existing conditions.
[3] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

Table 13-108.
Average Simulated Flow in Dry Years and Critical Years at San Joaquin River Upstream from Vernalis[1]

Month	Existing Level[2] (2005)				Future Level[2] (2030)			
	Existing Conditions (cfs)	Alt A1 and A2[3] (cfs)	Alt B1 and B2[3] (cfs)	Alt C1 and C2[3] (cfs)	No-Action Alt[3] (cfs)	Alt A1 and A2[4] (cfs)	Alt B1 and B2[4] (cfs)	Alt C1 and C2[4] (cfs)
Oct	2,310	2,387 (3%)	2,382 (3%)	2,387 (3%)	2,302 (0%)	2,376 (3%)	2,366 (3%)	2,371 (3%)
Nov	2,198	2,398 (9%)	2,395 (9%)	2,396 (9%)	2,173 (-1%)	2,372 (9%)	2,368 (9%)	2,369 (9%)
Dec	2,025	2,134 (5%)	2,131 (5%)	2,132 (5%)	2,002 (-1%)	2,110 (5%)	2,108 (5%)	2,108 (5%)
Jan	1,900	2,020 (6%)	2,020 (6%)	2,020 (6%)	1,874 (-1%)	1,993 (6%)	1,992 (6%)	1,993 (6%)
Feb	2,318	2,411 (4%)	2,412 (4%)	2,413 (4%)	2,192 (-5%)	2,298 (5%)	2,296 (5%)	2,296 (5%)
Mar	2,148	2,658 (24%)	2,655 (24%)	2,654 (24%)	1,971 (-8%)	2,581 (31%)	2,577 (31%)	2,577 (31%)
Apr	2,569	3,120 (21%)	3,111 (21%)	3,117 (21%)	2,526 (-2%)	3,075 (22%)	3,065 (21%)	3,073 (22%)
May	2,508	2,612 (4%)	2,588 (3%)	2,588 (3%)	2,464 (-2%)	2,540 (3%)	2,517 (2%)	2,516 (2%)
Jun	1,367	1,420 (4%)	1,388 (2%)	1,390 (2%)	1,295 (-5%)	1,333 (3%)	1,313 (1%)	1,313 (1%)
Jul	1,213	1,219 (0%)	1,215 (0%)	1,215 (0%)	1,170 (-4%)	1,173 (0%)	1,169 (0%)	1,169 (0%)
Aug	1,306	1,312 (0%)	1,308 (0%)	1,308 (0%)	1,261 (-3%)	1,266 (0%)	1,261 (0%)	1,261 (0%)
Sep	1,654	1,675 (1%)	1,674 (1%)	1,674 (1%)	1,633 (-1%)	1,654 (1%)	1,648 (1%)	1,650 (1%)

Source: Summarized from CalSim-II 2005 and 2030 simulations (Node C637).
Notes:
[1] Year type as defined by the Sacramento Valley Index Year Type.
[2] Simulation period: October 1921 – September 2003.
[3] (%) indicates percent change from existing conditions.
[4] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

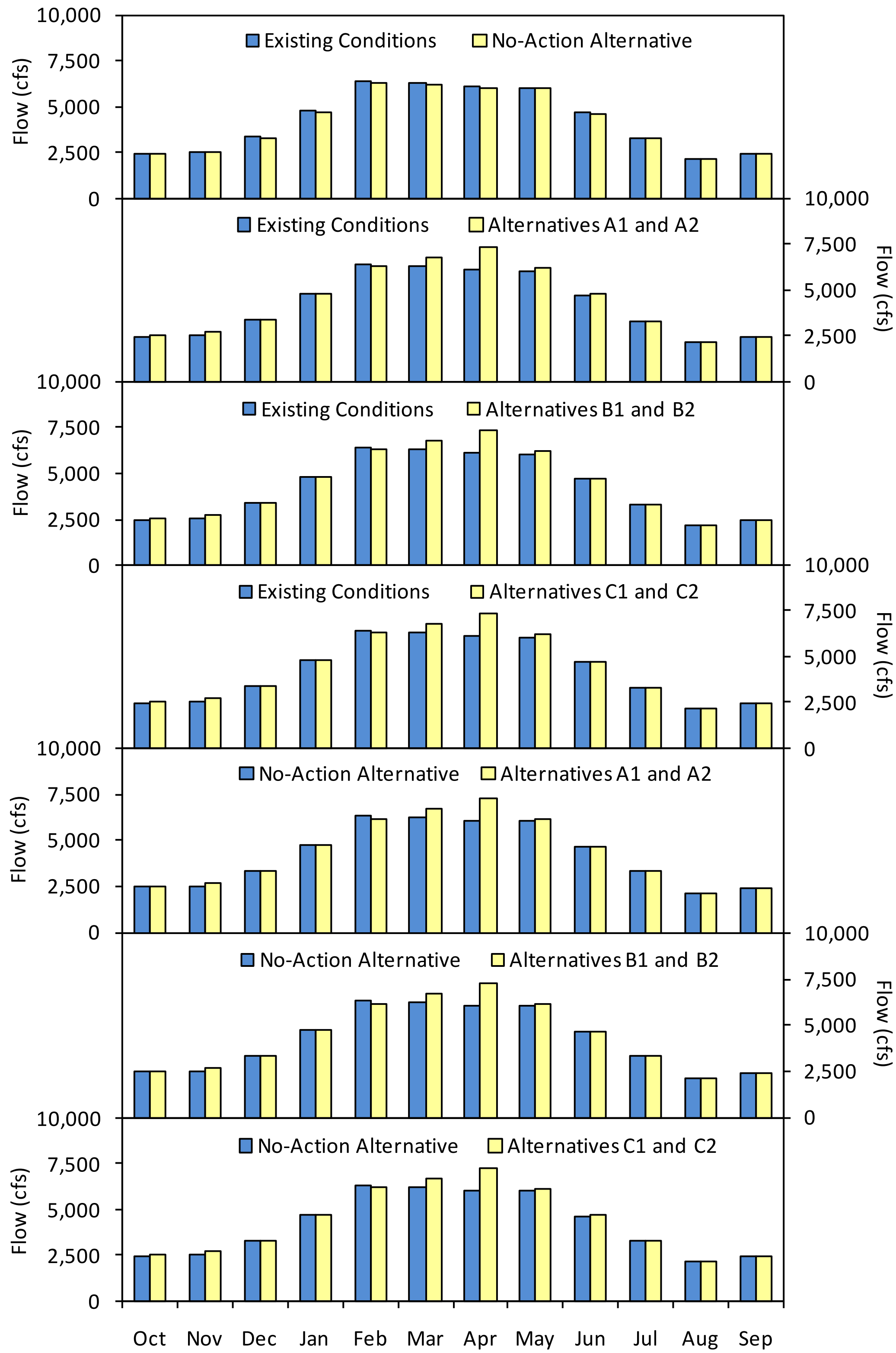


Figure 13-72.
Average Simulated Flow at San Joaquin River Upstream from Vernalis

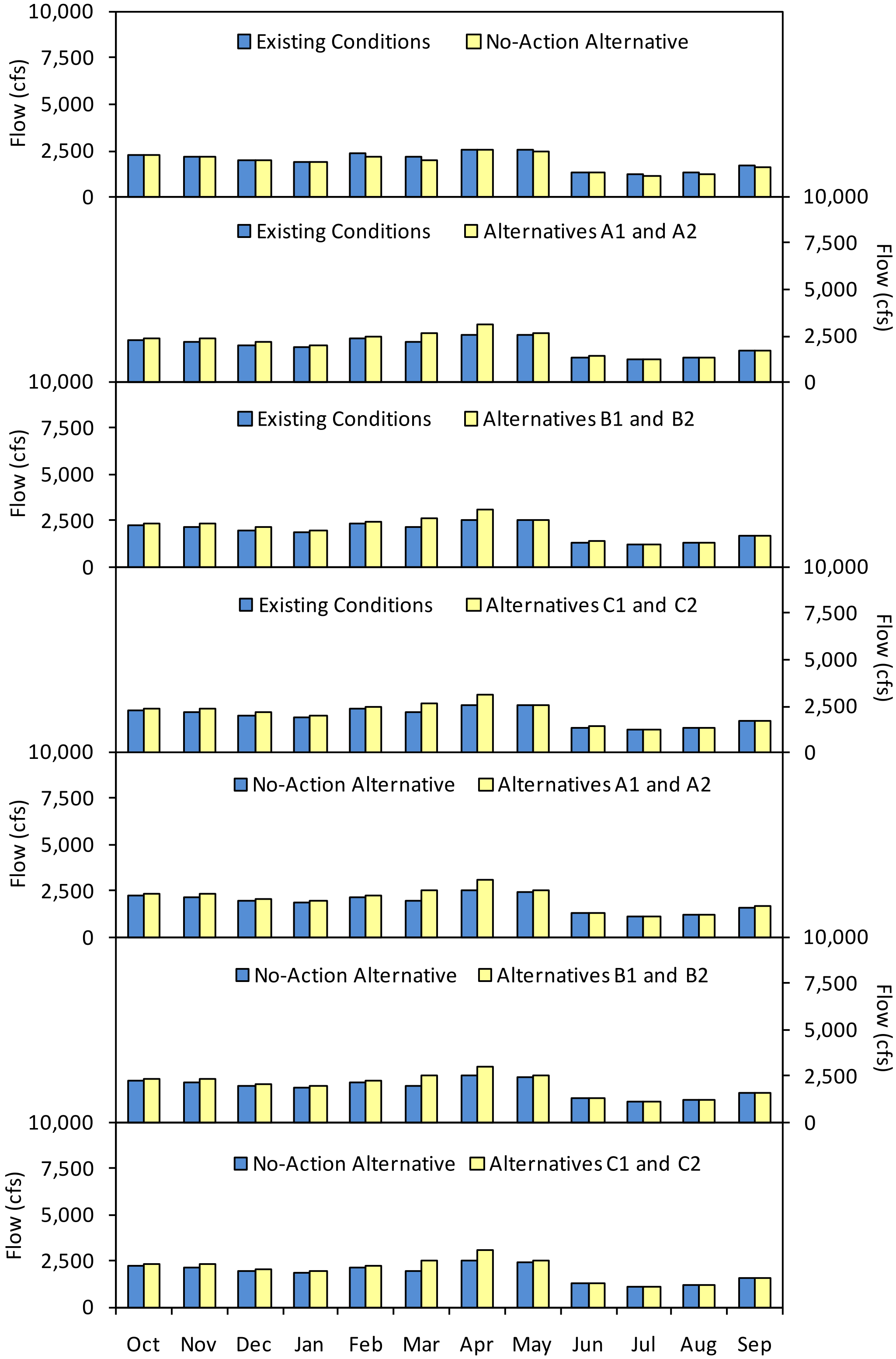


Figure 13-73.
Average Simulated Flow in Dry and Critical Years at San Joaquin River Upstream from Vernalis

Additional Interim and Restoration flows reaching the Delta are treated the same as any other Delta inflow within CalSim. This results in a reoperation of the CVP and SWP system under the physical and regulatory limits within the model. The reoperation results in changes to Delta pumping, which represents the upper limit of the potential return for Alternatives A1 and A2, and a portion of the potential return for Alternatives B1, B2, C1, and C2. Tables 13-109 and 13-110 and Figures 13-74 and 13-75 demonstrate Delta pumping of potential return flows. Tables 13-111 and 13-112 and Figures 13-76 and 13-77 show outflow from the Delta under similar conditions.

Table 13-109.
Average Simulated Exports Through Banks and Jones Pumping Plants

Month	Existing Level[1] (2005)				Future Level[1] (2030)			
	Existing Conditions (cfs)	Alt A1 and A2[2] (cfs)	Alt B1 and B2[2] (cfs)	Alt C1 and C2[2] (cfs)	No-Action Alt[2] (cfs)	Alt A1 and A2[3] (cfs)	Alt B1 and B2[3] (cfs)	Alt C1 and C2[3] (cfs)
Oct	8,546	8,607 (1%)	8,614 (1%)	8,600 (1%)	8,584 (0%)	8,645 (1%)	8,691 (1%)	8,683 (1%)
Nov	8,863	9,007 (2%)	8,987 (1%)	9,000 (2%)	8,842 (0%)	8,940 (1%)	8,947 (1%)	8,941 (1%)
Dec	9,987	10,090 (1%)	10,095 (1%)	10,100 (1%)	10,106 (1%)	10,265 (2%)	10,246 (1%)	10,258 (2%)
Jan	10,563	10,661 (1%)	10,696 (1%)	10,654 (1%)	10,493 (-1%)	10,644 (1%)	10,634 (1%)	10,625 (1%)
Feb	9,078	9,240 (2%)	9,251 (2%)	9,242 (2%)	9,067 (0%)	9,088 (0%)	9,078 (0%)	9,077 (0%)
Mar	7,950	8,208 (3%)	8,205 (3%)	8,200 (3%)	7,915 (0%)	8,175 (3%)	8,189 (3%)	8,186 (3%)
Apr	5,278	5,905 (12%)	5,896 (12%)	5,849 (11%)	5,365 (2%)	6,001 (12%)	5,988 (12%)	5,925 (10%)
May	5,098	5,168 (1%)	5,160 (1%)	5,160 (1%)	5,048 (-1%)	5,147 (2%)	5,139 (2%)	5,134 (2%)
Jun	6,250	6,275 (0%)	6,292 (1%)	6,275 (0%)	6,232 (0%)	6,252 (0%)	6,251 (0%)	6,251 (0%)
Jul	8,927	8,976 (1%)	8,977 (1%)	8,975 (1%)	9,072 (2%)	9,106 (0%)	9,064 (0%)	9,064 (0%)
Aug	8,765	8,723 (0%)	8,719 (-1%)	8,737 (0%)	9,150 (4%)	9,128 (0%)	9,112 (0%)	9,124 (0%)
Sep	9,055	9,075 (0%)	9,030 (0%)	9,065 (0%)	9,360 (3%)	9,389 (0%)	9,394 (0%)	9,399 (0%)

Source: Summarized from CalSim-II 2005 and 2030 simulations (Node D418 + D419).
Notes:
[1] Simulation period: October 1921 – September 2003.
[2] (%) indicates percent change from existing conditions.
[3] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

Table 13-110.
Average Simulated Exports in Dry and Critical Years Through Banks and Jones Pumping Plants[1]

Month	Existing Level[2] (2005)				Future Level[2] (2030)			
	Existing Conditions (cfs)	Alt A1 and A2[3] (cfs)	Alt B1 and B2[3] (cfs)	Alt C1 and C2[3] (cfs)	No-Action Alt[3] (cfs)	Alt A1 and A2[4] (cfs)	Alt B1 and B2[4] (cfs)	Alt C1 and C2[4] (cfs)
Oct	7,738	7,810 (1%)	7,811 (1%)	7,797 (1%)	7,845 (1%)	7,833 (0%)	7,889 (1%)	7,888 (1%)
Nov	7,378	7,673 (4%)	7,661 (4%)	7,666 (4%)	7,363 (0%)	7,561 (3%)	7,565 (3%)	7,562 (3%)
Dec	8,917	9,037 (1%)	9,040 (1%)	9,051 (2%)	9,112 (2%)	9,187 (1%)	9,183 (1%)	9,217 (1%)
Jan	9,547	9,691 (2%)	9,688 (1%)	9,665 (1%)	9,255 (-3%)	9,491 (3%)	9,489 (3%)	9,464 (2%)
Feb	7,202	7,483 (4%)	7,506 (4%)	7,495 (4%)	7,212 (0%)	7,237 (0%)	7,261 (1%)	7,255 (1%)
Mar	6,041	6,118 (1%)	6,100 (1%)	6,133 (2%)	5,928 (-2%)	6,089 (3%)	6,093 (3%)	6,099 (3%)
Apr	2,727	2,998 (10%)	2,989 (10%)	2,940 (8%)	2,774 (2%)	3,112 (12%)	3,101 (12%)	3,015 (9%)
May	2,914	2,956 (1%)	2,946 (1%)	2,947 (1%)	2,921 (0%)	3,030 (4%)	3,023 (4%)	3,010 (3%)
Jun	4,046	4,072 (1%)	4,116 (2%)	4,073 (1%)	3,997 (-1%)	4,050 (1%)	4,034 (1%)	4,030 (1%)
Jul	7,655	7,663 (0%)	7,674 (0%)	7,669 (0%)	7,647 (0%)	7,631 (0%)	7,584 (-1%)	7,571 (-1%)
Aug	5,733	5,732 (0%)	5,724 (0%)	5,751 (0%)	6,370 (11%)	6,464 (1%)	6,428 (1%)	6,454 (1%)
Sep	6,427	6,430 (0%)	6,320 (-2%)	6,410 (0%)	6,787 (6%)	6,792 (0%)	6,782 (0%)	6,792 (0%)

Summarized from CalSim-II 2005 and 2030 simulations (Node D418 + D419)
Notes:
[1] Year type as defined by the Sacramento Valley Index Year Type.
[2] Simulation period: October 1921 – September 2003.
[3] (%) indicates percent change from existing conditions.
[4] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second

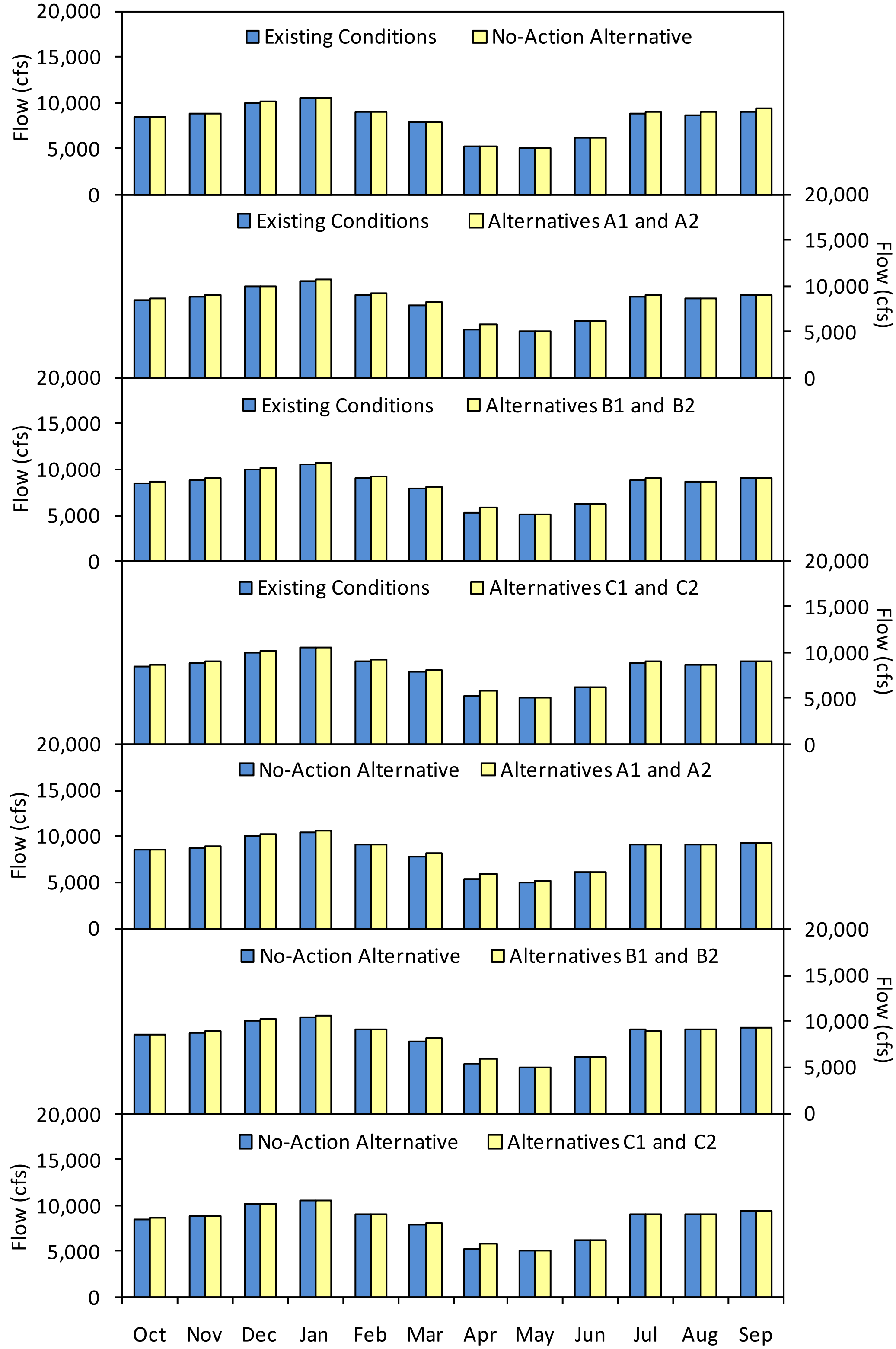


Figure 13-74.
Average Simulated Exports Through Banks and Jones Pumping Plants

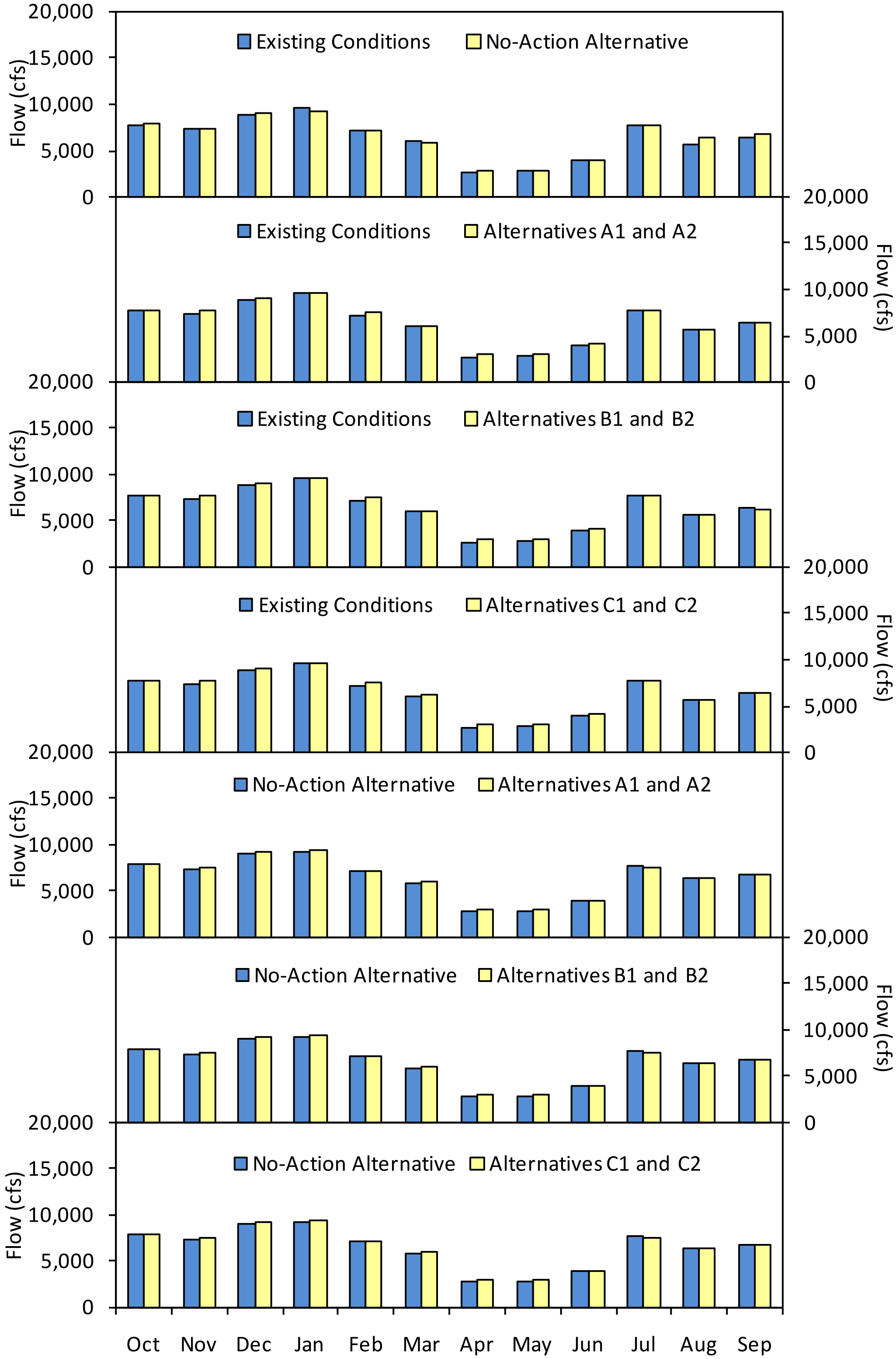


Figure 13-75.
Average Simulated Exports in Dry and Critical Years Through Banks and Jones Pumping Plants

Table 13-111.
Average Simulated Delta Outflow

Month	Existing Level[1] (2005)				Future Level[1] (2030)			
	Existing Conditions (cfs)	Alt A1 and A2[2] (cfs)	Alt B1 and B2[2] (cfs)	Alt C1 and C2[2] (cfs)	No-Action Alt[2] (cfs)	Alt A1 and A2[3] (cfs)	Alt B1 and B2[3] (cfs)	Alt C1 and C2[3] (cfs)
Oct	5,037	5,080 (1%)	5,072 (1%)	5,074 (1%)	4,852 (-4%)	4,861 (0%)	4,866 (0%)	4,860 (0%)
Nov	8,791	8,858 (1%)	8,844 (1%)	8,805 (0%)	8,549 (-3%)	8,645 (1%)	8,641 (1%)	8,598 (1%)
Dec	21,660	21,725 (0%)	21,708 (0%)	21,703 (0%)	21,339 (-1%)	21,349 (0%)	21,330 (0%)	21,309 (0%)
Jan	39,507	39,404 (0%)	39,373 (0%)	39,385 (0%)	39,396 (0%)	39,354 (0%)	39,361 (0%)	39,346 (0%)
Feb	51,064	50,663 (-1%)	50,687 (-1%)	50,646 (-1%)	50,955 (0%)	50,498 (-1%)	50,481 (-1%)	50,465 (-1%)
Mar	41,682	41,885 (0%)	41,871 (0%)	41,880 (0%)	41,617 (0%)	41,814 (0%)	41,810 (0%)	41,796 (0%)
Apr	26,811	27,344 (2%)	27,339 (2%)	27,223 (2%)	26,888 (0%)	27,427 (2%)	27,414 (2%)	27,201 (1%)
May	20,246	20,310 (0%)	20,299 (0%)	20,295 (0%)	20,061 (-1%)	20,125 (0%)	20,112 (0%)	20,115 (0%)
Jun	13,225	13,202 (0%)	13,200 (0%)	13,202 (0%)	13,085 (-1%)	13,089 (0%)	13,086 (0%)	13,089 (0%)
Jul	8,597	8,557 (0%)	8,568 (0%)	8,558 (0%)	8,750 (2%)	8,662 (-1%)	8,652 (-1%)	8,651 (-1%)
Aug	4,469	4,419 (-1%)	4,415 (-1%)	4,424 (-1%)	4,652 (4%)	4,637 (0%)	4,649 (0%)	4,657 (0%)
Sep	5,223	5,256 (1%)	5,250 (1%)	5,245 (0%)	5,211 (0%)	5,270 (1%)	5,265 (1%)	5,281 (1%)

Source: Summarized from CalSim-II 2005 and 2030 simulations (Node C406)
Notes:
[1] Simulation period: October 1921 – September 2003.
[2] (%) indicates percent change from existing conditions.
[3] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second
Delta = Sacramento-San Joaquin Delta

Table 13-112.
Average Simulated Delta Outflow in Dry and Critical Years[1]

Month	Existing Level[2] (2005)				Future Level[2] (2030)			
	Existing Conditions (cfs)	Alt A1 and A2[3] (cfs)	Alt B1 and B2[3] (cfs)	Alt C1 and C2[3] (cfs)	No-Action Alt[3] (cfs)	Alt A1 and A2[4] (cfs)	Alt B1 and B2[4] (cfs)	Alt C1 and C2[4] (cfs)
Oct	4,297	4,330 (1%)	4,329 (1%)	4,325 (1%)	4,273 (-1%)	4,244 (-1%)	4,249 (-1%)	4,247 (-1%)
Nov	5,724	5,719 (0%)	5,726 (0%)	5,671 (-1%)	5,637 (-2%)	5,663 (0%)	5,654 (0%)	5,596 (-1%)
Dec	7,226	7,335 (2%)	7,319 (1%)	7,312 (1%)	6,974 (-3%)	7,097 (2%)	7,083 (2%)	7,036 (1%)
Jan	9,772	9,874 (1%)	9,876 (1%)	9,864 (1%)	10,106 (3%)	10,010 (-1%)	10,011 (-1%)	9,998 (-1%)
Feb	16,483	16,089 (-2%)	16,056 (-3%)	16,096 (-2%)	16,524 (0%)	16,232 (-2%)	16,227 (-2%)	16,225 (-2%)
Mar	15,191	15,477 (2%)	15,473 (2%)	15,472 (2%)	14,738 (-3%)	15,138 (3%)	15,142 (3%)	15,128 (3%)
Apr	10,840	11,044 (2%)	11,036 (2%)	10,896 (1%)	10,858 (0%)	11,004 (1%)	10,997 (1%)	10,792 (-1%)
May	7,836	7,873 (0%)	7,859 (0%)	7,860 (0%)	7,884 (1%)	7,899 (0%)	7,883 (0%)	7,895 (0%)
Jun	6,366	6,325 (-1%)	6,328 (-1%)	6,329 (-1%)	6,392 (0%)	6,395 (0%)	6,394 (0%)	6,395 (0%)
Jul	5,427	5,458 (1%)	5,482 (1%)	5,461 (1%)	5,533 (2%)	5,525 (0%)	5,525 (0%)	5,521 (0%)
Aug	4,248	4,118 (-3%)	4,113 (-3%)	4,132 (-3%)	4,591 (8%)	4,535 (-1%)	4,543 (-1%)	4,547 (-1%)
Sep	3,051	3,050 (0%)	3,048 (0%)	3,039 (0%)	3,437 (13%)	3,452 (0%)	3,425 (0%)	3,445 (0%)

Source: Summarized from CalSim-II 2005 and 2030 simulations (Node C406)
Notes:
[1] Year type as defined by the Sacramento Valley Index Year Type.
[2] Simulation period: October 1921 – September 2003.
[3] (%) indicates percent change from existing conditions.
[4] (%) indicates percent change from No-Action Alternative.
Key:
Alt = Alternative
cfs = cubic feet per second
Delta = Sacramento-San Joaquin Delta

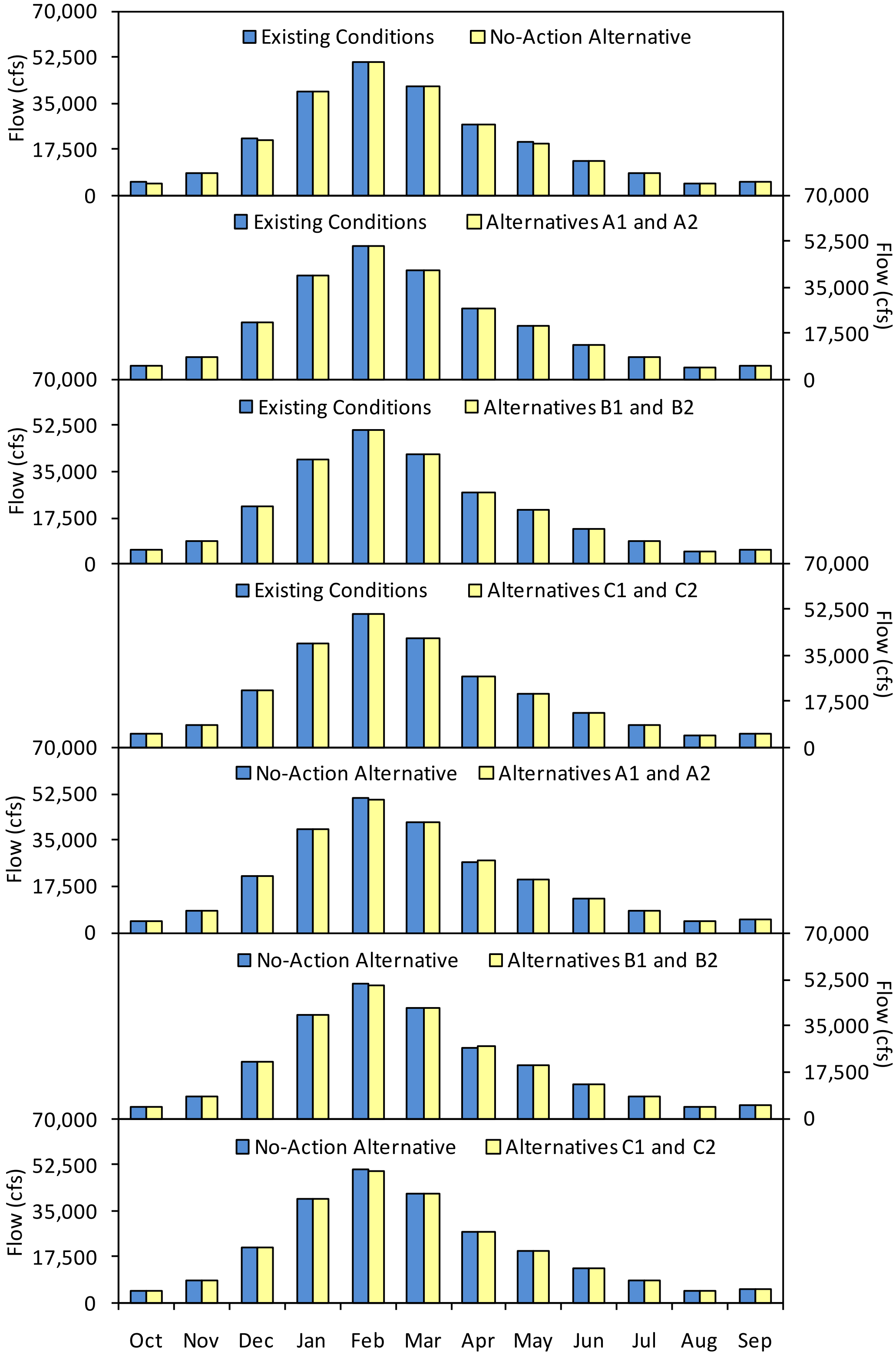


Figure 13-76.
Average Simulated Delta Outflow

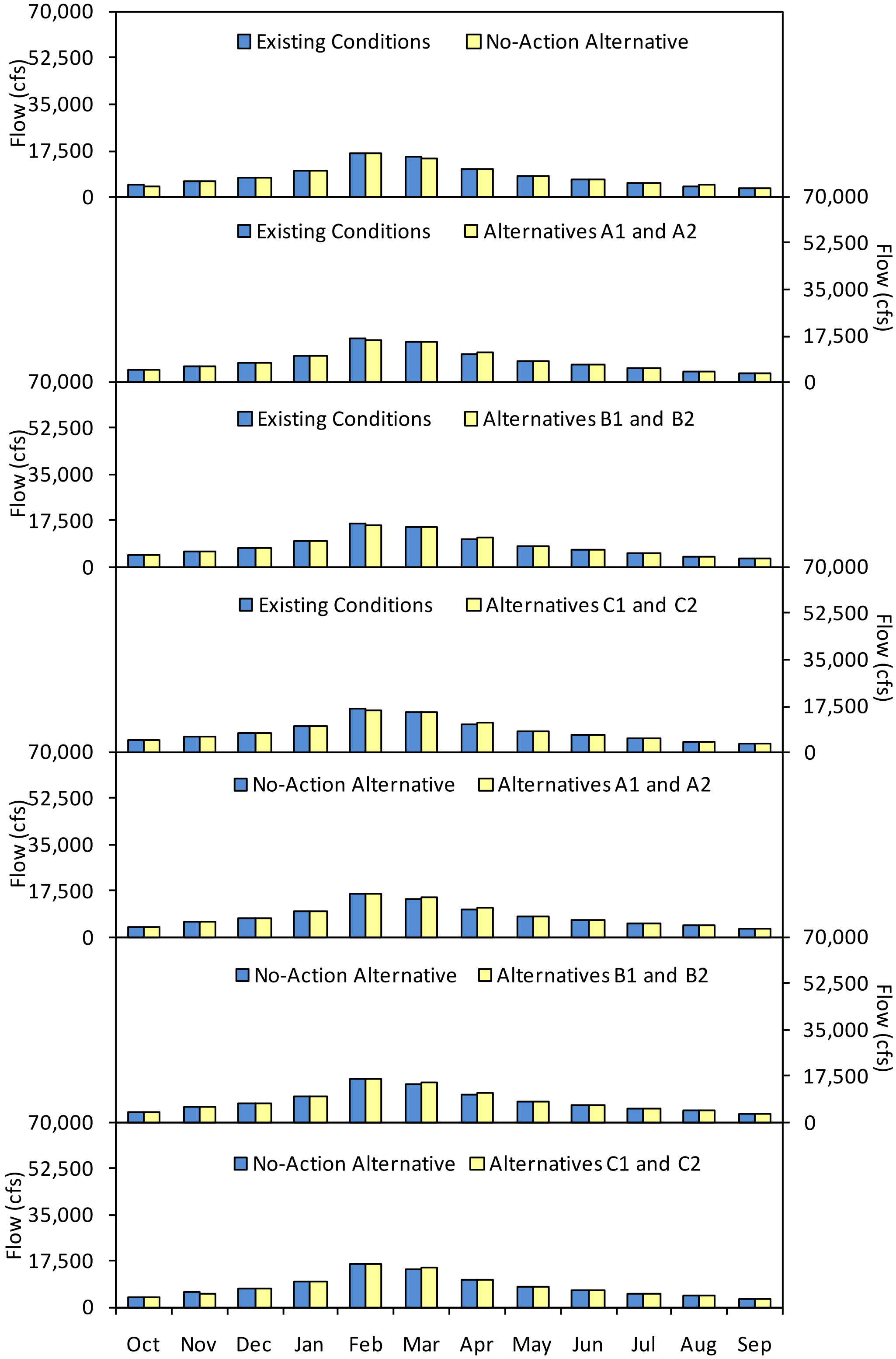


Figure 13-77.
Average Simulated Delta Outflow in Dry and Critical Years

Central Valley Project/State Water Project Water Service Areas

As the "central hub" of California's water supplies, minor changes in Delta operations due to Interim and Restoration flows could result in other minor changes throughout the CVP and SWP system. This section summarizes these potential changes in CVP and SWP deliveries and storages. Detailed impact analyses of the economic effects of changes in water deliveries to CVP and SWP water service areas are found in Chapter 22.0, "Socioeconomics." A description of CVP and SPW operations can be found in the "Environmental Setting" section of this chapter and in Appendix H, "Modeling."

Central Valley Project Friant Division. Changes in Friant Division deliveries from Millerton Lake are shown in Appendix J, "Surface Water Supplies and Facilities Operations." Substantial decreases in Class 1, Class 2, and Section 215 water deliveries would be due to Interim and Restoration flows and the conversion of prior delivery categories to 16(b) deliveries. These model results assume that water recaptured downstream from Friant Dam (potential 16(a) water) is not returned to the Friant Division and, therefore, represent the upper bound of delivery changes.

The potential return of recaptured water to the Friant Division pursuant to 16(a) is not explicitly modeled in CalSim. Average annual values of potential return, however, are shown in Table 13-113, and represent the maximum potential return. No attempt was made to allocate the potential return to individual years or months because the mechanism and facilities required to implement the return, either existing or new, are unknown at this time. These results were further post-processed to meet the needs of other resource impact analyses (e.g., socioeconomics, power and energy, groundwater).

Table 13-113.
Potential Return of Recaptured Water to Friant Pursuant to 16(a) Average Annual Values

Alternative		Delta (TAF)	Direct (TAF)	Total (TAF)
Existing Level (2005)	A1 and A2	58.8	NA	58.8
	B1 and B2	52.2	5.9	58.1
	C1 and C2	50.2	20.4	70.6
Future Level (2030)	A1 and A2	58.3	NA	58.3
	B1 and B2	47.7	8.0	55.7
	C1 and C2	46.3	29.7	76.0

Key:
Delta = Sacramento-San Joaquin Delta
NA = not applicable/not available
TAF – thousand acre-feet

Other Central Valley Project Service Areas and Facilities and State Water Project Service Areas and Facilities. Changes in Delta conditions associated with the program alternatives could result in changes in operations to other CVP and SWP facilities. Recipients of exports through the Banks and Jones pumping plants include San Joaquin Valley Exchange Contractors, Federal wildlife refuges, and CVP and SWP water service contractors. Economic effects of changes in deliveries to these recipients are assessed in Chapter 22.0, "Socioeconomics."

Changes to San Luis Reservoir operations depend on the quantity of water recaptured in both the San Joaquin River and the Delta, and if San Luis Reservoir is used for 16(a) water regulation. Appendix J, "Surface Water Supplies and Facilities Operations," shows total San Luis Reservoir storage changes if the reservoir was operated under existing regulatory requirements and institutional agreements, in response to the Delta pumping changes shown in this chapter.

North-of-Delta storages typically increased less than 2 percent of baseline values. North-of-Delta delivery changes would be typically less than 1 percent.

Chapter 14.0 Hydrology – Surface Water Quality

This chapter describes the environmental and regulatory settings for surface water quality, as well as environmental consequences and mitigation measures, as they pertain to implementation of the program alternatives.

14.1 Environmental Setting

The following sections describe the environmental setting for surface water quality within the five geographic areas of the study area.

14.1.1 San Joaquin River Upstream from Friant Dam

Water upstream from Friant Dam is generally soft with low mineral and nutrient concentrations due to the insolubility of granitic soils in the watershed and the river's granite substrate (SCE 2007). As the San Joaquin River and tributary streams flow from the Sierra Nevada foothills across the eastern valley floor, their mineral concentration increases. Sediment is likely captured behind the many impoundments in this geographic subarea.

Most of Millerton Lake becomes thermally stratified during spring and summer months. Complete mixing of the water column likely occurs during winter months (Reclamation 2008). Based on unpublished data collected by Reclamation during December 2004 through November 2005, dissolved oxygen concentrations in Millerton Lake are generally high during most of the year, with lowest concentrations typically exhibited during November at depths greater than 175 feet. Millerton Lake is listed in the draft 2008 update to CWA Section 303(d) listings for mercury (Central Valley RWQCB 2009a).

14.1.2 San Joaquin River from Friant Dam to Merced River

Water quality in various segments of the San Joaquin River below Friant Dam is degraded because of low flow and discharges from agricultural areas and wastewater treatment plants. The following sections describe surface water quality conditions within San Joaquin River reaches in the Restoration Area. The current triennial review of the WQCP for the Sacramento and San Joaquin River Basins (Basin Plan) is anticipated to provide the regulatory guidance for TMDL standards at locations along the San Joaquin River (Central Valley RWQCB 2009b).

Water quality in Reach 1 is influenced by releases from Friant Dam, with minor contributions from agricultural and urban return flows. Water quality data collected from the San Joaquin River below Friant Dam demonstrate the generally high quality of water released at Friant Dam from Millerton Lake to Reach 1. Temperatures of San Joaquin

River water releases to Reach 1 are dependent on the cold-water volume available at Millerton Lake (Reclamation 2007). The reach from Gravelly Ford to the Mendota Pool (Reach 2) is frequently dry, except during flood releases at Friant Dam, because water released at Friant Dam is diverted upstream to satisfy water right agreements, or the water percolates to groundwater. The draft CWA Section 303(d) listings include invasive species for Reaches 1 and 2 (Central Valley RWQCB 2009a).

During the irrigation season, water released at Mendota Dam to Reach 3 generally has higher concentrations of TDS than water in the upper reaches of the San Joaquin River. Increased EC and concentrations of total suspended solids demonstrate the effect of Delta contributions to San Joaquin River flow. Water temperatures below Mendota Dam are dependent on water temperatures of inflow from the DMC and, occasionally, the Kings River system via James Bypass (Reclamation 2007).

Water quality criteria applicable to some beneficial uses are not currently met within Reaches 3 and 4. The draft CWA Section 303(d) listings for these reaches include boron, chlorpyrifos, diazinon, DDT, EC, Group A pesticides, and unknown toxicity (Central Valley RWQCB 2009a). TMDL and Basin Plan amendments are currently in place for diazinon and chloropyrifos runoff into the San Joaquin River. TMDLs and Basin Plan amendments are currently being developed for selenium, salt and boron, and pesticides. Water temperature conditions in Reach 4A are dependent on inflow water temperatures during flood flows from Reach 3 (Reclamation 2007).

Reach 5 typically has the poorest water quality of any reach of the river. Reach 5 and its tributaries (Bear Creek and Mud and Salt sloughs) do not meet water quality criteria applicable to some designated beneficial uses, as shown in Table 14-1 (Central Valley RWQCB 2009a). In addition to TMDLs and Basin Plan amendments currently in place or being developed for Reaches 3 and 4 for the above water quality criteria limitations applicable to Reach 5, current TMDLs address selenium from Salt Slough and the Grasslands Drainage Area.

Water quality data collected at Salt Slough, Mud Slough, and San Joaquin River sites within Reach 5 demonstrate the effect of irrigation runoff contributions from east side tributaries. San Joaquin River water temperatures within Reach 5 are influenced greatly by the water temperature of Salt Slough inflow, which contributes the majority of streamflow in the reach (Reclamation 2007).

Table 14-1.
Draft 2008 Clean Water Act Section 303(d) List of Water Quality Limited Segments, San Joaquin River System, Reach 5 and Tributaries

Segment	Pollutant/Stressor	Potential Sources	Affected Area/ Reach Length
San Joaquin River, Bear Creek to Mud Slough (Reach 5)	Arsenic	Source Unknown	14 miles
	Boron	Agriculture	
	Chlorpyrifos	Agriculture	
	DDT	Agriculture	
	Electrical Conductivity	Agriculture	
	Escherichia coli (*E. Coli*)	Source Unknown	
	Group A Pesticides	Agriculture	
	Mercury	Agriculture	
	Unknown Toxicity	Source Unknown	
San Joaquin River, Mud Slough to Merced River (Reach 5)	Boron	Agriculture	3 miles
	Chlorpyrifos	Agriculture	
	DDT	Agriculture	
	Diazinon	Agriculture	
	Electrical Conductivity	Agriculture	
	Escherichia coli (*E. Coli*)	Source Unknown	
	Group A Pesticides	Agriculture	
	Mercury	Agriculture	
	Selenium	Agriculture	
	Unknown Toxicity	Source Unknown	
Bear Creek	*Escherichia coli* (*E. Coli*)	Source Unknown	84 miles
	Unknown Toxicity	Source Unknown	
Mud Slough (downstream from San Luis Drain)	Boron	Agriculture	13 miles
	Electrical Conductivity	Agriculture	
	Pesticides	Agriculture	
	Selenium	Agriculture	
	Unknown Toxicity	Source Unknown	
Mud Slough (upstream from San Luis Drain)	Boron	Agriculture	22 miles
	Electrical Conductivity	Agriculture	
	Escherichia coli (*E. Coli*)	Source Unknown	
	Pesticides	Agriculture	
	Unknown Toxicity	Source Unknown	
Salt Slough	Boron	Agriculture	9.9 miles
	Chlorpyrifos	Agriculture	
	Electrical Conductivity	Agriculture	
	Escherichia coli (*E. Coli*)	Source Unknown	
	Mercury	Resource Extraction	
	Prometryn	Agriculture	
	Unknown Toxicity	Agriculture	

Key:
DDT = dichloro-diphenyl-trichloroethane

14.1.3 San Joaquin River from Merced River to Delta

Below its confluence with the Merced River, San Joaquin River water quality generally improves at successive confluences with east side rivers draining the Sierra Nevada, particularly at confluences with the Merced, Tuolumne, and Stanislaus rivers. In the relatively long reach between the Merced and Tuolumne rivers, mineral concentrations tend to increase because of inflows of agricultural drainage water, other wastewaters, and effluent groundwater (DWR 1965). TDS in the San Joaquin River near Vernalis has historically (from 1951 to 1962) ranged from 52 mg/L (at high flows) to 1,220 mg/L (DWR 1965).

Draft CWA Section 303(d) listings for the San Joaquin River from the Merced River to the Delta are provided in Table 14-2 (Central Valley RWQCB 2009a). The Central Valley RWQCB is currently developing a Proposed Basin Plan Amendment to establish new salinity and boron water quality objectives in the lower San Joaquin River upstream from Vernalis, and a TMDL to implement the salinity and boron water quality objectives (Central Valley RWQCB 2009c). In addition to these water quality impairments, a TMDL and Basin Plan Amendment for organic enrichment and low dissolved oxygen in the Stockton Deepwater Ship Channel portion of the San Joaquin River were also identified.

14.1.4 Sacramento-San Joaquin Delta

Water quality in the Delta is highly variable temporally (timing) and spatially (location) and is a function of complex circulation patterns that are affected by inflows, pumping for Delta agricultural operations and exports, operation of flow control structures, and tidal action. The existing water quality problems of the Delta system may be categorized as presence of toxic materials, eutrophication and associated fluctuations in dissolved oxygen, presence of suspended sediments and turbidity, salinity, and presence of pathogenic bacteria (SWRCB 1999).

Draft CWA Section 303(d) listings for Delta waterways within the area under Central Valley RWQCB jurisdiction include low dissolved oxygen, EC, mercury, Group A pesticides, chlorpyrifos, diazinon, DDT, dieldrin, dioxin, furan compounds, (polychlorinated biphenyls (PCB)), unknown toxicity, pathogens, and invasive species (Central Valley RWQCB 2009a). The Delta is also listed as impaired for mercury, selenium, chlordane, DDT, diazinon, dieldrin, dioxin compounds, furan compounds, PCBs, and exotic species for areas within the San Francisco Bay Regional Water Quality Control Board (San Francisco Bay RWQCB) jurisdiction (2007a). San Francisco Bay RWQCB recommends removing nickel from the 2006 CWA 303(d) list because applicable water quality standards have not been exceeded (2009).

Table 14-2.
Draft 2008 Clean Water Act Section 303(d) List of Water Quality Limited Segments, San Joaquin River System from Merced River to Delta

Segment	Pollutant/Stressor	Potential Source	Affected Area/ Reach Length
San Joaquin River, Merced River to Tuolumne River	alpha-BHC	Source Unknown	29 miles
	Boron	Agriculture	
	Chlorpyrifos	Agriculture	
	DDE	Agriculture	
	DDT	Agriculture	
	Electrical Conductivity	Agriculture	
	Group A Pesticides	Agriculture	
	Mercury	Resource Extraction	
	Temperature, Water	Source Unknown	
	Unknown Toxicity	Agriculture	
San Joaquin River, Tuolumne River to Stanislaus River	Chlorpyrifos	Agriculture	8.4 miles
	DDT	Agriculture	
	Diazinon	Agriculture	
	Electrical Conductivity	Agriculture	
	Group A Pesticides	Agriculture	
	Mercury	Resource Extraction	
	Temperature, Water	Source Unknown	
	Unknown Toxicity	Agriculture	
San Joaquin River, Stanislaus River to Delta	Chlorpyrifos	Agriculture	3 miles
	DDE	Agriculture	
	DDT	Agriculture	
	Diuron	Agriculture	
	Escherichia coli (*E. Coli*)	Source Unknown	
	Group A Pesticides	Agriculture	
	Mercury	Resource Extraction	
	Temperature, Water	Source Unknown	
	Toxaphene	Source Unknown	
	Unknown Toxicity	Agriculture	

Key:
alpha-BHC= alpha-benzene hexachloride
DDE = dichloro-diphenyl-dichloroethylene
DDT = dichloro-diphenyl-trichloroethane

The north Delta tends to have better water quality primarily because of inflow from the Sacramento River. The quality of water in the west Delta is strongly influenced by tidal exchange with San Francisco Bay; during low-flow periods, seawater intrusion results in increased salinity. In the south Delta, water quality tends to be poorer because of the combination of inflows of poorer water quality from the San Joaquin River, discharges from Delta islands, and effects of diversions that can sometimes increase seawater intrusion from San Francisco Bay.

The Sacramento and San Joaquin rivers contribute approximately 61 percent and 33 percent, respectively, to tributary inflow TDS concentrations within the Delta. TDS concentrations are relatively low in the Sacramento River, but because of its large volumetric contribution, the river provides the majority of the TDS load supplied by tributary inflow to the Delta (DWR 2001). Although actual flow from the San Joaquin River is lower than from the Sacramento River, TDS concentrations in San Joaquin River water average approximately 7 times those in the Sacramento River. The influence of this relatively poor San Joaquin River water quality is greatest in the south Delta channels and in CVP and SWP exports. Water temperature in the Delta is only slightly influenced by water management activities (i.e., dam releases) (Reclamation and DWR 2005).

Delta exports contain elevated concentrations of disinfection byproduct precursors (e.g., dissolved organic carbon), and the presence of bromide increases the potential for formation of brominated compounds in treated drinking water. Organic carbon in the Delta originates from runoff from agricultural and urban land, drainage water pumped from Delta islands that have soils with high organic matter, runoff and drainage from wetlands, wastewater discharges, and primary production in Delta waters. Delta agricultural drainage can also contain high levels of nutrients, suspended solids, organic carbon, minerals (salinity), and trace chemicals such as organophosphate, carbamate, and organochlorine pesticides.

14.1.5 Central Valley Project/State Water Project Water Service Areas

Water delivered to Friant Division contractors via the Friant-Kern and Madera canals from Millerton Lake is representative of water quality conditions at Millerton Lake and the upper San Joaquin River watershed – generally soft with low mineral and nutrient concentrations. As described in Chapter 13.0, “Hydrology – Surface Water Supplies and Facilities Operations,” water from the Delta is delivered to Arvin-Edison WSD via the California Aqueduct in exchange for water delivered from Millerton Lake, when conditions permit. Water delivered to Arvin-Edison WSD is representative of a mixture of Delta and Millerton Lake water quality conditions. Surface water quality in the other CVP water service areas is affected by fluctuations of water quality in the Delta, which in turn are influenced by climate, water quality in the San Joaquin River, local agricultural diversions and drainage water, and the Sacramento River. Water quality concerns of particular importance are those related to salinity and drinking water quality. Surface water quality conditions within SWP water service areas and at SWP facilities are similar to the conditions described above for other CVP water service areas and facilities. Constituents that affect drinking water quality are of more concern within the SWP water service areas because of high demand for municipal water supplies for SWP contractors.

14.2 Regulatory Setting

This section focuses on laws related directly to water quality. A number of regulatory authorities at the Federal, State, and local levels control the flow, quality, and supply of water in California, either directly or indirectly.

At the State level, SWRCB, the Central Valley RWQCB, and San Francisco Bay RWQCB regulate and monitor Delta water quality. EPA also plays an important role under the auspices of the Federal CWA and Safe Drinking Water Act. The California Department of Health Services (DHS) has an interest in the Delta because the Delta is the source of drinking water for over 25 million Californians. DWR extensively monitors Delta water quality as part of its Municipal Water Quality Investigations program and DWR, in cooperation with Reclamation, monitors Delta water quality under SWRCB's compliance monitoring requirements.

At the local level, water agencies that divert from the Delta have both strong interest in and influence on Delta water quality management. These agencies include CCWD, Solano County Water Agency (SCWA), and City of Stockton Metropolitan Area (COSMA).

14.2.1 Federal

This section presents the applicable Federal regulations associated with surface water quality.

Safe Drinking Water Act

The Safe Drinking Water Act was established to protect the quality of drinking water in the U.S. The Safe Drinking Water Act authorized EPA to set National health-based standards for drinking water, and requires many actions to protect drinking water and its sources, including rivers, lakes, reservoirs, springs, and groundwater wells. Furthermore, the Safe Drinking Water Act requires all owners or operators of public water systems to comply with primary (health-related) standards. EPA has delegated to the California DHS, Division of Drinking Water and Environmental Management, the responsibility for administering California's drinking-water program.

Clean Water Act

The CWA is the primary Federal legislation governing the water quality aspects of the SJRRP. The objective of the act is "to restore and maintain the chemical, physical, and biological integrity of the nation's waters." The CWA establishes the basic structure for regulating discharge of pollutants into the waters of the United States and gives EPA the authority to implement pollution control programs such as setting wastewater standards for industries. In certain states such as California, EPA has delegated authority to state agencies.

Section 303 of the CWA requires states to adopt water quality standards for all surface waters of the United States. The three major components of water quality standards are designated users, water quality criteria, and antidegradation policy. Section 303(d) of the CWA requires states and authorized Native American tribes to develop a list of water-quality-impaired segments of waterways. The list includes waters that do not meet water quality standards necessary to support the beneficial uses of a waterway, even after point sources of pollution have installed the minimum required levels of pollution control technology. Only waters impaired by “pollutants” (including clean sediments, nutrients such as nitrogen and phosphorus, pathogens, acids/bases, temperature, metals, cyanide, and synthetic organic chemicals (EPA 2002)), not those impaired by other types of “pollution” (e.g., altered flow, channel modification), are to be included on the list.

Section 303(d) of the CWA also requires states to maintain a list of impaired water bodies so that a TMDL can be established. A TMDL is a plan to restore the beneficial uses of a stream or to otherwise correct an impairment. It establishes the allowable pollutant loadings or other quantifiable parameters (e.g., pH, temperature) for a water body and thereby provides the basis for establishing water quality-based controls. The calculation for establishing TMDLs for each water body must include a margin of safety to ensure that the water body can be used for the purposes of State designation. Additionally, the calculation also must account for seasonal variation in water quality (EPA 2002). Central Valley RWQCB develops TMDLs for the San Joaquin River (see discussion on the Porter-Cologne Water Quality Control Act below).

Section 401 of the CWA requires Federal agencies to obtain certification from the State or Native American tribes before issuing permits that would result in increased pollutant loads to a water body. The certification is issued only if such increased loads would not cause or contribute to exceedances of water quality standards.

Section 402 creates the NPDES permit program. This program covers point sources of pollution discharging into a surface water body.

A permit must be obtained from USACE under Section 404 for the discharge of dredged or fill material into “waters of the United States, including wetlands” under Section 404 of the CWA. Waters of the United States include wetlands and lakes, rivers, streams, and their tributaries. Wetlands are defined for regulatory purposes as areas inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support and, under normal circumstances do support, vegetation typically adapted for life in saturated soil conditions.

Antidegradation Policy

The antidegradation policy, established in 1968 and revised in 2005 (Title 40, Section 131.12 of the CFR), is designed to protect existing uses and water quality and National water resources, as authorized by Section 303(c) of the CWA.

Rivers and Harbors Act Section 10

Section 10 of the RHA (33 USC 401 et seq.) requires authorization from USACE for construction of any structure over, in, or under navigable waters of the United States.

Executive Order 11990 (Wetlands Policy)

Executive Order 11990 is an overall wetlands policy for all agencies that manage Federal lands, sponsor Federal projects, or provide Federal funds to state or local projects. The order requires Federal agencies to follow avoidance, mitigation, and preservation procedures with public input before the agencies propose new construction in wetlands.

14.2.2 State

This section presents the applicable State regulations associated with surface water quality.

Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act is California's statutory authority for protecting water quality. Under the act, the State must adopt water quality policies, plans, and objectives protecting the State's waters for the use and enjoyment of people. Obligations of SWRCB and the RWQCBs to adopt and periodically update their WQCPs (Basin Plans) are set forth in the act. A Basin Plan identifies the designated beneficial uses for specific surface water and groundwater resources, applicable water quality objectives necessary to support the beneficial uses, and implementation programs that are established to maintain and protect water quality from degradation for each of the RWQCBs. The act also requires waste dischargers to notify the RWQCBs of their activities through filing reports of waste discharge (RWD), and authorizes SWRCB and the RWQCBs to issue and enforce WDR, NPDES permits, Section 401 water quality certifications, or other approvals. The RWQCBs also have authority to issue waivers for RWDs/WDRs for broad categories of "low threat" discharge activities that have minimal potential for adverse water quality effects when implemented according to prescribed terms and conditions.

The Basin Plan (Central Valley RWQCB 1998) and San Francisco Bay Basin Water Quality Control Plan (San Francisco Bay RWQCB 2007b) regulate waters of the State located within the study area. Beneficial uses and water quality objectives for Millerton Lake, the San Joaquin River, and Delta are described in the environmental setting section of this chapter.

Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California

The *Water Quality Control Plan for the Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California* sets limits for "thermal waste" and "elevated temperature waste" discharged into coastal and interstate waters and enclosed bays and estuaries of California (SWRCB 1975).

Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary

The 1995 *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary* (SWRCB 1995) established water quality control measures that contribute to protecting beneficial uses in the Delta. The 1995 WQCP identified (1) beneficial uses of the Delta to be protected, (2) water quality objectives for the reasonable protection of beneficial uses, and (3) a program of implementation for achieving the water quality objectives.

The 1995 WQCP was developed as part of the December 15, 1994, Bay-Delta Accord, which committed the CVP and SWP to new Delta habitat objectives. Since these new beneficial objectives and water quality standards were more protective than those of the previous D-1485, the new objectives were adopted by amendment in 1995 through a Water Right Order for operation of the CVP and SWP. One key feature of the 1995 WQCP was the estuarine habitat ("X2") objectives for Suisun Bay and the west Delta. X2 represents the geographic location of the 2 ppt near-bottom salinity isohaline in the Delta, which is measured in distance upstream from the Golden Gate Bridge in Suisun Bay. The X2 objective required specific daily or 14-day surface EC criteria, or 3-day averaged outflow requirements to be met for a certain number of days each month, February through June. These requirements were designed to provide improved shallow water habitat for fish species in spring. Because of the relationship between seawater intrusion and interior Delta water quality, the X2 criterion also improved water quality at Delta drinking water intakes. Other new elements of the 1995 WQCP included export/inflow (E/I) ratios intended to reduce entrainment of fish at the export pumps, Delta Cross Canal gate closures, and San Joaquin River EC and flow standards.

Following review of the 1995 WQCP, workshops, and public comment period, the SWRCB amended the 1995 WQCP with only minor changes and adopted the 2006 WQCP (SWRCB 2006). No changes were made to the beneficial uses, and water quality objective implementation dates were updated. The 2006 WQCP also included several directives and recommendations for water quality control planning activities to address emerging issues related to pelagic organism decline, climate change, Delta and Central Valley salinity, and San Joaquin River flows (SWRCB 2006).

Water Right Decision 1641

D-1641 and Water Right Order 2001-05 contain the current water right requirements to implement the 1995 WQCP. D-1641 incorporates water right settlement agreements between Reclamation and DWR and certain water users in the Delta and upstream watersheds regarding contributions of flows to meet water quality objectives. However, Reclamation and/or DWR have the responsibility to meet water quality objectives in the Delta. D-1641 also authorizes the CVP and SWP to use JPOD in the south Delta, and recognizes the CALFED Operations Coordination Group process for operational flexibility in applying or relaxing certain protective standards. The additional exports allowed under the JPOD could result in additional degradation of water quality for water users in the south and central Delta, including CCWD. The JPOD also could impact water levels in the south Delta and endangered fish species.

In February 2006, SWRCB issued notice to Reclamation and DWR that each agency is responsible for meeting water quality objectives in the interior south Delta, as described in D-1641. The SWRCB order requires Reclamation and DWR to comply with a detailed plan and time schedule that will bring them into compliance with their respective permit and license requirements for meeting interior south Delta salinity objectives by July 1, 2009. The SWRCB order also revised the previously issued (July 1, 2005) *Water Quality Response Plan* (SWRCB 2005) approval governing Reclamation's and DWR's use of each other's respective points of diversion in the south Delta. Additionally, the order specifies that JPOD operations are authorized pursuant to the 1995 WQCP, and that

Reclamation and DWR may conduct JPOD diversions, provided that both agencies are in compliance with all conditions of their respective water right permits and licenses at the time the JPOD diversions would occur.

Municipal & Industrial Water Quality Objectives

In the 1978 WQCP, SWRCB set two objectives that it believed provided reasonable protection for M&I beneficial uses of Delta waters from the effects of salinity intrusion. The first objective established a year-round maximum mean daily chloride concentration measured at five Delta intake facilities, including CCWD's Pumping Plant No. 1, of 250 mg/L for the reasonable protection of municipal beneficial uses. The second objective established a maximum mean daily chloride concentration of 150 mg/L (measured at either CCWD Pumping Plant No.1 or the San Joaquin River at the Antioch water works intake) for the reasonable protection of industrial beneficial uses (specifically manufacture of cardboard boxes by Gaylord Container Corporation in Antioch).

Coordinated Operations Agreement

The COA defines how Reclamation and DWR share their joint responsibility to meet Delta water quality standards and meet the water demands of senior water right holders. The COA defines the Delta as being in either "balanced water conditions" or "excess water conditions." Balanced conditions are periods when Delta inflows are just sufficient to meet water user demands within the Delta, outflow requirements for water quality and flow standards, and export demands. Under excess conditions, Delta outflow exceeds the flow required to meet water quality and flow standards. Typically, the Delta is in balanced water conditions from June to November, and in excess water conditions from December through May. However, depending on the volume and timing of winter runoff, excess or balanced conditions may extend throughout the year.

14.2.3 Local

Each county in the study area has a general plan that includes numerous policies to protect water quality, water supply, water resources, and watersheds. Local policies included in general plans for counties in the study area related to surface water quality are consistent with Federal and State regulations described above, and CEQA policy to prevent environmental damage.

14.3 Environmental Consequences and Mitigation Measures

This section describes the direct and indirect effects that the program alternatives would have on surface water quality. This section describes the methodology, criteria for determining significance of effects, and environmental consequences and mitigation measures associated with effects of each of the program alternatives. Implementing the action alternatives could affect surface water quality of the San Joaquin River system upstream from Friant Dam, from Friant Dam to the Delta, in the Delta, and in CVP and SWP water service areas. The program alternatives evaluated in this chapter are described in detail in Chapter 2.0, “Description of Alternatives,” and summarized in Table 14-3. The potential impacts to surface water quality and associated mitigation measures are summarized in Table 14-4 below.

Table 14-3.
Actions Included Under Action Alternatives

Level of NEPA/CEQA Compliance	Actions[1]		Action Alternative					
			A1	A2	B1	B2	C1	C2
Project-Level	Reoperate Friant Dam and downstream flow control structures to route Interim and Restoration flows		✓	✓	✓	✓	✓	✓
	Recapture Interim and Restoration flows in the Restoration Area		✓	✓	✓	✓	✓	✓
	Recapture Interim and Restoration flows at existing CVP and SWP facilities in the Delta		✓	✓	✓	✓	✓	✓
Program-Level	Common Restoration actions[2]		✓	✓	✓	✓	✓	✓
	Actions in Reach 4B1 to provide at least:	475 cfs capacity	✓	✓	✓	✓	✓	✓
		4,500 cfs capacity with integrated floodplain habitat		✓		✓		✓
	Recapture Interim and Restoration flows on the San Joaquin River downstream from the Merced River at:	Existing facilities on the San Joaquin River			✓	✓	✓	✓
		New pumping infrastructure on the San Joaquin River					✓	✓
	Recirculation of recaptured Interim and Restoration flows		✓	✓	✓	✓	✓	✓

Notes:
[1] All alternatives also include the Physical Monitoring and Management Plan and the Conservation Strategy, which include both project- and program-level actions intended to guide implementation of the Settlement.
[2] Common Restoration actions are physical actions to achieve the Restoration Goal that are common to all action alternatives and are addressed at a program level of detail.

Key:
CEQA = California Environmental Quality Act
cfs = cubic feet per second
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
NEPA = National Environmental Policy Act
PEIS/R = Program Environmental Impact Statement/Report
SWP = State Water Project

Table 14-4.
Summary of Environmental Consequences and Mitigation Measures – Surface Water Quality

Impacts	Alternative	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance After Mitigation
Hydrology – Surface Water Quality: Program-Level				
SWQ-1: Temporary Construction-Related Effects on Surface Water Quality in the San Joaquin River from Friant Dam to the Merced River, San Joaquin River from the Merced River to the Delta, the Delta, and CVP/SWP Water Service Areas	No-Action	LTS and Beneficial	--	LTS and Beneficial
	A1	PS	SWQ-1A: Prepare and Implement a Stormwater Pollution Prevention Plan that Minimizes the Potential Contamination of Surface Waters, and Complies with Applicable Federal Regulations Concerning Construction Activities SWQ-1B: Conduct and Comply with Phase I Environmental Site Assessments in the Restoration Area	LTS
	A2	PS		LTS
	B1	PS		LTS
	B2	PS		LTS
	C1	PS		LTS
	C2	PS		LTS
SWQ-2: Long-Term Effects on Water Quality that Cause Violations of Existing Water Quality Standards or Adversely Affect Beneficial Uses in the CVP/SWP Water Service Areas	No-Action	No Impact	--	No Impact
	A1	LTS	--	LTS
	A2	LTS	--	LTS
	B1	LTS	--	LTS
	B2	LTS	--	LTS
	C1	LTS	--	LTS
	C2	LTS	--	LTS
Hydrology – Surface Water Quality: Project-Level				
SWQ-3: Long-Term Effects on Water Quality that Cause Violations of Existing Water Quality Standards or Adversely Affect Beneficial Uses in Millerton Lake	No-Action	LTS	--	LTS
	A1	LTS	--	LTS
	A2	LTS	--	LTS
	B1	LTS	--	LTS
	B2	LTS	--	LTS
	C1	LTS	--	LTS
	C2	LTS	--	LTS

Table 14-4.
Summary of Environmental Consequences and Mitigation Measures – Surface Water Quality (contd.)

Impacts	Alternative	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance After Mitigation
Hydrology – Surface Water Quality: Project-Level (contd.)				
SWQ-4: Long-Term Effects on Water Quality that Cause Violations of Existing Water Quality Standards or Adversely Affect Beneficial Uses in the San Joaquin River from Friant Dam to the Merced River	No-Action	LTS and Beneficial	--	LTS and Beneficial
	A1	LTS	--	LTS
	A2	LTS	--	LTS
	B1	LTS	--	LTS
	B2	LTS	--	LTS
	C1	LTS	--	LTS
	C2	LTS	--	LTS
SWQ-5: Long-Term Effects on Water Quality that Cause Violations of Existing Water Quality Standards or Adversely Affect Beneficial Uses in the San Joaquin River from the Merced River to the Delta	No-Action	LTS and Beneficial	--	LTS and Beneficial
	A1	LTS	--	LTS
	A2	LTS	--	LTS
	B1	LTS	--	LTS
	B2	LTS	--	LTS
	C1	LTS	--	LTS
	C2	LTS	--	LTS
SWQ-6: Effects on X2 Position	No-Action	LTS	--	LTS
	A1	No Impact	--	No Impact
	A2	No Impact	--	No Impact
	B1	No Impact	--	No Impact
	B2	No Impact	--	No Impact
	C1	No Impact	--	No Impact
	C2	No Impact	--	No Impact
SWQ-7: Delta Salinity in San Joaquin River at Vernalis, San Joaquin River at Brandt Bridge, Old River near Middle River, and Old River at Tracy Road Bridge	No-Action	LTS	--	LTS
	A1	LTS and Beneficial	--	LTS and Beneficial
	A2	LTS and Beneficial	--	LTS and Beneficial
	B1	LTS and Beneficial	--	LTS and Beneficial
	B2	LTS and Beneficial	--	LTS and Beneficial
	C1	LTS and Beneficial	--	LTS and Beneficial
	C2	LTS and Beneficial	--	LTS and Beneficial
SWQ-8: Delta Salinity in San Joaquin River at Jersey Point, Sacramento River at Emmaton, and Sacramento River at Collinsville	No-Action	LTS	--	LTS
	A1	LTS	--	LTS
	A2	LTS	--	LTS
	B1	LTS	--	LTS
	B2	LTS	--	LTS
	C1	LTS	--	LTS
	C2	LTS	--	LTS

Table 14-4.
Summary of Environmental Consequences and Mitigation Measures – Surface Water Quality (contd.)

Impacts	Alternative	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance After Mitigation
Hydrology – Surface Water Quality: Project-Level (contd.)				
SWQ-9: Delta Water Quality at Contra Costa Water District's Contra Costa Canal Pumping Plant No. 1, Old River at Los Vaqueros Intake, and Proposed Victoria Canal Intake, and City of Stockton's Proposed Delta Intake	No-Action	LTS	--	LTS
	A1	LTS and Beneficial	--	LTS and Beneficial
	A2	LTS and Beneficial	--	LTS and Beneficial
	B1	LTS and Beneficial	--	LTS and Beneficial
	B2	LTS and Beneficial	--	LTS and Beneficial
	C1	LTS and Beneficial	--	LTS and Beneficial
	C2	LTS and Beneficial	--	LTS and Beneficial
SWQ-10: Water Quality in the Delta-Mendota Canal at Jones Pumping Plant and in the West Canal at the Clifton Court Forebay	No-Action	LTS	--	LTS
	A1	LTS and Beneficial	--	LTS and Beneficial
	A2	LTS and Beneficial	--	LTS and Beneficial
	B1	LTS and Beneficial	--	LTS and Beneficial
	B2	LTS and Beneficial	--	LTS and Beneficial
	C1	LTS and Beneficial	--	LTS and Beneficial
	C2	LTS and Beneficial	--	LTS and Beneficial

Key:
-- = not applicable
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
LTS = less than significant
PS = potentially significant
SWP = State Water Project

14.3.1 Impact Assessment Methodology

Water quality monitoring data and computer modeling were used to aid in evaluating potential impacts. Both temporary, construction-related effects and long-term operational effects were considered as part of this evaluation. Temporary construction impacts were evaluated qualitatively based on anticipated construction practices, materials, locations, and duration of project construction and related activities. Long-term effects were evaluated using computer modeling tools. Specifically, CalSim-II was used to simulate CVP and SWP operations, determining surface water flows, storages, and deliveries associated with each alternative. These data were applied as inputs for computer models used for surface water quality impact assessments. Computer models were used to evaluate impacts for each alternative on reservoir water temperature at Millerton Lake, San Joaquin River water temperature from Friant Dam to the Merced River, San Joaquin River salinity (EC) from the Mendota Pool to the Delta, and salinity and X2 position in the Delta. The long-term effects analysis focuses on water temperature and salinity. Water temperature is an important water quality parameter for fisheries. Salinity is an important water quality parameter for multiple beneficial uses.

As evaluated in this Draft PEIS/R, the alternatives would include the proposed SDIP actions intended to improve water quality in south Delta channels. The 2009 NMFS CVP/SWP Operations BO includes an action to end SDIP. Analytical tools are currently under development to capture this and other changes related to the 2009 NMFS CVP/SWP Operations BO (and 2008 USFWS CVP/SWP Operations BO); however, these tools were not available in time to be presented in the Draft PEIS/R. Additional simulation will be prepared to determine the impacts of the program alternatives, including updating the No-Action Alternative, under the 2008 USFWS CVP/SWP Operations BO and the 2009 NMFS CVP/SWP Operations BO. The results of this assessment will be provided in the Final PEIS/R.

Reservoir Temperature

Daily Millerton Lake water operation data were used in a temperature model to generate daily release temperatures into the Friant-Kern Canal, Madera Canal, and San Joaquin River. The reservoir temperature model is a two-dimensional model based on the CE-QUAL-W2 (W2) modeling platform. The model uses daily water operations data from the daily disaggregation tool and historical meteorology to simulate temperatures every 6 hours from January 1, 1980, to September 30, 2003. This time period is shorter than the CalSim model time period to reduce the volume of output, allow acceptable model execution times, and still cover the full range of temperature operations expected over the longer CalSim time period.

River Temperature

Daily Millerton Lake/San Joaquin River release flows and temperatures were used in a temperature model of the San Joaquin River, developed during the Settlement process, from Millerton Lake to the Merced River to route releases through the system, and to compute the temperature at various locations. The river temperature model is based on the HEC-5Q modeling platform. The model performs two separate functions. The first, based on the HEC-5 model embedded in the HEC-5Q modeling platform, routes water through the San Joaquin River and bypass system from Millerton Lake to the confluence with the Merced River. This portion of the model handles the physical diversion of water between the Chowchilla, Eastside, and Mariposa bypasses and the San Joaquin River, local accretions and depletions along the channels, and hydrologic routing of water to develop daily flows throughout the system. The second function uses flows and historical meteorology to simulate temperatures every 6 hours from January 1, 1980, to September 30, 2003.

San Joaquin River Salinity

The CalSim-II San Joaquin River water quality module was used to simulate salinity (EC) on the mainstem San Joaquin River from the Mendota Pool to Vernalis. CalSim-II includes the Link-Node approach algorithm, implemented in March 2004, to estimate San Joaquin River salinity at Vernalis by replacing the single regression equation with a series of salt balances from Friant Dam to Vernalis. The salt balances dynamically account for all inflows and outflows along a given reach, and assume perfect mixing of different waters. West-side inflows to the San Joaquin are disaggregated into various flow components and each component assigned an EC value. San Joaquin River salinity results simulated for alternatives with the CalSim-II San Joaquin River water quality module were used only for comparative analysis of alternatives.

Delta Water Quality

DSM2 was used with CalSim-II results to describe Delta water quality for each program alternative. DSM2 is a hydrodynamic model of the Delta developed by DWR that simulates flow and salinity changes throughout the Delta caused by changes in Delta inflow or CVP/SWP pumping. The model uses monthly CalSim-II results and produces mean monthly flow and salinity values. The analysis of potential impacts on Delta water quality evaluates potential impacts on surface water quality for all in-Delta water users. Parameters used in the evaluation include simulated changes in X2 location, Delta outflow, E/I ratio, salinity, chloride ion concentrations, dissolved organic carbon concentrations, and flows in the Old and Middle rivers. The water quality impact assessment focuses on EC, expressed in micromhos per centimeter (μmhos/cm), and chloride ion concentration in mg/L, as indicators of Delta water quality because they are the primary water quality constituents most likely to be affected by temporal shifts in Delta pumping operations.

14.3.2 Significance Criteria

The thresholds of significance for impacts are based on the environmental checklist in Appendix G of the State CEQA Guidelines, as amended. These thresholds also encompass the factors taken into account under the NEPA to determine the significance of an action in terms of its context and the intensity of its impacts. The program alternatives under consideration were determined to result in a significant impact related to surface water quality if they would do any of the following:

- Violate existing water quality standards or otherwise substantially degrade water quality.
- Result in substantial water quality changes that adversely affect beneficial uses.
- Result in substantive impacts on public health or environmental receptors.

14.3.3 Program-Level Impacts and Mitigation Measures

This section provides a program-level evaluation of the direct and indirect effects of the program alternatives on surface water quality. Actions under the program alternatives that could result in impacts to surface water quality include specific channel and structural improvements considered necessary to achieve the Restoration Goal, and the recapture of Interim and Restoration flows either at existing facilities or at new infrastructure on the San Joaquin River between the Merced River and the Delta. Impacts of all action alternatives related to the release and recapture of Interim and Restoration flows at existing facilities in the Restoration Area and in the Delta are described as project-level impacts in Section 14.3.4.

Water quality impacts were evaluated for five geographic areas: The San Joaquin River upstream from Friant Dam, San Joaquin River from Friant Dam to the Merced River, San Joaquin River from the Merced River to the Delta, the Delta, and the CVP/SWP water service areas.

No-Action Alternative

This section describes potential water quality impacts under the No-Action Alternative.

Impact SWQ-1 (No-Action Alternative): ***Temporary Construction-Related Effects on Surface Water Quality in the San Joaquin River from Friant Dam to the Merced River, San Joaquin River from the Merced River to the Delta, the Delta, and CVP/SWP Water Service Areas – Program-Level.*** Under the No-Action Alternative, the Settlement would not be implemented. Therefore, there would be no construction-related impacts on surface water quality under the No-Action Alternative. These effects would be **less than significant** and **beneficial**.

Future conditions for the No-Action Alternative include the *Westside Regional Drainage Plan (2003)*, which is anticipated to eliminate salt discharges to the San Joaquin River from the Grasslands Drainage Area and improve water quality conditions within Reach 5 and the San Joaquin River from the Merced River to the Delta.

Within the Delta, CVP and SWP facilities would continue operating similarly to existing conditions. Changes in regulatory conditions and increases in water supply demands would result in differences in flows in the San Joaquin and Sacramento rivers, and the Delta.

Impact SWQ-2 (No-Action Alternative): ***Long-Term Effects on Water Quality that Cause Violations of Existing Water Quality Standards or Adversely Affect Beneficial Uses in the CVP/SWP Water Service Areas – Program-Level.*** Under the No-Action Alternative, incidental recapture of Interim and Restoration flows would not occur, and the quality of water delivered to the CVP/SWP water service areas would not be impacted. Therefore, there would be **no impact**.

Alternatives A1 and A2

This section describes potential program-level impacts on surface water quality conditions in the study area associated with specific channel and structural improvements under Alternatives A1 and A2. Alternatives A1 and A2 have the same specific channel and structural improvements outside of Reach 4B. Alternative A2 includes greater construction activities to increase Reach 4B1 channel capacity to at least 4,500 cfs and, therefore, would have similar but greater effects.

Incidental recapture of Interim and Restoration flows in the Delta using existing facilities, operated under existing operating criteria, and delivery of recaptured water to the CVP Friant Division would affect water quality in the Friant Division.

Impact SWQ-1 (Alternatives A1 and A2): ***Temporary Construction-Related Effects on Surface Water Quality in the San Joaquin River from Friant Dam to the Merced River, San Joaquin River from the Merced River to the Delta, the Delta, and CVP/SWP***

Water Service Areas – Program-Level. Construction associated with channel and structural improvements under Alternatives A1 and A2 would temporarily influence water quality in the Restoration Area. These impacts would be **potentially significant**.

Ground-disturbing activities associated with construction could cause soil erosion and sedimentation in local drainages and the San Joaquin River. Construction activities could also discharge waste petroleum products or other construction-related substances that could enter waterways in runoff. In addition, chemicals associated with operating heavy machinery would be used, transported, and stored on site during construction activities. These substances could be inadvertently introduced into the San Joaquin River through site runoff or on-site spills. Sediment and chemicals could degrade water quality in the San Joaquin River. Alternative A2 includes greater construction activities to increase Reach 4B1 channel capacity to at least 4,500 cfs (compared to 475 cfs with Alternative A1) and, therefore, would have similar but greater effects.

Outside the Restoration Area, construction impacts on surface water quality would be temporary and indirect. Construction within the Restoration Area associated with channel and structural improvements would only temporarily influence water quality in the San Joaquin River from the Merced River to the Delta, and the effects would be attenuated with distance from the Restoration Area. Construction activities in the Restoration Area under Alternatives A1 and A2 would not be anticipated to affect surface water quality within the Delta or CVP and SWP water service areas.

Mitigation Measure SWQ-1A (Alternatives A1 and A2): ***Prepare and Implement a Stormwater Pollution Prevention Plan that Minimizes the Potential Contamination of Surface Waters, and Complies with Applicable Federal Regulations Concerning Construction Activities – Program-Level.*** Construction activities associated with action alternatives are subject to construction-related stormwater permit requirements of the Federal Clean Water Act's NPDES program. Any required permits through the Central Valley RWQCB will be obtained by project proponents for site-specific projects before any ground-disturbing construction activity. A Stormwater Pollution Prevention Plan (SWPPP) will be prepared that identifies best management practices (BMPs) to prevent or minimize the introduction of contaminants into surface waters. BMPs for the project could include, but would not be limited to, silt fencing, straw bale barriers, fiber rolls, storm drain inlet protection, hydraulic mulch, and a stabilized construction entrance.

The SWPPP will include development of site-specific structural and operational BMPs to prevent and control impacts on runoff quality, measures to be implemented before each storm event, inspection and maintenance of BMPs, and monitoring of runoff quality by visual and/or analytical means.

This impact would be **less than significant** after mitigation.

Mitigation Measure SWQ-1B (Alternatives A1 and A2): ***Conduct and Comply with Phase I Environmental Site Assessments in the Restoration Area – Program-Level.*** This mitigation measure is the same as Mitigation Measure PHH-1 (Alternatives A1 and B1). This impact would be **less than significant** after mitigation.

Impact SWQ-2 (Alternatives A1 and A2): ***Long-Term Effects on Water Quality that Cause Violations of Existing Water Quality Standards or Adversely Affect Beneficial Uses in the CVP/SWP Water Service Areas – Program-Level.*** Program-level impacts on water quality in the CVP Friant Division under Alternatives A1 and A2 would be associated with differences in constituent concentrations, particularly salinity, of water supplies diverted from the Delta and potentially delivered to some Friant Division contractors compared to water delivered via the Friant-Kern and Madera canals. These impacts could lead to plugging of drip irrigation systems, additional treatment requirements for M&I supplies, reduction in crop yield for sensitive crops, accumulation of salts in soils and groundwater, additional leaching requirements, enhanced corrosion of metals, and additional sedimentation in canals, reservoirs, and recharge basins. Surface water quality impacts would require project-specific evaluation, but are not likely to result in violations of existing water quality standards, or substantial water quality changes that adversely affect beneficial uses, or have substantive impacts on public health. These impacts would be **less than significant**.

Alternatives B1 and B2

Potential program-level impacts on surface water quality conditions in the study area under Alternatives B1 and B2 are described below. Impacts on surface water quality would be associated with specific channel and structural improvements considered necessary to achieve the Restoration Goal and incidental recapture of Interim and Restoration flows in the Delta using existing facilities, as well as effects associated with the recapture of water at existing facilities along the San Joaquin River. Alternatives B1 and B2 would have the same specific channel and structural improvements outside of Reach 4B, while Alternative B2 includes greater construction activities to increase Reach 4B1 channel capacity to at least 4,500 cfs.

Impact SWQ-1 (Alternatives B1 and B2): ***Temporary Construction-Related Effects on Surface Water Quality in the San Joaquin River from Friant Dam to the Merced River, San Joaquin River from the Merced River to the Delta, the Delta, and CVP/SWP Water Service Areas – Program-Level.*** These impacts would be the same as Impact SWQ-1 described for Alternatives A1 and A2. Construction associated with channel and structural improvements under Alternatives B1 and B2 would temporarily influence water quality in the Restoration Area. These impacts would be **potentially significant**.

Mitigation Measure SWQ-1A (Alternatives B1 and B2): ***Prepare and Implement a Stormwater Pollution Prevention Plan that Minimizes the Potential Contamination of Surface Waters, and Complies with Applicable Federal Regulations Concerning Construction Activities – Program-Level.*** This mitigation measure is the same as Mitigation Measure SWQ-1A (Alternatives A1 and A2). This impact would be **less than significant** after mitigation.

Mitigation Measure SWQ-1B (Alternatives B1 and B2): ***Conduct and Comply with Phase I Environmental Site Assessments in the Restoration Area – Program-Level.*** This mitigation measure is the same as Mitigation Measure PHH-1 (Alternatives A1 and B1). This impact would be **less than significant** after mitigation.

Impact SWQ-2 (Alternatives B1 and B2): ***Long-Term Effects on Water Quality that Cause Violations of Existing Water Quality Standards or Adversely Affect Beneficial Uses in the CVP/SWP Water Service Areas – Program-Level.*** This impact would be similar to Impact SWQ-2 (Alternatives A1 and A2). Effects on water quality in the CVP Friant Division would be associated with differences in constituent concentrations of water supplies diverted from the Delta and/or San Joaquin River and potentially delivered to Friant Division contractors compared to water delivered via the Friant-Kern and Madera canals. Water quality conditions within CVP water service areas, where water pumped from the San Joaquin River may be exchanged for water delivered from the Delta, would also be affected. Surface water quality impacts are not likely to result in violations of existing water quality standards, or substantial water quality changes that adversely affect beneficial uses, or have substantive impacts on public health. This impact would be **less than significant**.

Alternatives C1 and C2

Construction-related effects of Alternatives C1 and C2 include those described for Alternatives A1 through B2, as well as effects associated with construction of new infrastructure on the San Joaquin River below the confluence of the Merced River under Alternatives C1 and C2, as described below. The potential program-level impacts of Alternatives C1 and C2 on surface water quality associated with recapture and recirculation of water include those described (Alternatives B1 and B2), as well as effects associated with the operation of new infrastructure on the San Joaquin River.

Impact SWQ-1 (Alternatives C1 and C2): ***Temporary Construction-Related Effects on Surface Water Quality in the San Joaquin River from Friant Dam to the Merced River, San Joaquin River from the Merced River to the Delta, the Delta, and CVP/SWP Water Service Areas – Program-Level.*** This impact under Alternatives C1 and C2 within the Restoration Area is the same as described (Alternatives A1 through B2), with the same impact conclusions and mitigation measures. Alternatives C1 and C2 also include potential impacts to surface water quality in the San Joaquin River downstream from the Merced River and the Delta due to construction and operation of new infrastructure. This impact would be **potentially significant**.

Mitigation Measure SWQ-1A (Alternatives C1 and C2): ***Prepare and Implement a Stormwater Pollution Prevention Plan that Minimizes the Potential Contamination of Surface Waters, and Complies with Applicable Federal Regulations Concerning Construction Activities – Program-Level.*** SWPPPs, as described in Mitigation Measure SWQ-1A (Alternatives A1 through B2), would be prepared for any construction work. This impact would be **less than significant** after mitigation.

Mitigation Measure SWQ-1B (Alternatives C1 and C2): ***Conduct and Comply with Phase I Environmental Site Assessments in the Restoration Area – Program-Level.*** This mitigation measure is the same as Mitigation Measure PHH-1 (Alternatives A1 and B1). This impact would be **less than significant** after mitigation.

Impact SWQ-2 (Alternative C1 and C2): ***Long-Term Effects on Water Quality that Cause Violations of Existing Water Quality Standards or Adversely Affect Beneficial Uses in the CVP/SWP Water Service Areas – Program-Level.*** This impact would be similar to Impact SWQ-2 (Alternatives B1 and B2). Effects on water quality in the CVP Friant Division would be associated with differences in constituent concentrations of water supplies diverted from the Delta and/or San Joaquin River and potentially delivered to Friant Division contractors compared to water delivered via the Friant-Kern and Madera canals. Water quality conditions within CVP and/or SWP water service areas, where water pumped from the San Joaquin River may mix or be exchanged with water delivered from the Delta, would also be affected. Surface water quality impacts are not likely to result in violations of existing water quality standards, or substantial water quality changes that adversely affect beneficial uses, or have substantive impacts on public health. This impact would be **less than significant**.

14.3.4 Project-Level Impacts and Mitigation Measures

The following sections describe project-level impacts and mitigation measures for the No-Action Alternative and action alternatives. Complete results from San Joaquin River and Delta water quality analyses for the program alternatives, including those cited below, are provided in Appendix H, "Modeling."

No-Action Alternative

Under the No-Action Alternative, the continued operation of Friant Dam as under existing conditions would not include releases to the San Joaquin River to meet the Restoration Goal. Complete results from San Joaquin River and Delta water quality analyses for the program alternatives, including those cited below, are provided in Appendix H, "Modeling."

Impact SWQ-3 (No-Action Alternative): ***Long-Term Effects on Water Quality that Cause Violations of Existing Water Quality Standards or Adversely Affect Beneficial Uses in Millerton Lake – Project-Level.*** Under the No-Action Alternative, reservoir fluctuations would continue as under historical annual reservoir water surface elevations and, therefore, surface water quality would not change. Surface water quality impacts are not likely to occur, and would therefore not result in violations of existing water quality standards, or substantial water quality changes that adversely affect beneficial uses, or have substantive impacts on public health. These impacts would be **less than significant**.

Impact SWQ-4 (No-Action Alternative): ***Long-Term Effects on Water Quality that Cause Violations of Existing Water Quality Standards or Adversely Affect Beneficial Uses in the San Joaquin River from Friant Dam to the Merced River – Project-Level.*** As described previously for program-level impacts and mitigation measures, continued implementation of the Westside Regional Drainage Plan is anticipated to eliminate salt discharges to the San Joaquin River from the Grasslands Drainage Area and improve water quality conditions within Reach 5 and the San Joaquin River from the Merced River to the Delta (SJRECWA et al. 2003). These improvements would reduce the likelihood of violations of existing water quality standards or adverse effects to beneficial uses. These effects would be **less than significant** and **beneficial.**

Impact SWQ-5 (No-Action Alternative): ***Long-Term Effects on Water Quality that Cause Violations of Existing Water Quality Standards or Adversely Affect Beneficial Uses in the San Joaquin River from the Merced River to the Delta – Project-Level.*** As described previously for Impact SWQ-4 for the No-Action Alternative, San Joaquin River water quality conditions from the Merced River to the Delta would improve under the No-Action Alternative. This impact would be **less than significant** and **beneficial**.

Impact SWQ-6 (No-Action Alternative): ***Effects on X2 Position – Project-Level.*** The No-Action Alternative would not, in itself, result in any changes in surface water quality conditions in the Delta. CVP and SWP facilities within the Delta would continue operating similarly to existing conditions, and changes in regulatory conditions and water supply demands would result in differences in flows in the San Joaquin and Sacramento rivers and the Delta. As described for program-level impacts, future conditions under the Delta water quality requirements would continue to be met under the No-Action Alternative at levels of compliance similar to existing conditions, and would not result in any appreciable degradation of water quality. These effects would be **less than significant**.

Impact SWQ-7 (No-Action Alternative): ***Delta Salinity in San Joaquin River at Vernalis, San Joaquin River at Brandt Bridge, Old River near Middle River, and Old River at Tracy Road Bridge – Project-Level.*** As described previously for Impact SWQ-6 for the No-Action Alternative, the No-Action Alternative would not, in itself, result in any changes in surface water quality conditions in the Delta. This impact would be **less than significant**.

Impact SWQ-8 (No-Action Alternative): ***Delta Salinity in San Joaquin River at Jersey Point, Sacramento River at Emmaton, and Sacramento River at Collinsville – Project Level.*** As described previously for Impact SWQ-6 for the No-Action Alternative, the No-Action Alternative would not, in itself, result in any changes in surface water quality conditions in the Delta. This impact would be **less than significant**.

Impact SWQ-9 (No-Action Alternative): ***Delta Water Quality at Contra Costa Water District's Contra Costa Canal Pumping Plant No. 1, Old River at Los Vaqueros Intake, and Proposed Victoria Canal Intake, and City of Stockton's Proposed Delta Intake – Project-Level.*** As described previously for Impact SWQ-6 for the No-Action Alternative, the No-Action Alternative would not, in itself, result in any changes in surface water quality conditions in the Delta. This impact would be **less than significant**.

Impact SWQ-10 (No-Action Alternative): ***Water Quality in the Delta-Mendota Canal at Jones Pumping Plant and in the West Canal at the Clifton Court Forebay – Project-Level.*** As described previously for Impact SWQ-6 for the No-Action Alternative, the No-Action Alternative would not, in itself, result in any changes in surface water quality conditions in the Delta, and therefore would not result in surface water quality changes in the Delta-Mendota Canal or West Canal. This impact would be **less than significant**.

Alternatives A1 and A2

This section provides a project-level evaluation of direct and indirect effects of the program alternatives on surface water quality. Alternatives A1 and A2 could affect salinity in Millerton Lake, the San Joaquin River, the Delta, and CVP/SWP service areas, water temperature conditions in the San Joaquin River, and X2 position in the Delta. Complete results from San Joaquin River and Delta water quality analyses for the program alternatives, including those cited below, are provided in Appendix H, "Modeling."

Impact SWQ-3 (Alternatives A1 and A2): ***Long-Term Effects on Water Quality that Cause Violations of Existing Water Quality Standards or Adversely Affect Beneficial Uses in Millerton Lake – Project-Level.*** Under Alternatives A1 and A2, reservoir fluctuations would be within historical annual reservoir water surface elevations and, therefore, surface water quality would likely reflect conditions similar to the No-Action Alternative. Surface water quality impacts are not likely to result in violations of existing water quality standards, or substantial water quality changes that adversely affect beneficial uses, or have substantive impacts on public health. These impacts would be **less than significant**.

Impact SWQ-4 (Alternatives A1 and A2): ***Long-Term Effects on Water Quality that Cause Violations of Existing Water Quality Standards or Adversely Affect Beneficial Uses in the San Joaquin River from Friant Dam to the Merced River – Project-Level.*** Under Alternatives A1 and A2, surface water quality conditions would be improved in some areas through effects on temperatures and constituent concentrations. However, surface water quality would be adversely affected in other reaches because of the possible exposure of potentially hazardous materials through mobilization. Overall, this impact would be **less than significant**.

Changes in operation of Friant Dam would not introduce new contaminants to the San Joaquin River system. However, by changing the timing and location of flows, changes in operation would change the relative concentrations of constituents in various segments of the river. The following analysis describes the types of changes anticipated under the different flow regimes for the various river segments and bypasses.

Surface water quality conditions within Reach 1 would continue to reflect the generally high quality of water released at Friant Dam from Millerton Lake. Constituent concentrations within Reach 1 are likely to be similar or less than concentrations observed under the No-Action Alternative because of the increase in the proportion of high-quality water released at Friant Dam compared to the existing lower quality return flows within Reach 1 tributaries. This impact would be beneficial.

Analysis of temperature modeling results indicates that water temperature conditions within upstream sections of Reach 1 under Alternatives A1 and A2 are likely to be similar to conditions under the No-Action Alternative. The temperature of water released at Friant Dam would be higher than water temperatures under the No-Action Alternative from spring to late fall based on historical monthly averages. Restoration Flow releases to the San Joaquin River from the low-level river outlets at Friant Dam would reduce the cold-water volume in Millerton Lake compared to the No-Action Alternative. Within downstream sections of Reach 1, increased river flow under the action alternatives would result in less thermal heating of San Joaquin River flows. This reduced thermal heating would offset any increase in Millerton Lake release temperatures and result in cooler water temperatures within Reach 1, based on the historical monthly average compared to the No-Action Alternative from late winter to early fall. This impact would be beneficial.

Surface water quality conditions within Reach 2 are likely to be similar to or better than conditions observed under the No-Action Alternative because of the increase in the proportion of high-quality water released at Friant Dam compared to the existing lower quality return flows within the reach. This impact would be beneficial. Water temperatures within Reach 2 under the action alternatives would be cooler during most of the year compared to the No-Action Alternative. The increased river flow under the action alternatives would result in less thermal heating of San Joaquin River flows and also result in cooler water temperatures within portions of Reach 2 upstream from the proposed Mendota Pool Bypass to the Mendota Pool for most months compared to the No-Action Alternative. This impact would be beneficial. EC and water temperature conditions at the Mendota Pool would be similar to the No-Action Alternative during the irrigation season, and higher during other periods because the proposed Mendota Pool Bypass would convey San Joaquin River flows around the Mendota Pool, increasing the proportion of DMC contributions to Mendota Pool inflow. This impact would be less than significant.

Downstream from the Mendota Pool within Reach 3, Restoration Flow releases under the action alternatives would reduce San Joaquin River salinity concentrations through reducing the proportion of DMC and return flow contributions to San Joaquin River flow in Reach 3, particularly during the irrigation season. This impact would be beneficial. Water temperature conditions within Reach 3 under Alternatives A1 and A2 would be similar to the No-Action Alternative. Impacts to water temperature within Reach 3 would be less than significant.

Below Sack Dam (Reach 4A), simulated monthly average EC would be less under the action alternatives compared to the No-Action Alternative. This impact would be beneficial. Water temperature conditions within Reach 4A under the action alternatives would be similar to the No-Action Alternative. Impacts to water temperature within Reach 4A would be less than significant.

Reach 4B does not convey San Joaquin River flow under existing conditions. It is dry in some segments, and where it does flow, conveys agricultural return flows and local runoff. Short-term surface water quality impacts would occur under the action alternatives because constituents that may have accumulated in dry segments of Reach 4B, including pollutants associated with agricultural practices in the region, would be flushed from sediments within the river channel. On a long-term basis, Alternatives A1 and A2 would improve San Joaquin River water quality conditions within Reach 4B compared to the No-Action Alternative. Increased flow through Reach 4B under the action alternatives would decrease concentrations of constituents in San Joaquin River flows. Water temperatures of runoff conveyed through Reach 4B would be reduced compared to the No-Action Alternative because of decreased thermal heating. Overall, surface water quality impacts within Reach 4B would be less than significant.

Water quality conditions within Reach 5 under Alternatives A1 and A2 would be similar to conditions under the No-Action Alternative. EC and water temperatures of San Joaquin River flows in Reach 5 would be comparable to the No-Action Alternative based on historical monthly averages. Changes of this magnitude and frequency would not adversely affect existing beneficial uses or cause additional violations of water quality standards. Therefore, this impact would be less than significant. During March and April, EC would improve relative to the No-Action Alternative. This impact would be beneficial.

Water quality criteria applicable to some beneficial uses are not currently met within Reaches 3, 4, and 5 because of constituent loading to and within these reaches. Under Alternatives A1 and A2, concentrations of these constituents may decrease, but it is not anticipated that water quality criteria would be met. This impact would be less than significant and beneficial.

These potential surface water quality effects within the San Joaquin River from Friant Dam to the Merced River would not result in any additional violations of existing water quality standards or substantial water quality changes that would adversely affect beneficial uses, or have substantive impacts on public health. These impacts would be less than significant and beneficial.

Within the Chowchilla Bypass, surface water quality conditions under Alternatives A1 and A2 would be impacted during winter, spring, and some summer months because of the reduction of flood flows released from Friant Dam that are conveyed through the Chowchilla Bypass. The reduction of flows in the Chowchilla Bypass would likely result in increased constituent concentrations and water temperatures within the Chowchilla Bypass, but would not result in any additional violations of existing water quality standards or substantial water quality changes that would adversely affect beneficial uses, or have substantive impacts on public health. These impacts would be less than significant.

Surface water quality conditions within the Eastside Bypass below the Sand Slough Control Structure would also be impacted through implementing Alternatives A1 or A2. During March and early April, the Eastside Bypass upstream from Mariposa Bypass would convey more flow under the action alternatives on a historical monthly average basis compared to the No-Action Alternative. Less flow would be conveyed through the Eastside Bypass on a historical monthly average basis during other months. Downstream from the Mariposa Bypass, the Eastside Bypass would convey more flow under Alternatives A1 and A2 on a historical monthly average basis compared to the No-Action Alternative during January, and March through July. Less flow would be conveyed through the Eastside Bypass below the Mariposa Bypass on a historical monthly average basis during February, and August through December, under Alternatives A1 and A2. Periods of increased flow through the Eastside Bypass under the action alternatives are likely to improve surface water quality within the bypass through decreasing constituent concentrations, while periods of decreased flow are likely to adversely impact surface water quality. Additional water quality impacts may result from increased flows through the Eastside Bypass as a result of bank erosion and sedimentation associated with higher flows through the bypass compared to the No-Action Alternative. Potential impacts to surface water quality within the Eastside Bypass, however, would not result in any additional violations of existing water quality standards or substantial water quality changes that would adversely affect beneficial uses, or have substantive impacts on public health. These impacts would be less than significant.

Water quality conditions within the Mariposa Bypass would be impacted by Alternatives A1 and A2 as a result of the changes in flow conditions through the bypass compared to the No-Action Alternative. Also, compared to the No-Action Alternative, simulated monthly average flows through the bypass would be reduced under the action alternatives on a historical monthly average basis for all months except April. Decreased flows through the Mariposa Bypass may result in increased constituent concentrations and water temperatures within the bypass, but would not result in any additional violations of existing water quality standards or substantial water quality changes that would adversely affect beneficial uses, or have substantive impacts on public health. These impacts would be less than significant.

Impact SWQ-5 (Alternatives A1 and A2): *Long-Term Effects on Water Quality that Cause Violations of Existing Water Quality Standards or Adversely Affect Beneficial Uses in the San Joaquin River from the Merced River to the Delta – Project-Level.* San Joaquin River water quality conditions from the Merced River to the Delta would improve under Alternatives A1 and A2. This impact would be **less than significant**.

On a historical monthly average basis, EC at San Joaquin River sites below the Merced River and below the Tuolumne River would be less than under the No-Action Alternative, particularly during March and April. Below the Merced River confluence, monthly average San Joaquin River water temperatures under Alternatives A1 and A2 would be similar to the No-Action Alternative on a historical monthly average basis, with increases of up to 1 percent from March through May and in November. Impacts to water temperature within the San Joaquin River from the Merced River to the Delta would be less than significant.

These potential surface water quality effects within the San Joaquin River from the Merced River to the Delta would not result in any additional violations of existing water quality standards or substantial water quality changes that would adversely affect beneficial uses, or have substantive impacts on public health. Overall, surface water quality impacts in the San Joaquin River from the Merced River to the Delta under Alternatives A1 and A2 would be less than significant.

Impact SWQ-6 (Alternatives A1 and A2): *Effects on X2 Position – Project-Level.* Alternatives A1 and A2 would not impact the X2 position. Historically, average monthly X2 position under Alternatives A1 and A2 would be similar to X2 positions for the No-Action Alternative. While in several months the X2 position may be out of compliance under the bases of comparison, the change resulting from the action alternatives would not further impact X2 position compliance. Therefore, this impact would have **no impact**.

Impact SWQ-7 (Alternatives A1 and A2): ***Delta Salinity in San Joaquin River at Vernalis, San Joaquin River at Brandt Bridge, Old River near Middle River, and Old River at Tracy Road Bridge – Project-Level.*** Simulated historical monthly average salinity in the San Joaquin River at Vernalis, San Joaquin River at Brandt Bridge, Old River near Middle River, and Old River at Tracy Road Bridge would be less under Alternatives A1and A2 compared to the No-Action Alternative, particularly during March and April. This impact would be **less than significant** and **beneficial**.

Impact SWQ-8 (Alternatives A1 and A2): ***Delta Salinity in San Joaquin River at Jersey Point, Sacramento River at Emmaton, and Sacramento River at Collinsville – Project Level.*** Simulated historical monthly average salinity under Alternatives A1 and A2 in the San Joaquin River at Jersey Point, Sacramento River at Emmaton, and Sacramento River at Collinsville would be similar to the No-Action Alternative during most months. Simulated historical monthly average salinity would decrease during April, November, and December. Simulated historical monthly average salinity at San Joaquin River at Jersey Point would be up to 1 percent higher during January and August, and up to 4 percent higher during February. In the Sacramento River at Emmaton and at Collinsville, simulated historical monthly average salinity would be up to 6 percent higher during February, up to 3 percent higher during March, and up to 1 percent higher during July and August. Surface water quality impacts are not likely to result in violations of existing water quality standards, or substantial water quality changes that adversely affect beneficial uses, or have substantive impacts on public health. This impact would be **less than significant**.

Impact SWQ-9 (Alternatives A1 and A2): ***Delta Water Quality at Contra Costa Water District's Contra Costa Canal Pumping Plant No. 1, Old River at Los Vaqueros Intake, and Proposed Victoria Canal Intake, and City of Stockton's Proposed Delta Intake – Project-Level.*** Under Alternatives A1 and A2, simulated historical monthly average salinity and chloride concentrations at CCWD's Contra Costa Canal Pumping Plant No. 1, Old River at Los Vaqueros Intake, and proposed Victoria Canal Intake, and Stockton Proposed Intake would be comparable to the No-Action Alternative. These impacts would be **less than significant** and **beneficial**.

Simulated historical monthly average salinity at CCWD's Contra Costa Canal Pumping Plant No.1 would decrease under Alternative A1 and Alternative A2 compared to the No-Action Alternative during January, May, and November through December. Simulated historical monthly average salinity would not be impacted by Alternatives A1 and A2 during February, and June through October. From March to April, simulated historical monthly average salinity would increase by up to 1 percent under Alternatives A1 and A2 compared to the No-Action Alternative. The maximum increase in simulated monthly average salinity under Alternatives A1 and A2 (3 percent) would occur during February in Above-Normal years and April in Critical years, while the maximum decrease (4 percent) would occur during December in Wet and Above-Normal years and January in Critical years.

At CCWD’s Old River at Los Vaqueros Intake, simulated historical monthly average salinity under Alternatives A1 and A2 would decrease compared to the No-Action Alternative during May, November, and December. Simulated historical monthly average salinity would increase by up to 2 percent during March, April, and June, and would not be impacted during January to February and July through October. Under Alternatives A1 and A2, the maximum increase in simulated monthly average salinity (5 percent) would occur during the month of April in Critical years. The maximum decrease (3 percent) compared to the No-Action Alternative would occur during December in Wet years, November in Above-Normal years, and January in Critical years.

Simulated historical monthly average salinity at CCWD’s proposed Victoria Canal Intake would decrease under Alternatives A1 and A2 compared to the No-Action Alternative during May, November, and December. Simulated historical monthly average salinity under Alternatives A1 and A2 would increase by up to 3 percent during March and April, and would not be impacted during January through February, and July to October. The maximum increase in simulated monthly average salinity under Alternatives A1 and A2 (7 percent) would occur during April in Critical years. The maximum decrease (3 percent) compared to the No-Action Alternative would occur during April in Wet years, May in Above-Normal years, and January in Critical years.

At the City of Stockton’s proposed Delta Intake, simulated historical monthly average salinity under Alternatives A1 and A2 would decrease compared to the No-Action Alternative during May and December, and increase by up to 6 percent during February through April, and in June. Compared to the No-Action Alternative, simulated historical monthly average salinity would not be impacted during January, or July through November. Under Alternatives A1 and A2, the maximum increase in simulated monthly average salinity (9 percent) would occur in Critical years. The maximum decrease (2 percent) compared to the No-Action Alternative would occur during December in Wet, Below-Normal, and Dry years.

Simulated historical monthly average chloride concentrations at CCWD’s Contra Costa Canal Pumping Plant No. 1 would decrease under Alternatives A1 and A2 during January, May, and November through December. Simulated historical monthly average chloride concentrations under Alternatives A1 and A2 would increase by up to 2 percent from March through April, and in August, and would not be impacted during February, June to July, or September to October.

Simulated historical monthly average chloride concentrations at CCWD’s Old River at Los Vaqueros Intake would decrease under Alternatives A1 and A2 compared to the No-Action Alternative during January, May, November, and December. Simulated historical monthly average chloride concentrations would increase under Alternatives A1 and A2 compared to the No-Action Alternative by up to 3 percent during March, April, and June through August, and would not be impacted during February, September, or October.

At the CCWD’s proposed Victoria Canal Intake, simulated historical monthly average chloride concentrations would decrease under Alternatives A1 and A2 compared to the No-Action Alternative during May, November, and December. Simulated historical monthly average chloride concentrations would increase by up to 4 percent during March, April, and June, and would not be impacted during January, February, or July through October.

Simulated historical monthly average chloride concentrations at the City of Stockton's proposed Delta Intake would decrease under Alternatives A1 and A2 compared to the No-Action Alternative during January, March through May, November, and December, and increase by up to 11 percent in March. Simulated historical monthly average chloride concentrations would not be impacted under Alternatives A1 and A2 from August to October.

Impacts to water quality at existing and planned CCWD or City of Stockton pumping facilities in the Delta under Alternatives A1 and A2 would not result in any additional violations of existing water quality standards or substantial water quality changes that would adversely affect beneficial uses, or have substantive impacts on public health. These impacts would be less than significant.

Impact SWQ-10 (Alternatives A1 and A2): ***Water Quality in the Delta-Mendota Canal at Jones Pumping Plant and in the West Canal at the Clifton Court Forebay – Project-Level.*** Under Alternatives A1 and A2, simulated historical monthly average salinity in the DMC at Jones Pumping Plant and in the West Canal at Clifton Court Forebay would be comparable to the No-Action Alternative. These impacts would be **less than significant** and **beneficial**.

At the DMC at Jones Pumping Plant and in the West Canal at Clifton Court Forebay, simulated historical monthly average salinity would decrease under Alternatives A1 and A2 compared to the No-Action Alternative from March through April, and November through December. Simulated historical monthly average salinity in the DMC at Jones Pumping Plant would not be impacted by Alternatives A1 or A2 during February, or July through October, and would increase by up to 1 percent during June. Under Alternatives A1 and A2, the maximum increase in simulated monthly average salinity (2 percent) at the DMC at Jones Pumping Plant would occur during February in Above-Normal years and May in Critical years, while the maximum decrease (9 percent) would occur during April in Above-Normal years.

Simulated historical monthly average salinity in the West Canal at Clifton Court Forebay under Alternatives A1 and A2 would increase by up to 1 percent higher during June, and would not be impacted during January through February, in May, or July through October. The maximum increase in simulated monthly average salinity under Alternatives A1 and A2 (4 percent) compared to the No-Action Alternative would occur during February in Above-Normal years. The maximum decrease (5 percent) would occur during April in Wet, Above-Normal, and Below-Normal years.

Simulated historical monthly average chloride concentrations under Alternatives A1 and A2 in the DMC at Jones Pumping Plant and in the West Canal at Clifton Court Forebay would be comparable to the No-Action Alternative.

Under Alternatives A1 and A2, simulated historical monthly average chloride concentrations at the DMC at Jones Pumping Plant and in the West Canal at the Clifton Court Forebay would decrease during January, March through May, and November through December. Simulated historical monthly average chloride concentrations at the DMC at Jones Pumping Plant would increase by up to 1 percent under Alternatives A1 and A2 during June, and would not be impacted by Alternatives A1 or A2 during February, or July through October. Simulated historical monthly average salinity in the West Canal at the Clifton Court Forebay under Alternatives A1 and A2 would increase by up to 1 percent higher from June through July, and would not be impacted during February, or August through October. These impacts would be less than significant and beneficial.

Impacts to water quality at CVP and SWP pumping facilities in the Delta would not result in any additional violations of existing water quality standards or substantial water quality changes that would adversely affect beneficial uses, or have substantive impacts on public health. These impacts would be less than significant.

Alternatives B1 and B2

This section describes potential impacts to surface water quality in the study area under Alternatives B1 and B2. Complete results from San Joaquin River and Delta water quality analyses for the program alternatives, including those cited below, are provided in Appendix H, "Modeling."

Impact SWQ-3 (Alternatives B1 and B2): ***Long-Term Effects on Water Quality that Cause Violations of Existing Water Quality Standards or Adversely Affect Beneficial Uses in Millerton Lake – Project-Level.*** These impacts would be the same as Impact SWQ-3 (Alternatives A1 and A2). Surface water quality impacts are not likely to result in violations of existing water quality standards, or substantial water quality changes that adversely affect beneficial uses, or have substantive impacts on public health. These impacts would be **less than significant**.

Impact SWQ-4 (Alternatives B1 and B2): ***Long-Term Effects on Water Quality that Cause Violations of Existing Water Quality Standards or Adversely Affect Beneficial Uses in the San Joaquin River from Friant Dam to the Merced River – Project-Level.*** These impacts would be the same as Impact SWQ-4 (Alternatives A1 and A2). Under Alternatives B1 and B2, surface water quality conditions would be improved in some areas through effects on temperatures and constituent concentrations, and potentially adversely affected in other reaches. Overall, this impact would be **less than significant**.

Impact SWQ-5 (Alternatives B1 and B2): ***Long-Term Effects on Water Quality that Cause Violations of Existing Water Quality Standards or Adversely Affect Beneficial Uses in the San Joaquin River from the Merced River to the Delta – Project-Level.*** These impacts would be the same as Impact SWQ-5 (Alternatives A1 and A2). Potential surface water quality effects within the San Joaquin River from the Merced River to the Delta would not result in any additional violations of existing water quality standards or substantial water quality changes that would adversely affect beneficial uses, or have substantive impacts on public health. Overall, surface water quality impacts in the San

Joaquin River from the Merced River to the Delta under Alternatives B1 and B2 would be **less than significant**.

Impact SWQ-6 (Alternatives B1 and B2): ***Effects on X2 Position – Project-Level.*** This impact would be the same as Impact SWQ-6 (Alternatives A1 and A2). Alternatives B1 and B2 would not impact the X2 position. While in several months the position of X2 may be out of compliance under the bases of comparison, the change resulting from the action alternatives would not further impact X2 position compliance. Therefore, this impact would have **no impact**.

Impact SWQ-7 (Alternatives B1 and B2): ***Delta Salinity in San Joaquin River at Vernalis, San Joaquin River at Brandt Bridge, Old River near Middle River, and Old River at Tracy Road Bridge – Project-Level.*** This impact would be similar to Impact SWQ-7 (Alternatives A1 and A2). Simulated historical monthly average salinity in the San Joaquin River at Vernalis, San Joaquin River at Brandt Bridge, Old River near Middle River, and Old River at Tracy Road Bridge would be less under Alternatives B1 and B2 compared to the No-Action Alternative, particularly during March and April. This impact would be **less than significant** and **beneficial**.

Impact SWQ-8 (Alternatives B1 and B2): ***Delta Salinity at San Joaquin River at Jersey Point, Sacramento River at Emmaton, and Sacramento River at Collinsville – Project-Level.*** Simulated historical monthly average salinity under Alternatives B1 and B2 in the San Joaquin River at Jersey Point, Sacramento River at Emmaton, and Sacramento River at Collinsville would be similar to Impact SWQ-8 (Alternatives A1 and A2). This impact would be **less than significant**.

In the San Joaquin River at Jersey Point, simulated historical monthly average salinity under Alternatives B1 and B2 would be up to 4 percent higher during February, and up to 1 percent higher during January. Simulated historical monthly average salinity in the Sacramento River at Collinsville would be up to 6 percent higher during February, 3 percent higher during March, and up to 1 percent higher during July and August. In the Sacramento River at Emmaton, simulated historical monthly average salinity would be up to 5 percent higher during February, up to 2 percent higher during March, and up to 1 percent higher during August. Surface water quality impacts are not likely to result in violations of existing water quality standards, or substantial water quality changes that adversely affect beneficial uses, or have substantive impacts on public health. This impact would be less than significant.

Impact SWQ-9 (Alternatives B1 and B2): ***Delta Water Quality at Contra Costa Water District's Contra Costa Canal Pumping Plant No. 1, Old River at Los Vaqueros Intake, and Proposed Victoria Canal Intake, and City of Stockton's Proposed Delta Intake – Project-Level***. This impact would be similar to Impact SWQ-9 for Alternative A1. These impacts would be **less than significant** and **beneficial**.

At CC WD's Contra Costa Canal Pumping Plant No. 1, simulated historical monthly average salinity would be up to 1 percent higher during March and April, compared to the No-Action Alternative. During January, May, November, and December, simulated historical monthly average salinity would decrease by up to 2 percent. Under Alternatives B1 and B2, the maximum increase in simulated historical monthly average salinity (3 percent) would occur during February in Above-Normal years and April in Critical years. The maximum decrease (4 percent) would occur during December in Above-Normal years and January in Critical years.

Simulated historical monthly average salinity under Alternatives B1 and B2 at CCWD's Old River at Los Vaqueros Intake would decrease compared to the No-Action Alternative during May, November, and December, and would increase by up to 2 percent during March, April, and June. Simulated historical monthly average salinity under Alternatives B1 and B2 would not be impacted during January, February, or June through October. The maximum increase in simulated historical monthly average salinity under Alternatives B1 and B2 (5 percent) compared to the No-Action Alternative would occur during April in Critical years, while the maximum decrease (4 percent) would occur during December in Above-Normal years.

At CCWD's proposed Victoria Canal Intake, simulated historical monthly average salinity would decrease under Alternatives B1 and B2 compared to the No-Action Alternative during May, and November through December. Simulated historical monthly average salinity concentrations under Alternatives B1 and B2 would increase by up to 2 percent during March and April, and would not be impacted during January, or from June through October. Under Alternatives B1 and B2, the maximum increase in simulated historical monthly average salinity (7 percent) would occur during April in Critical years, while the maximum decrease (4 percent) would occur during May in Above-Normal years.

Under Alternatives B1 and B2, simulated historical monthly average salinity at the City of Stockton's proposed Delta Intake would decrease compared to the No-Action Alternative during May and December, and increase by up to 5 percent during February, March, April, and June. Simulated historical monthly average salinity would not be impacted during January, or July through November. The maximum increase in simulated historical monthly average salinity under Alternatives B1 and B2 (9 percent) compared to the No-Action Alternative would occur during March in Dry and Critical years. The maximum decrease (2 percent) would occur during December in Below-Normal years.

Simulated historical monthly average chloride concentrations at CCWD's Contra Costa Canal Pumping Plant No.1 would increase by up to 1 percent during March and April. During January, May, November, and December, simulated historical monthly average salinity would decrease by up to 3 percent.

Simulated historical monthly average chloride concentrations at CCWD's Old River at Los Vaqueros Intake would decrease under Alternatives B1 and B2 compared to the No-Action Alternative during January, May, November, and December. Simulated historical monthly average chloride concentrations would increase by up to 3 percent during March, April, and June, and would not be impacted during February, or July through October.

At CCWD's proposed Victoria Canal Intake, simulated historical monthly average chloride concentrations would decrease under Alternatives B1 and B2 compared to the No-Action Alternative during May, November, and December. Simulated historical monthly average chloride concentrations would increase under Alternatives A1 and A2 by up to 4 percent during March, April, June, and would not be impacted during January or February, or July through October.

Simulated historical monthly average chloride concentrations at the City of Stockton's proposed Delta Intake would decrease under Alternatives B1 and B2 compared to the No-Action Alternative during January, March through May, and November through December. Simulated historical monthly average chloride concentrations under Alternatives B1 and B2 would not be impacted during February, or June through October.

Impacts to water quality at existing and planned CCWD or City of Stockton pumping facilities in the Delta under Alternatives B1 and B2 would not result in any additional violations of existing water quality standards or substantial water quality changes that would adversely affect beneficial uses, or have substantive impacts on public health. These impacts would be less than significant.

Impact SWQ-10 (Alternatives B1 and B2): ***Water Quality in the Delta-Mendota Canal at Jones Pumping Plant and in the West Canal at Clifton Court Forebay – Project-Level.*** This impact would be the similar to Impact SWQ-10 for Alternatives A1 and A2. Project-level impacts to water quality at CVP and SWP pumping infrastructure in the Delta under Alternatives B1 and B2 would be **less than significant** and **beneficial**.

Simulated historical monthly average salinity at the DMC at Jones Pumping Plant under Alternatives B1 and B2 compared to the No-Action Alternative would be up to 6 percent lower during April, up to 3 percent lower during March, and up 2 percent lower during January, May, November, and December. Under Alternatives B1 and B2, the maximum increase in simulated monthly average salinity (2 percent) would occur during February in Above-Normal years, while the maximum decrease (9 percent) would occur during April in Above-Normal years.

In the West Canal at the Clifton Court Forebay, simulated historical monthly average salinity under Alternatives B1 and B2 compared to the No-Action Alternative would be up to 3 percent lower during April, and up to 2 percent lower during January, March, May, November, and December. Under Alternatives B1 and B2, simulated historical monthly average salinity at the DMC at Jones Pumping Plant and in the West Canal at the Clifton Court Forebay would not be impacted during February, or June through October. The maximum increase in simulated monthly average salinity under Alternatives B1 and B2 (4 percent) compared to the No-Action Alternative would occur during February in Above-Normal years. The maximum decrease (6 percent) would occur during April in Above-Normal years.

Simulated historical monthly average chloride concentrations at the DMC at Jones Pumping Plant under Alternatives B1 and B2, compared to the No-Action Alternative would be up to 9 percent lower during April, up to 4 percent lower during March, and up to 2 percent lower during January, May, November, and December. Simulated historical monthly average chloride under Alternatives B1 and B2 in the West Canal at the Clifton Court Forebay would increase by up to 1 percent during September, decrease by up to 5 percent during April, and decrease by up to 1 percent during January, March, May, November, and December. Under Alternatives B1 and B2, simulated historical monthly average chloride concentrations at the DMC at Jones Pumping Plant and in the West Canal at the Clifton Court Forebay would not be impacted during February, or June through October.

Potential surface water quality effects at the DMC at Jones Pumping Plant and in the West Canal at the Clifton Court Forebay under Alternatives B1 or B2 would not result in any additional violations of existing water quality standards or substantial water quality changes that would adversely affect beneficial uses, or have substantive impacts on public health. Impacts of Alternatives B1 and B2 on simulated historical monthly average salinity and simulated monthly average chloride concentrations in the DMC at Jones Pumping Plant and in the West Canal at the Clifton Court Forebay would be less than significant and beneficial.

Alternatives C1 and C2

Potential impacts to surface water quality in the Delta and CVP/SWP water service areas under Alternatives C1 and C2 are described below. Complete results from San Joaquin River and Delta water quality analyses for the program alternatives, including those cited below, are provided in Appendix H, “Modeling.”

Impact SWQ-3 (Alternatives C1 and C2): ***Long-Term Effects on Water Quality that Cause Violations of Existing Water Quality Standards or Adversely Affect Beneficial Uses in Millerton Lake – Project-Level.*** These impacts would be the same as Impact SWQ-3 (Alternatives A1 and A2). Surface water quality impacts are not likely to result in violations of existing water quality standards, or substantial water quality changes that adversely affect beneficial uses, or have substantive impacts on public health. These impacts would be **less than significant**.

Impact SWQ-4 (Alternatives C1 and C2): ***Long-Term Effects on Water Quality that Cause Violations of Existing Water Quality Standards or Adversely Affect Beneficial Uses in the San Joaquin River from Friant Dam to the Merced River – Project-Level.*** These impacts would be the same as Impact SWQ-4 (Alternatives A1 and A2). Surface water quality conditions under Alternatives C1 and C2 would be improved in some areas through effects on temperatures and constituent concentrations, and potentially adversely affected in other reaches. Overall, this impact would be **less than significant**.

Impact SWQ-5 (Alternatives C1 and C2): ***Long-Term Effects on Water Quality that Cause Violations of Existing Water Quality Standards or Adversely Affect Beneficial Uses in the San Joaquin River from the Merced River to the Delta – Project-Level.*** These impacts would be the same as Impact SWQ-5 (Alternatives A1 and A2). Potential surface water quality effects within the San Joaquin River from the Merced River to the Delta would not result in any additional violations of existing water quality standards or substantial water quality changes that would adversely affect beneficial uses, or have substantive impacts on public health. Surface water quality impacts in the San Joaquin River from the Merced River to the Delta under Alternatives C1 and C2 would be **less than significant**.

Impact SWQ-6 (Alternatives C1 and C2): ***Effects on X2 Position – Project-Level.*** This impact would be the same as Impact SWQ-6 (Alternatives A1 and A2). The X2 position would not be affected by Alternatives C1 and C2. While in several months the X2 position may be out of compliance under the bases of comparison, the change resulting from the action alternatives would not further impact X2 position compliance. Therefore, this impact would have **no impact**.

Impact SWQ-7 (Alternatives C1 and C2): ***Delta Salinity in the San Joaquin River at Vernalis, San Joaquin River at Brandt Bridge, Old River near Middle River, and Old River at Tracy Road Bridge – Project-Level.*** This impact would be similar to Impact SWQ-7 (Alternatives B1 and B2). Simulated historical monthly salinity in the San Joaquin River at Vernalis, San Joaquin River at Brandt Bridge, Old River near Middle River, and Old River at Tracy Road Bridge would be less under Alternatives C1 and C2 compared to the No-Action Alternative, particularly during March and April. This impact would be **less than significant** and **beneficial**.

Impact SWQ-8 (Alternatives C1 and C2): ***Delta Salinity in the San Joaquin River at Jersey Point, Sacramento River at Emmaton, and Sacramento River at Collinsville – Project Level.*** This impact would be similar to Impact SWQ-8 (Alternatives B1 and B2). In the San Joaquin River at Jersey Point, simulated historical monthly average salinity under Alternatives C1 and C2 would be up to 4 percent higher during February, and up to 1 percent higher during January and March. Simulated historical monthly average salinity in the Sacramento River at Collinsville would be up to 6 percent higher during February, 3 percent higher during March, and up to 1 percent higher during July. In the Sacramento River at Emmaton, simulated historical monthly average salinity would be up to 5 percent higher during February, up to 2 percent higher during March, and up to 1 percent higher during January and August. Surface water quality impacts are not likely to result in violations of existing water quality standards, or substantial water quality changes that adversely affect beneficial uses, or have substantive impacts on public health. This impact would be **less than significant**.

Impact SWQ-9 (Alternatives C1 and C2): ***Delta Water Quality at Contra Costa Water District's Contra Costa Canal Pumping Plant No. 1, Old River at Los Vaqueros Intake, and Proposed Victoria Canal Intake, and City of Stockton's Proposed Delta Intake – Project-Level.*** This impact would be similar to Impact SWQ-9 (Alternatives B1 and B2). This impact would be **less than significant** and **beneficial**.

At CCWD's Contra Costa Canal Pumping Plant No. 1, simulated historical monthly average salinity would be up to 1 percent higher during March and April, compared to the No-Action Alternative. During May, October, November, and December, simulated monthly average salinity would decrease by up to 2 percent. The maximum increase in simulated monthly average salinity under Alternatives C1 and C2 (3 percent) would occur during February in Above-Normal years and during April in Critical years, while the maximum decrease (4 percent) would occur during December in Wet, Above-Normal, and Below-Normal years.

Compared to the No-Action Alternative, simulated monthly average salinity under Alternatives C1 and C2 at CCWD's Old River at Los Vaqueros Intake would decrease during May, and from October through December, and would increase by up to 2 percent during March, April, and June. Simulated historical monthly average salinity under Alternatives C1 and C2 would not be impacted during January, February, or from July through September. Under Alternatives C1 and C2, the maximum increase in simulated monthly average salinity (5 percent) would occur during April in Critical years. The maximum decrease (3 percent) compared to the No-Action Alternative would occur during December in Wet and Below-Normal years, November in Above-Normal years, and February in Critical years.

At CCWD's proposed Victoria Canal Intake, simulated historical monthly average salinity would decrease under Alternatives C1 and C2 compared to the No-Action Alternative during May, November, and December. Simulated historical monthly average chloride concentrations under Alternatives C1 and C2 would increase by up to 3 percent during March, April, and June, and would not be impacted in January or February, or July through October. The maximum increase in simulated monthly average salinity under Alternatives C1 and C2 (7 percent) compared to the No-Action Alternative would occur during April in Critical years, while the maximum decrease (4 percent) would occur during May in Above-Normal years.

Under Alternatives C1 and C2, simulated historical monthly average salinity at the City of Stockton's proposed Delta Intake would decrease compared to the No-Action Alternative during May and December, and increase by up to 11 percent during February, March, April, and June. Simulated historical monthly average salinity would not be impacted during January, or July through November. The maximum increase in simulated monthly average salinity under Alternatives C1 and C2 (9 percent) compared to the No-Action Alternative would occur during March in Dry and Critical years, while the maximum decrease (2 percent) would occur during December in Below-Normal and Dry years.

Simulated historical monthly average chloride concentrations at CCWD's Contra Costa Canal Pumping Plant No.1 would increase by up to 2 percent during March and April, compared to the No-Action Alternative. During January, May, October, November, and December, simulated historical monthly average salinity would decrease by up to 3 percent. Impacts of Alternatives C1 and C2 on simulated monthly average chloride concentrations would be less than significant.

At CCWD's Old River at Los Vaqueros Intake, simulated historical monthly average chloride concentrations would decrease under Alternatives C1 and C2 compared to the No-Action Alternative during May, and October through December. Compared to the

No-Action Alternative, simulated historical monthly average chloride concentrations would increase by up to 3 percent during March, April, and June under Alternatives C1 and C2 and would not be impacted during January, February, or July through September.

Simulated historical monthly average chloride concentrations at CCWD's proposed Victoria Canal Intake would decrease under Alternatives C1 and C2 during May, November, and December. Simulated historical monthly average chloride concentrations under Alternatives C1 and C2 would increase by up to 4 percent compared to the No-Action Alternative during March, April, and June, and would not be impacted during January, February, or July through October.

Under Alternatives C1 and C2, simulated historical monthly average chloride concentrations at the City of Stockton's proposed Delta Intake would increase by up to 11 percent in March. Simulated historical monthly average chloride concentrations under Alternatives C1 and C2 would be comparable to the No-Action Alternative during January, February, and July through September.

Impacts to water quality at existing and planned CCWD or City of Stockton pumping facilities in the Delta under Alternatives C1 and C2 would not result in any additional violations of existing water quality standards or substantial water quality changes that would adversely affect beneficial uses, or have substantive impacts on public health. These impacts would be less than significant.

Impact SWQ-10 (Alternatives C1 and C2): ***Water Quality at in the Delta-Mendota Canal at Jones Pumping Plant and in the West Canal at the Clifton Court Forebay – Project-Level.*** This impact would be similar to Impact SWQ-10 (Alternatives B1 and B2). Overall, project-level impacts at CVP and SWP pumping facilities in the Delta under Alternatives C1 and C2 would be **less than significant** and **beneficial**.

Simulated historical monthly average salinity at the DMC at Jones Pumping Plant under Alternatives C1 and C2 would be up to 5 percent lower during April, up to 3 percent lower during March, and up to 2 percent lower during January, May, October, November, and December. Under Alternatives C1 and C2, the maximum increase in simulated monthly average salinity (2 percent) would occur during February in Wet and Above-Normal years. The maximum decrease (9 percent) would occur during April in Above-Normal years.

In the West Canal at the Clifton Court Forebay, simulated historical monthly average salinity under Alternatives C1 and C2 compared to the No-Action Alternative would be up to 1 percent higher during February, July, and August, up to 3 percent lower during April, and up to 2 percent lower during March, May, and October to December. The maximum increase in simulated monthly average salinity under Alternatives C1 and C2 (3 percent) compared to the No-Action Alternative would occur during February in Above-Normal years, while the maximum decrease (6 percent) would occur during April in Above-Normal years.

Simulated historical monthly average chloride concentrations in the DMC at Jones Pumping Plant would be up to 9 percent lower during April, up to 4 percent lower during March, and up to 2 percent lower during January, May, November, and December. Simulated historical monthly average chloride under Alternatives C1 and C2 in the West Canal in the Clifton Court Forebay would increase by up to 1 percent during June, decrease by up to 6 percent higher during April, and decrease by up to 2 percent higher during March, May, October, and November.

Potential surface water quality effects in the DMC at Jones Pumping Plant and in the West Canal at the Clifton Court Forebay under Alternatives C1 or C2 would not result in any additional violations of existing water quality standards or substantial water quality changes that would adversely affect beneficial uses, or have substantive impacts on public health. Impacts of Alternatives C1 and C2 on simulated historical monthly average salinity and simulated monthly average chloride concentrations in the DMC at Jones Pumping Plant and in the West Canal at the Clifton Court Forebay would be less than significant and beneficial.

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Chapter 15.0 Indian Trust Assets

This chapter describes the environmental and regulatory settings of Indian Trust Assets (ITA), as well as environmental consequences and mitigation, as it pertains to implementation of the program alternatives.

ITAs are legal interests in property held in trust by the United States for federally recognized Indian tribes or individual Indians. An Indian trust has three components: (1) the trustee, (2) the beneficiary, and (3) the trust asset. ITAs can include land, minerals, federally reserved hunting and fishing rights, federally reserved water rights, and in-stream flows associated with trust land. Beneficiaries of the Indian trust relationship are federally recognized Indian tribes with trust land; the United States is the trustee. By definition, ITAs cannot be sold, leased, or otherwise encumbered without approval of the United States. The characterization and application of the U.S. trust relationship have been defined by case law that interprets Congressional acts, executive orders, and historic treaty provisions. CEQA does not require evaluation of ITAs. The Federal requirements to evaluate impacts to ITAs are discussed in the subsequent section on the regulatory setting.

15.1 Environmental Setting

An examination of records held by the Bureau of Indian Affairs and Reclamation was conducted by the Regional ITA Coordinator. No reservations or rancherias are located within the San Joaquin River upstream from Friant Dam, the Restoration Area, San Joaquin River from Merced River to the Delta, and the Delta (see Figure 15-1). The action alternatives are not anticipated to have impacts on ITAs as a result in a change of CVP and SWP operations; therefore, the CVP and SWP service areas were not evaluated for ITAs.

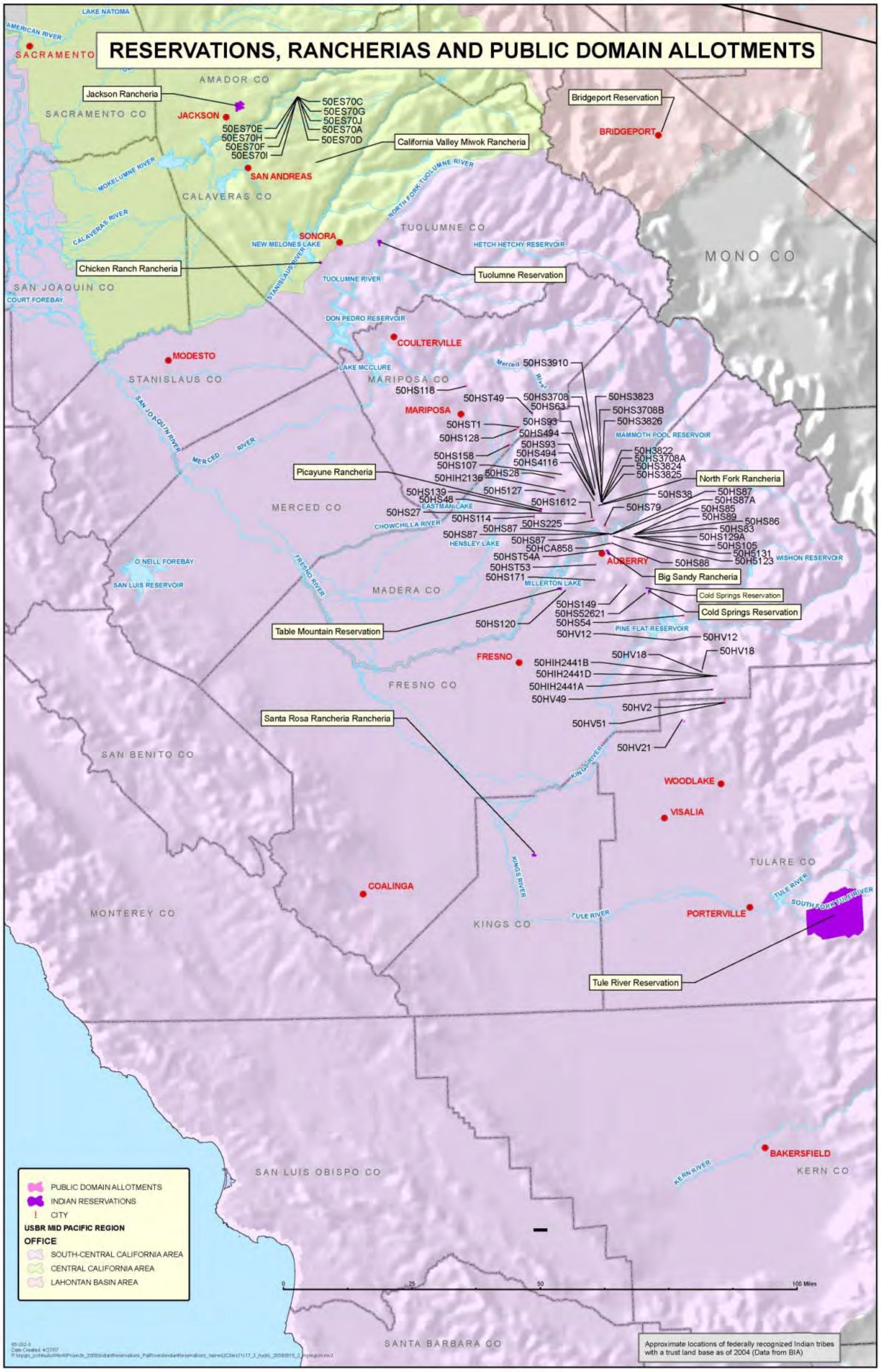

Figure 15-1.
Reservations, Rancherias, and Public Domain Allotments

15.2 Regulatory Setting

This section discusses the Federal laws and regulations pertaining to ITAs.

Consistent with President William J. Clinton's 1994 memorandum, "Government-to-Government Relations with Native American Tribal Governments," Reclamation assesses the effects of its programs on tribal trust resources and federally recognized tribal governments. Reclamation is tasked to actively engage federally recognized tribal governments and consult with such tribes on a government-to-government level (59 FR 1994) when its actions affect ITAs. The U.S. Department of the Interior Departmental Manual, Part 512.2, ascribes the responsibility for ensuring protection of ITAs to the heads of bureaus and offices. Reclamation will comply with procedures contained in Departmental Manual, Part 512.2, guidelines, which protect ITAs. In addition, Executive Order 13175 *(Executive Order 13175, Consultation and Coordination with Indian Tribal Governments, 65 F.R. 218)* was issued to establish regular and meaningful consultation and collaboration with tribal officials in the development of Federal policies that have tribal implications, to strengthen the U.S. government-to-government relationships with Indian tribes, and to reduce the imposition of unfunded mandates upon Indian tribes. When implementing such policies, agencies consult with tribal officials as to the need for Federal standards and any alternatives that limit their scope or otherwise preserve the prerogatives and authority of Indian tribes.

Through FR, Vol. 59, No. 85, and implementing memorandum on *Government-to-Government Relations with Native American Tribal Governments*, Federal agencies are directed to consult, to the greatest extent practicable and to the extent permitted by law, with tribal governments before taking actions that affect federally recognized tribal governments. Federal agencies must assess the impact of Federal government plans, projects, programs, and activities on tribal trust resources and assure that tribal government rights and concerns are considered during such development.

Further, the U.S. Department of the Interior is required to "protect and preserve ITAs from loss, damage, unlawful alienation, waste, and depletion" (Reclamation 2000). It is the general policy of the U.S. Department of the Interior to perform its activities and programs in such a way as to protect ITAs and avoid adverse effects whenever possible (Reclamation 2000).

15.3 Environmental Consequences and Mitigation Measures

Potential impacts to ITAs would stem from any actions that affect land, minerals, federally reserved hunting and fishing rights, federally reserved water rights, and in-stream flows associated with trust land in the study area. No reservations or rancherias are located along the San Joaquin River upstream from Friant Dam, the Restoration Area, the San Joaquin River from Merced River to the Delta, or the Delta. The nearest ITA is Table Mountain Rancheria, which is approximately 3 miles east-southeast of Millerton Lake. Therefore, no program- or project-level impacts would occur to ITAs caused by the program alternatives, as shown in Table 15-1. Future ITA analysis would be conducted for program-level actions and documented in subsequent site-specific NEPA documentation, as required by law.

Table 15-1.
Summary of Environmental Consequences and Mitigation Measures – Vegetation and Wildlife

Impacts	Alternative	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance After Mitigation
Indian Trust Assets: Program-Level				
ITA-1: Affect Land, Minerals, Federally Reserved Hunting and Fishing Rights, Federally Reserved Water Rights, and In-Stream Flows Associated With Trust Land	No-Action	No Impact	--	No Impact
	A1	No Impact	--	No Impact
	B1	No Impact	--	No Impact
	B1	No Impact	--	No Impact
	B2	No Impact	--	No Impact
	C1	No Impact	--	No Impact
	C2	No Impact	--	No Impact
Indian Trust Assets: Project-Level				
ITA-2: Affect Land, Minerals, Federally Reserved Hunting and Fishing Rights, Federally Reserved Water Rights, and In-Stream Flows Associated With Trust Land	No-Action	No Impact	--	No Impact
	A1	No Impact	--	No Impact
	A2	No Impact	--	No Impact
	B1	No Impact	--	No Impact
	B2	No Impact	--	No Impact
	C1	No Impact	--	No Impact
	C2	No Impact	--	No Impact

Key:
-- = not applicable

Chapter 16.0 Land Use Planning and Agricultural Resources

This chapter describes the environmental and regulatory settings of land use, as well as environmental consequences and mitigation, as it pertains to implementation of program alternatives. The discussion of land use existing conditions and the potential impacts of the program alternatives on land use encompasses the Restoration Area, the San Joaquin River downstream from the Restoration Area, and the CVP/SWP service areas. Implementation of the Settlement is not anticipated to cause impacts to land use upstream from Friant Dam or in the Delta. Therefore, these areas were eliminated from detailed environmental analysis.

16.1 Environmental Setting

The following sections describe the land use within four of the five geographic subareas of the study area. There would be no effects on land use upstream from Friant Dam or in the Delta because no Settlement projects would be constructed in these areas, and agricultural land would not be altered in these areas, so these geographic areas are not covered further.

16.1.1 San Joaquin River from Friant Dam to Merced River

The Restoration Area is defined as the length of the San Joaquin River basin, from Friant Dam downriver to its confluence with the Merced River. The width of the Restoration Area includes an area approximately 1,500 feet from the river centerline outward from both banks, for a total width of approximately 3,000 feet, where restoration actions could affect existing land uses or agricultural resources.

Most of the land in the Restoration Area is privately owned. The primary land uses are open space and agriculture. Urban land uses (e.g., residential, commercial, industrial) account for only a small percentage of land use along the San Joaquin River. This type of use is associated primarily with the small communities located near the river between Friant Dam and the confluence with the Merced River.

As described in the *San Joaquin River Restoration Study Background Report* (FWUA and NRDC 2002), land ownership data were compiled from Reclamation's database (2001). Data depicting lands managed by the San Joaquin River Parkway and Conservation Tract (SJRPCT) were provided by GreenInfo Network (2002). Data provided by the SJRPCT also were reviewed. As a historic navigable river, the bed of the San Joaquin River is subject to the jurisdiction of the California State Lands Commission. California holds the fee ownership in the river bed between the two ordinary low water marks in Reach 1A (State Lands Commission 1992). Data from the 1989 to 1992 State Lands Boundary Survey located the State's fee title (low water) and Public Trust easement (high water) claims, and were used as a basis for defining property boundaries from Friant Dam to Herndon on both sides of the river. The 1989 to 1992 State Lands Commission surveys did not go downstream from Reach 1A. However, the California State Lands Commission initiated work in the fall of 2010 to develop an administrative decision on the ordinary low and high water marks in the remaining reaches of the Restoration Area. Land between the ordinary high water marks is subject to a Public Trust Easement. A lease is required for projects on State-owned lands under the jurisdiction of the California State Lands Commission.

Land ownership was separated into two broad classifications: public and private. Public lands were classified as Federal lands, State Lands Commission public trust and fee title lands, other State and county lands, and lands owned by the SJRPCT.

In the Restoration Area, action alternatives on public lands would be located in the jurisdictions of the following Federal, State, and local agencies, respectively: USFWS, USACE, and Reclamation; State Parks; and Fresno, Madera, and Merced counties, and the cities of Fresno and Firebaugh. Available land use management plans, comprehensive plans, and general plans adopted by jurisdictions in the Restoration Area were reviewed to identify existing and future land uses. These plans are described in the Regulatory Setting section below.

Existing Land Uses in and Adjacent to the Restoration Area

The Restoration Area includes the San Joaquin River and Eastside, Mariposa, and Chowchilla Bypasses, which are located in Fresno, Madera, and Merced counties. The river flows adjacent to the community of Friant, the City of Fresno, the community of Herndon, and the City of Firebaugh, and passes near (outside the Restoration Area) the communities of Biola and Mendota.

For purposes of this analysis, the Restoration Area has been divided into five reaches. Existing land uses along these five reaches were compiled from review of DWR's GIS databases for Merced, Madera, and Fresno counties (FWUA and NRDC 2002) and visual analysis of current aerial photographs. The Restoration Area occupies approximately 72,581 acres along the San Joaquin River (Table 16-1). Land uses within the Restoration Area were identified, inventoried, and placed into the following broad land use categories: agricultural, open space, and urban. Most of the land along the San Joaquin River downstream from Friant Dam is privately owned. Primary land uses are open space and agriculture. Urban land uses (e.g., residential, commercial, industrial) account for only a small percentage of land use along the San Joaquin River. Table 16-1 shows the approximate acreages for each land use category along the San Joaquin River, by reach, and for the bypass areas.

Table 16-1.
Acreage of Land Uses Along San Joaquin River in Restoration Area[1]

River Reach	Land Use (acres)[2]			
	Agricultural	**Open Space**	**Urban**	**Total**
Reach 1	9,436 (60%)	4,480 (28%)	1,916 (12%)	15,832
Reach 2	6,068 (66%)	3,009 (33%)	96 (1%)	9,173
Reach 3	6,150 (76%)	1,517 (19%)	389 (5%)	8,056
Reach 4	9,514 (66%)	4,901 (34%)	24 (<1%)	14,439
Reach 5	821 (13%)	4,615 (85%)	26 (2%)	5,460
Bypass Areas	10,235 (52%)	9,341 (48%)	47 (<1%)	19,623
Total	**42,224 (58%)**	**27,863 (38%)**	**2,498 (4%)**	**72,581**

Source: Data provided by EDAW in 2008 based on digitized GIS data

Notes:

[1] The width of the Restoration Area includes an area approximately 1,500 feet from the river centerline outward from both banks, for a total width of approximately 3,000 feet.

[2] Acreage numbers have been rounded to the nearest acre.

Key:
% = percent
< = less than

Agricultural land uses include a variety of different crop types and specific annual and permanent crops. These crops include, but are not limited to, the following examples:

- **Annual crops –** Field crops (cotton, sweet corn, sugar beets, dry beans, and safflower); truck, nursery, and berry crops (lettuce, bell peppers, strawberries, melons, nursery products, eggplant, garlic, onions, asparagus, squash, broccoli, peas, and tomatoes); grain and hay crops (alfalfa, barley, wheat, oats, and other mixed grain and hay); and rice
- **Vineyards –** Kiwifruit and a variety of grape types that may be used as table grapes or raisins or for wine
- **Orchards –** Evergreen fruit crops (lemons, oranges, and olives), and deciduous fruit and nut crops (almonds, walnuts, pistachios, apples, sweet cherries, figs, peaches, persimmons, plums, and pomegranates)
- **Semiagricultural and incidental to agriculture –** Apiary products, cattle, poultry, dairy, and wool. This category also includes other agriculture-related infrastructure, such as agricultural disposal areas, equipment maintenance areas, and storage areas

Open space lands include the following categories:

- **Idle land –** Cropland that is fallow but has been farmed within the past 3 years or land that is being prepared for agricultural production. This also includes passive agriculture such as pasture (forage, irrigated, and range lands and may include alfalfa, clover, and other native or mixed pasture plant species) and land that is not farmed because of proximity to the San Joaquin River floodplain.

- **Native vegetation** – Wetland/marsh, grassland, shrub/brush, and riparian scrub and forest plant communities.

- **Aquatic environments** – Rivers, creeks, canals, agricultural ditches, ponds, and open water created by mining operations.

Urban land uses fall into a variety of categories, including residential, commercial/ industrial, and landscaped properties, such as golf courses, parks, and other uses. The following sections describe land use and ownership in the Restoration Area by reach. Figure 16-1 shows wildlife refuges, wildlife areas, ecological reserves, wildlife management areas, and State parks in the vicinity of the Restoration Area.

A general description of land uses along each river reach, and approximate acreages for broad land uses (listed in Table 16-1), are presented below for each of the five river reaches and the bypass structures between Friant Dam and the Merced River confluence. Land use category acreage by reach is presented in Table 16-1. Because land use in the Restoration Area changes from year to year based on a variety of market and landowner factors, the acreage results presented below should be considered representative, not absolute.

Reach 1. Approximately 1,636 acres of Reach 1 of the Restoration Area are in the City of Fresno. Reach 1 also includes the town of Friant, as well as the unincorporated communities of Rolling Hills, Herndon, and Biola. The approximate acreage of land uses, as inventoried in Reach 1, is approximately 15,832 acres (see Table 16-1). The primary land use category of Reach 1 is agriculture (60 percent), followed by open space (28 percent) and urban land uses (12 percent). Approximately 93.8 percent of lands found in Reach 1 are privately owned.

Reach 1 is divided into two subreaches. Reach 1A flows to the north of Fresno and also passes near the communities of Friant and Rolling Hills and two trailer parks located adjacent to the Yosemite Freeway Bridge. Between Friant Dam and the SR 99 bridge that crosses the San Joaquin River, several roads parallel the river in this subreach, and six bridges (North Fork Road Bridge, Yosemite Freeway Bridge, West Nees Bridge, and three unnamed bridges) cross the river.

The primary nonurban land uses along the remaining areas of this subreach are gravel mining, agriculture, and recreation/open space. Several active gravel quarries, and related roads and other infrastructure, are located adjacent to the river. Agricultural land uses include vineyards, annual crops, and orchards.

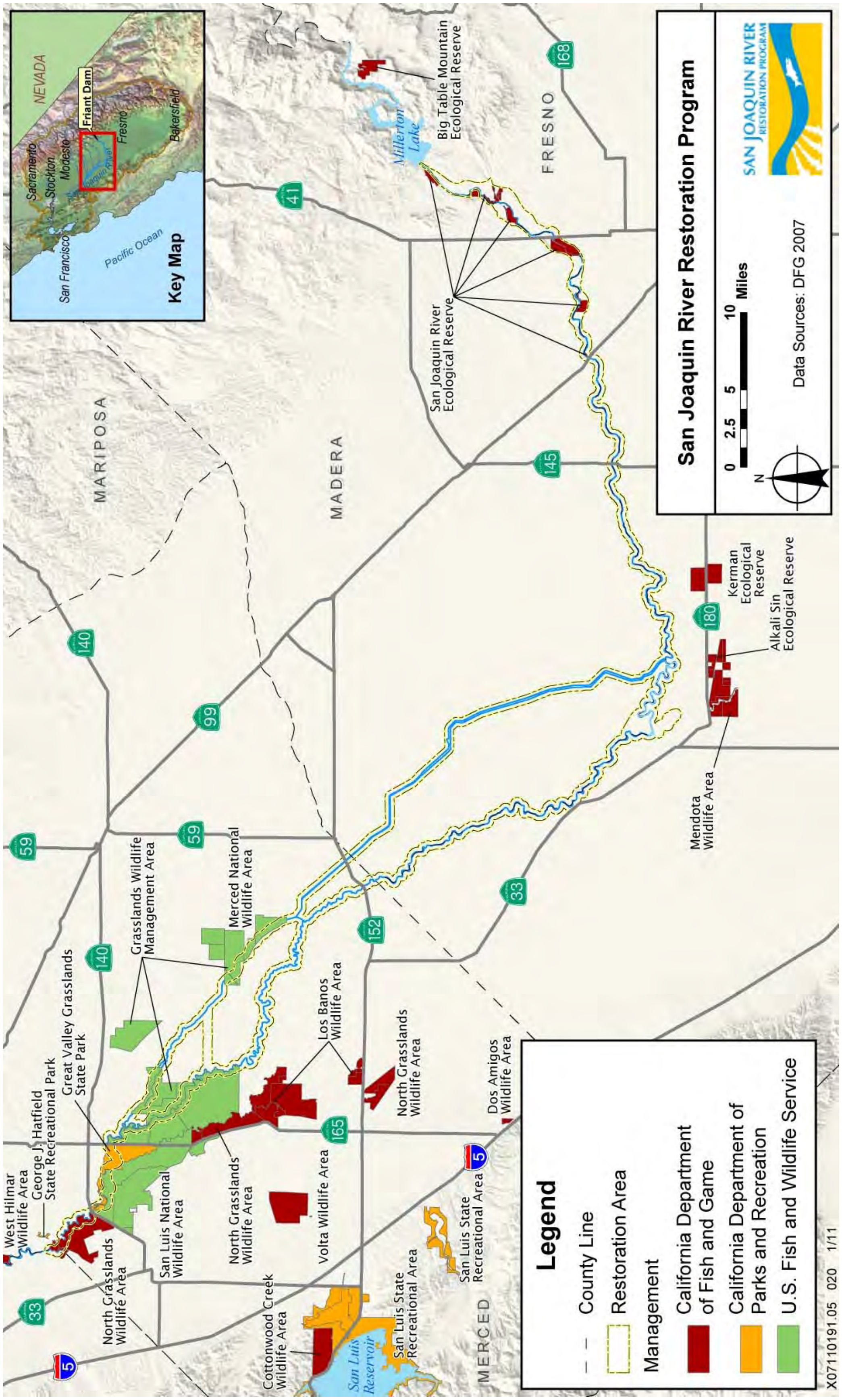

Figure 16-1.
Wildlife Refuges Near the Restoration Area

In addition to mining and agriculture, several recreation areas are located in Reach 1A. The San Joaquin River Parkway extends upstream from, and includes, the Millerton Lake SRA and areas along both river banks of this subreach. The parkway includes multiple recreation sites and use areas, including Lost Lake Park, an approximately 273-acre recreation area along 1.8 miles of the southern bank, Fort Washington Beach, Sycamore Island Ranch, and Camp Pashayan, among others. Three private golf courses (Riverbend Golf Club, Fig Garden Golf Club, and San Joaquin Country Club) and one public golf course (Riverside Golf Course) are present in this subreach. Multiple ponds are also located in this reach. These ponds were created in abandoned mining gravel pits and are now stocked with game fish.

Reach 1B flows north of the unincorporated community of Herndon. Similar to Reach 1A, this subreach also includes agricultural (vineyards, orchards, and annual crops) and recreational/open space land uses. The San Joaquin River Parkway extends slightly downstream from the SR 99 bridge, although only one recreation site (Skagg's Bridge Park) is located in this subreach. Several fishing ponds are also located in Reach 1B.

Reach 2. The approximate acreage of land uses in the approximately 24-mile-long Reach 2 is 9,173 acres, as shown in Table 16-1. All lands found in Reach 2 are in private ownership. Similar to other reaches, the primary agricultural land uses along this reach are annual crops, vineyards, and orchards. Open space is the primary nonagricultural land use along Reach 2B, although there are no designated protected areas or recreation sites.

Similar to Reach 1, Reach 2 is divided into two subreaches. Reach 2A begins at Gravelly Ford and extends downstream to the Chowchilla Bypass Bifurcation Structure. Reach 2A contains no incorporated communities and only one bridge (North Madera Avenue), which provides access across the river. Several roads parallel the river along this subreach, and multiple confining levees protect agricultural land uses in this subreach. Agricultural uses include annual crops, vineyards, and orchards. Remaining nonagricultural areas of the Restoration Area in Reach 2A are characterized by open space, although there are no designated protected areas or recreation sites.

Pacific Gas and Electric Company (PG&E) plans to build the Gill Ranch storage facility to store natural gas along both banks of the San Joaquin River in Reach 2A, upstream from the Chowchilla Bifurcation Structure. The facility would store approximately 20 billion cubic feet of natural gas in a depleted, 1-mile-deep underground natural gas reservoir. The first phase of the Gill Ranch storage facility would likely be completed by 2010, pending environmental permitting and review. Development of the storage facility also would include constructing a 25-mile-long underground pipeline leading from the storage facility along the river to an existing gas transmission system near Interstate (I) 5.

Reach 2B extends from the Chowchilla Bypass Bifurcation Structure downstream to Mendota Dam. As with Reach 2A, there are no incorporated communities in Reach 2B. Several roads are located adjacent to the river, although no bridges are present, and multiple confining levees protect agricultural land uses. Similar to other subreaches, the primary agricultural land uses along this subreach are annual crops, vineyards, and orchards. Open space is the primary nonagricultural land use in Reach 2B, although there are no designated protected areas or recreation sites.

Reach 3. The approximate acreage of Reach 3, approximately 23 miles from Mendota Dam to Sack Dam, is 8,056 acres (Table 16-1). The primary land use in this reach is agriculture (76 percent adjacent). Open space accounts for approximately 19 percent of lands in Reach 3. The remaining 5 percent of lands is categorized as urban. All lands found in Reach 3 are privately owned.

Annual crops account for nearly all agricultural land uses in this reach. Open space is the primary nonagricultural land use, although there are no designated protected areas or recreation sites. The City of Firebaugh and associated connecting roads, located between the San Joaquin River and Helm Canal, are the only urban land uses found in Reach 3. This urban zone occupies about 389 acres in the Restoration Area. Several roads provide access to or parallel the river, and one bridge (13 Street/Avenue 7½ bridge) provides access across the river in this reach. Additional infrastructure found in Reach 3 includes local dikes and canals, including the Arroyo Canal.

Reach 4. Reach 4 is 46 miles long, extending from Sack Dam to the confluence with Bear Creek and the Eastside Bypass. The approximate acreage of this reach is 14,439 acres (Table 16-1). Most lands in this reach are either agricultural (64 percent) or open space (31 percent). Less than 1 percent of land in Reach 4 is categorized as urban. Additionally, similar to Reaches 1 through 3, most lands in this reach are privately owned (91.1 percent). In the San Luis NWR, the Grasslands WMA constitutes approximately 30 percent of the remaining wetlands in the Central Valley, a portion of which are in the Restoration Area.

This reach is divided into two subreaches. Reach 4A extends from Sack Dam downstream to the Sand Slough Control Structure. Few urban land uses are present in Reach 4A. The urban land uses that exist are primarily transportation corridors. Several roads are located adjacent to or provide access to the river, and the Brazil Road (SR 152) bridge provides access across the river in Reach 4A. Primary land uses in this subreach are agriculture (annual crops) and open space (there are no designated protected areas or recreation sites).

Reach 4B extends from the Sand Slough Control Structure downstream to the confluence with Bear Creek and the Eastside Bypass. It is subdivided into Reaches 4B1 and 4B2. As with Reach 4A, there are few urban land uses in Reach 4B. Several roads are located in

Reach 4B, as are two public bridges (West Washington Road and Turner Island Road bridges). Annual crops account for the agricultural land uses in this subreach, and the San Luis NWR, portions of which are located in both Reach 4B1 and Reach 4B2, account for most of the open space land use (Figure 16-1).

Reach 5. The approximate acreage of land uses in Reach 5, which extends from the Eastside Bypass to the confluence with the Merced River, is 5,460 acres (Table 16-1). This reach has the highest percentage of open space lands (85 percent) of the five reaches. Most of the remaining lands found in Reach 5 are categorized as agricultural (13 percent). Urban lands account for approximately 2 percent of lands in this reach. Reach 5 also has the lowest percentage of private lands (22 percent) of the five reaches. Public lands account for approximately 78 percent of lands in this reach.

There are no designated communities in this reach, and most of the lands adjacent to the San Joaquin River are considered rural and provide important open space and wildlife values to Merced County. Open space is the primary land use in this reach and is protected in the San Luis NWR, Great Valley Grasslands State Park, and George J. Hatfield SRA (Figure 16-1). Annual crops account for most of the agricultural land uses found in Reach 5. This reach is bounded by levees on the left bank downstream to the Salt Slough confluence and on the right bank to the Merced River confluence. In addition, several roads and three bridges (Lander Avenue bridge, SR 140 bridge, and Hills Ferry bridge) are located in Reach 5.

Chowchilla Bypass and Tributaries. The primary land use along the Chowchilla Bypass is agriculture; irrigated fields are located along both sides of the bypass. The bypass is also used for livestock grazing. Several roads parallel the bypass, and 11 roadway crossings provide access across it. Few other urban areas are located along the Chowchilla Bypass.

Eastside Bypass and Tributaries. The primary land uses along the Eastside Bypass are agriculture and open space. In general, irrigated crops are prevalent south of the Mariposa Bypass, whereas open space is the principal land use north of the Mariposa Bypass between the Eastside Bypass and the San Joaquin River. The Merced NWR is also located along the Eastside Bypass, south of West Sandy Mush Road between the start of the bypass and the Mariposa Bypass diversion. Although several access roads parallel the Eastside Bypass south of the Mariposa Bypass, only two bridges provide access across the bypass.

Approximately 52 percent of the land use surrounding the Chowchilla and Eastside bypass structures is classified as agriculture; 48 percent is classified as open space; and less than 1 percent is urban, which consists of scattered access roads that cross the river.

Land Use Designations and Zoning

For purposes of this analysis, various land use designations, as defined in the Fresno, Madera, and Merced county general plans were combined into a common classification. These designations reflect each county’s vision of ultimate future land uses for the Restoration Area. As shown in Table 16-2, the future land uses will remain overwhelmingly in agricultural production, with more than 82 percent of the land area being designated as agricultural land.

**Table 16-2.
Land Use Designations Along the
San Joaquin River in the Restoration Area**

River Reach and Bypasses	Land Use (acres)[2]			
	Agriculture	**Urban[1]**	**Open Space**	**Total**
Reach 1	7,216 (46%)	5,195 (33%)	3,419 (22%)	15,830
Reach 2	9,107 (99%)	37 (<1%)	28 (<1%)	9,172
Reach 3	7,218 (90%)	606 (8%)	231 (3%)	8,055
Reach 4	14,439 (100%)	0 (0%)	0 (0%)	14,439
Reach 5	5,461 (100%)	0 (0%)	0 (0%)	5,461
Bypass Structures	16,306 (83%)	0 (0%)	3,317 (17%)	19,623
Total	**59,747 (82%)**	**5,838 (8%)**	**6,996 (10%)**	**72,581**

Source: California Resources Agency and University of California, Davis 2004.

Notes:

[1] These acreages include lands designated Urban Reserve.

[2] Acreage numbers have been rounded to the nearest acre.

Key:

% = percent

< = less than

A relatively small portion of the Restoration Area, approximately 8 percent, is designated for urban use by the local planning authorities, which may consist of various residential, commercial, industrial, and recreational uses. These lands are limited to portions of the cities of Fresno and Firebaugh. Appendix P, "Land Use," illustrates the location of these land use designations for the Restoration Area and vicinity.

Agricultural Resources, Including Williamson Act Lands

Much of the acreage in and adjacent to the Restoration Area is agricultural land. The State has developed processes to discourage continued conversion of agricultural land to nonagricultural uses. The use of Williamson Act contracts and Farmland Security Zone (FSZ, also known as Super Williamson Act lands) enables local governments to provide private landowners with tax incentives to continue agricultural or related open space uses. Table 16-3 shows Williamson Act lands, including "Lands in Nonrenewal," which will not be continued as Williamson Act lands.

A considerable amount of the land in the Restoration Area is under Williamson Act contracts, as shown in Table 16-4 (see also Appendix P, "Land Use"). In Table 16-4, FSZ information is included under the Williamson Act classification. In addition, lands that are currently in Williamson Act contracts, but will not be continued, are identified as "Lands in Nonrenewal" in Table 16-4. These lands total about 1 percent of the Williamson Act lands in the Restoration Area.

Table 16-3.
Total 2007 Acreage of Williamson Act Lands in the Restoration Area

River Reach	Land Use (acres)[2]		
	Williamson Act Lands[1]	Lands in Nonrenewal	Total
Reach 1	4,190 (94%)	275 (6%)	4,465
Reach 2	6,813 (100%)	0 (0%)	6,813
Reach 3	5,665 (98%)	132 (2%)	5,797
Reach 4	5,295 (100%)	0 (0%)	5,295
Reach 5	1,314 (100%)	0 (0%)	1,314
Bypasses	8,750 (100%)	0 (0%)	8,750
Total	**32,027 (99%)**	**407 (1%)**	**32,434**

Sources: DOC 2004a, 2005, 2006; Madera County 2008

Notes:
[1] These acreages include Farmland Security Zone lands.
[2] Acreage numbers have been rounded to the nearest acre.
Key:
% = percent
< = less than

The State of California Farmland Mapping and Monitoring Program (FMMP) classifies agricultural lands. The following Important Farmland classifications are used in the FMMP (DOC 2004b):

- **Prime Farmland –** Farmland with the best combination of physical and chemical features able to sustain long-term agricultural production. This land has the soil quality, growing season, and moisture supply needed to produce sustained high yields. Land must have been used for irrigated agricultural production at some time during the 4 years before the mapping date.

- **Farmland of Statewide Importance –** Farmland similar to Prime Farmland but with minor shortcomings, such as greater slopes or less ability to store soil moisture. Land must have been used for irrigated agricultural production at some time during the 4 years before the mapping date.

- **Unique Farmland –** Farmland of lesser quality soils used for the production of the State's leading agricultural crops. This land is usually irrigated but may include nonirrigated orchards or vineyards as found in some climatic zones in California. Land must have been cropped at some time during the 4 years before the mapping date.

- **Farmland of Local Importance –** Land of importance to the local agricultural economy as determined by each county's board of supervisors and a local advisory committee. Fresno, Madera, and Merced counties have agricultural land designated as Farmland of Local Importance.

- **Grazing Land –** Land on which existing vegetation is suited for grazing livestock. This category was developed in cooperation with the California Cattlemen's Association, University of California Cooperative Extension, and other groups interested in the extent of grazing activities. The minimum mapping unit for Grazing Land is 40 acres.

- **Urban and Built-up Lands –** Land occupied by structures with a building density of at least one unit to 1.5 acres or approximately six structures to a 10-acre parcel. This land is used for residential, industrial, commercial, institutional, and other developed purposes.
- **Other Land –** Land not included in any other mapping category. Common examples include low-density rural developments; brush, timber, wetland, and riparian areas not suitable for livestock grazing; confined livestock, poultry, or aquaculture facilities; strip mines and borrow pits; and water bodies smaller than 40 acres. Vacant and nonagricultural land surrounded on all sides by urban development and greater than 40 acres is mapped as Other Land.
- **Water –** Perennial water bodies with an extent of at least 40 acres

The designations for Prime Farmland, Farmland of Statewide Importance, Unique Farmland, and Farmland of Local Importance are defined together under the terms "Agricultural Land" and "Important Farmland" in CEQA (Public Resources Code Sections 21060.1 and 21095 and Appendix G of the State CEQA Guidelines).

The acreages associated with the four categories of agricultural land that make up the Important Farmland classification are presented in Table 16-4 (see also Appendix P, "Land Use"). As shown, Important Farmlands total approximately 36,713 acres in the Restoration Area.

Table 16-4.
Total 2004 Acreage of Agricultural Lands in the Restoration Area

River Reach	Land Use (acres)[1]				
	Prime Farmland	Farmland of Statewide Importance	Unique Farmland	Farmland of Local Importance	Total
Reach 1	3,273 (55%)	1,215 (20%)	452 (8%)	1,023 (17%)	5,963
Reach 2	3,573 (53%)	1,725 (26%)	486 (7%)	949 (14%)	6,733
Reach 3	5,003 (83%)	635 (11%)	333 (6%)	44 (<1%)	6,015
Reach 4	7,053 (79%)	1,213 (14%)	571 (6%)	143 (2%)	8,980
Reach 5	104 (22%)	191 (41%)	113 (24%)	55 (12%)	463
Bypasses	1,570 (18%)	939 (11%)	4,724 (55%)	1,308 (15%)	8,541
Total	**20,576 (56%)**	**5,918 (16%)**	**6,697 (18%)**	**3,522 (10%)**	**36,695**

Sources: DOC 2004a, 2006

Note:
[1] Acreage numbers have been rounded to the nearest acre.
Key:
% = percent
< = less than

Forest Land

Forest land is defined as native tree cover greater than 10 percent that allows for management of timber, aesthetics, fish and wildlife, recreation, and other public benefits (PRC Section 12220(g)). Natural forest and woodland vegetation types in the study area typically have greater than 10 percent cover by native trees. (Appendix L, "Biological Resources – Vegetation and Wildlife" shows the distribution of natural forest and woodland in the Restoration Area.)

Forest land in the Restoration Area consists of riparian forest that has been classified into four major types based on the dominant species: cottonwood riparian forest, willow riparian forest, mixed riparian forest, and valley oak riparian forest (see Chapter 6.0, "Biological Resources—Vegetation and Wildlife," for a detailed discussion of these habitat types and their distribution by reach within the Restoration Area). As shown in Table 16-5, forest lands total approximately 4,320 acres in the Restoration Area.

Table 16-5.
Habitats and Acreage of Forest Land in the Restoration Area

Habitat Type	Habitat Acreage[1]						
	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Bypasses	Total
Cottonwood Riparian Forest	386 (37%)	120 (12%)	452 (43%)	56 (5%)	29 (3%)	-- (0%)	1,043
Willow Riparian Forest	345 (16%)	163 (8%)	124 (6%)	777 (36%)	755 (35%)	2 (<1%)	2,166
Mixed Riparian Forest	783 (99%)	2 (<1%)	-- (0%)	6 (<1%)	1 (<1%)	-- (0%)	792
Valley Oak Riparian Forest	265 (41%)	-- (0%)	-- (0%)	23 (7%)	35 (11%)	-- (0%)	323
Total	**1,779 (41%)**	**285 (7%)**	**576 (13%)**	**862 (20%)**	**820 (19%)**	**-- (0%)**	**4,324**

Source: DWR 2002

Note:

[1] Acreage numbers have been rounded to the nearest acre.

Key:

% = percent

< = less than

Public and Private Lands

For purposes of this analysis, land ownership was separated into two broad classifications: public and private. Public lands were classified as any of the following: Federal lands (e.g., Reclamation, USFWS), State Lands Commission public trust and fee title lands, other State and county lands (e.g., DFG (Wildlife Conservation Board), Lower San Joaquin River Levee District, Fresno County Parks), and lands owned by the SJRPCT (Reach 1 only).

Overall, land ownership along the San Joaquin River from Friant Dam to the confluence with the Merced River encompasses approximately 72,581 acres, of which approximately 6 percent is held publicly and 94 percent is held privately (Table 16-6). Public ownership is approximately 6 percent in Reach 1; there is no significant public ownership in Reaches 2 or 3. Public ownership increases substantially in Reach 4 (8.9 percent) and

Reach 5 (22.4 percent) and decreases again in the bypasses (3.5 percent). These public lands are largely USFWS refuges (San Luis National Wildlife Refuge) (Figure 16-1) and California State parks. Between 93.8 percent and 100 percent of lands in Reaches 1 through 3 are privately owned. Private land decreases to 91.1 percent in Reach 4 and 77.6 percent in Reach 5 and increases again in the bypasses to 96.5 percent.

Table 16-6.
Public and Private Lands in the Restoration Area

River Reach and Bypasses	Land Ownership (acres)[1]			Percent of Total Public and Private Lands in the Restoration Area
	Public (Federal and State)	Private	Total	
Reach 1	977 (6%)	14,854 (94%)	15,831	21.8%
Reach 2	0 (0%)	9,172 (100%)	9,172	12.6%
Reach 3	0 (0%)	8,056 (100%)	8,056	11.1%
Reach 4	1,280 (9%)	13,159 (91%)	14,439	19.9%
Reach 5	1,223 (22%)	4,238 (78%)	5,461	7.5%
Bypasses	683 (3%)	18,940 (97%)	19,623	27.0%
Total	**4,163 (6%)**	**68,419 (94%)**	**72,582**	**100%**

Source: CASIL 1999

Note:

[1] Acreage numbers have been rounded to the nearest acre.

16.1.2 San Joaquin River from Merced River to the Delta

Downstream from the Restoration Area, the San Joaquin River traverses primarily agricultural land, including annual and permanent cropland. In a few locations, urban uses, including a wastewater treatment plant and small, unincorporated towns, are located adjacent to the river. Various State and county highways are located near or cross the river.

16.1.3 Central Valley Project/State Water Project Water Service Areas

Program alternatives have the potential to affect land use patterns and land use designations in the Friant Division of the CVP. Discussion in this section emphasizes land uses in the Friant Division because significant land use effects are not anticipated in the CVP/SWP water service areas outside of the Friant Division.

Friant Division Water Supply and Deliveries

Water at Friant Dam is diverted through two canal outlets and conveyed to Friant Division contractors north in the Madera Canal and south in the Friant-Kern Canal. More than 90 varieties of crops are grown in the Friant Division with water diverted from the San Joaquin River. The Friant Division, together with the San Joaquin River below the Merced River confluence and CVP/SWP water conveyance facilities from the Delta, provide water to the CVP/SWP water service areas. Federal, State, and local water service entities manage water supplies throughout the Study Area.

The Friant Division supports conjunctive water management in an area that was subject to groundwater overdraft prior to construction of Friant Dam. Reclamation employs a two-class system of water allocation. Class 1 contracts are based on a firm water supply, and are generally assigned to agricultural and M&I water users who have limited access to good quality groundwater. Water is delivered to Class 2 contracts when surplus water is available.

For this discussion, each district or water supplier's geographic location, service boundary, and general description of its land use are presented. The terms "service boundary" and "place of use" (POU) both mean the area to which each district supplies its water; the land use discussion is focused on this area.

Land Use Within the Friant Division

Table 16-7 shows the acreages of land use by Friant Division contractors. Locations of the Friant Division contractors are shown in Chapter 13.0, "Hydrology - Surface Water Supplies and Facilities Operations." The 28 contractors include agricultural and M&I contractors. Each contractor's boundary area corresponds to its POU, and its land use is designated by both regional and local planning agencies.

Agricultural land uses include crops similar to those described above for the Restoration Area; urban land uses include cities, major roadways, and other urban features; and open space land uses, which occur in only a few of the districts, correspond to various conservation easements and are described below.

Table 16-7.
Existing Land Uses in Friant Division

Water District	Land Uses (acres)[3]			
	Agricultural	Open Space	Urban	Total
Arvin-Edison WSD	128,941 (97%)	220 (<1%)	3,691 (3%)	132,852
Chowchilla WD	85,869 (97%)	0 (0%)	2,250 (3%)	88,119
City of Fresno Service Area[1]	85,869 (97%)	0 (0%)	2,250 (3%)	88,119
City of Lindsay	415 (27%)	0 (0%)	1,113 (73%)	1,528
City of Orange Cove	286 30%)	0 (0%)	674 (70%)	960
Delano-Earlimart ID	56,264 (99%)	0 (0%)	353 (<1%)	56,617
Exeter ID	14,078 (93%)	0 (0%)	1,136 (7%)	15,214
Fresno County Waterworks No.18	251 (99%)	2 (<1%)	0 (0%)	253
Fresno ID[1]	187,489 (76%)	64 (<1%)	60,336 (24%)	247,889
Garfield WD	1,813 (100%)	0 (0%)	0 (0%)	1,813
Gravelly Ford WD	8,431 (100%)	0 (0%)	0 (0%)	8,431
International WD	724 (100%)	0 (0%)	0 (0%)	724
Ivanhoe ID	10,983 (100%)	0 (0%)	0 (0%)	10,983
Lewis Creek WD	1,297 (100%)	0 (0%)	0 (0%)	1,297
Lindmore ID	27,483 (99%)	0 (0%)	214 (<1%)	27,697
Lindsay-Strathmore ID	15,628 (97%)	0 (0%)	492 (3%)	16,120
Lower Tule River ID	102,159 (99%)	932 (<1%)	185 (<1%)	103,276
Madera County[2]	365,436 (27%)	986,084 (72%)	26,014 (2%)	1,377,534
Madera ID	123,830 (95%)	1 (<1%)	6,882 (5%)	130,713
Orange Cove ID	29,163 (100%)	0 (0%)	116 (<1%)	29,279
Porterville ID	15,842 (93%)	0 (0%)	1,194 (7%)	17,036

Table 16-7.
Existing Land Uses in Friant Division (contd.)

Water District	Land Uses (acres)[3]			
	Agricultural	Open Space	Urban	Total
Saucelito ID	19,826 (100%)	0 (0%)	0 (0%)	19,826
Shafter-Wasco ID	36,042 (92%)	0 (0%)	2,952 (8%)	38,994
Southern San Joaquin MUD	56,233 (91%)	79 (<1%)	5,308 (9%)	61,620
Stone Corral ID	6,882 (100%)	0 (0%)	0 (0%)	6,882
Tea Pot Dome WD	3,581 (100%)	0 (0%)	0 (0%)	3,581
Terra Bella ID	13,642 (98%)	0 (0%)	272 (2%)	13,914
Tulare ID	69,293 (94%)	0 (0%)	4,220 (6%)	73,513

Source: Data provided by EDAW in 2008 based on digitized GIS data

Notes:

Table based on digitized GIS data. Some water user polygons overlap, so acreage will be higher than actual footprint.

[1] Acreages shown for the City of Fresno Service Area and Fresno Irrigation District are inflated because more than 70,000 acres of land uses in these two service areas overlap.

[2] Land use data available for Madera County included categories not reflected in the three land use categories shown in this table. The additional acreage—from the water (6,055.25 acres), rural residential/vacant (38,952.74 acres), and not mapped (primarily the Sierra National Forest) (516,494.54 acres) categories—is included in the calculation shown for open space.

[3] Acreage numbers have been rounded to the nearest acre.

Key:
% = percent
< = less than
ID = irrigation district
MUD = municipal utility district
WD = water district
WSD = water storage district

Arvin-Edison Water Storage District. The Arvin-Edison WSD service area is located in Kern County and encompasses a small portion of the eastern portion of the City of Bakersfield and the towns of Weedpatch and Arvin. The Arvin-Edison WSD POU is approximately 132,853 acres; 97.1 percent of this is agricultural and 2.8 percent is urban. Urban areas are composed primarily of the city and towns described above, and major highways crossing the service area (SRs 58, 178, 184, and 99). The City of Bakersfield maintains open space in the Arvin-Edison WSD POU, accounting for approximately 0.2 percent of the total acreage.

Delano-Earlimart Irrigation District. The Delano-Earlimart Irrigation District (Delano-Earlimart ID) serves approximately 56,617 acres. Its southern boundary is adjacent to the Southern San Joaquin Irrigation District's northern edge. Delano-Earlimart ID does not serve the cities of Delano or Earlimart, but rather the agricultural lands surrounding the cities. Its service boundary is bordered by Delano on its southwest side and surrounds the town of Earlimart. The town of Richgrove borders Delano-Earlimart ID on the east. Of the total acreage in Delano-Earlimart ID's POU, approximately 99.4 percent is agricultural land use, and the remaining 0.6 percent is urban. There is no open space use.

Exeter Irrigation District. The Exeter ID service boundary encompasses approximately 15,214 acres, located in Tulare County, east of the City of Visalia. Exeter ID's POU includes most of the City of Exeter. The dominant land use is agriculture, which constitutes 92.5 percent of the total land use, with urban uses consisting of Exeter, SR 65, and SR 245 (remaining 7.5 percent). There is no open space use.

Fresno Irrigation District. Located adjacent to the City of Fresno's service area in Fresno County, the Fresno ID encompasses approximately 247,889 acres, most of which are rural agriculture lands surrounding the city (75.6 percent). Fresno ID is bounded on the north by the Fresno County line and the San Joaquin River, and touches the Garfield WD and International WD on its northeastern side. Fresno ID's service boundary substantially overlaps the service boundary of the City of Fresno, and, therefore, the district's urban land use is estimated at approximately 24.3 percent. The San Joaquin River Ecological Reserve is present in the Fresno ID POU and is considered open space land use. The reserve accounts for less than 1 percent of the total acreage.

Garfield Water District. Garfield Water District's (service boundary is adjacent to the northeast border of Fresno ID. Garfield WD serves a total of 1,813 acres with water. In its POU, land use is completely rural and is agricultural. There are no urban or open space land uses.

International Water District. International WD is located east of the City of Fresno in Fresno County. It serves approximately 724 acres; 100 percent of that area is used for agriculture.

Ivanhoe Irrigation District. Located northeast of Visalia and just north of the town of Ivanhoe in Tulare County, Ivanhoe ID serves approximately 10,983 acres. Agriculture is the only land use; there are no open space or urban land uses.

Lewis Creek Water District. Bordered on the north by Exeter ID and on the south by the Lindmore ID and Lindsay-Strathmore ID, the Lewis Creek WD is in Tulare County, just north of the town of Lindsay. Lewis Creek WD serves approximately 1,297 acres, all of which are used for agriculture. The closest large urban use is the town of Lindsay.

Lindmore Irrigation District. Lindmore ID borders the town of Lindsay, Lindsay-Strathmore ID, and Lewis Creek WD in Tulare County. The Lindmore ID POU is approximately 16,121, acres and is primarily agricultural, which accounts for 96.9 percent of the land use. The exception is urban roads crossing from northwest to southeast, which account for the remaining 3.1 percent.

Lindsay-Strathmore Irrigation District. Lindsay-Strathmore ID is bordered on the west by Lindmore ID and the town of Lindsay, and serves approximately 16,121 acres. Approximately 96.9 percent is used for agriculture, and the remaining 3.1 percent of the acreage is urban. There is no open space use.

Lower Tule River Irrigation District. Lower Tule River ID is located in Tulare County, southeast of Lindmore ID, west of the Porterville ID, northwest of the Saucelito ID, and southeast of the Tulare ID. It serves approximately 103,276 acres.

Agriculture accounts for 99 percent of the total land use. Most of the remaining area (slightly less than 1 percent) is open space. A very small area is in urban use.

Orange Cove Irrigation District. Orange Cove ID, with a POU approximately 29,279 acres in size, and which surrounds, but does not provide service to, the City of Orange Cove (Orange Cove), is located in Tulare County near the Tulare-Fresno county border. Land use is 99.6 percent agricultural and 0.4 percent urban, with some small roads connecting the city to major highways.

Porterville Irrigation District. Porterville ID is located in Tulare County and serves approximately 17,036 acres. Urban uses include the City of Porterville, SR 65, and SR 190. Agriculture accounts for approximately 93 percent of the total land use and urban uses account for the remaining 7 percent. There is no open space use.

Saucelito Irrigation District. Saucelito ID is located in Tulare County, bordered by the Lower Tule River ID on the north and Delano-Earlimart ID on the south. The Saucelito ID service area is approximately 19,826 acres, all of which are used for agriculture. There are no urban or open space uses.

Shafter-Wasco Irrigation District. Located northwest of Bakersfield in Kern County on SR 43, the Central Valley Highway, Shafter-Wasco ID serves the cities of Shafter and Wasco and the surrounding agricultural area. Shafter-Wasco ID's service boundary includes approximately 38,994 acres. Of Shafter-Wasco ID's service area, approximately 92.4 percent is used for agriculture, and the remaining 7.6 percent acres is urban. There is no open space use.

Southern San Joaquin Municipal Utilities District. Southern San Joaquin Municipal Utilities District (Southern San Joaquin MUD) is located in Kern County, bordered on its north side by the Kern/Tulare county line and Delano-Earlimart ID service boundary. The City of Bakersfield is approximately 20 miles southeast of Southern San Joaquin MUD's service boundary, which includes approximately 61,621 acres. Land use is primarily agricultural, consisting of 91.3 percent of the total land use, with urban uses taking up 8.6 percent. The main urban land uses are the cities of Delano and McFarland and SR 99 and SR 46. Open space accounts for 0.1 percent of the total.

Stone Corral Irrigation District. Stone Corral ID, located in Tulare County, is approximately 2.5 miles southeast from the Orange Cove. Stone Corral ID's land use in its service area, which is approximately 6,882 acres, is entirely agricultural.

Tea Pot Dome Water District. Tea Pot Dome WD, located just south of Porterville ID and the cities of Porterville and East Porterville in Tulare County, serves approximately 3,581 acres. The Tea Pot Dome WD service area land use is entirely agricultural.

Terra Bella Irrigation District. Serving the City of Terra Bella, which has a population of approximately 4,000 residents, Terra Bella ID is located south of Tea Pot Dome ID, east of Saucelito ID in Tulare County, and has a service area of approximately 13,914 acres. Terra Bella ID service area land use is 98.2 percent agricultural and 0.8 percent urban. Urban uses include the City of Terra Bella and connector roads.

Tulare Irrigation District. Located in Tulare County north of the Tulare River Irrigation District and south of the City of Visalia, the Tulare ID service area is approximately 73,513 acres. Tulare ID serves agricultural users and the western portion of the City of Tulare. The Tulare ID service area land use is 94.3 percent agricultural and 5.7 percent urban, including SR 99 and the portion of the city that Tulare ID serves.

Chowchilla Water District. Encompassing 88,119 acres, the Chowchilla WD is one of the largest Friant Division Water User POUs. Chowchilla WD is located in Madera County, northwest of the City of Madera. It serves the City of Chowchilla and also includes SR 99, SR 233, and SR 152. Agriculture is the primary land use, accounting for 97.4 percent of Chowchilla WD's service area. Urban land uses accounts for the remaining 2.6 percent. There is no open space use.

Madera Irrigation District. The Madera ID is located in Madera County, and overlaps the City of Madera, encompassing approximately 130,714 acres. Urban land use is composed primarily of the City of Madera and SR 99 and accounts for approximately 5.3 percent. Agricultural uses surround the urban area and account for approximately 94.7 percent of all land use. A small portion, less than 1 percent of the total acreage, of Madera ID's POU overlaps the San Joaquin River Ecological Reserve, which is considered an open space land use.

Gravelly Ford Water District. The Gravelly Ford WD is located in Madera County, southwest of the City of Madera and Madera ID. Its service area is approximately 8,431 acres, and Gravelly Ford WD serves agricultural land uses only.

City of Fresno. The City of Fresno, which is located in Fresno County, serves a population of approximately 466,400 residents (City-data.com 2008) inside its 90,465-acre service area. Land uses within Fresno are primarily urban within city limits, and account for 69.9 percent of total land use. Agriculture accounts for 28.2 percent of land use and typically occurs outside city limits. The San Joaquin River Ecological Reserve overlaps with Fresno's POU, and this overlap is considered an open space land use. Open space makes up approximately 1.9 percent of the total acreage.

City of Lindsay. The City of Lindsay is located in Tulare County and serves a population of approximately 10,297 residents (City-data.com 2008) within its 1,528-acre service area. The Lindsay service area boundary primarily includes Lindsay and is thus 72.8 percent urban. Agricultural uses make up the remaining 27.2 percent and generally occur on the outskirts of the city. There is no open space land use.

City of Orange Cove. Orange Cove is located in Fresno County and serves a population of approximately 10,000 residents (City-data.com 2008) within its 960-acre service area. Orange Cove's service area boundary includes the city's urban area and a small portion of surrounding agricultural lands. The Orange Cove service area land use is 70.2 percent urban, with 29.8 percent agricultural land use. There is no open space use.

Fresno County Waterworks District No. 18. The Fresno County Waterworks District (FCWD) No. 18 is located in Fresno County, just southeast of Millerton Lake and northwest of the City of Fresno. FCWD's 290-acre service area's land use is primarily agricultural (99.2 percent), with a small amount of open space, (0.8 percent) which is attributable to the Lost Lake Recreation Area where it overlaps with FCWD's POU.

Madera County. Madera County serves a population of approximately 146,345 residents (U.S. Census Bureau 2008) inside its 2,147-square-mile service area where groundwater is not plentiful. Land use in the county is primarily open space (including the water, rural residential/vacant, and not mapped categories) (71.6 percent). Open space lands include portions the Sierra and Inyo national forests, the Ansel Adams and John Muir wilderness areas, Yosemite National Park, Devils Postpile National Monument, Millerton Lake State Recreation Area, and Bass Lake. Agricultural uses make up 26.5 percent and urban uses make up slightly less than 2 percent of the land uses in the county.

16.2 Regulatory Setting

The regulatory setting for land use resources includes Federal, State, regional, and local requirements.

16.2.1 Federal

Federal laws and regulations pertaining to land use resources are discussed below.

Farmland Protection Policy Act of 1981

The Farmland Protection Policy Act is intended to minimize the impact of Federal programs with respect to the conversion of farmland to nonagricultural uses. It ensures that, to the extent possible, Federal programs are administered to be compatible with State, local, and private programs and policies to protect farmland. The U.S. NRCS is the agency primarily responsible for implementing the Farmland Protection Policy Act (NRCS 2007a).

The Farmland Protection Policy Act established the Farmland Protection Program and the Land Evaluation and Site Assessment (LESA) system. The NRCS administers the Farmland Protection Program, which is a voluntary program that helps purchase development rights to keep productive farmland in agricultural uses. The program provides matching funds to State, local, and tribal government entities and nongovernmental organizations with existing Farmland Protection Programs to purchase conservation easements. Participating landowners agree not to convert land to nonagricultural uses, and retain all rights to the property for future agriculture. A minimum 30-year term is required for conservation easements, and priority is given to applications with perpetual easements (NRCS 2007b). The LESA system is a tool used to rank lands for suitability and inclusion in the Farmland Protection Program. Land evaluations involve rating soils and placing them into groups ranging from the best to the least suited for a specific agricultural use, such as cropland, forestland, or rangeland. Site assessments involve three major areas: nonsoil factors related to agricultural use of a site, factors related to development pressures, and other public values of a site. Each factor selected is assigned a range of possible values according to local needs and objectives (NRCS 2007c).

16.2.2 State of California

State laws and regulations pertaining to land use resources are discussed below.

State Planning and Zoning Laws

California Government Code Section 65300 et seq. establishes the obligation of cities and counties to adopt and implement general plans. A general plan is a comprehensive, long-term strategy document that sets forth the expected location and general type of physical development expected in the city or county developing the document. The plan also may consider land outside its boundaries that, in the city's or county's judgment, may affect land use activities within its borders. The general plan addresses a broad range of topics, including, at a minimum, land use, circulation, housing, conservation, open space, noise, and safety. In addressing these topics, the general plan identifies the goals, objectives, policies, principles, standards, and plan proposals that support the city's or county's vision for the area. The general plan is a long-range document that typically addresses development over a 20-year period. Although the general plan serves as a blueprint for future development and identifies the overall vision for the planning area, it remains general enough to allow flexibility in the approach taken to achieve the plan's goals.

The State Zoning Law (California Government Code Section 65800 et seq.) establishes that zoning ordinances, which are laws that define allowable land uses in a specific district, are required to be consistent with the general plan and any applicable specific plans. When amendments to the general plan are made, corresponding changes in the zoning ordinance may be required within a reasonable time to ensure that the land uses designated in the general plan also would be allowable by the zoning ordinance (Government Code Section 65860(c)).

Williamson Act

The California Land Conservation Act of 1965, commonly known as the Williamson Act, was enacted when population growth and rising property taxes were recognized as a threat to the viability of valuable farmland in California. It enables local governments to enter into contracts with private landowners to promote the continued use of relevant land in agricultural or related open space use. In return, landowners receive property tax assessments that are based on farming and open space uses instead of full market value. Local governments receive an annual subvention (subsidy) of forgone property tax revenues from the State via the Open Space Subvention Act of 1971.

The Williamson Act empowers local governments to establish "agricultural preserves" consisting of lands devoted to agricultural and other compatible uses. After such preserves are established, the locality may offer to owners of included agricultural land the opportunity to enter into annually renewable contracts that restrict the land to agricultural use for at least 10 years (i.e., the contract continues to run for 10 years following the first date on which the contract is not renewed). In return, the landowner is guaranteed a relatively stable tax rate, based on the value of the land for agricultural/open space use only, and is unaffected by its development potential.

Contracts can be terminated only by a cancellation or nonrenewal. Cancellation of a Williamson Act contract involves an extensive review and approval process, in addition to payment of fees of up to 12.5 percent of the property value. The local jurisdiction approving the cancellation must find that the cancellation is consistent with the purpose of the California Land Conservation Act or is in the public interest. Several subfindings must be made to support either finding, as defined in California Government Code Section 51282. Filing for a nonrenewal, which can be done unilaterally by either the property owner or the local government, initiates a gradual increase in the property tax rate over the 10-year renewal period until it reaches the market rate by the end of the term. During the nonrenewal period, the property continues to be limited to uses allowed by the Williamson Act.

Farmland Security Zones

In August 1998, the legislature enhanced the Williamson Act with the FSZ provisions. FSZs, also known as Super Williamson Act lands, were established by the California Department of Conservation (DOC) with the same intent as Williamson Act contracts. The FSZ provisions offer landowners greater property tax reductions in return for a minimum rolling contract term of 20 years. An FSZ must be located in an Agricultural Preserve (area designated as eligible for a Williamson Act contract) and designated as Prime Farmland, Farmland of Statewide Importance, Unique Farmland, or Farmland of Local Importance. Land protected in an FSZ cannot be annexed by a city or county government or school district. FSZ contracts constitute nearly 2 percent of statewide Williamson Act enrollment (DOC 2007a).

An FSZ can be terminated through a nonrenewal or cancellation. The nonrenewal allows a rollout process to occur over the remainder of the term of the contract, when the tax rates would gradually rise to the full rate by the end of the 20-year term. A cancellation must be applied for and approved by the director of the DOC, and specific criteria must be met. The cancellation must be in the public interest and consistent with Williamson Act criteria. If a cancellation is approved, fees equal to 25 percent of the full market value of the property must be paid (DOC 2007a).

California Important Farmland Inventory System and Farmland Mapping and Monitoring Program

The DOC, Office of Land Conservation, maintains a statewide inventory of farmlands. These lands are mapped by the Division of Land Resource Protection as part of the FMMP. The FMMP was established by the State in 1982 to continue the Important Farmland mapping efforts begun in 1975 by the U.S. Soil Conservation Service (now called the NRCS). The intent of the NRCS was to produce agricultural resource maps based on soil quality and land use across the nation. The maps are updated every 2 years with the use of aerial photographs, a computer mapping system, public review, and field reconnaissance.

As part of the nationwide effort to map agricultural land uses, the NRCS developed a series of definitions known as Land Inventory and Monitoring (LIM) criteria. The LIM criteria classify land's suitability for agricultural production. Suitability includes both physical and chemical characteristics of soils, as well as the actual land use. Maps of Important Farmland are derived from NRCS soil survey maps using the LIM criteria and are available by county (DOC 2004b).

California Farmland Conservancy Program

The California Farmland Conservancy Program (CFCP) is a statewide grant funding program that supports local efforts to establish agricultural conservation easements and planning projects for the purpose of preserving important agricultural land resources (DOC 2007c). The CFCP provides grants to local governments and qualified nonprofit organizations for the following (DOC 2007b):

- Voluntary acquisition of conservation easements on agricultural lands that are under pressure of being converted to nonagricultural uses
- Temporary purchase of agricultural lands that are under pressure of being converted to nonagricultural uses, as a phase in the process of placing agricultural conservation easements on farmland
- Agricultural land conservation policy and planning projects
- Restoration of and improvements to agricultural land already under easement

Land Evaluation and Site Assessment Model

Based on the Federal LESA system, the California LESA model was developed in 1997 to provide lead agencies with an optional methodology to ensure that potentially significant effects on the environment of agricultural land conversions are quantitatively and consistently considered in the environmental review process, including in CEQA reviews. The California Agricultural LESA model evaluates measures of soil resource quality, a given project's size, water resource availability, surrounding agricultural lands, and surrounding protected resource lands. For a given project, the factors are rated, weighted, and combined, resulting in a single numeric score. The project score becomes the basis for determining a project's potential significance (DOC 1997).

16.2.3 Regional and Local

Regional and local laws and regulations pertaining to land use resources are discussed below.

Fresno County General Plan

The *Fresno County General Plan* (Fresno County 2000) was updated in October 2000. This plan identifies allowable uses and relevant goals, policies, and implementation programs that should be considered when assessing the action alternatives.

In the Restoration Area, Fresno County's land use jurisdiction lies to the south and west of the San Joaquin River centerline, through Reaches 1, 2, 3, and into 4A. The *Fresno County General Plan* identifies 27 primary land use designations and three overlay designations (an overlay land use designation modifies the policies, standards, or procedures established for the underlying primary land use designation). One of the three overlay designations is for the San Joaquin River corridor. Each primary land use designation is defined in terms of allowable uses and intensity standards. The land use designations are implemented largely through the zoning ordinance.

The Agriculture and Land Use Element and Open Space and Conservation Element of the *Fresno County General Plan* are of importance to the evaluations of the action alternatives. Agricultural land produces crops and livestock and contains necessary agricultural commercial centers, processing facilities, and certain semiagricultural activities. Conservation and open space areas are essentially unimproved and are planned to remain open in character to preserve natural resources; the managed production of resources, parks, and recreation, thereby protecting and enhancing cultural resources and providing recreational opportunities; and the protection of the community from natural and human-made hazards.

The primary overlay designation on these land uses (agricultural and open space) is the San Joaquin River Corridor Overlay, which provides for agricultural activities with incidental home sites, sand and gravel extraction, various recreational activities, wildlife habitat areas, and uses that serve the San Joaquin River Parkway. Both of these land uses are described in more detail below. The uses described below are not always consistent with land use designations presented in Section 2.4 because land use designations vary between each of the county general plans.

Agriculture and Land Use Element. Agriculture is essential to the visions and goals of the *Fresno County General Plan* (Fresno County 2000). This focus is reflected in its land use policies, which guide decisions to minimize conversion of productive agriculture land, to protect agricultural activities from incompatible land uses, and to control expansion of nonagricultural development onto productive agricultural lands.

Open Space and Conservation Element. A primary section of the Open Space and Conservation Element is governance of groundwater and surface water in Fresno County.

Madera County General Plan

The *Madera County General Plan Policy Document* (Madera County 1995), adopted in October 1995, is a stand-alone document that is part of the *Madera County General Plan*. In the Restoration Area, Madera County's land use jurisdiction lies north and east of the San Joaquin River centerline and continues downstream from Friant Dam through Reaches 1, 2, 3, and 4A. The *Madera County General Plan* is organized differently from the *Fresno County General Plan* but shares many of the same components. The *Madera County General Plan* also contains a section that incorporates the *Recompiled San Joaquin River Parkway Master Plan* (SJRC 2000). The *Recompiled San Joaquin River Parkway Master Plan* and other applicable chapters of the *Madera County General Plan* are described below.

San Joaquin River Parkway Plan

The SJRC was created in 1993 to acquire, manage, and operate San Joaquin River Parkway lands. The San Joaquin River Parkway Task Force, an advisory body created by State statute in 1990, adopted the San Joaquin River Parkway Task Force (SJRC 1992) in 1992. The *Recompiled San Joaquin River Parkway Master Plan* (SJRC 2000) was adopted on July 20, 2000. The parkway plan is a conceptual, long-range planning document intended to help preserve, enhance, and provide for enjoyment of the natural landscape of the San Joaquin River corridor. The parkway would include the San Joaquin River and approximately 4,650 acres of land on both sides of the river (in both Madera and Fresno counties) between Friant Dam and the SR 99 crossing.

Portions of the proposed parkway are managed for recreational or natural resource protection, conservation, and education purposes, although other parts are privately owned and are used for other purposes. Approximately 2,900 of the 4,650 acres in the proposed parkway are private land. The parkway master plan includes the following six fundamental goals (SJRC 2000):

- Preserve and restore a riparian corridor of regional significance along the San Joaquin River from Friant Dam to Highway 99 (Reach 1A)
- Protect wildlife species that depend on or prefer the river environment for at least part of their existence
- Provide for conservation, education, and recreation, particularly a continuous trail, in a cooperative manner with affected landowners
- Protect irreplaceable natural and cultural resources in a way that will also meet people’s recreational and educational needs
- Protect existing undeveloped areas of the river bottom, which should remain non-urbanized and be retained in open space or agriculture if feasible
- Provide land use and management policies for the San Joaquin River and areas of the river bottom included in the San Joaquin River Parkway that will enhance the attractiveness of the Fresno-Madera metropolitan area and enhance the quality of life of its residents.

More specific goals, objectives, and policies are included in various elements. The Natural Resources Element in the parkway master plan identifies goals, objectives, and policies for natural resources and flood management. Recreation areas are addressed in the Recreation Element. The plan also includes a Mineral Resource Element and a Plan Implementation Element that address land acquisition and a parkway managing entity. The parkway master plan addresses other land uses, including agriculture, commercial services, and public services facilities.

Merced County General Plan

The *Merced County Year 2000 General Plan* was adopted in December 1990 (Merced County 2000). In the Restoration Area, Merced County's land use jurisdiction includes about half of Reach 4A and all of Reach 5. The general plan recognizes two primary categories of land uses: urban and rural. As with the other county general plans, the *Merced County Year 2000 General Plan's* goals, objectives, and policies should be referenced when considering the effects of the action alternatives. Applicable sections of the *Merced County Year 2000 General Plan* are summarized below.

Open Space/Conservation Chapter. The Open Space/Conservation chapter is a plan for comprehensive and long-range management, preservation, and conservation of open space lands. The chapter identifies provisions for managing and conserving Merced County's natural resources and for protecting life, health, and property from natural hazards. The natural resources addressed in the chapter include land, water, plant, animal, cultural, archaeological, scenic resources, and air quality. The chapter's policies are designed to ensure that the development of Merced County will not significantly interfere with or destroy valuable natural resources, and that development will occur with recognition of sensitive resources and hazardous conditions. The purpose of the general plan is to maintain the natural topography, vegetation, wildlife, and scenic beauty of Merced County to the greatest extent possible, while recognizing that Merced County must balance needs for affordable housing and economic opportunities.

Agriculture Chapter. The purpose of the Agriculture chapter is to define policies that improve the viability of agricultural operations and promote the conservation of agricultural land.

Friant Division Water Users County or City General Plans

Land uses in the counties and cities that are served by Friant Division Water Users are governed by the local county or city general plan land use goals and implementation policies. Restoration of the San Joaquin River and alternatives are not reasonably expected to require local land use decision makers to change existing or future land use designations. Therefore, the local county and city land use designations, goals, and policies are not described at this time.

16.3 Environmental Consequences and Mitigation Measures

This section describes the methodology, criteria for determining significance of effects, and environmental consequences and mitigation measures associated with effects of each of the program alternatives on land use and agricultural resources. The program alternatives evaluated in this chapter are described in detail in Chapter 2.0, “Descriptions of Alternative,” and summarized in Table 16-8. Table 16-9 summarizes the impacts and mitigation measures.

Table 16-8.
Actions Included Under Action Alternatives

Level of NEPA/CEQA Compliance	Actions[1]		Action Alternative					
			A1	A2	B1	B2	C1	C2
Project-Level	Reoperate Friant Dam and downstream flow control structures to route Interim and Restoration flows		✓	✓	✓	✓	✓	✓
	Recapture Interim and Restoration flows in the Restoration Area		✓	✓	✓	✓	✓	✓
	Recapture Interim and Restoration flows at existing CVP and SWP facilities in the Delta		✓	✓	✓	✓	✓	✓
Program-Level	Common Restoration actions[2]		✓	✓	✓	✓	✓	✓
	Actions in Reach 4B1 to provide at least:	475 cfs capacity	✓	✓	✓	✓	✓	✓
		4,500 cfs capacity with integrated floodplain habitat		✓		✓		✓
	Recapture Interim and Restoration flows on the San Joaquin River downstream from the Merced River at:	Existing facilities on the San Joaquin River			✓	✓	✓	✓
		New pumping infrastructure on the San Joaquin River					✓	✓
	Recirculation of recaptured Interim and Restoration flows		✓	✓	✓	✓	✓	✓

Notes:

[1] All alternatives also include the Physical Monitoring and Management Plan and the Conservation Strategy, which include both project- and program-level actions intended to guide implementation of the Settlement.

[2] Common Restoration actions are physical actions to achieve the Restoration Goal that are common to all action alternatives and are addressed at a program level of detail.

Key:
CEQA = California Environmental Quality Act
cfs = cubic feet per second
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
NEPA = National Environmental Policy Act
PEIS/R = Program Environmental Impact Statement/Report
SWP = State Water Project

Table 16-9.
Summary of Environmental Consequences and Mitigation Measures – Land Use Planning and Agricultural Resources

Impacts	Alternative	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance After Mitigation
Land Use Planning and Agricultural Resources: Program-Level				
LUP-1: Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts	No-Action	SU	--	SU
	A1	Significant	LUP-1a: Design and Implement Levee Setbacks to Preserve Agricultural Productivity of Important Farmland to the Extent Possible and Comply with the Surface Mining and Reclamation Act LUP-1b: Minimize Impacts on Williamson Act–Contracted Lands, Comply with Government Code Sections 51290–51293, and Coordinate with Landowners and Agricultural Operators	SU
	A2	Significant		SU
	B1	Significant		SU
	B2	Significant		SU
	C1	Significant		SU
	C2	Significant		SU
LUP-2: Conversion of Riparian Forest to Non-Forest Uses	No-Action	LTS	--	LTS
	A1	LTS	--	LTS
	A2	LTS	--	LTS
	B1	LTS	--	LTS
	B2	LTS	--	LTS
	C1	LTS	--	LTS
	C2	LTS	--	LTS
LUP-3: Conflict with Adopted Land Use Plans, Goals, Policies, and Ordinances of Affected Jurisdictions	No-Action	No Impact	--	No Impact
	A1	SU	--	SU
	A2	SU	--	SU
	B1	SU	--	SU
	B2	SU	--	SU
	C1	SU	--	SU
	C2	SU	--	SU
Land Use Planning and Agricultural Resources: Project-Level				
LUP-4: Physically Divide or Disrupt an Established Community	No-Action	No Impact	--	No Impact
	A1	PS	LUP-4: Implement Vehicular Traffic Detour Planning	LTS
	A2	PS		LTS
	B1	PS		LTS
	B2	PS		LTS
	C1	PS		LTS
	C2	PS		LTS
LUP-5: Substantial Diminishment of Agricultural Land Resource Quality and Importance Because of Altered Inundation and/or Soil Saturation	No-Action	No Impact	LUP-5: Preserve Agricultural Productivity of Important Farmland to Minimize Effects of Inundation and Saturation Effects	No Impact
	A1	PS		PSU
	A2	PS		PSU
	B1	PS		PSU
	B2	PS		PSU
	C1	PS		PSU
	C2	PS		PSU

Table 16-9.
Summary of Environmental Consequences and Mitigation Measures – Land Use Planning and Agricultural Resources (contd.)

Impacts	Alternative	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance After Mitigation
Land Use Planning and Agricultural Resources: Project-Level (continued.)				
LUP-6: Diminishment of Agricultural Production by Increased Orchard and Vineyard Diseases	No-Action	No Impact	--	No Impact
	A1	LTS	--	LTS
	A2	LTS	--	LTS
	B1	LTS	--	LTS
	B2	LTS	--	LTS
	C1	LTS	--	LTS
	C2	LTS	--	LTS
LUP-7: Potential Conversion of Riparian Forest Because of Altered Inundation	No-Action	No Impact	--	No Impact
	A1	LTS and Beneficial	--	LTS and Beneficial
	A2	LTS and Beneficial	--	LTS and Beneficial
	B1	LTS and Beneficial	--	LTS and Beneficial
	B2	LTS and Beneficial	--	LTS and Beneficial
	C1	LTS and Beneficial	--	LTS and Beneficial
	C2	LTS and Beneficial	--	LTS and Beneficial
LUP-8: Substantial Diminishment of Agricultural Land Resource Quality and Importance Because of Altered Water Deliveries	No-Action	No Impact	--	No Impact
	A1	SU	--	SU
	A2	SU	--	SU
	B1	SU	--	SU
	B2	SU	--	SU
	C1	SU	--	SU
	C2	SU	--	SU

Key:
-- = not applicable
LTS = less than significant
PS = potentially significant
PSU = potentially significant and unavoidable
SU = significant and unavoidable

16.3.1 Impact Assessment Methodology

Both program- and project-level actions may affect land use planning and agricultural resources in several ways. Of particular interest for this assessment, because of their potential to affect land use planning and agricultural resources, are modifications to the levee system in Reaches 2B and 4B1 and the Mendota Pool Bypass and establishing floodplain habitat; the change in the duration, magnitude, and seasonality of flows in the San Joaquin River from Friant Dam to the Merced River; and the change in water deliveries to Friant Division long-term contractors.

Evaluation of potential impacts on land use planning and agricultural resources was based in part on the following planning documents pertaining to the study area:

- *San Joaquin River Restoration Study Background Report* (FWUA and NRDC 2002)
- *Fresno County General Plan* (Fresno County 2000)
- *Madera County General Plan Policy Document* (Madera County 1995)
- *Merced County Year 2000 General Plan* (Merced County 2000)

Information for this analysis was also obtained through aerial imagery, field reconnaissance review, and consultation and coordination with appropriate agencies. The Important Farmland maps of the DOC and California Land Conservation Act (Williamson Act) maps for Fresno, Madera, and Merced counties were used to determine the agricultural significance of the lands in the study area. The area and distribution of riparian forests |are based on review of aerial photographs, studies by DWR (2002), and GIS data.

16.3.2 Significance Criteria

The thresholds of significance for impacts are based on the environmental checklist in Appendix G of the State CEQA Guidelines, as amended. These thresholds also encompass the factors taken into account under NEPA to determine the significance of an action in terms of its context and the intensity of its impacts. Based on these criteria, impacts on land use planning and agricultural resources would be significant if implementing an alternative under consideration would do any of the following:

- Physically divide an established community
- Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project adopted for the purpose of avoiding or mitigating an environmental effect
- Conflict with any applicable Habitat Conservation Plan or Natural Community Conservation Plan
- Convert Important Farmland (i.e., Prime Farmland, Unique Farmland, or Farmland of Statewide Importance), as shown on the maps prepared pursuant to the FMMP of the California Resources Agency, to nonagricultural use
- Conflict with existing zoning for agricultural use or a Williamson Act contract
- Conflict with existing zoning for, or cause rezoning of, forest land (as defined in PRC Section 12220(g)), timberland (as defined in PRC Section 4526), or timberland zoned Timberland Production (as defined in PRC Section 51104(g))
- Result in the loss of forest land or conversion of forest land to nonforest use

- Involve other changes in the existing environment that, because of their location or nature, could result in conversion of Important Farmland to nonagricultural use or the substantial diminishment of agricultural land resource quality or importance

Conflicts with applicable land use plans are not necessarily adverse alterations of the physical environment and thus not necessarily impacts. Therefore, with regard to applicable land use plans, conclusions are “consistent” or “inconsistent” not “less than significant,” “potentially significant,” or “significant.” If the inconsistency relates to a plan, policy, or regulation adopted to avoid environmental effects, then an inconsistency can result in a significant impact under CEQA.

The study area is not located within a Habitat Conservation Plan or Natural Community Conservation Plan area; therefore, no impacts related to this threshold would occur under any of the alternatives and no further discussion of this issue is necessary.

16.3.3 Program-Level Impacts and Mitigation Measures

This section provides a program-level evaluation of the direct and indirect effects of the program alternatives on land use planning, agricultural resources, and forest land. These actions could affect land use planning, agricultural resources, and forest land during the modification or construction of facilities or during other potential actions. In addition, the evaluation of effects on land use planning, agricultural resources, and forest land considered at a program level the potential effects of recapture of Restoration Flows using existing facilities on the San Joaquin River between the Merced River and the Delta and using potential new infrastructure in this segment of the river (Alternatives C1 and C2).

Constructing the levee system in Reaches 2B and 4B1, the Mendota Pool Bypass, establishing floodplain habitat, and other restoration actions (e.g., potentially constructing a new fish hatchery) could affect land use planning, agricultural resources, and forest land directly or indirectly. Constructing new pumping and conveyance infrastructure along the San Joaquin River between the Merced River and the Delta could further affect agricultural resources and forest land.

To the extent possible, this Draft PEIS/R identifies impacts associated with future borrow activity. However, there is insufficient information to identify specific borrow locations at this time; thus, it may not be possible to identify all impacts from future borrow activity associated with the Settlement. Accordingly, the Land Use Borrow Area (see Appendix P, “Land Use”) would be used to help project proponents and the SMARA (California PRC Section 2710 et seq.) lead agency to determine if impacts associated with future borrow activities have been analyzed at a sufficient level of detail in this Draft PEIS/R or if further environmental review is required. If further environmental review and analysis are required, this checklist would help guide project proponents and the SMARA lead agency in determining the appropriate document for NEPA and/or CEQA compliance.

No program-level actions proposed upstream from Friant Dam or in the Delta would have the potential to affect land use or agricultural resources. Therefore, these geographic areas are not discussed further in this section.

No-Action Alternative

The No-Action Alternative would not conflict with and would be consistent with adopted local land use plans, goals, policies, and ordinances of affected jurisdictions. The No-Action Alternative would not include construction or improvement activities that would result in conflicts with adopted local land use plans, goals, policies, or ordinances. Future development proposals over the 30-year planning horizon within the study area would be consistent with growth and development projected in applicable county general plans or within nearby city spheres of influence, which would also be included in the urban reserve area of applicable city general plans. It is possible that future development proposals could require general plan amendments and zoning actions; however, such actions would require approvals at the local level.

Impact LUP-1 (No-Action Alternative): ***Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts – Program-Level.*** Implementing the No-Action Alternative would involve the conversion of Important Farmland to nonagricultural urban uses. This impact would be **significant and unavoidable.**

Because the study area is largely in agricultural use and contains vast tracts of lands classified as Important Farmland and lands under Williamson Act and Super Williamson Act contracts, implementing future development projects to accommodate projected growth would result in the conversion of Important Farmland to nonagricultural urban uses and the cancellation of Williamson Act contracts. Although the magnitude and extent of the agricultural land that would be converted from future development is unknown, any loss of Important Farmland would be significant because there are no measures to fully mitigate the loss of Important Farmland. Additionally, the conversion of Important Farmland could also involve cancellation or expiration of many Williamson Act contracts. Contract cancellations would indirectly lead to urban development and subsequent agricultural land conversion. This impact would be significant.

Since there are no measures available to fully mitigate the loss of Important Farmland, this impact is significant and unavoidable.

Impact LUP-2 (No-Action Alternative): ***Conversion of Riparian Forest to Non-Forest Uses – Program-Level.*** Implementing the No-Action Alternative would not involve the conversion of riparian forest to non-forest uses. This impact would be **less than significant**.

Under the No-Action Alternative, Settlement actions that could remove, disturb, or otherwise alter riparian forest would not be carried out. Riparian forest would remain comparable to existing habitat and conditions; vegetation removal or habitat alterations associated with the Settlement would not occur. This impact would be less than significant.

Impact LUP-3 (No-Action Alternative): ***Conflict with Adopted Land Use Plans, Goals, Policies, and Ordinances of Affected Jurisdictions – Program-Level.*** The reasonably foreseeable, future projects included in the No-Action Alternative would not conflict with adopted land use plans, goals, policies, and ordinances of affected jurisdictions. Also, under the No-Action Alternative, Settlement actions that could conflict with adopted land use plans, goals, policies, and ordinances of affected jurisdictions would not be carried out. There would be **no impact**.

Alternatives A1 and B1

Some program-level actions included in Alternatives A1 and B1 would be inconsistent with county land use designations. It should be noted that inconsistencies with county land use designations and zoning codes are a land use regulation issue that could result in the conversion of agricultural and forest land to other uses, which is considered a significant impact and potentially unavoidable under CEQA. Alternatives A1 and B1 would also result in the conversion of agricultural land to nonagricultural uses and riparian forest to non-forest uses. These impacts would occur in the Restoration Area, as described below.

Impact LUP-1 (Alternatives A1 and B1): ***Conversion of Important Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts – Program-Level.*** Construction of modifications to the Reach 2B levee system and constructing Mendota Pool Bypass would convert Important Farmland to nonagricultural uses and require cancellation of lands under Williamson Act and Super Williamson Act contracts. Additional Important Farmland would be temporarily converted and additional Williamson Act and Super Williamson Act contracts could be canceled to allow use of the farmland as borrow sites. In addition, land at construction staging areas and access haul roads could be temporarily removed from agricultural production, and construction activities that occur during the growing season may result in a temporary loss in agricultural productivity. This impact would be **significant**.

Alternatives A1 and B1 would include construction of a bypass around the Mendota Pool and new levees with integrated floodplain habitat along either or both sides of Reach 2B to create an average floodplain width of between 500 feet and 3,700 feet and an associated levee system width of between 700 feet and 3,900 feet, depending on the level of floodplain modifications incorporated, and other restoration actions. Specific levee and bypass alignments and other modifications would be determined during project design.

Where actions under Alternatives A1 and B1 would transect portions of properties, agricultural parcels could be fragmented, reduced in size, or become irregularly shaped to such a degree as to make the continuation of agricultural land uses on lands that remain outside of project footprints difficult or infeasible, which may result in indirect temporary or long-term conversion of additional Important Farmland to nonagricultural land uses. In addition, Alternatives A1 and B1 would require termination of Williamson Act and Super Williamson Act contracts for the portions of properties required for construction. The extent and magnitude of this additional conversion cannot be quantified at this time.

Land at construction staging areas and access haul roads could be temporarily removed from agricultural production to accommodate preconstruction and construction activities. Construction activities that occur during the growing season may temporarily hinder plant growth and result in a temporary loss in agricultural productivity if staging areas cannot be sited on disturbed sites or on fallow sites.

Construction activities could require more than 3 million cubic yards of soil borrow (excluding construction of the Mendota Pool Bypass, which would both require and provide fill; borrow quantities are summarized in the air quality modeling output that is an attachment to Appendix H, "Modeling"). If only a 2-foot-deep layer of soil were removed from borrow sites (to facilitate subsequent reclamation), more than 1.5 square miles of land could be affected. The locations of proposed borrow sites have not yet been determined. The locations would depend on the availability of material at each site, proximity of each borrow site to the project component (length of haul route), and quality of borrow materials. Borrow sites could be on Important Farmland or on lands under Williamson Act and Super Williamson Act contracts. The acreages of Important Farmland and land under Williamson Act and Super Williamson Act contracts that may be directly converted to nonagricultural uses cannot be quantified at this time; therefore, the extent of the impact cannot be determined. It is conservatively assumed that the borrow sites in areas of Important Farmland or on Williamson Act and Super Williamson Act contract lands could be permanently converted to nonagricultural uses and that lands under Williamson Act and Super Williamson Act contracts would be ineligible for reenrollment under a new contract. It is also conservatively assumed that borrow sites could be in addition to the land otherwise affected by the construction of levees, Mendota Pool Bypass, and integrated floodplain habitat.

As described above, construction activities could disrupt existing agricultural production. Most disruption would be the result of constructing levees and the Mendota Pool Bypass, which have footprints that are much larger than all other potential actions under Alternatives A1 and B1. Furthermore, constructing the new levee system, bypass, and floodplain habitat (and possibly other project components) and using additional land as borrow sites would permanently convert Important Farmland to nonagricultural uses and result in cancellation of Williamson Act and Super Williamson Act contracts. The extent to which agricultural operations could be converted to nonagricultural uses would vary depending on the amount of active agricultural land needed for construction activities, the extent to which agricultural fields are affected, and the nature of agricultural operations on agricultural land. For these reasons, this impact would be **significant**.

Mitigation Measure LUP-1a (Alternatives A1 and B1): ***Design and Implement Levee Setbacks to Preserve Agricultural Productivity of Important Farmland to the Extent Possible and Comply with the Surface Mining and Reclamation Act – Program-Level.*** To support the continued productive use of Important Farmland in the corridor between proposed levees and at borrow sites, the project proponent will implement the following measures where appropriate, and be consistent with the purpose and objectives of the SJRRP (as determined by Reclamation and DWR), in the design and implementation of the levee setback:

- When selecting sites for borrow excavation, minimize the fragmentation of lands that are to remain in agricultural use. Retain contiguous parcels of agricultural land of sufficient size to support their efficient use for continued agricultural production.

- Perform reclamation of all borrow sites in compliance with the California SMARA, thus retaining their potential use for agriculture. Under SMARA, the removal of borrow material is a surface mining activity and as such is regulated by the SMARA statute. SMARA requires that the surface mine operator secure a use permit, reclamation plan, and financial assurance mechanism. The SMARA statute also identifies activities and situations that are exempt from SMARA. The project proponent will comply with SMARA by coordinating with the relevant SMARA lead agency (usually within the county in which mining occurs) and the DOC to identify and implement the appropriate mechanism for satisfying SMARA.

- Where the levee system and Mendota Pool Bypass would transect agricultural properties, and the landowners desire to continue agricultural use on the portions located within the levee system and bypass, provide a means of convenient access to these properties.

- The project proponent will either (1) acquire agricultural conservation easements at a 1:1 ratio (i.e., 1 acre on which easements are acquired to 1 acre of Important Farmland removed from agricultural use) to be held by land trusts or public agencies who will be responsible for enforcement of the deed restrictions maintaining these lands in agricultural use, or (2) provide funds to a land trust or government program that conserves agricultural land sufficient to obtain easements on comparable land at a 1:1 ratio.

- Stockpile the upper 2 feet of soil from borrow sites and from portions of levee, bypass, and other project feature footprints that are Important Farmland. Stockpiled soil would be used in subsequent restoration of agricultural uses or redistributed for agricultural purposes.

- Restore for agricultural uses those portions of borrow sites and of levee, bypass, and other project feature footprints that are Important Farmland and are not converted to project features, managed habitat, or project mitigation for nonagricultural impacts. Restoration for agricultural use would include redistribution of salvaged topsoil and earthwork for necessary irrigation and drainage.

- Redistribute the most productive salvaged topsoil that is not used in restoring agricultural uses to affected Important Farmland. Redistribution will be to less productive agricultural lands near but outside the levee setback and Mendota Pool Bypass areas that could benefit from the introduction of good-quality soil. By agreement between Reclamation or landowners of affected properties and the recipient(s) of the topsoil, the recipient(s) must use the topsoil for agricultural purposes.

- Minimize disturbance of Important Farmland and continuing agricultural operations during construction by implementing the following measures:
  - Locate construction laydown and staging areas on sites that are fallow, disturbed, or to be discontinued for use as agricultural land to the extent possible.
  - Use existing roads to access construction areas to the extent possible.
- Coordinate with growers to develop appropriate construction practices to minimize construction-related impairment of agricultural productivity. Practices may include coordinating the movement of heavy equipment within the levee setback and Mendota Pool Bypass areas and implementing traffic control measures outside these areas.

Implementing this mitigation measure would reduce potential impacts of constructing the levee system and Mendota Pool Bypass on Important Farmland, including indirect effects that may lead farming to be discontinued on some lands. However, the measure would not reduce the impact to a less-than-significant level because a substantial amount of Important Farmland would still be converted, and there are no additional measures to fully mitigate the loss of this Important Farmland. Therefore, this impact would be **significant and unavoidable**.

Mitigation Measure LUP-1b (Alternatives A1 and B1): *Minimize Impacts on Williamson Act–Contracted Lands, Comply with Government Code Sections 51290–51293, and Coordinate with Landowners and Agricultural Operators – Program-Level.* To reduce impacts on lands under Williamson Act and Super Williamson Act contracts, the project proponent will implement the measures described below.

- The project proponent will comply with California Government Code Sections 51290–51295 with regard to acquiring lands under Williamson Act–contracted lands. Sections 51290(a)–51290(b) state that State policy, consistent with the purpose of the Williamson Act to preserve and protect agricultural land, is to avoid locating public improvements and any public utilities improvements in agricultural preserves, whenever practicable. If such improvements must be located within a preserve, they will be located on land that is not under contract.
- More specifically, the project proponent will comply with the following basic requirements stated in the California Government Code:
  - Whenever it appears that land within a preserve or under contract may be required for a public improvement, DOC and the city or county responsible for administering the preserve must be notified (Section 51291(b)).

- Within 30 days of being notified, DOC and the city or county would forward comments, which would be considered by the proponent of the public improvement (Section 51291(b)).
- A public improvement may not be located within an agricultural preserve unless findings are made that (1) the location is not based primarily on the lower cost of acquiring land in an agricultural preserve and (2) for agricultural land covered under a contract for any public improvement, no other land exists within or outside the preserve where it is reasonably feasible to locate the public improvement (Sections 51921(a) and 51921(b)).
- The contract would be terminated when land is acquired by eminent domain or in lieu of eminent domain (Section 51295).
- DOC would be notified within 10 working days upon completion of the acquisition (Section 51291(c)).
- DOC and the city or county would be notified before completion of any proposed substantial changes to the public improvement (Section 51291(d)).
- If, after acquisition, the acquiring public agency determines that the property would not be used for the proposed public improvement, DOC and the city or county administering the involved preserve will be notified before the land is returned to private ownership. The land would be reenrolled in a new contract or encumbered by an enforceable restriction at least as restrictive as that provided by the Williamson Act (Section 51295).

- The project proponent will coordinate with landowners and agricultural operators to sustain existing agricultural operations, at the landowners' discretion, within the study area until the individual agricultural parcels are needed for project construction.

Implementation of this mitigation measure would reduce the impacts from loss of Williamson Act – contracted lands, but not to a less-than-significant level. No additional mitigation is available to fully compensate for the loss of land under Williamson Act contracts and its conversion to nonagricultural use. Therefore, this impact would be **significant and unavoidable**.

Impact LUP-2 (Alternatives A1 and B1): Conversion of Riparian to Non-Forest Uses – Program-Level. Under Alternatives A1 and B1, in-channel riparian forest may be removed. Constructing haul roads, staging areas, new levees, and other potential ancillary facilities, and improving existing levees, could also result in removal of riparian forest. However, implementing the riparian habitat conservation measures included in these alternatives would offset adverse effects on riparian forests. This impact would be **less than significant**.

A detailed analysis of the potential effects of facility construction and modification and other actions on riparian forest and related conservation measures are described in Chapter 6.0, "Biological Resources – Vegetation and Wildlife," and that analysis is summarized here as it relates to the potential conversion of riparian forest to non-forest uses. Under Alternatives A1 and B1, in-channel riparian forest within Reach 4B1 could be removed to improve flow conveyance (to convey at least 475 cfs) and a low-flow channel, or system of channels, would be constructed in the Mariposa and Eastside bypasses. These alternatives would also construct a new levee system in Reach 2B and a bypass around the Mendota Pool with integrated floodplain habitat. These and other restoration actions included in Alternatives A1 and B1 could result in the conversion of riparian forest to non-forest uses. However, Alternatives A1 and B1 also include conservation measures that require lead agencies to identify and map riparian forest, avoid riparian forest to the extent feasible, develop a riparian habitat mitigation and monitoring plan, State lead agencies to comply with Section 1602 of the California Fish and Game Code, and detailing methods to establish in-kind replacement riparian vegetation cover to compensate for the acreage of riparian vegetation removed. These measures would ensure that loss of riparian forest is compensated on a no-net-loss basis. This impact would be less than significant.

Impact LUP-3 (Alternatives A1 and B1): ***Conflict with Adopted Land Use Plans, Goals, Policies, and Ordinances of Affected Jurisdictions – Program-Level.*** The restoration actions, including modifications to the Reach 2 levee system, construction of the Mendota Pool Bypass, and integrated floodplain habitat would be inconsistent with land uses in the adopted general plan and zoning ordinances of Fresno and Madera counties. Because the general plan designations are intended to maintain an important resource in the counties (i.e., agricultural land), inconsistency in this case would indicate a significant impact under CEQA because the resulting loss of the agricultural land resources would be an environmental effect. This impact would be **significant and unavoidable**.

Alternatives A1 and B1 would include modifying the levee system in Reach 2B and constructing a bypass around the Mendota Pool, with integrated floodplain habitat. These actions would take place within Fresno and Madera counties and, as noted above, are not consistent with existing general plan land use plan or zoning designations for areas where these facilities would be located.

Areas south and west of Reach 2B are within the land use jurisdiction of Fresno County and are designated and zoned for agricultural land uses. Potential actions within these designated areas are not consistent uses because these land use and zoning designations are intended to support Fresno County General Plan goals and policies to minimize the conversion of productive agricultural land, protect agricultural activities from incompatible land uses, and control expansion of nonagricultural development onto productive agricultural lands (Fresno County 2000).

The Madera County General Plan Policy Document designates and zones areas north and east of the San Joaquin River along Reach 2B and in the bypass area around the Mendota Pool for agricultural land uses (Madera County 1995). Potential actions within these designated areas are not consistent with these planned uses because the planned uses are intended to support the general plan's goals and policies to promote developing agricultural uses to support the viability of the county's agricultural economy.

Modifying the Reach 2B levee system, constructing the Mendota Pool Bypass, and integrating floodplain habitat are not consistent with planned uses under adopted general plan land use and zoning designations for Fresno and Madera counties. If the levee system and bypass and integrated floodplain habitat were developed, land would be removed from agricultural production. Therefore, modifications to the Reach 2B levee system, including integrated floodplain habitat, and constructing the Mendota Pool Bypass would be inconsistent with the land use designations in the general plans of Fresno and Madera counties and with the zoning ordinances of the counties. This impact would be significant.

No mitigation is available for these impacts; therefore, this impact would be significant and unavoidable.

Alternatives A2 and B2

Under Alternatives A2 and B2, program-level impacts related to land use and agricultural resources in the study area would be similar to, but potentially greater than, those previously described under Alternatives A1 and B1. Implementation of the mitigation measures under Alternatives A1 and B1 would also be required for Alternatives A2 and B2, but would not reduce program-level impacts to a less-than-significant level. LUP-1 and LUP-3 would remain significant and unavoidable.

Whereas under Alternatives A1 and B1, improvements would be constructed in Reach 4B to achieve flow capacity of at least 475 cfs, under Alternatives A2 and B2 improvements would be constructed in Reach 4B to achieve flow capacity of at least 4,500 cfs. This nearly 10-fold increase in flow capacity is understood to take significantly more fill material than for increasing flow capacity to 475 cfs. Therefore, these alternatives would also result in indirect temporary or long-term conversion of additional Important Farmland to nonagricultural land uses, convert riparian forest to non-forest uses, or otherwise be inconsistent with land uses in the adopted general plan and zoning ordinances of Fresno and Madera counties. The significant impacts described above under Alternatives A1 and B1 would be similar to but potentially greater than under Alternatives A2 and B2.

Alternative C1

Under Alternative C1, potential program-level actions along the San Joaquin River between the Merced River confluence and the Delta could result in indirect temporary or long-term conversion of additional Important Farmland to nonagricultural land uses, convert riparian forest to non-forest uses, or otherwise be inconsistent with land uses in the adopted general plan and zoning ordinances of counties in this reach. Impacts LUP-1 and LUP-3 under Alternative C1 would be identical to LUP-1 and LUP-3 under Alternatives A1 and B1 in the Restoration Area, and would be potentially significant along the San Joaquin River between the Merced River confluence and the Delta. Impact LUP-2 in this area would be similar to those in the Restoration Area. Implementation of the mitigation measures under Alternatives A1 and B1 would also be required for Alternative C1, and would apply to activities along the San Joaquin River between the Merced River confluence and the Delta. However, implementation of these mitigation measures would not reduce program-level impacts to a less-than-significant level. LUP-1 and LUP-3 would remain significant and unavoidable.

Alternative C2

Under Alternative C2, potential program-level actions along the San Joaquin River between the Merced River confluence and the Delta could result in indirect temporary or long-term conversion of additional Important Farmland to nonagricultural land uses, convert riparian forest to non-forest uses, or otherwise be inconsistent with land uses in the adopted general plan and zoning ordinances of counties in this reach. Impacts LUP-1 and LUP-3 under Alternative C2 would be identical to LUP-1 and LUP-3 under Alternatives A2 and B2 in the Restoration Area, and would be potentially significant along the San Joaquin River between the Merced River confluence and the Delta. Impact LUP-2 in this area would be similar to those in the Restoration Area. Implementation of the mitigation measures under Alternatives A2 and B2 would also be required for Alternative C2, and would apply to activities along the San Joaquin River between the Merced River confluence and the Delta. However, implementation of these mitigation measures would not reduce program-level impacts to a less-than-significant level. LUP-1 and LUP-3 would remain significant and unavoidable.

16.3.4 Project-Level Impacts and Mitigation Measures

This section provides a project-level evaluation of the direct and indirect effects of the program alternatives on land use planning, agricultural resources, and forest land. The action alternatives could affect land use planning, agricultural resources, and forest land directly by increasing the areas inundated by seasonal flows and altering the existing duration and seasonality of inundation in the Restoration Area.

The evaluation of effects on land use planning, agricultural resources, and forest land considered at a project level the potential effects resulting from the recapture of Interim and Restoration flows in the Restoration Area and at existing Delta facilities. Water deliveries to Friant Division long-term contractors in the CVP/SWP water service areas would be affected. No effects of project-level actions on current land use planning, agricultural resources, and forest land are anticipated along the San Joaquin River upstream from Friant Dam, downstream from the Merced River to the Delta, or in the Delta. Therefore, these geographic areas are not discussed further in this section.

Actions identified in the Physical Monitoring and Management Plan (Appendix D) as potential immediate actions to address nonattainment of management objects also were evaluated at a project level. Potential immediate actions are related to flow, seepage, capacity, native vegetation, and spawning gravel. Potential immediate actions include acquiring additional water from willing sellers, reoperating Friant Dam to reduce flows, monitoring sites, preparing reports, and documenting, monitoring, and removing obstructions/debris from channels in the Restoration Area. Immediate actions related to flow management would affect the CVP/SWP water service areas and are discussed further below.

No-Action Alternative

Under the No-Action Alternative, an increase in inundated areas as a result of Interim and Restoration flows would not occur. No local roads or vehicle bridges would be closed; therefore, no established communities would be physically divided or disrupted. Under the No-Action Alternative, the existing duration and seasonality of inundation by seasonal flows or flood flows would not change, and no adverse changes would occur that could cause agricultural land to be idled or otherwise reduce the land's quality and importance for agriculture or affect riparian forest. Under the No-Action Alternative, water deliveries to Friant Division long-term contractors would not change, and there would be no additional shortfall of surface water or additional groundwater pumping that could result in changes in agricultural practices. Therefore, no project-level impacts on land use planning and agricultural resources would occur under the No-Action Alternative. There would be no impact.

Alternatives A1 Through C2

Project-level impacts under the action alternatives are associated with Interim and Restoration flows and are identical under all action alternatives. These impacts would occur in the Restoration Area and in the CVP/SWP water service areas, as described below.

San Joaquin River from Friant Dam to Merced River. Impacts under Alternatives A1 through C2 in the Restoration Area would include the potential to physically divide or disrupt an established community through temporary inundation of roadways and through the substantial diminishment of agricultural land resource quality and importance because of changes in the duration and seasonality of inundation.

Impact LUP-4 (Alternatives A1 through C2): ***Physically Divide or Disrupt an Established Community – Project-Level.*** An increase in inundated areas as a result of Interim and Restoration flows could physically divide or disrupt an established community. Intermittent local road and bridge closures and detours would disrupt access for residents and business operators; therefore, this impact would be **potentially significant**.

An increase in inundated areas as a result of Interim and Restoration flows could physically divide or disrupt an established community by causing the closure of local roads and vehicle bridges. Many of these roadways and bridges provide the only access to residences and businesses. Intermittent road closures and detours would disrupt such access for residents and business operators; therefore, this impact would be potentially significant.

Mitigation Measure LUP-4 (Alternatives A1 through C2): ***Implement Vehicular Traffic Detour Planning – Project-Level***. This mitigation measure is identical to Mitigation Measure TRN-7, as described in Chapter 23.0, "Transportation and Infrastructure."

This impact would be **less than significant** after mitigation.

Impact LUP-5 (Alternatives A1 through C2): ***Substantial Diminishment of Agricultural Land Resource Quality and Importance Because of Altered Inundation and/or Soil Saturation – Project-Level.*** At some locations, Interim and Restoration flows could change the duration and seasonality of inundation, or soil saturation, which could potentially affect crop production. As described in the Physical Monitoring and Management Plan (Appendix D), if all physical actions to protect property are unsuccessful, Interim and Restoration flows could diminish the quality and importance of land as an agricultural resource. This impact would be potentially significant.

Some portions of the Restoration Area have historically experienced groundwater seepage to adjacent lands associated with elevated flows. Groundwater seepage has the potential to cause waterlogging of crops and salt mobilization in the crop root zone. Similarly, some portions of the Restoration Area have experienced levee instability resulting from through-levee and under-levee seepage during periods of elevated flows.

Interim and Restoration flows would increase water flow in reaches of the San Joaquin River and in the Eastside and Mariposa bypasses, and thus, could affect agricultural land that historically experienced groundwater seepage. Overall, most of the potential effects of Interim and Restoration flows would be comparable to those of the periodic flood flows that have occurred every 2 to 5 years historically and would continue under Alternatives A1 through C2. The primary difference from existing seasonal flows or flood flows would be the duration and frequency of inundation and soil saturation.

Interim or Restoration flows, or both, would alter this existing pattern of inundation and soil saturation. Interim and Restoration flows could inundate or saturate areas for longer periods and more frequently than flood flows under current conditions. Interim and Restoration flows also could inundate some areas during seasons when flood flows do not typically occur (i.e., summer and fall). These changes in duration, frequency, and seasonality could affect agricultural production, and therefore the land's agricultural resource quality and importance, by inundating sites or saturating soil in the rooting zone, and thus interfering with the ability to use machinery to work soil, impairing plant growth and survival, or temporarily reducing grazing suitability. Most of these effects would be adverse and may necessitate changes in cropping patterns or grazing practices at some locations. At some sites, these adverse changes could occur in most years and cause agricultural land to be idled or otherwise reduce the land's quality and importance for agriculture.

The action alternatives include a Physical Monitoring and Management Plan (Appendix D) that includes a seepage monitoring and management plan that would avoid or reduce inundation and soil saturation effects to agricultural land. As described in Appendix D, the physical monitoring and management plan includes groundwater monitoring, levee patrols, landowner feedback, and several potential management responses to address nonattainment with the seepage management objective, which is to address or avoid seepage impacts. Seepage impacts to agricultural land may be avoided by keeping groundwater levels below thresholds above which agricultural practices are affected. Seepage effects attributable to Interim or Restoration flows also may be addressed through easements and/or compensation for seepage effects to landowners.

If seepage effects cannot be avoided or are addressed by compensating affected landowners, the productivity of agricultural land would be reduced and agricultural land could be converted to nonagricultural use. This impact would be potentially significant.

Mitigation Measure LUP-5 (Alternatives A1 through C2): ***Preserve Agricultural Productivity of Important Farmland to Minimize Effects of Inundation and Saturation Effects – Project-Level.*** If seepage effects cannot be avoided or are addressed by compensating affected landowners resulting in conversion of agricultural land to nonagricultural use or a reduction in productivity of agricultural land, Reclamation will implement the following measures to minimize effects of inundation and saturation of agricultural land by Interim and Restoration flows:

- During Interim Flows, Reclamation will determine the acreage of Important Farmland that after implementation of the Physical Monitoring and Management Plan would still be affected by inundation and/or soil saturation resulting from Interim or Restoration flows to an extent sufficient to convert Important Farmland to nonagricultural use. This would result in this land no longer being classified as Important Farmland. This acreage of Important Farmland may be identified through flow, groundwater, and seepage monitoring and modeling included in the action alternatives, or through alternative or additional monitoring or modeling, as necessary.

- Reclamation will, as necessary, either (1) acquire agricultural conservation easements at a 1:1 ratio (i.e., acquire easements on 1 acre for each 1 acre of Important Farmland removed from agricultural use) to be held by land trusts or public agencies who are responsible for enforcement of the deed restrictions maintaining these lands in agricultural use, or (2) provide funds to a land trust or government program that conserves agricultural land sufficient to obtain easements on comparable land at a 1:1 ratio.

Implementing this mitigation measure would reduce this impact, but not to a less-than-significant level. This impact would be **potentially significant and unavoidable**.

Impact LUP-6 (Alternatives A1 through C2): ***Diminishment of Agricultural Production by Increased Orchard and Vineyard Diseases – Project-Level.*** Additional water and vegetation along river and bypass channels within the Restoration Area could affect the incidence of some diseases on adjacent land by serving as a source of causal organisms. However, the additional sources of causal organisms that could result from implementing any of the action alternatives would not substantially reduce agricultural activity for several reasons: disease-causing organisms already occur on a variety of widely planted fruit and nut crops, the incidence of disease is not solely or even primarily determined by the presence of causal organisms in the vicinity of an orchard or vineyard, and incidence of disease is only one of many factors affecting agricultural productivity. This impact would be **less than significant**.

Additional water and vegetation along river and bypass channels within the Restoration Area could affect the incidence of some diseases on adjacent land by serving as a source of causal organisms. Because some riparian plants are alternative hosts for the causal organisms of some diseases of fruit and nut crops, it is possible for riparian vegetation in the Restoration Area to affect the incidence of some diseases in adjacent orchards and vineyards. For example, *Botryosphaeria dothedia* has been isolated from riparian plants. This bacterium can cause a shoot blight on pistachio and a canker on almonds, and it occurs on a number of crop, ornamental, and wild plants, causing diseases in some of them (Ogawa and English 1991; Ma et al. 2001). Also, English walnut (*Juglans regia*) and stone fruits (*Prunus* species, including cherries and plums) can invade and persist in riparian vegetation and host disease organisms that also could affect the same species in orchards.

However, for several reasons, riparian vegetation would not substantially reduce agricultural productivity by increasing the incidence of disease. First, disease-causing organisms occur on a variety of fruit and nut crops, and these crops occupy much larger acreages in the study area than the additional acreage of riparian host plants that would result from the action alternatives. Therefore, riparian vegetation would likely be a less important source of disease-causing organisms than orchard and vineyard vegetation. Second, the incidence of disease is not solely or even primarily determined by the presence of causal organisms in the vicinity of an orchard or vineyard. Physical conditions (including weather), irrigation and other management practices, and susceptibility of crop cultivars and their rootstocks, are also important factors in the incidence of disease. Third, incidence of disease is only one of many factors affecting agricultural productivity. For these reasons, implementing any of the action alternatives would not substantially reduce agricultural productivity by increasing disease. This impact would be less than significant.

Impact LUP-7 (Alternatives A1 through C2): *Potential Conversion of Riparian Forest Because of Altered Inundation – Project-Level.* Reoperation of Friant Dam would permanently inundate and thus eliminate some patches of riparian forest. However, reoperation would also expand or create additional areas of riparian forest, and a net increase in the extent of riparian forest is anticipated. In addition, as necessary, applicable conservation measures of the Conservation Strategy (Chapter 2.0, “Description of Alternatives”) would be implemented to offset any potential adverse effects of Friant Dam reoperation on riparian forest. This impact would be **less than significant** and **beneficial**.

Reoperation of Friant Dam could directly or indirectly cause both adverse and less than significant and beneficial effects on riparian forest. A detailed analysis of the potential effects of reoperation of Friant Dam on riparian forest and related conservation measures are described in Chapter 6.0, “Biological Resources – Vegetation and Wildlife.” The following analysis summarizes information provided in Chapter 6.0 as it relates to riparian forest.

In some locations within the Restoration Area, Interim and Restoration flows under Alternatives A1 through C2 would permanently inundate and thus eliminate some patches of riparian vegetation. However, mortality would be expected only in riparian forest that is subjected to complete and continual submergence for several weeks or months every year, and would not occur on a large enough scale to substantially reduce the extent of existing riparian forest. In addition, the action alternatives also include a Conservation Strategy with conservation measures to avoid and minimize the loss of riparian habitat during implementation of Interim and Restoration flows, and to promote the establishment of riparian vegetation.

In the long term, reoperation of Friant Dam is expected to result in a net increase in riparian forest throughout the Restoration Area and result in less than significant and beneficial effects. Specifically, dam reoperation would increase the extent and duration of inundation, raise groundwater levels, and restore flows to reaches (e.g., Reaches 2 and 4) that currently are not inundated by most seasonal flows and are inundated by flood flows only periodically (every 2 to 5 years) that occur during winter, spring, or early summer. This inundation would create conditions suitable for dispersal, establishment, and growth of riparian plants Therefore, on balance, the reoperation is expected to increase the extent of riparian forest. This would be a less than significant and beneficial effect.

CVP/SWP Water Service Areas. Impacts under Alternatives A1 through C2 in the CVP/SWP water service areas would include the substantial diminishment of agricultural land resource quality and importance through reduced water deliveries to Friant Division long-term contractors.

Impact LUP-8 (Alternatives A1 through C2): ***Substantial Diminishment of Agricultural Land Resource Quality and Importance Because of Altered Water Deliveries – Project-Level.*** The amount of Interim and Restoration flows would change with water-year type, and the amount of Interim and Restoration flows released and recaptured would change over time as program-level actions are implemented. On average, however, water deliveries to Friant Division long-term contractors would be reduced, which would result in a shortfall of surface water supplies during some dry years and, thus, would result in additional groundwater pumping, changes in agricultural practices (e.g., crop selection), and idling of cropland. This impact would be **significant and unavoidable**.

Implementing Alternatives A1 through C2 would change surface water deliveries to Friant Division long-term contractors by releasing a greater amount of water to the San Joaquin River as Interim and Restoration flows, and then recapturing and returning to Friant Division long-term contractors a portion of those flows. Interim and Restoration flows would be recaptured downstream and returned to the Friant Division long-term contractors via existing pumps and canals or through water transfers or a combination of both existing facilities and transfers. The volume of Interim and Restoration flows would change with water-year type, and would increase after restoration actions that reduce the constraints of channel capacities are implemented. The volume of Interim and Restoration flows also could potentially change if flow-related actions in the physical monitoring and management plan are implemented, or if additional water is acquired from willing sellers.

On average, as a result of implementing Alternatives A1 through C2, Friant Division long-term contractors would experience a reduction in deliveries of surface water. Alternatives A1 through C2 partially compensate for periodic shortfalls in water deliveries by creating an economic incentive for Friant Division long-term contractors to purchase surplus water during wet hydrologic years. The contractors are anticipated to store the surplus water for use in dry water years, or to use surplus water to recharge groundwater, which is an important source of water supply in the region. Nonetheless, over the 30-year planning horizon, this action related to implementing Interim and Restoration flows would not be sufficient to result in surface water deliveries equal to current conditions.

The reduction in water deliveries could be compensated for by changes to cropping patterns or other agricultural practices, additional groundwater pumping, or idling of cropland with implementation of Alternatives A1 through C2. An analysis using the Central Valley Production Model (CVPM) was conducted to assess the effects on agricultural crop production (see Chapter 22.0, “Socioeconomics,” which includes a discussion of employment and economic effects related to changes in agricultural production). According to the CVPM simulations (which were based on existing irrigated acreage and crop mix), implementing Alternatives A1 through C2 would on average reduce irrigated acreages by less than 1,000 acres. However, the CVPM modeling did not address some issues resulting from the replacement of some water deliveries with additional groundwater pumping that could affect agricultural productivity. These issues include the need to install or modify wells at some sites, and limited access to adequate quality groundwater at other sites. Thus, some reduction in irrigated acreage in addition to CVPM estimates could occur. Therefore, irrigated acreages could be reduced by more than 1,000 acres. This impact would be significant.

Because of the close relationship between the quality of agricultural resources and water supply (i.e., soil capability increases when it is irrigated), mechanisms for reducing this adverse effect on agricultural resources are limited and related to providing alternative water supplies. Feasible means of providing alternative water supplies have been included in Alternatives A1 through C2 or would be implemented to reduce potential impacts on groundwater resources, including creating an economic incentive for Friant Division long-term contractors to purchase surplus water during wet hydrologic years (i.e., Paragraph 16(b) water), and committing to considering regional overdraft conditions in evaluation of candidate groundwater banking projects developed under Title III of the Act. After these actions were implemented, effects on agricultural productivity and the quality and importance of agricultural land would remain significant. No other means of providing an alternative supply of water to Friant long-term contractors are feasible for Reclamation. Therefore, this impact after mitigation would be significant and unavoidable.

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Chapter 17.0 Noise

This chapter describes the environmental and regulatory settings of the noise environment, as well as environmental consequences and mitigation measures, as they pertain to implementation of the program alternatives. Noise effects from the program alternatives in and surrounding Millerton Lake upstream of Friant Dam, the Delta, and CVP/SWP service areas would be negligible; these areas are not considered further in this analysis.

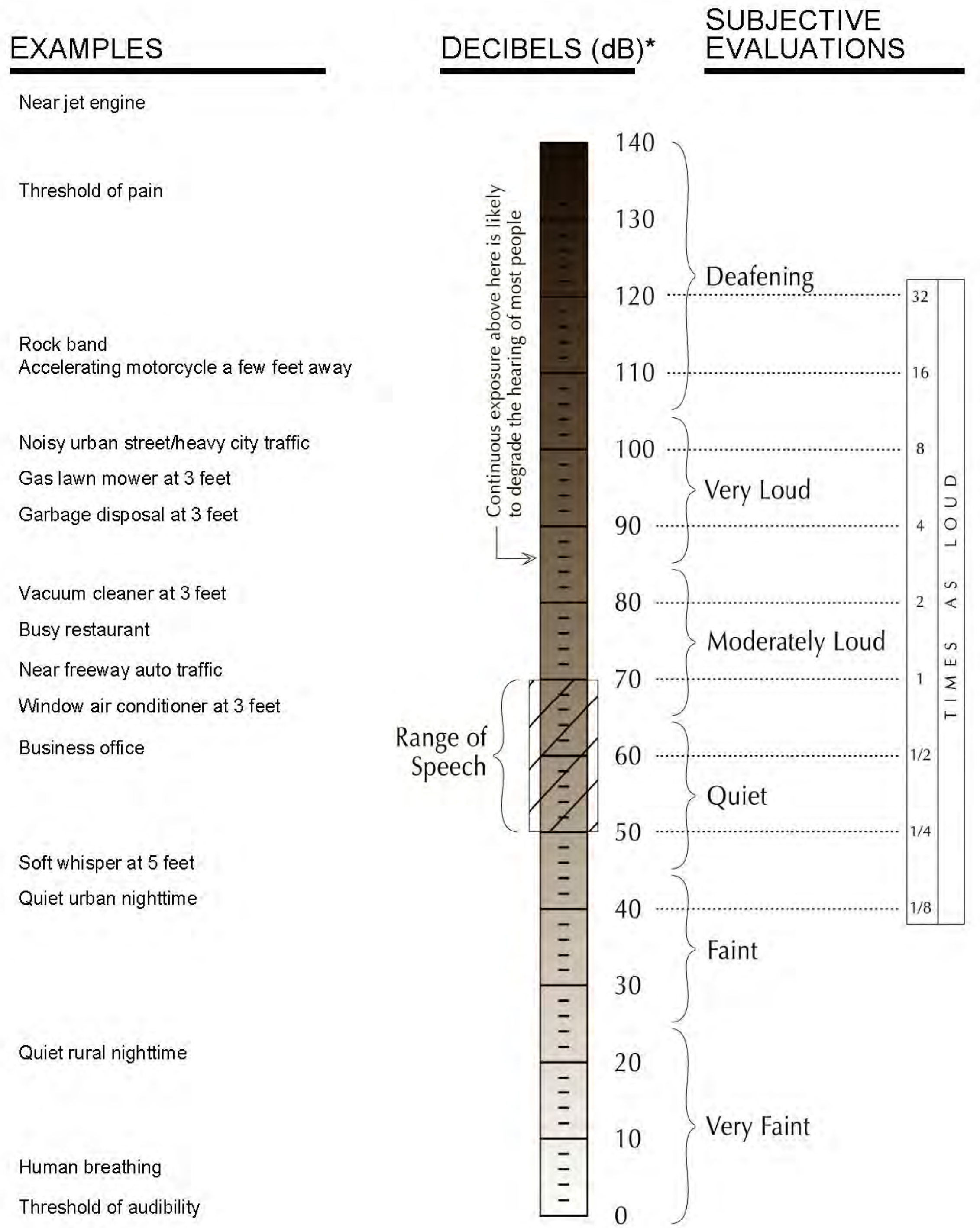
17.1 Environmental Setting

This section provides a background discussion on how noise is characterized and discussed within this chapter, as well as the existing noise (and vibration) environment in and surrounding the study area, focusing on the Restoration Area, and the San Joaquin River from the Merced River to the Delta.

17.1.1 Background

Common environmental noise sources and noise levels are presented in Figure 17-1. Noise is generally defined as sound that is loud, disagreeable, unexpected, or unwanted. Sound is characterized by two parameters: amplitude (loudness) and frequency (tone). Amplitude is the size of a sound wave. The frequency of a wave refers to the rate at which particles vibrate when a wave passes through a medium. Frequency can be defined as the number of back-and-forth cycles completed by a particle occurring per second. The unit of measure for frequency is hertz (Hz), which is equivalent to one complete cycle per second. An undamaged human ear can perceive frequencies ranging from 20 Hz to 20,000 Hz. The human ear is not equally sensitive to loudness at all frequencies in the audible spectrum. To better relate overall sound levels, loudness, and sound pressure to human perception, frequency-dependent weighting networks were developed. The standard weighting networks are identified as A through E. Strong correlations have been identified between the way humans perceive environmental sounds, and it is commonplace to use A-weighted sound levels (dBA) to estimate community response to environmental and transportation noise. Therefore, in this chapter, all sound levels expressed in decibels are A-weighted sound levels unless otherwise specified.

Directly measuring sound pressure fluctuations would require the use of a very large and cumbersome range of numbers. To have a more useable numbering system, the logarithmic decibel (dB) scale is commonly used. The normal range of human hearing extends from about 10 dB to about 140 dB. Decibels are logarithmic, and therefore doubling the source strength does not double the decibel level. For example, a 65 dB source of sound, such as a truck, when joined by another 65 dB source results in a sound amplitude of 68 dB, not 130 dB (i.e., doubling the source strength increases the sound pressure by 3 dB). Outside of controlled laboratory conditions, the average human ear barely perceives a change of 3 dB. A change of 5 dB is a noticeable change in human response, and a change of 10 dB is subjectively heard as a doubling of loudness.



Source: HUD 1985
Key:
dB = A-weighted decibels

Figure 17-1.
Common Noise Sources and Levels

The intensity of environmental noise changes over time, and several different descriptors of time-averaged noise levels are used. The selection of a proper noise descriptor for a specific source depends on the spatial and temporal distribution, duration, and fluctuation of the noise. The noise descriptors most often used to describe environmental noise are defined below:

- **L_{max} (Maximum Noise Level) –** The highest A/B/C-weighted integrated noise level occurring during a specific period of time.
- **L_{min} (Minimum Noise Level) –** The lowest A/B/C-weighted integrated noise level occurring during a specific period of time.
- **Peak –** The highest weighted or unweighted instantaneous peak to peak value occurring during a measurement period.
- **L_n (Statistical Descriptor) –** The noise level exceeded n percent of a specific period of time, generally accepted as an hourly statistic. An L_{10} would be the noise level exceeded 10 percent of the measurement period.
- **L_{eq} (Equivalent Noise Level) –** The energy mean (average) noise level. The steady-state sound level which, in a specified period of time, contains the same acoustical energy as a varying sound level over the same time period.
- **L_{dn} (Day-Night Noise Level) –** The 24-hour L_{eq} with a 10 dBA "penalty" applied during nighttime noise-sensitive hours, 10:00 p.m. through 7:00 a.m. The L_{dn} attempts to account for the fact that noise during this specific period of time is a potential source of disturbance with respect to normal sleeping hours.
- **CNEL (Community Noise Equivalent Level) –** The CNEL is similar to the L_{dn} described above, but with an additional 5 dBA "penalty" for the noise-sensitive hours between 7:00 p.m. and 10:00 p.m., which are typically reserved for relaxation, conversation, reading, and television viewing. If using the same 24 hour noise data, the CNEL is typically 0.5 dBA higher than the L_{dn}.
- **SEL (Sound Exposure Level) –** The SEL describes the cumulative exposure to sound energy over a stated period of time.

Noise can be generated by a number of sources, including mobile sources such as automobiles, trucks, and airplanes, and stationary sources, such as construction sites, machinery, and industrial operations. Noise generated by mobile sources (e.g., cars, trains) typically attenuates at a rate between 3.0 and 4.5 dB per doubling of distance. The rate depends on the ground surface and the number or type of objects between the noise source and the receiver. Hard and flat surfaces, such as concrete or asphalt, have an attenuation rate of 3.0 dB per doubling of distance. Soft surfaces, such as uneven or vegetated terrain, have an attenuation rate of about 4.5 dB per doubling of distance. Noise generated by stationary sources typically attenuates at a rate between 6.0 and 7.5 dB per doubling of distance.

The human response to environmental noise is subjective and varies considerably from individual to individual. Noise in the community has often been regarded as a health problem, not in terms of actual physiological damage, such as hearing impairment, but in terms of inhibiting general wellbeing and contributing to undue stress and annoyance. These effects of noise in the community arise from interference with human activities, including sleep, speech, recreation, and tasks demanding concentration or coordination. When community noise interferes with human activities or contributes to stress, public annoyance with the noise source increases. The acceptability of noise and the threat to public wellbeing are the basis for land-use planning policies that aim to prevent exposure to excessive community noise levels. Furthermore, exposure to elevated noise levels may result in damage to the auditory system, leading to gradual or traumatic hearing loss.

Vibration is the periodic oscillation of a medium or object. The rumbling sound caused by the vibration of surfaces is called structure-borne noise. Sources of ground-borne vibrations include natural phenomena (e.g., earthquakes, volcanic eruptions, sea waves, landslides) or human-made causes (e.g., explosions, machinery, traffic, trains, construction equipment). Vibration sources may be continuous, such as operating factory machinery, or transient, such as explosions. As is the case with airborne sound, ground-borne vibrations may be described by amplitude and frequency.

Vibration amplitudes are usually expressed in peak particle velocity (PPV) or root mean square (RMS) vibration velocity. PPV is defined as the maximum instantaneous positive or negative peak of a vibration signal. PPV is often used in monitoring of blasting vibration because it is related to the stresses that are experienced by buildings (FTA 2006). PPV and RMS are normally described in inches per second (in/sec).

Human and structural response to different vibration levels is influenced by a number of factors, including ground type, distance between source and receptor, duration, and the number of perceived vibration events. Table 17-1, developed by the California Department of Transportation (Caltrans), shows the vibration levels that would normally be required to result in damage to structures. The vibration levels are presented in terms of PPV in in/sec.

Although PPV is appropriate for evaluating the potential for building damage, it is not always suitable for evaluating human response. It takes some time for the human body to respond to vibration signals. In a sense, the human body responds to average vibration amplitude. The RMS of a signal is the average of the squared amplitude of the signal, typically calculated over a period of 1 second. Like airborne sound, the RMS velocity is often expressed in decibel notation, as vibration decibels (VdB), which serves to compress the range of numbers required to describe vibration (FTA 2006). This is based on a reference value of 1 microinch per second (μin/sec).

**Table 17-1.
Effects of Various Vibration Levels on People and Buildings**

PPV		Human Reaction	Effect on Buildings
in/sec	mm/sec		
0.006–0.019	0.15–0.30	Threshold of perception; possibility of intrusion	Vibrations unlikely to cause damage of any type
0.08	2.0	Vibrations readily perceptible	Recommended upper level to which ruins and ancient monuments should be subjected
0.10	2.5	Level at which continuous vibrations begin to annoy people	Virtually no risk of architectural damage to normal buildings
0.20	5.0	Vibrations annoying to people in buildings	Threshold at which there is a risk of architectural damage to normal dwelling-houses with plastered walls and ceilings
0.4–0.6	10–15	Vibrations considered unpleasant by people subjected to continuous vibrations and unacceptable to some people walking on bridges	Vibrations at a greater level than normally expected from traffic, but would cause architectural damage and possibly minor structural damage

Source: Caltrans 2002
Key:
in/sec = inches per second
mm/sec = millimeters per second
PPV = peak particle velocity

The background vibration-velocity level in residential areas is usually approximately 50 VdB. Ground-borne vibration is normally perceptible to humans at approximately 65 VdB. For most people, a vibration-velocity level of 75 VdB is the approximate dividing line between barely perceptible and distinctly perceptible levels (FTA 2006).

Typical outdoor sources of perceptible ground-borne vibration are construction equipment, steel-wheeled trains, and traffic on rough roads. If a roadway is smooth, the ground-borne vibration is rarely perceptible. The range of interest is from approximately 50 VdB, which is the typical background vibration-velocity level, to 100 VdB, which is the general threshold where minor damage can occur in fragile buildings. Construction activities can generate ground-borne vibrations, which can pose a risk to nearby structures. Constant or transient vibrations can weaken structures, crack facades, and disturb occupants (FTA 2006).

Construction vibrations can be transient, random, or continuous. Transient construction vibrations are generated by blasting, impact pile driving, and wrecking balls. Continuous vibrations result from vibratory pile drivers, large pumps, horizontal directional drilling, and compressors. Random vibration can result from jackhammers, pavement breakers, and heavy construction equipment. Table 17-2 describes the general human response to different levels of ground-borne vibration-velocity levels.

Table 17-2.
Human Response to Ground-Borne Vibration Levels

Vibration-Velocity (VdB)	Human Response
65	Approximate threshold of perception for many humans
75	Approximate dividing line between barely perceptible and distinctly perceptible
85	Vibration acceptable only if there is a small number of events per day

Source: FTA 2006
Key:
VdB = vibration decibels

17.1.2 San Joaquin River from Friant Dam to the Merced River

The existing noise (and vibration) environment in and surrounding the Restoration Area is influenced by transportation noise emanating from vehicular traffic on area roadways, train operations, and aircraft overflights. Agricultural activities, mining operations, urban uses, light industrial uses, commercial uses, and recreational uses are nontransportation noise sources that also contribute to the existing background noise levels in the Restoration Area. Sources of noise in the Restoration Area include the following:

- Vehicular Traffic
- Railroads
- Aeronautical Sources
- Parks and School Playgrounds
- Agriculture
- Industry
- Quarries

Transportation Sources

This section describes noise levels for transportation sources located within the Restoration Area.

Vehicular Traffic. Vehicular traffic noise levels along area roadways were calculated using the Federal Highway Administration (FHWA) Traffic Noise Prediction Computer Model (FHWA-RD-77-108). Traffic volumes and medium and heavy truck mix percentages were obtained from Caltrans. Additional input data include assumed day/night percentages of automobiles, vehicle speeds, and ground attenuation factors. Existing noise levels at several representative roadway segments are provided in Table 17-3. Actual noise levels will vary from day to day, dependent on various factors, including local traffic volumes, shielding from existing structures, variations in attenuation rates attributable to changes in surface parameters, and meteorological conditions.

Table 17-3.
Summary of Existing Noise Levels from Vehicle Traffic in the Restoration Area

Roadway	Segment Location			L_{dn} (dB) at 100 feet	Distance (feet) from Roadway Centerline to L_{dn} (dB) Contour		
	From	To	Nearest Restoration Area Reach		70	65	60
State Route 33	Junction 180	Mendota	2B, 3	66.3	57	122	263
State Route 33	Firebaugh	8th Street	3	66.4	57	123	266
State Route 33	Firebaugh	Brannon Avenue	3	63.6	37	80	173
State Route 41	Herndon Avenue	Friant Road	1A, 1B	74.8	209	450	969
State Route 41	Friant Road	the North	1A	72.9	155	335	721
State Route 99	Herndon Avenue	County Line	1A	78.8	388	835	1,800
State Route 99	County Line	the North	1A	79.2	408	879	1,894
State Route 140	Junction 33	South Hunt Road	5	60.6	24	51	110
State Route 140	South Hunt Road	Junction 165	5	63.5	37	79	170
State Route 145	State Route 180	State Route 99	1B	70.3	104	225	485
State Route 152	Junction 33	County Line	4A	72.9	157	339	730
State Route 165	Los Banos	Junction 140	4B2, 5	65.3	48	104	224
State Route 180	James Road	Junction 33	2A, 2B	65.5	50	108	232

Sources: Caltrans 2007, FHWA 1988
Key:
dB = decibels
L_{dn} = day-night average noise level

Railroads. Trains along area railroads located within the Restoration Area are another source of noise. There are three railroad companies that operate lines in the Restoration Area carrying both freight and passengers. Burlington Northern and Santa Fe Railway (BNSF), and the Union Pacific Railroad (UPRR) train passby data were taken from the Fresno County General Plan Update. Train passby data were not available for the Port Railroad Inc. (PRI) railroad line. Table 17-4 summarizes the L_{dn} noise levels at 50 feet from the centerline of the railroad tracks and distance from the railway centerline to the 60-, 65-, and 70-dBA L_{dn} contours.

Table 17-4.
Summary of Existing Railroad Traffic Noise Levels in the Restoration Area

Railroad Line	L_{dn} (dB) 50 feet	Reach	Distance (Feet) from Railroad Centerline to L_{dn} (dB) Contour		
			60	65	70
UPRR	78	1A	570	270	130
BNSF	79	1A	870	410	170
PRI	--	2B, 3	--	--	--

Source: Fresno County 2000b
Key:
dB = decibels
L_{dn} = day-night average noise level

Aeronautical Sources

Airports that are either public or serve a scheduled airline are required to have a Comprehensive Land Use Plan (CLUP) prepared by the Airport Land Use Commission (ALUC). ALUC has two purposes:

- It is designed to protect public health, safety, and welfare through the adoption of land-use standards that minimize the public's exposure to safety hazards and excessive levels of noise.
- It is designed to prevent the encroachment of incompatible land uses around public-use airports, thereby preserving the utility of these airports into the future.

The adoption and implementation of a CLUP embodies the land use compatibility guidelines for height, noise, and safety. The Council of Fresno County Governments (Fresno COG) is the ALUC for the cities of Fresno, Firebaugh, and Mendota, and the County of Fresno.

There are three airports in or immediately adjacent to the Restoration Area that have adopted a CLUP. The Sierra Sky Park Airport, Firebaugh Municipal Airport, and Mendota Municipal Airport contribute to the background noise environment in Reaches 1A, 2B, and 3. Noise contours for individual airports are shown in Figures 17-2, 17-3, and 17-4. There are several agricultural airstrips throughout the Restoration Area and in the vicinity of the san Joaquin River from the Merced River to the Delta that operate seasonal flights for crop spraying, as well as larger commercial airports in major cities.

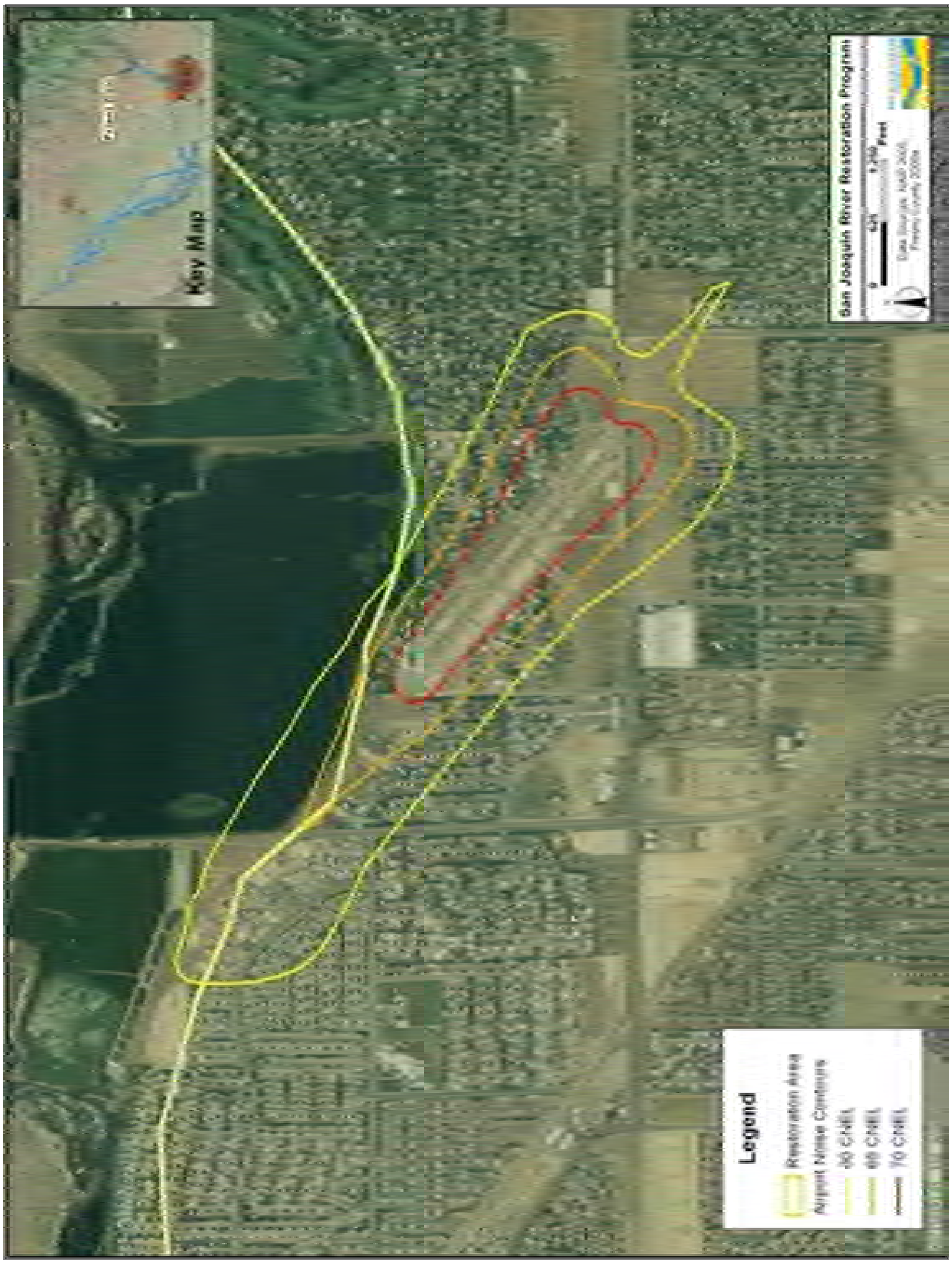


Figure 17-2.
Sierra Sky Park Airport Noise Contours

Figure 17-3.
Firebaugh Municipal Airport Noise Contours

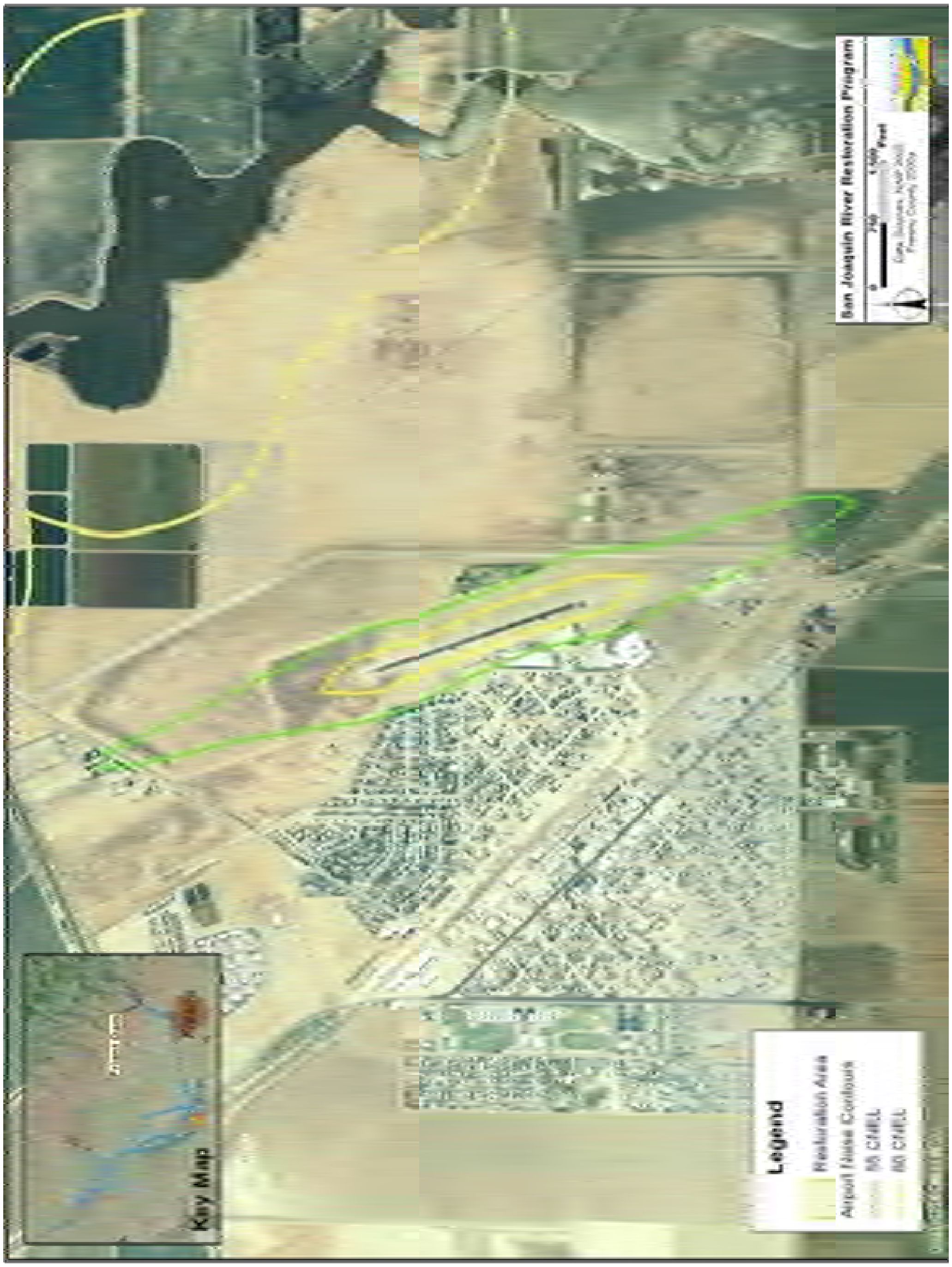


Figure 17-4.
Mendota Municipal Airport Noise Contours

Nontransportation Sources

This section describes noise levels from nontransportation sources within the Restoration Area.

Parks and School Playgrounds. Children playing at neighborhood parks or elementary school playgrounds are considered a nontransportation noise source and contribute to the existing noise environment. Typical noise levels associated with groups of approximately 50 children playing at a distance of 50 feet generally range from 55 to 60 dB L_{eq} and from 70 to 75 dBA L_{max}. Little league baseball games, with only players and no active fans, typically generate a noise level between 50 and 55 dB L_{eq} at 150 feet with an L_{max} of 65 dBA at 150 feet for a bat connecting with the ball. A girls' soccer game, with only players and no active fans, typically measures between 45 and 50 dB L_{eq} at 200 feet. A small group of parents cheering on an average play measured 65 dB L_{max} at 150 feet. School playgrounds and athletic fields are located in Reach 1A and 3 of the Restoration Area.

Agriculture. Noise sources emanating from agricultural operations, including activities associated with the processing or transportation of crops are conducted seasonally on agriculturally zoned lands within the Restoration Area. Noise sources associated with agricultural activities are heavy equipment, such as heavy duty trucks, tractors, harvesters, bailers, tillers, seeders, augers, front end loaders, and hay rakes. Aircraft overflights associated with crop spraying are also a component of agricultural noise. Intermittent noise levels of up to 85 dB L_{max} at a distance of 50 feet are associated with the heavy equipment discussed above. There are existing agricultural noise sources within each reach of the Restoration Area.

Industry. Industrial noise sources are associated with trucks idling, onsite truck circulation, continual use of refrigeration units on trucks, pallets dropping, use of railroad spurs, and forklifts operating on the site. Noise levels at industrial loading docks typically average hourly noise levels between 55 and 60 dB L_{eq} and between 80 and 84 dB L_{max} at a distance of 50 feet.

Among the other fixed or industrial-type noise sources that are typically of concern are cooling towers/evaporative condensers, pump stations, lift stations, steam valves, steam turbines, generators, fans, air compressors, heavy equipment, conveyor systems, transformers, pile drivers, grinders, drill rigs, gas or diesel motors, welders, cutting equipment, outdoor speakers, blowers, chippers, and amplified music and voices.

Some of the industrial uses that may typically operate these noise sources are wood processing facilities, pump stations, industrial manufacturing facilities, trucking operations, tire shops, auto maintenance shops, metal fabricating shops, shopping centers, drive-up windows, car washes, loading docks, public works projects, batch plants, bottling and canning plants, recycling centers, and electric generating stations. Industrial noise sources are located in Reaches 1A, 1B, 2B, and 3.

Quarries. The Restoration Area has a number of quarry and mining operations located in Reach 1A. Quarry sites require an extensive conveyor system, crushers, screeners, front end loaders, bulldozers, draglines, water trucks, haul trucks, hot plants, ready-mix concrete plants, and other large pieces of equipment that generate elevated noise levels. Additionally, many quarries run during more noise-sensitive night and evening hours to save on electricity costs. Noise levels associated with quarries and mining sites can range between 78 and 88 dB L_{eq} at a distance of 100 feet.

Reach 1

The existing noise environment in and around Reach 1 is dominated by urban uses (Reach 1A) and agricultural uses (Reach 1B). Existing noise-sensitive land uses within Reach 1 include residential uses, churches, schools, hospitals, parks, and golf courses. The nearest residential receiver located in Reach 1 is approximately 100 feet from the centerline of the Restoration Area and there are a large number of residential receivers within 1,000 feet of the centerline. The nearest church, school, and hospital are located 2,500 feet, 2,875 feet, and 3,500 feet, respectively, from the centerline of the Restoration Area.

Reach 2

The existing noise environment in and around Reach 2 is dominated by agricultural uses (Reach 2A), but it is also influenced by urban uses (Reach 2B). Urban use noise in Reach 2 emanates from the City of Mendota, an industrial use to the south, and the Mendota Municipal Airport. The nearest noise-sensitive receiver (residential) in Reach 2A is located 740 feet from the centerline of the Restoration Area. No other noise-sensitive uses are present in Reach 2A. Reach 2B has a handful of sensitive receivers (residential) in close proximity to the Restoration Area; the nearest is located 460 feet from the centerline.

Reach 3

The existing noise environment in and around Reach 3 is primarily dominated by agricultural uses. Urban use noise in Reach 3 emanates from the City of Firebaugh, industrial uses located along the river and south of the City, and the Firebaugh Municipal Airport. The nearest noise-sensitive receiver (residential) in Reach 3 is located 200 feet from the centerline of the Restoration Area. The nearest church and school are located 570 feet and 300 feet, respectively, from the centerline of the Restoration Area.

Reaches 4 and 5

The existing noise environment in and around Reaches 4 and 5 is primarily dominated by agricultural noise sources. Only three noise-sensitive receivers (residential) in Reaches 4 and 5 are located within 500 feet of the Restoration Area centerline. No other noise-sensitive land uses are present in Reaches 4 and 5.

Chowchilla Bypass, Eastside Bypass, and Tributaries

The existing noise environment in and around the Chowchilla Bypass and Eastside Bypass areas is primarily dominated by agricultural uses. Noise-sensitive land uses near the Restoration Area are residences and a school. The nearest residential use is located

380 feet from the Restoration Area centerline. The school is located 4,400 feet from the Restoration Area centerline.

17.1.3 San Joaquin River from Merced River to the Delta

The existing noise environment in and around the San Joaquin River from the Merced River to the Delta is primarily dominated by agricultural uses. Traffic noise emanating from rural roads (e.g., River Road, Crows Landing Road, Carpenter Road, Dos Rios Road, Maze Road) also contribute to the existing noise environment relative to their proximity to the San Joaquin River from the Merced River to the Delta, located just north of SR 132 (Maze Road). Noise-sensitive land uses near the lower San Joaquin River area are residences and churches. The nearest residential use is located 200 feet from the river's centerline. The nearest church is located 2,700 feet from the river's centerline. The noise policies and standards that apply to this section of the San Joaquin River are (Merced County 2000) and (Stanislaus County 1994) general plans and ordinances.

17.2 Regulatory Setting

Various private and public agencies have established noise guidelines and standards to protect citizens from potential hearing damage and various other adverse physiological and social effects associated with noise. Applicable standards and guidelines are discussed below.

17.2.1 Federal

The EPA Office of Noise Abatement and Control was originally established to coordinate Federal noise control activities. After its inception, the EPA's Office of Noise Abatement and Control issued the Federal Noise Control Act of 1972, establishing programs and guidelines to identify and address the effects of noise on public health and welfare, and the environment. EPA administrators determined in 1981 that subjective issues such as noise would be better addressed at lower levels of government. Consequently, in 1982 responsibilities for regulating noise-control policies were transferred to State and local governments. However, noise-control guidelines and regulations contained in the rulings of the EPA in prior years remain upheld by designated Federal agencies, allowing more individualized control for specific issues by designated Federal, State, and local government agencies.

Standards have also been established to address the potential for ground-borne vibration to cause structural damage to buildings. These standards were developed by the Committee of Hearing, Bioacoustics, and Biomechanics (CHABA) at the request of EPA (FTA 2006). For fragile structures, CHABA recommends a maximum limit of 0.25 in/sec PPV (FTA 2006).

17.2.2 State of California

State laws and regulations pertaining to noise are discussed below.

Governor's Office of Planning and Research

The OPR published the State of California General Plan Guidelines (OPR 2003), which provide guidance for the acceptability of projects within specific L_{dn} contours. Table 17-5 summarizes acceptable and unacceptable community noise-exposure limits for various land-use categories. Generally, residential uses (e.g., mobile homes) are considered to be acceptable in areas where exterior noise levels do not exceed 60 dB L_{dn}. Residential uses are normally unacceptable in areas exceeding 70 dBA L_{dn} and conditionally acceptable within 55 to 70 dB L_{dn}. Schools are normally acceptable in areas up to 70 dB L_{dn} and normally unacceptable in areas exceeding 70 dB L_{dn}. Commercial uses are normally acceptable in areas up to 70 dB CNEL. Between 67.5 and 77.5 dB L_{dn}, commercial uses are conditionally acceptable, depending on the noise insulation features and the noise reduction requirements.

Table 17-5.
Summary of Land Use Noise Compatibility Guidelines

Land Use Category	Community Noise Exposure (dB L_{dn})			
	Normally Acceptable[1]	Conditionally Acceptable[2]	Normally Unacceptable[3]	Clearly Unacceptable[4]
Residential—Low-Density Single-Family, Duplex, Mobile Home	<60	55–70	70–75	75+
Residential—Multifamily	<65	60–70	70–75	75+
Transient Lodging—Motel, Hotel	<65	60–70	70–80	80+
Schools, Libraries, Churches, Hospitals, Nursing Homes	<70	60–70	70–80	80+
Auditoriums, Concert Halls, Amphitheaters		<70	65+	
Sports Arena, Outdoor Spectator Sports		<75	70+	
Playgrounds, Neighborhood Parks	<70		67.5–75	72.5+
Golf Courses, Riding Stables, Water Recreation, Cemeteries	<75		70–80	80+
Office Building, Business Commercial, and Professional	<70	67.5–77.5	75+	
Industrial, Manufacturing, Utilities, Agriculture	<75	70–80	75+	

Source: OPR 2003

Notes:

[1] Specified land use is satisfactory, based on the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.

[2] New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning, will normally suffice.

[3] New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design. Outdoor areas must be shielded.

[4] New construction or development should generally not be undertaken.

Key: dB = decibels L_{dn} = day-night average noise level

The guidelines present adjustment factors that may be used to arrive at noise acceptability standards reflecting the noise-control goals of the community, the particular community's sensitivity to noise, and the community's assessment of the relative importance of noise pollution. In addition, Title 24 CCR establishes standards governing interior noise levels that apply to all new single-family and multifamily residential units in California. These standards require that acoustical studies be performed before construction at building locations where the existing L_{dn} exceeds 60 dB. Such acoustical studies must establish mitigation measures that will limit maximum L_{dn} levels to 45 dB in any habitable room. Although there are no generally applicable interior noise standards pertinent to all uses, many communities in California have adopted an L_{dn} of 45 dB as an upper limit on interior noise in all residential units.

California Department of Transportation

For the protection of fragile, historic, and residential structures, Caltrans recommends a more conservative threshold of 0.2 in/sec PPV for normal residential buildings and 0.08 in/sec PPV for old or historically significant structures (Caltrans 2002). These standards are more stringent than the Federal standard established by CHABA, presented above.

17.2.3 Regional and Local

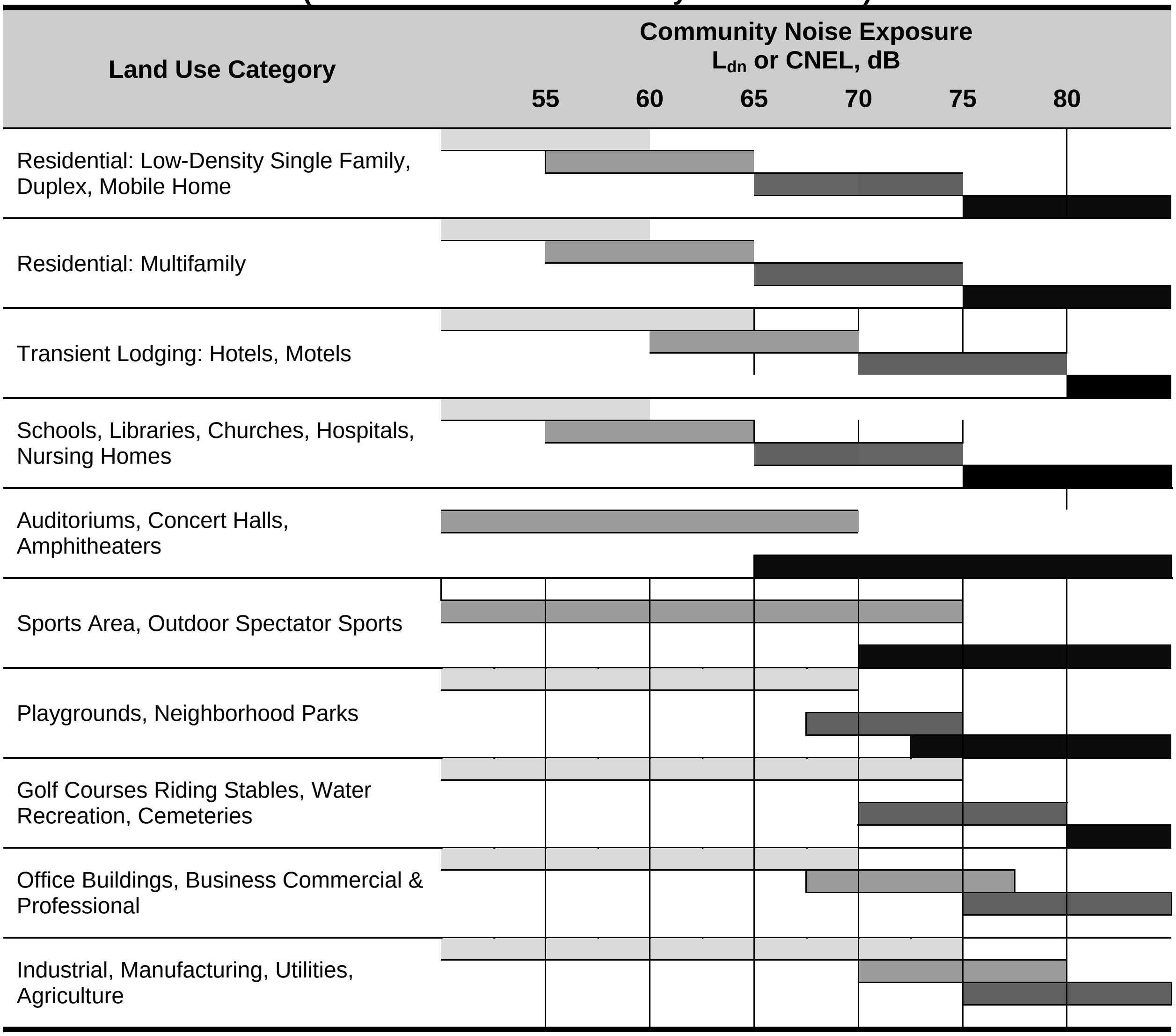
Regional and local laws and regulations pertaining to noise are discussed below.

17.2.4 Fresno County General Plan Noise Element

The Fresno County General Plan Noise Element contains policies that address noise-sensitive land uses and standards to avoid noise-related impacts from existing uses and to ensure an acceptable noise environment for each land use within the unincorporated areas of Fresno County. Table 17-6 presents land use compatibility for community noise environments from the Fresno County General Plan. Applicable goals and policies applied to the program alternatives include the following:

- **Goal HS-G –** To protect residential and other noise-sensitive uses from exposure to harmful or annoying noise levels, to identify maximum acceptable noise levels compatible with various land use designations, and to develop a policy framework necessary to achieve and maintain a healthful noise environment.
  - **Policy HS-G.4 –** So that noise mitigation may be considered in the design of new projects, the County shall require an acoustical analysis as part of the environmental review process where:
    - b. Proposed projects are likely to produce noise levels exceeding the levels shown in the County's Noise Control Ordinance at existing or planned noise-sensitive uses.

Table 17-6.
Land Use Compatibility for Community Noise Environments
(Chart HS-1 of Fresno County General Plan)



Normally Acceptable – Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction, without any special noise requirements

Conditionally Acceptable – New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice.

Generally Unacceptable – New construction or development should be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirement must be made and needed noise insulation features included in the design.

Clearly Unacceptable – New construction or development clearly should not be undertaken.

Source: Fresno County 2000b

- **Policy HS-G.5 –** Where noise mitigation measures are required to achieve acceptable levels according to land use compatibility or the Noise Control Ordinance, the County shall place emphasis of such measures upon site planning and project design. These measures may include, but are not limited to, building orientation, setbacks, earthen berms, and building construction practices. The County shall consider the use of noise barriers, such as soundwalls, as a means of achieving the noise standards after other design related noise mitigation measures have been evaluated or integrated into the project.

- **Policy HS-G.6 –** The County shall regulate construction-related noise to reduce impacts on adjacent uses in accordance with the County's Noise Control Ordinance.

17.2.5 Fresno County Noise Ordinance Code

The Fresno County Noise Ordinance Code establishes exterior and interior noise standards for noise sensitive land uses. Noise sensitive land uses are defined as single or multifamily residences, schools, hospitals, churches, or public libraries located within either the incorporated of unincorporated areas. Chapter 8.40 Noise Control of Title 8 of the County Code sets exterior noise standards for non-transportation sources, as shown in Table 17-7. Chapter 8.40 of the County Code also sets interior noise standards for non-transportation sources, as shown in Table 17-8.

Table 17-7.
Fresno County Exterior Noise Standards Title 8 Health and Safety, Chapter 8.40.040 Noise Control

Category[1]	Cumulative Number of Minutes in any 1-Hour Time Period	Noise Level Standards, dBA Daytime 7 a.m. to 10 p.m.	Noise Level Standards, dBA Nighttime 10 p.m. to 7 a.m.
1	30	50	45
2	15	55	50
3	5	60	55
4	1	65	60
5	0	70	65

Source: Fresno County Ordinance Code, Chapter 8.40, December 2007
Note:
[1] Categories are defined in terms of cumulative units of time and noise level standards.
Key:
dBA = A-weighted decibels

Table 17-8.
Fresno County Interior Noise Standards Title 8 Health and Safety, Chapter 8.50.040 Noise Control

Category[1]	Cumulative Number of Minutes in any 1Hour Time Period	Noise Level Standards, dBA Daytime 7 a.m. to 10 p.m.	Noise Level Standards, dBA Nighttime 10 p.m. to 7 a.m.
1	5	45	35
2	5	50	40
3	1	55	45

Source: Fresno County Ordinance Code, Chapter 8.40, December 2007
Note:
[1] Categories are defined in terms of cumulative units of time and noise level standards.

Key:
dBA = A-weighted decibels

The Fresno County Noise Ordinance noise standards shall be adjusted to existing ambient noise levels provided that the existing ambient noise levels exceed the current exterior noise standard. The noise standards above shall be reduced by 5 dBA for simple tone noises or noises consisting of speech or music, or for recurring impulsive noises.

The Fresno County Noise Ordinance Code establishes noise standard exemptions for construction noise. Construction noise is considered exempt from noise standards provided that construction activities are conducted from 6:00 a.m. to 9:00 p.m. Monday through Friday. Construction noise is exempt from the noise standards provided that construction activities are conducted from 7:00 a.m. to 5:00 p.m. on Saturday and Sunday.

17.2.6 Madera County General Plan Noise Element

The Madera County General Plan Noise Element contains policies that address noise-sensitive land uses and standards to avoid noise-related impacts from existing uses. Applicable goals and policies applied to the program alternatives include the following:

- **Goal 7.4 –** To protect County residents from the harmful and annoying effects of exposure to excessive noise.

Transportation Noise Source Policies

- **7.A.2 –** Noise created by new transportation noise sources, including roadway improvement projects, shall be mitigated so as not to exceed 60 dB L_{dn} within the outdoor activity areas of existing or planned noise-sensitive land uses and 45 dB L_{dn} in interior spaces of existing or planned noise-sensitive land uses.

Non-transportation Noise Source Policies

- **7.A.5 –** Noise which will be created by new non-transportation noise sources, or existing non-transportation noise sources which undergo modifications that may increase noise levels, shall be mitigated so as not to exceed the noise level standards of Table 7.A.4 (Table 17-9 of this section) on lands designated for noise-sensitive uses.

- **7.A.6 –** The County shall enforce the State Noise Insulation Standards (California Code of Regulations, Title 24) and Chapter 35 of the Uniform Building Code (UBC) concerning interior noise exposure for multi-family housing, hotels and motels.

- **7.A.7 –** Where the development of a project may result in land uses being exposed to existing or projected future noise levels exceeding the levels specified by the policies of the noise section of the General Plan, the County shall require an acoustical analysis early in the review process so that noise mitigation may be included in the project design. For development not subject to environmental review, the requirements for an acoustical analysis shall be implemented prior to the issuance of a building permit.

Table 17-9.
Maximum Allowable Noise Exposure for Non-Transportation Noise Sources[1]
(Table 7.A.4 of the Madera County General Plan)

	Daytime (7 a.m. to 10 p.m.)	Nighttime (10 p.m. to 7 a.m.)
Hourly Leq, dB	50	45
Maximum level, dB	70	65

Source: Madera County 1995

Notes:
[1] As determined at the property line of the receiving land use. When determining the effectiveness of noise mitigation measures, the standards may be applied on the receptor side of noise barriers at the property line.

Each of the noise levels specified above shall be lowered by 5 dB for pure tone noises, noises consisting primarily of speech or music, or for recurring impulsive noises. These noise level standards do not apply to residential units established in conjunction with industrial or commercial uses (e.g., caretaker dwellings).

Key:
dB = decibel
L_{eq} = energy-equivalent noise level

17.2.7 Merced County General Plan Noise Element

The Merced County General Plan Noise Element contains policies that address noise-sensitive land uses and standards to avoid noise-related impacts from existing uses. Applicable goals and policies applied to the program alternatives include the following:

- **Goal 1 –** All citizens of the County free from the harmful effects of excessive noise.

- **Objective 1.A –** Residential areas are not significantly impacted by excessive exterior noise levels.

  – **Policy –** Exterior noise level standard for single family and multi-family residential uses is 65 dBA L_{dn}.

- **Objective 1.B** – Interior noise levels for residential dwelling units in residential areas do not exceed 45 dBA.
  - **Policy** – Interior noise level standard for residential uses is 45 dBA L_{dn}.
- **Objective 1.C** – Hospitals and schools are not significantly impacted by excessive exterior noise levels.
  - **Policy** – Exterior noise level standard for hospitals and schools is 70 dBA L_{dn}.

17.2.8 Merced County Code

The Merced County Code establishes sound level limitations, restricts construction hours, and specifies prohibited acts. Permissible noise levels are established under Title 10 Public Peace, Morals and Welfare, Chapter 10.60 Noise Control, Section 10.60.030 Sound Level Limitations:

> *A. No person shall cause, suffer, allow, or permit the operation of any sound source on property of any public space of public right-of-way in such a manner as to create a sound level that exceeds the background sound level by at least 10 dBA during daytime hours (seven a.m. to ten p.m.) and by at least 5 dBA during the nighttime hours (ten p.m. to seven a.m.) when measured at or within the real property line of the receiving property, which shall constitute a noise disturbance, provided, however, that if the background sound level cannot be determined, the absolute sound level limits set forth in Table 1 (Table 17-10 of this section), Maximum Permissible Sound Levels, provided that if the sound source in question is a pure tone, the limits of Table 1 (Table 17-10 of this section) shall be reduced by 5 dBA.*

Table 17-10.
Permissible Sound Levels
(Table 1 of Merced County Code, Title 10, Chapter 10.60)

If Residential Property	If Other Than Residential Property
65 dBA L_{dn} or	70 dBA L_{dn} or
75 dBA L_{max}	80 dBA L_{max}

Source: Merced County Code, 2004

Key:
dBA = A-weighted sound levels
L_{dn} = day-night average noise level
L_{max} = Maximum Sound Level

B. The following is exempt from the sound level limits of Section 10.60.030 (A):

5. Noise from construction activity, provided that all construction in or adjacent to urban areas shall be limited to the daytime hours between seven a.m. and six p.m., and all construction equipment shall be properly muffled and maintained.

The following portion of Section 10.60.040 Specific Prohibited Acts is applicable to the program alternatives:

A. No person shall cause, suffer, allow, or permit to the following acts:

5. Operating or permitting the operation of any tools or equipment used in construction, drilling, earthmoving, excavating, or demolition work between six p.m. and seven a.m. the following day on a weekday or at any time on a weekend day or legal holiday, except for emergency work, or when the sound levels does not exceed any applicable relative or absolute limit specified in Section 10.60.030.

17.2.9 City of Fresno General Plan Noise Element

The City of Fresno General Plan Noise Element (City of Fresno 2002) contains policies that address noise-sensitive land uses and standards to avoid noise-related impacts from existing uses. Applicable goals and policies applied to the program alternatives include the following:

- **Goal 1** – Enhance the quality of life for the citizens of Fresno and plan for the projected population within the moderately expanded Fresno urban boundary in a manner which will respect physical, environmental, fiscal, economic, and social issues.

- **Goal 14 –** Protect and improve public health and safety.

    - **H-1-a. Policy –** Noise-sensitive land uses impacted by existing or projected future transportation noise sources shall include mitigation measures so that resulting noise levels do not exceed the standards shown in Table 8 (Table 17-11 of this section).

Table 17-11.
Maximum Allowable Noise Exposure for Noise-Sensitive Land Uses
(Table 8 of the City of Fresno General Plan Noise Element)

Land Use[4]	Outdoor Activity Areas[1] L_{dn} dB	Interior Spaces	
		L_{dn} dB	L_{eq} dB[2]
Residential	60[3]	45	---
Transient Lodging	60[3]	45	---
Hospitals, Nursing Homes	60[3]	45	---
Theaters, Auditoriums, Music Halls	---	---	35
Churches, Meeting Halls	60[3]	---	45
Office Buildings	---	---	45
Schools, Libraries, Museums	---	---	45

Source: City of Fresno General Plan Noise Element, February 2002.

Notes:
[1] Where the location of the outdoor activity area is unknown or is not applicable, the exterior noise level standard shall be applied to the property line of the receiving land use.
[2] As determined for a typical worst-case hour during periods of use.
[3] Noise levels up to 65 dB L_{dn} adjacent to the Burlington Northern Santa Fe and Union Pacific mainline tracks may be allowed by the project approving authority when it is determined that it is not possible to achieve 60 dB L_{dn} in outdoor activity areas using a practical application of the best-available noise reduction technology, and when all feasible exterior noise reduction measures have been proposed.
[4] The Planning and Development Director, ona case-by-case basis, may designate land uses other than those shown in this table to be noise-sensitive, and may require appropriate noise mitigation measures.

Key:
dB = decibel
L_{dn} = day-night average noise level

– **H-1-b. Policy** – For purposes of city analyses of noise impacts, and for determining appropriate noise mitigation, a significant increase in ambient noise levels is assumed if the project causes ambient noise levels to exceed the following:

- The ambient noise level is less than 60 dB L_{dn} and the project increase noise levels by 5 dB or more.
- The ambient noise level is 60-65 dB L_{dn} and the project increases noise levels by 3 dB or more
- The ambient noise level is greater than 65 dB L_{dn} and the project increases noise levels by 1.5 dB or more.

– **H-1-c. Policy** – The city shall review new public and private development proposals to determine conformance with the policies of this Noise Element.

– **H-1-d. Policy** – The city shall require an acoustical analysis in those cases where a project potentially threatens to expose existing or proposed noise-sensitive land uses to excessive noise levels. The presumption of potentially excessive noise levels shall be based on the location of new noise-sensitive uses to known noise sources of staff's professional judgment that a potential for adverse noise impacts exists. Acoustical analyses shall be required early in the review process so that noise mitigation may be included in the project design. For development not subject to environmental review, the requirements for an acoustical analysis shall be implemented prior to the issuance of building permits. The requirements for the content of an acoustical analysis are established by the Planning and Development Department in conjunction with environmental health agencies.

- **H-1-e. Policy –** The city shall develop and employ procedures to ensure that noise mitigation measures required pursuant to an acoustical analysis are implemented in the development review and building permit processes.

- **H-1-j Policy –** Noise created by new transportation noise sources, including roadway improvement projects, shall be mitigated so that resulting noise levels do not exceed the adopted standards at noise-sensitive land uses.

- **H-1-k. Policy –** Noise-sensitive land uses impacted by stationary noise sources shall include mitigation measures so that resulting noise levels do not exceed the standards shown in Table 9 (Table 17-12 of this section) as follows:

Table 17-12.
Maximum Allowable Noise Exposure-Stationary Noise Sources[1]
(Table 9 of the City of Fresno General Plan Noise Element)

	Daytime (7 a.m. to 10 p.m.)	Nighttime (10 p.m. to 7 a.m.)
Hourly Equivalent Sound Level (L_{eq}), dB	50	45
Maximum Sound Level (L_{max}), dB	70	65

Source: City of Fresno General Plan Noise Element, February 2002
Note:
[1] As determined at the outdoor activity areas. Where the location of outdoor activity areas is unknown or not applicable, the noise exposure standard shall be applied at the property line of the receiving land use. When ambient noise levels exceed or equal the levels in this table, mitigation shall only be required to limit noise to the ambient plus five (5) dB.
Key:
dB = decibel

- **H-1-l. Policy –** Noise created by new proposed stationary noise sources or existing stationary noise sources which undergo modifications that may increase noise levels shall be mitigated so as not to exceed the noise level standards of Table 9 (Table 17-12 of this section) at noise-sensitive land uses.

- **H-1-m Policy –** As a guideline, noise barrier (wall, earth berms, or berm/wall combinations) shall not exceed 15 feet in height as measured from the elevation of the nearest building pad. The Planning Department Director, on a case-by-case basis, may allow noise barrier heights differing from this guideline. However, resulting noise levels must satisfy the maximum allowable noise exposure standards.

17.2.10 City of Fresno Noise Municipal Code

The Fresno Municipal Code Chapter 10 Regulations Regarding Public Nuisances and Real Property Conduct and Use, Article 1 Noise Regulations establishes excessive noise guidelines and exemptions to the Municipal Code. The following sections (SEC) of the Municipal Code are applicable to the program alternatives:

> *SEC 10-105. Excessive Noise Prohibited.*
>
> *No person shall make, cause, or suffer or permit to be made or caused upon any premises of upon any public street, alley, or place within the city any sound or noise which causes discomfort or annoyance to any reasonable person of normal sensitiveness residing or working in the area, unless such noise or sound is specifically authorized by or in accordance with this article. The provisions of this section shall apply to, but shall be limited to, the control, use, and operation of the following noise sources:*
>
> *(d) Construction equipment or work, including the operation, use or employment of pile drivers, hammers, saws, drills, derricks, hoists, or similar construction equipment or tools.*
>
> *SEC 10-109 Exceptions.*
>
> *The provisions of this article shall not apply to:*
>
> *(a) Construction, repair or remodeling work accomplished pursuant to a building, electrical, plumbing, mechanical, or other construction permit issued by the city of other governmental agency, or to site preparation and grading, provided such work takes place between the hours of 7:00 a.m. and 10:00 p.m. on any day except Sunday.*

17.2.11 San Joaquin River Parkway Master Plan

The San Joaquin River Parkway Master Plan contains policies relating to allowable noise levels within the River Parkway and the allowable noise levels attributable to activities at the River Parkway in relation to adjacent noise-sensitive land uses (e.g., recreation policy (RP), recreation policy-facilities (RPF), and recreation policy siting (RPS)). The Master Plan also addresses noise issues relating to construction noise. The following portions of the San Joaquin Parkway Master Plan are applicable to the program alternatives:

- **RPS2 –** To the extent feasible, any new access roadways associated with specific projects under the Plan should be located to reduce disturbance from intermittent vehicle passbys at the nearest noise-sensitive land uses.

- **RPS3** At a minimum, avoid siting any recreational or educational facilities in any areas exposed to existing or projected future noise levels exceeding applicable California Office of Noise Control (ONC) noise guidelines:

- **RPS3.1** – 75 dBA L_{dn}/CNEL for golf courses, equestrian facilities, canoe put-out and take-in facilities and swimming areas.
- **RPS3.2** – 70 dBA L_{dn}/CNEL for picnic areas, turf and other play areas, and any other daytime gathering areas.
- **RPS3.3** – 60 dBA L_{dn}/CNEL for camping areas or indoor educational facilities, although noise exposure up to 70 dBA L_{dn} may be acceptable for the latter if adequate sound insulation can be demonstrated.

- **RP34 –** Recreational activities will be evaluated for potential noise impacts on avian species and sited to avoid noise impacts.

- **RPF9 –** Construction activities potentially impacting noise-sensitive land uses in Madera County shall comply with the most stringent of applicable provisions from the County and City of Fresno’s noise ordinances. Specifically, any construction activities occurring outside of the hours between 7 a.m. and 9 p.m., Monday through Saturday, shall comply with the noise exposure limits for most noise-sensitive land uses established in Fresno County’s Noise Control Ordinance, and with the exposure limits for other (commercial and industrial) land uses established in the City of Fresno’s Noise Regulations.

17.3 Environmental Consequences and Mitigation Measures

The purpose of this section is to provide information about the noise associated with implementation of the program alternatives. This section describes the methodology, criteria for determining significance of effects, and environmental consequences and mitigation measures associated with effects of each of the program alternatives. The program alternatives evaluated in this chapter are described in detail in Chapter 2.0, "Description of Alternatives," and summarized in Table 17-13. Table 17-14 summarizes the impacts and mitigation measures.

Table 17-13.
Actions Included Under Action Alternatives

Level of NEPA/CEQA Compliance	Actions[1]		Action Alternative					
			A1	A2	B1	B2	C1	C2
Project-Level	Reoperate Friant Dam and downstream flow control structures to route Interim and Restoration flows		✓	✓	✓	✓	✓	✓
	Recapture Interim and Restoration flows in the Restoration Area		✓	✓	✓	✓	✓	✓
	Recapture Interim and Restoration flows at existing CVP and SWP facilities in the Delta		✓	✓	✓	✓	✓	✓
Program-Level	Common Restoration actions[2]		✓	✓	✓	✓	✓	✓
	Actions in Reach 4B1 to provide at least:	475 cfs capacity	✓	✓	✓	✓	✓	✓
		4,500 cfs capacity with integrated floodplain habitat		✓		✓		✓
	Recapture Interim and Restoration flows on the San Joaquin River downstream from the Merced River at:	Existing facilities on the San Joaquin River			✓	✓	✓	✓
		New pumping infrastructure on the San Joaquin River					✓	✓
	Recirculation of recaptured Interim and Restoration flows		✓	✓	✓	✓	✓	✓

Notes:
[1] All alternatives also include the Physical Monitoring and Management Plan and the Conservation Strategy, which include both project- and program-level actions intended to guide implementation of the Settlement.
[2] Common Restoration actions are physical actions to achieve the Restoration Goal that are common to all action alternatives and are addressed at a program level of detail.

Key:
CEQA = California Environmental Quality Act
cfs = cubic feet per second
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
NEPA = National Environmental Policy Act
PEIS/R = Program Environmental Impact Statement/Report
SWP = State Water Project

Table 17-14.
Summary of Impacts and Mitigation Measures – Noise

Impacts	Alternative	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance After Mitigation
Noise: Program-Level				
NOI-1: Exposure of Sensitive Receptors to Generation of Temporary and Short-Term Construction Noise	No-Action	Too Speculative for Meaningful Consideration	--	Too Speculative for Meaningful Consideration
	A1	PS	NOI-1: Implement Measures to Reduce Temporary and Short-Term Noise Levels from Construction-Related Equipment Near Sensitive Receptors	PSU
	A2	PS		PSU
	B1	PS		PSU
	B2	PS		PSU
	C1	PS		PSU
	C2	PS		PSU
NOI-2: Exposure of Sensitive Receptors to Increased Off-Site Traffic Noise Levels	No-Action	Too Speculative for Meaningful Consideration	--	Too Speculative for Meaningful Consideration
	A1	PS	NOI-2: Implement Measures to Reduce Temporary Noise Levels from Construction-Related Traffic Increases Near Sensitive Receptors	PSU
	A2	PS		PSU
	B1	PS		PSU
	B2	PS		PSU
	C1	PS		PSU
	C2	PS		PSU
NOI-3: Exposure of Sensitive Receptors to Long-Term Operation-Related Noise Levels from Stationary Sources	No-Action	Too Speculative for Meaningful Consideration	--	Too Speculative for Meaningful Consideration
	A1	LTS	--	LTS
	A2	LTS	--	LTS
	B1	LTS	--	LTS
	B2	LTS	--	LTS
	C1	PS	NOI-3: Implement Measures to Reduce Long-Term Operation-Related Noise Levels from Stationary Sources on Sensitive Receptors	LTS
	C2	PS		LTS

Table 17-14.
Summary of Impacts and Mitigation Measures – Noise (contd.)

Impacts	Alternative	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance After Mitigation
NOI-4: Exposure of Sensitive Receptors to Increased Noise from Borrow Site-Related Activities	No-Action	Too Speculative for Meaningful Consideration	--	Too Speculative for Meaningful Consideration
	A1	PS	NOI-4: Implement Measures to Reduce Borrow Site Noise Levels Near Sensitive Receptors	LTS
	A2	PS		LTS
	B1	PS		LTS
	B2	PS		LTS
	C1	PS		LTS
	C2	PS		LTS
NOI-5: Exposure of Sensitive Receptors to or Generation of Excessive Groundborne Vibration	No-Action	Too Speculative for Meaningful Consideration	--	Too Speculative for Meaningful Consideration
	A1	PS	NOI-5: Implement Measures to Reduce Temporary and Short-term Groundborne Noise and Vibration Levels Near Sensitive Receptors	LTS
	A2	PS		LTS
	B1	PS		LTS
	B2	PS		LTS
	C1	PS		LTS
	C2	PS		LTS
Noise: Project-Level				
NOI-6: Effects of the Reoperation of Friant Dam on the Noise Environment	No-Action	No Impact	--	No Impact
	A1	LTS	--	LTS
	A2	LTS	--	LTS
	B1	LTS	--	LTS
	B2	LTS	--	LTS
	C1	LTS	--	LTS
	C2	LTS	--	LTS

Key:
-- = not applicable
LTS = less than significant
PS = potentially significant
PSU = potentially significant and unavoidable

17.3.1 Impact Assessment Methodology

The noise impact assessment is based on the alternatives descriptions contained in Chapter 2.0, “Description of Alternatives,” existing documentation (e.g., equipment noise levels and attenuation rates), and site reconnaissance data collected during on-site noise monitoring. This information was used to identify the location of sensitive receptors, as well as existing sources of noise and vibration in and near the Restoration Area.

To assess potential temporary and short-term construction-related noise impacts, sensitive receptors and their relative exposure (considering intervening topography and distance) to project-generated noise levels were identified. Project-generated noise levels were predicted using the Federal Transit Administration (FTA) Noise and Vibration Impact Assessment Methodology (FTA 2006, pages 5-1 through 5-29 and 10-1 through 10-12). Reference noise emission levels and the equipment usage factors were based on the FHWA Roadway Construction Noise Model (FHWA 2006, Section 3). Resulting combined noise levels from the use of specific construction equipment were predicted at identified noise-sensitive receptors.

Potential noise impacts from long-term nontransportation (i.e., stationary) sources were assessed based on existing documentation (e.g., equipment noise levels) and site reconnaissance data. This analysis also evaluated proposed noise-generating uses that could affect sensitive receptors in and near the Restoration Area.

Groundborne vibration impacts were qualitatively assessed based on existing documentation (e.g., vibration levels produced by specific heavy-duty equipment operations) and the distance of sensitive receptors from the given source.

17.3.2 Significance Criteria

The thresholds of significance for impacts are based on the environmental checklist in Appendix G of the State CEQA Guidelines, as amended, and the Noise Element of the applicable General Plans (i.e., Fresno County, Madera County, Merced County, and City of Fresno). These thresholds also encompass the factors taken into account under the NEPA to determine the significance of an action in terms of its context and the intensity of its impacts. Predicted noise levels were compared with applicable standards for determination of significance. Program alternatives under consideration were determined to result in a significant impact related to noise or vibration if they would do any of the following:

- Expose persons to or generate noise levels in excess of applicable standards established by the General Plans for the counties of Fresno, Madera, and Merced, and the City of Fresno, and by applicable codes and ordinances for exterior noise levels.

- Result in a substantial long-term, permanent increase in ambient noise levels in the study area above levels existing without the project (where existing ambient noise levels are less than 60 dB, a significant increase would be considered a “+5”-dB change in ambient noise levels attributable to the project; and where existing ambient noise levels exceed 60 dB, a significant increase would be considered “+3”-dB change in ambient noise levels attributable to the project (FICON 1992, Caltrans 1998).

- Result in a substantial temporary or periodic increase in ambient noise levels in the study area above levels existing without the project (where existing ambient noise levels are less than 60 dB, a significant increase would be considered “+5”-

dB change in ambient noise levels attributable to the project; and where existing ambient noise levels exceed 60 dB, a significant increase would be considered a "+3"-dB change in ambient noise levels attributable to the project (FICON 1992, Caltrans 1998).

- Expose people residing or working in the study area to excessive noise levels caused by a project located within an airport land use plan or, where such a plan has not been adopted, within 2 miles of a public airport or public-use airport.

- Expose people residing or working in the study area to excessive noise levels caused by a project within the vicinity of a private airstrip.

- Expose persons to or generate excessive groundborne vibration or groundborne noise levels. Temporary, short-, and long-term vibration impacts would be significant if project implementation would generate or result in the exposure of sensitive receptors to vibration levels that exceed Caltrans' recommended standard of 0.2 in/sec PPV with respect to the prevention of structural damage for normal buildings (Caltrans 2002) or FTA's maximum acceptable vibration standard of 80 VdB with respect to human response for residential uses (i.e., annoyance) (FTA 2006) at any nearby existing sensitive land uses.

17.3.3 Program-Level Impacts and Mitigation Measures

This section provides a program-level evaluation of the direct and indirect effects of program alternatives on the noise environment. The action alternatives could affect the noise environment during the modification or construction of facilities or during other restoration actions (e.g., spawning gravel enhancements). However, the potential for significant effects on the noise environment would not extend upstream from Friant Dam or downstream into the Delta or CVP/SWP water service areas. Changing reservoir elevations upstream from Friant Dam would not generate noise. Noise effects resulting from additional flows entering the Delta, moving through the Delta, being exported from the Delta, being conveyed to a service area, and put to beneficial use in that service area would not substantially differ from existing and future noise effects in the absence of the project. For these reasons, these geographic regions are not discussed further in this section. Flowing water from the Interim and Restoration flows in the river channel and bypasses also would not surpass any of the significance thresholds, is not considered to be "noise," and is not considered further in this section.

The evaluation of program-level impacts on the noise environment considered potential effects of recapture of Interim and Restoration flows using existing facilities on the San Joaquin River between the Merced River and the Delta, and using a potential new pumping facility in this segment of the river (Alternatives C1 and C2).

No-Action Alternative

Under the No-Action Alternative, many reasonably foreseeable actions could cause noise impacts. However, the significance of these impacts would be too speculative for meaningful consideration, as described below.

Impact NOI-1 (No-Action Alternative): ***Exposure of Sensitive Receptors to Generation of Temporary and Short-Term Construction Noise – Program-Level***. Population growth and resulting associated noise-generating activities would increase temporary and short-term noise levels under the No-Action Alternative. Any new large developments or other major facilities or activities that occur within or near the Restoration Area and downstream as a result of future population growth could cause an increase in site-specific noise levels on sensitive receptors that would be potentially significant. However, this indirect impact would be **too speculative for meaningful consideration**.

Under the No-Action Alternative, no construction or other activities related to the Settlement would occur; therefore no potential exists for these activities to generate noise. However, given expected projected population increases, there would likely be other projects and developments in the Restoration Area and downstream that would generate additive noise to the existing noise environment. These projects would be subject to applicable noise standards and be required to comply with those noise standards. Implementation of proposed general plan buildout scenarios would also contribute to the existing noise environment in relation to construction activities, increased traffic noise, and new stationary sources. As implementation of general plan buildout scenarios commence, individual projects would also be required to comply with applicable noise standards. However, noise standards during project implementation, especially during construction, cannot always be expected to reduce noise levels to less-than-significant levels for all sensitive noise receptors. Because of the long planning horizon (to 2030) and uncertainty with respect to specific projects and project location, a determination of significance is not possible and cannot be made because the extent and magnitude of the impact is unknown. Because of this uncertainty, this temporary and short-term indirect impact is considered to be too speculative for meaningful consideration.

Impact NOI-2 (No-Action Alternative): ***Exposure of Sensitive Receptors to Increased Off-Site Traffic Noise Levels – Program-Level***. Under the No-Action Alternative, average daily traffic volumes along roadways in the study area would be expected to increase, generating increased noise levels on sensitive receptors. For reasons discussed above for Impact NOI-1 (No-Action Alternative), this impact would be **too speculative for meaningful consideration.**

Impact NOI-3 (No-Action Alternative): ***Exposure of Sensitive Receptors to Long-Term Operation-Related Noise Levels from Stationary Sources – Program-Level***. The No-Action Alternative would not introduce new long-term, operation-related noise levels from stationary sources associated with the Settlement. Reasonably foreseeable future projects, however, could increase long-term noise levels on sensitive receptors. For reasons discussed above for Impact NOI-1 (No-Action Alternative), this impact would be **too speculative for meaningful consideration**.

Impact NOI-4 (No-Action Alternative): ***Exposure of Sensitive Receptors to Increased Noise from Borrow Site-Related Activities – Program-Level***. The No-Action Alternative would not involve the borrow-site activities associated with the Settlement. However, it is unknown whether other reasonably foreseeable projects or projects associated with projected population increases would require the use of borrow materials and thus involve borrow activities. Borrow activities could expose sensitive receptors to temporary, short-term noise levels in excess of acceptable standards and/or result in a substantial increase in ambient noise levels. For reasons discussed above for Impact NOI-1 (No-Action Alternative), this impact would be **too speculative for meaningful consideration**.

Impact NOI-5 (No-Action Alternative): ***Exposure of Sensitive Receptors to or Generation of Excessive Groundborne Vibration – Program-Level***. The No-Action Alternative would not introduce new long-term, program-generated, operation-related vibration levels from construction activities associated with the Settlement. Projects associated with projected population increases would be required to comply with applicable noise and vibration standards, including Caltrans' Vibration or Groundborne Noise Levels, as outlined in Caltrans' and FTA's Maximum Acceptable Vibration Standards designed to reduce effects on the noise environment. However, groundborne vibration-related effects could still occur. For reasons discussed above for Impact NOI-1 (No-Action Alternative), this impact would be **too speculative for meaningful consideration**.

Alternatives A1 and B1

Program-level impacts under Alternatives A1 and B1 would result from construction actions and would occur within the Restoration Area, as described below.

Impact NOI-1 (Alternatives A1 and B1): ***Exposure of Sensitive Receptors to Generation of Temporary and Short-Term Construction Noise – Program-Level***. Many Settlement actions would involve minor to substantial construction activities, which would likely temporarily expose some sensitive receptors to noise levels in excess of applicable noise standards and/or result in a substantial increase in ambient noise levels. These temporary and short-term impacts would be **potentially significant**.

Implementation of the action alternatives would result in intermittent construction activities (e.g., constructing the Mendota Pool bypass, fish screens, and seasonal barriers; establishing low-flow channels; augmenting riffles; modifying gravel pits; constructing or strengthening levees). These construction activities could potentially expose sensitive receptors temporarily to noise levels in excess of the applicable noise standards, result in a noticeable increase in ambient noise levels, or both. Construction noise levels in the Restoration Area would fluctuate depending on the particular type, number, and duration of usage for the varying equipment. The effects of construction noise largely depend on the type of construction activities occurring on any given day, noise levels generated by those activities, distances to noise-sensitive receptors, and the existing ambient noise environment in the receptor's vicinity. Construction generally occurs in several discrete stages, each phase requiring a specific complement of equipment of varying type, quantity, and intensity. These variations in the operational characteristics of the equipment would change the effect they have on the noise environment along the San Joaquin River and the surrounding community for the duration of the construction process.

The site preparation phase typically generates the highest noise levels, which are caused by on-site equipment associated with grading, compacting, and excavation. Site preparation equipment could include backhoes, bulldozers, loaders, excavation equipment such as graders and scrapers, and compaction equipment. Erection of large structural elements and mechanical systems could require the use of a crane for placement and assembly tasks, which may also generate high noise levels. Pile drivers may be required for construction of some restoration features. Table 17-15 depicts the noise levels generated by various types of construction equipment.

Table 17-15.
Noise Emission Levels from Construction Equipment

Equipment Type	Typical Noise Level at 50 Feet (dBA)
Air compressor	78
Asphalt paver	77
Auger drill rig	85
Backhoe	78
Clam shovel	93
Compactor	83
Concrete breaker	82
Concrete pump	81
Concrete saw	90
Crane, mobile	81
Bulldozer	82
Drill rig truck	84
Front-end loader	79
Generator	81
Grader	85
Hoe ram extension	90
Jackhammer	89
Pneumatic tools	85
Pile driver	101
Rock drill	81
Scraper	84
Trucks	74–81
Water pump	81

Source: Bolt Beranek and Newman 1981, FTA 2006:12-6

Note:

All equipment is fitted with a properly maintained and operational noise control device, per manufacturer specifications. Noise levels listed are manufacture-specified noise levels for each piece of heavy construction equipment.

Key:

dBA = A-weighted decibels

To assess noise levels associated with the various equipment types and operations, construction equipment can be considered to operate in two modes, mobile and stationary. Mobile equipment sources move around a construction site performing tasks in a recurring manner (e.g., loaders, graders, bulldozers). Stationary equipment operates in a given location for an extended period to perform continuous or periodic operations. Thus, determining the location of stationary sources during specific phases, or the effective acoustical center of operations for mobile equipment during various phases of the construction process, is necessary. Operational characteristics of heavy construction equipment are additionally typified by short periods of full-power operation followed by extended periods of operation at lower power, idling, or powered-off conditions.

As indicated in Table 17-15, operational noise levels for typical construction activities would range from 74 to 101 dB at a distance of 50 feet. Continuous combined noise levels generated by the simultaneous operation of the loudest pieces of equipment would result in noise levels of 101 dB at 50 feet. Accounting for the usage factor of individual pieces of equipment and absorption effects, construction activities would be expected to result in hourly average noise levels of 92 dB L_{eq}, at a distance of 50 feet. Maximum noise levels generated by construction activities are not predicted to exceed 101 dB L_{max} (maximum sound level) at 50 feet.

Noise from localized point sources (such as construction sites) typically decreases (attenuates) by 6 dB to 7.5 dB with each doubling of distance from source to receptor. Assuming a conservative attenuation rate of 6 dB per doubling of distance, construction operations and related activities are predicted to generate exterior hourly noise levels at the nearest sensitive receptor in each construction area, as shown in Table 17-16.

Table 17-16.
Summary of Modeled Equipment Noise Levels

Program Restoration Area	Distance to Nearest Receptor (feet)	Exterior Noise Level (dBA, L_{eq})	Jurisdiction	Significant Impact	
				Daytime	Nighttime
Reach 1A	100	83.6	Madera and Fresno counties/City of Fresno	Yes	Yes
Reach 1B	140	79.7	Madera and Fresno counties	Yes	Yes
Reach 2A	740	60.7	Madera and Fresno counties	Yes	Yes
Reach 2B	460	66.1	Madera and Fresno counties	Yes	Yes
Reach 3	100	83.6	Madera and Fresno counties	Yes	Yes
Reach 4A	375	68.4	Madera, Fresno, and Merced counties	Yes	Yes
Reach 4B1	360	68.9	Merced County	Yes	Yes
Reach 5	1,000	57.2	Merced County	Yes	Yes
East Side Bypass	1,575	52.0	Merced County	No	Yes
Chowchilla Bypass	380	68.3	Madera, Fresno, and Merced counties	Yes	Yes
Mariposa Bypass	8,000	33.4	Merced County	No	No
Madera Canal	3,800	42.0	Madera and Fresno counties	No	No

Note:
Refer to Appendix H, “Modeling,” for input assumptions and output results.
Key:
* Noise prediction modeling conducted by EDAW Noise Specialist
dBA = A-weighted decibel
L_{eq} = energy mean (average) noise level

Construction-related noise levels are predicted to exceed daytime and nighttime nontransportation exterior noise standards at construction sites, as shown above. Those noise levels also could result in a temporary substantial increase in ambient noise levels, especially if construction activities were to occur during the nighttime hours. As a result, construction-generated noise would be a potentially significant temporary, short-term impact.

Mitigation Measure NOI-1 (Alternatives A1 and B1): ***Implement Measures to Reduce Temporary and Short-Term Noise Levels from Construction-Related Equipment Near Sensitive Receptors – Program-Level***. Project proponents of subsequent site-specific projects will ensure that the following noise-reduction protocol measures are implemented during construction for actions implemented under the action alternatives to reduce temporary and short-term construction-related noise impacts near sensitive receptors:

- Conduct a preliminary noise analysis report to determine future program construction noise levels at sensitive receptors based on, but not limited to, a detailed construction equipment list, construction schedule, ground attenuation factors, and distances to sensitive receptors located within 500 feet of future program construction sites.
- Provided that future program construction noise results in significant impacts at sensitive receptors, the following mitigation measures shall be implemented:
  - Equipment will be used as far away as practical from noise-sensitive uses.
  - Construction equipment will be properly maintained per manufacturers' specifications and fitted with the best available noise suppression devices (e.g., mufflers, silencers, wraps). All impact tools will be shrouded or shielded, and all intake and exhaust ports on power equipment will be muffled or shielded.
  - Equipment that is quieter than standard equipment will be used, including electrically powered equipment instead of internal combustion equipment where use of such equipment is a readily available substitute that accomplishes program tasks in the same manner as internal combustion equipment.
  - Construction site and haul road speed limits will be established and enforced.
  - The use of bells, whistles, alarms, and horns will be restricted to safety and warning purposes only.
  - Construction equipment will not idle for extended periods of time when not being used during construction activities.

- When construction activities are conducted within 2,000 feet of noise-sensitive uses, noise measurements will be taken at the nearest noise-sensitive land uses relative to construction activities with a sound-level meter that meets the standards of the American National Standards Institute (ANSI Section S14 1979, Type 1 of Type 2). This would allow that construction noise levels associated with the restoration program to comply with applicable daytime and nighttime noise standards. When construction noise exceeds applicable daytime and nighttime standards, berms, or stockpiles will be used in an attempt to lower noise levels to within acceptable nontransportation standards. If noise levels are still determined to exceed noise standards, temporary barriers will be erected as close to the construction activities as feasible, breaking the line of sight between the source and receptor where noise levels exceed applicable standards. All acoustical barriers would be constructed with material having a minimum surface weight of 2 pounds per square foot or greater and a demonstrated Sound Transmission Class (STC) rating of 25 or greater, as defined by Test Method E90 of the American Society for Testing and Materials. Placement, orientation, size, and density of acoustical barriers will be specified by a qualified acoustical consultant.

- A disturbance coordinator will be designated to post contact information in a conspicuous location near the construction site entrance so that it is clearly visible to nearby receivers most likely to be disturbed. The coordinator will manage complaints resulting from the construction noise. Reoccurring disturbances will be evaluated by a qualified acoustical consultant to ensure compliance with applicable standards. The disturbance coordinator will contact nearby noise-sensitive receptors, advising them of the construction schedule.

Implementation of this mitigation measure would reduce this impact, but may not reduce noise levels at all times to a less-than-significant level because of the potential close proximity of noise-sensitive receptors to construction activities and the limited feasibility of mitigating construction noise to acceptable levels. Therefore, with mitigation this impact would be **potentially significant and unavoidable**.

Impact NOI-2 (Alternatives A1 and B1): *Exposure of Sensitive Receptors to Increased Off-Site Traffic Noise Levels – Program-Level*. Construction-related traffic increases could expose sensitive receptors to noise levels in excess of the applicable noise standards and/or result in a substantial temporary increase in ambient noise levels. This impact would be **potentially significant**.

Construction-related noise from roadway traffic (e.g., heavy-duty truck travel) on off-site area public roadways would occur during construction activities. Traffic noise-level increases would depend on the increase of average daily traffic volumes attributable to construction worker trips and the number of heavy-duty trucks traveling on haul routes associated with each construction activity. The existing noise levels for roadways are discussed above. Existing traffic noise levels on major roadways (State Routes) range from approximately 61 dB to 79 dB L_{dn} at a distance of 100 feet from roadway centerlines. It is assumed that most Restoration Area roadways, other than State Routes or roadways in and around Fresno, would have relatively low average daily traffic volumes. Typically, traffic volumes must double before the associated increase in noise levels is noticeable (3 dB (CNEL/L_{dn})) along roadways (Caltrans 1998). A doubling of traffic volumes is expected for restoration actions that require a large amount of haul material to be transported from borrow sites to construction sites (e.g., levee construction).

Haul routes, borrow sites, haul material amounts, and program-related construction traffic volumes have yet to be defined; however, the potential for traffic-related increases in noise would exist and construction-related impact mechanisms are similar. Thus, temporary and short-term off-site construction traffic source noise could result in the exposure of sensitive receptors to noise levels in excess of applicable standards, or create a substantial temporary increase in ambient noise levels. As a result, this temporary, short-term impact would be potentially significant.

Mitigation Measure NOI-2 (Alternatives A1 and B1): ***Implement Measures to Reduce Temporary Noise Levels from Construction-Related Traffic Increases Near Sensitive Receptors – Program-Level.*** If impacts under subsequent site-specific projects are found to have the potential to cause significant or potentially significant impacts during site-specific studies, proponents of those projects will ensure that the following noise-reduction protocol measures are implemented during construction for actions implemented under the action alternatives that would affect the roadway network/system to reduce temporary and short-term construction-related noise impacts near sensitive receptors:

- Conduct a preliminary noise analysis report to determine future program haul routes for construction-related traffic noise associated with Settlement actions, and conduct a traffic noise analysis for individual actions to establish existing average daily traffic volumes, fleet mixes (percentages of automobiles, medium-duty trucks, and heavy-duty trucks during daytime, evening, and nighttime hours), and vehicle speeds along designated haul-route roadways.

- Provided that future program construction haul route noise results in significant impacts at sensitive receptors, the following mitigation measures shall be implemented:

  - Conduct a noise survey to determine ground attenuation factors, roadway grades, and distances to sensitive receptors along designated haul-route roadways.

  - Model existing traffic noise levels for comparison of construction-related traffic noise level increases along haul-route roadway segments using the FHWA Traffic Noise Prediction Model (FHWA-RD-77-108) or other acceptable traffic noise prediction models (e.g., TNM, Soundplan).

- Identify roadway segments along haul routes that result in a substantial increase of construction-related traffic noise levels caused by SJRRP actions.
- Develop and implement project-specific mitigation measures to reduce construction-related traffic noise-level increases on haul routes near sensitive resources to include, but not be limited to the following:
  - reduce haul truck operation speeds
  - limit the amount of borrow site material to be hauled daily
  - limit the hours of operation for haul trucks
  - install temporary noise barriers adjacent to sensitive receptor locations
- Equip all heavy trucks with noise-control devices (e.g., mufflers) in accordance with manufacturers' specifications.
- Inspect all heavy trucks periodically to ensure proper maintenance and presence of noise-control devices (e.g., lubrication, non-leaking mufflers, and shrouding).

Implementation of this mitigation measure would reduce this impact but may not reduce noise levels at all times to a less-than-significant level for some haul routes because of the potential close proximity of noise-sensitive receptors to haul routes, potential site restrictions when installing temporary noise barriers, and the limited feasibility of mitigating construction noise to acceptable levels. Therefore, this impact would be **potentially significant and unavoidable**.

Impact NOI-3 (Alternatives A1 and B1): ***Exposure of Sensitive Receptors to Long-Term Operation-Related Noise Levels from Stationary Sources – Program-Level***. Few actions under the action alternatives would create long-term operation-related noise levels. Maintenance of new or modified facilities could increase long-term noise levels, but these maintenance activities would not be continuous but punctuated by time intervals of days, weeks, months, or years. Maintenance and other project-related activities would be required to comply with applicable noise standards, reducing effects on the noise environment. Because the long-term operation-related noise effects would be expected to be limited and periodic, this impact would be **less than significant**.

Impact NOI-4 (Alternatives A1 and B1): ***Exposure of Sensitive Receptors to Increased Noise Levels from Borrow Site-Related Activities – Program-Level***. Borrow site activities could potentially expose sensitive receptors to noise levels in excess of applicable noise standards and/or result in a substantial increase in ambient noise levels. This impact would be **potentially significant**.

Certain actions under the action alternatives would result in borrow site-related noise levels associated with harvesting borrow material required for levee construction in Reach 2A. Typical heavy-duty equipment used for borrow site operations include scrapers, graders, excavators, dozers, and haul trucks. Representative noise levels for these heavy-duty equipment types are shown in Table 17-15. Borrow site operations may be characterized by reoccurring heavy-duty equipment movements on a designated borrow area. Borrow site activities are less intermittent than construction operations owing to constant activity of collecting borrow material, loading haul trucks, and the arrival and departure of haul trucks.

Borrow sites have not yet been designated for program-level actions involving construction activities that require borrow sites. It is not feasible to evaluate borrow site noise levels at specific sensitive receptors without having established an acoustical center for borrow activities and relative distances to adjacent sensitive receptors. Modeled borrow site activities, assuming the use of typical heavy-duty equipment, would result in hourly noise levels of 85 dB L_{eq}. Thus, borrow site activity source noise could result in the exposure of persons to noise levels in excess of applicable standards or create a substantial temporary increase in ambient noise levels. As a result, this impact would be potentially significant.

Mitigation Measure NOI-4 (Alternatives A1 and B1): ***Implement Measures to Reduce Borrow Site Noise Levels Near Sensitive Receptors – Program-Level.*** Project proponents of subsequent site-specific projects will ensure that measures such as the following noise-reduction protocol measures are implemented for actions implemented under the action alternatives that requires the use of borrow sites near sensitive receptors:

- Conduct a preliminary noise analysis report to determine future construction-related program borrow site noise based on, but not limited to, a detailed equipment list, hours of operation, ground attenuation factors, and distances to sensitive receptors located within 500 feet of future program borrow sites.
- Provided that future program borrow site noise results in significant impacts at sensitive receptors, the following mitigation measures shall be implemented:
  - Evaluate resultant borrow site activity noise levels at sensitive receptor locations, taking into account distance, site topography, and ground type.
  - Identify sensitive receptors that would experience borrow site noise levels that exceed applicable noise standards.
  - Incorporate the use of stockpiles, dumpsters, trailers, or inactive heavy-duty equipment to perform as temporary barriers. If noise levels are still determined to exceed noise standards, temporary barriers will be erected as close to the construction activities as feasible, breaking the line of sight between the source and the receptor where noise levels exceed applicable standards. All acoustical barriers will be constructed with material having a

minimum surface weight of 2 pounds per square foot or greater and a demonstrated STC rating of 25 or greater, as defined by Test Method E90 of the American Society for Testing and Materials. Placement, orientation, size, and density of acoustical barriers will be specified by a qualified acoustical consultant.

– Limit borrow site activities to daytime hours only when in close proximity to sensitive receptors, to avoid the more sensitized state of receptors typical of evening and nighttime hours.

Implementation of this mitigation measure would reduce this impact to a less-than-significant level. With mitigation, this impact would be **less than significant**.

Impact NOI-5 (Alternatives A1 and B1): ***Exposure of Sensitive Receptors to or Generation of Excessive Groundborne Vibration – Program-Level***. Construction activities under the action alternatives may result in varying degrees of temporary ground vibration, depending on the specific construction equipment used and operations involved. This impact would be **potentially significant**.

Activities would result in vibration levels from heavy-duty truck travel on haul routes for material transport and heavy-duty equipment at construction sites. Construction activities may generate intermittent groundborne noise and vibration on a temporary and short-term basis. Groundborne vibration levels would depend on specific construction equipment used and operations involved. Groundborne vibration levels caused by various types of construction equipment are summarized in Table 17-17.

Construction details for specific actions, and thus the vibration-generating equipment that would be used, are not known at this time. To evaluate vibration impacts at sensitive receptors, the construction activity that would generate the highest PPV (pile driving) was analyzed at the nearest sensitive receptor relative to the Restoration Area. A summary of potential vibration levels at the nearest sensitive receptor is shown in Table 17-18.

The modeled vibration levels identified for pile driving in the Restoration Area shows that sensitive receptors would not be exposed to groundborne vibration levels that exceed Caltrans' recommended standard of 0.2 in/sec peak PPV with respect to the prevention of structural damage for normal buildings (Caltrans 2002). Pile-driving activities would expose receptors to groundborne vibration levels that exceed FTA's maximum acceptable vibration standard of 80 VdB with respect to human response for residential uses (i.e., annoyance) at some locations (FTA 2006). As a result, this impact would be potentially significant.

Table 17-17.
Representative Vibration Source Levels for Construction Equipment

Equipment		PPV at 25 feet (in/sec)[1]	Approximate Lv (VdB) at 25 feet[2]
Pile driver (impact)	Upper range	1.518	112
	Typical	0.644	104
Pile driver (sonic)	Upper range	0.734	105
	Typical	0.170	93
Large bulldozer		0.089	87
Caisson drilling		0.089	87
Trucks		0.076	86
Jackhammer		0.035	79
Small bulldozer		0.003	58

Sources: Caltrans 2002, FTA 2006
Notes:
[1] Where PPV is the peak particle velocity.
[2] Where Lv is the RMS velocity expressed in vibration decibels (VdB), assuming a crest factor of 4.
Key:
in/sec = inches per second
VdB = vibration decibels

Table 17-18.
Summary of Modeled Equipment Vibration Levels in the Restoration Area

Program Restoration Area (in/sec)	Distance to Nearest Receptor (feet)	PPV[1]	Exceeds Caltrans 0.2 PPV in/sec Threshold	Approximate Lv (VdB)[2]	Exceeds FTA 80 VdB Threshold
Reach 1A	100	0.190	No	93.5	Yes
Reach 1B	140	0.115	No	89.1	Yes
Reach 2A	740	0.009	No	67.4	No
Reach 2B	460	0.019	No	73.6	No
Reach 3	100	0.190	No	93.5	Yes
Reach 4A	375	0.026	No	76.3	No
Reach 4B1	360	0.039	No	76.8	No
Reach 5	1,000	0.006	No	63.5	No
Eastside Bypass	1,575	0.003	No	57.6	No
Chowchilla Bypass	380	0.026	No	76.1	No
Mariposa Bypass	8,000	0.000	No	36.4	No
Madera Canal	3,800	0.001	No	46.1	No

Sources: Caltrans 2002, FTA 2006
Notes:
Modeling conducted by EDAW in 2009.
[1] Where PPV is the peak particle velocity.
[2] Where Lv is the RMS velocity expressed in VdB, assuming a crest factor of 4.
Key:
in/sec = inches per second
VdB = vibration decibels

Mitigation Measure NOI-5 (Alternatives A1 and B1): ***Implement Measures to Reduce Temporary and Short-term Groundborne Noise and Vibration Levels Near Sensitive Receptors – Program-Level***. Project proponents of subsequent site-specific projects will ensure that the following protocol measures are implemented during construction for actions implemented under the action alternatives to reduce temporary and short-term groundborne noise and vibration levels on sensitive receptors:

- Conduct a preliminary groundbourne noise and vibration analysis report to determine future construction-related program groundbourne noise and vibration levels based on, but not limited to, a detailed equipment list, hours of operation and distances to sensitive receptors located within 500 feet of future program borrow sites.

- Provided that future program groundbourne noise and vibration results in significant impacts at sensitive receptors, the following mitigation measures shall be implemented:

  - A disturbance coordinator will be designated and this person's contact information will be posted in a location near construction areas where it is clearly visible to the nearby receptors most likely to be disturbed. The coordinator would manage complaints and concerns resulting from activities that cause vibrations. The severity of the vibration concern should be assessed by the coordinator and, if necessary, evaluated by a qualified noise and vibration control expert.

  - Vibration monitoring will be conducted before and during pile driving operations occurring within 100 feet of historic structures. Every attempt will be made to limit construction-generated vibration levels during pile driving and other groundborne noise and vibration-generating activities in the vicinity of the historic structures in accordance with Caltrans recommendations.

  - Adjacent historic features will be covered or temporarily shored, as necessary, for protection from vibrations, in consultation with the appropriate cultural resources authority.

  - Pile driving required within a 50-foot radius of residences will use alternative installation methods where possible (e.g., pile cushioning, jetting, predrilling, cast-in-place systems, resonance-free vibratory pile drivers). This would reduce the number and amplitude of blows required to seat the pile.

  - Pile-driving activities conducted within 285 feet of sensitive receptors will occur during daytime hours to avoid sleep disturbance during evening and nighttime hours.

Implementation of these mitigation measures would substantially limit the effects of groundborne noise and vibration on sensitive receptors and would reduce this impact to a less-than-significant level. With mitigation this impact would be **less than significant**.

Alternatives A2 and B2

Alternatives A2 and B2 would require increased levels of construction activities to increase Reach 4B1 channel capacity to 4,500 cfs (compared to 475 cfs with Alternatives A1 and B1). These noise impacts would be limited to the site-specific location of the construction areas associated with the Reach 4B1. At the program-level, noise impacts from these alternatives are similar to those for Alternatives A1 and B1, but dependent on site- and action-specific details that are unknown at this time. The significance conclusions under Alternatives A2 and B2 are the same as those under Alternatives A1 and B1.

Alternative C1

Alternative C1 includes those impacts described for Alternatives A1 and B1, and additional construction and long-term operational noise impacts due to the construction of new infrastructure to recapture Interim and Restoration flows on the San Joaquin River. At the program-level, noise impacts from this alternative are similar to those for Alternatives A1 and B1, but dependent on site- and action-specific details that are unknown at this time. The significance conclusions under Alternative C1 are the same as for Alternatives A1 and B1, with one additional impact and mitigation measure as described below.

Impact NOI-3 (Alternative C1): ***Exposure of Sensitive Receptors to Long-Term Operation-Related Noise Levels from Stationary Sources – Program-Level***. Specific equipment to be installed at new infrastructure to recapture Interim and Restoration flows is not known at this time but is assumed to generate 81 dB at 50 feet, as shown in Table 17-15. Depending on its location, the new infrastructure could potentially expose sensitive receptors to noise levels in excess of the applicable noise standards and/or result in a substantial increase in ambient noise levels. As a result, this impact would be **potentially significant**.

Mitigation Measure NOI-3 (Alternative C1): ***Implement Measures to Reduce Long-Term Operation-Related Noise Levels from Stationary Sources on Sensitive Receptors – Program-Level***. Project proponents of subsequent site-specific projects will conduct a preliminary noise analysis report to determine future operation-related noise and distances to sensitive receptors. Provided that future operation-related noise results in significant impacts at sensitive receptors, project proponents of subsequent site-specific projects will incorporate into the construction design measures such as a structure encasing the new pumping infrastructure. Materials (masonry brick, metal shed, wood) used to house the pumping infrastructure will be of solid construction and void of gaps at the ground, roof line, and joints. All vents will include acoustically rated louvers.

Implementation of this mitigation measure would reduce this impact to a less-than-significant level. With mitigation this impact would be **less than significant**.

Alternative C2

Program-level impacts in the Restoration Area under Alternative C2 include the same impacts described for Alternatives A2 and B2. One additional impact, associated with the construction of new infrastructure to recapture Interim and Restoration flows on the San Joaquin River below the Merced River confluence, would be the same under Alternative C2 as described for Alternative C1.

17.3.4 Project-Level Impacts and Mitigation Measures

This section provides a project-level evaluation of the direct and indirect effects of the reoperation of Friant Dam on the noise environment. The reoperation of Friant Dam could affect the noise environment as a consequence of altering releases from Friant Dam.

The project-level evaluation of effects on the noise environment included consideration of the potential effects resulting from the recapture of Interim Flows at existing facilities in the Restoration Area and in the Delta, and from the recapture of Restoration Flows using existing Delta facilities. No associated changes that would occur to the noise environment were identified. Therefore, the effects of these actions on the noise environment are not discussed further.

Immediate actions to address nonattainment of management objectives identified in the Physical Monitoring and Management Plan (Appendix D) were evaluated at a project level. Potential immediate actions are related to flow, seepage, capacity, native vegetation, and spawning gravel. Immediate actions include acquiring additional water from willing sellers, reoperating Friant Dam to reduce flows, monitoring sites, and removing obstructions/debris from channels in the Restoration Area. Monitoring would only cause inconsequential effects on the noise environment and are not discussed further, and no future review of these effects is necessary as the Settlement is implemented.

Other actions evaluated at a project level would not result in physical actions that would affect the noise environment. These include reoperation of Mendota Dam, Chowchilla Bypass Bifurcation Structure, Eastside Bypass Bifurcation Structure, Mariposa Bypass Bifurcation Structure, and the Hills Ferry Barrier. The proposed changes to the operation of these structures would have minimal effect on the noise environment. Actions to obtain encroachment permits, water transfers, and long-term water rights also would not affect the noise environment. However, the product of these authorizations (the release of Interim and Restoration flows in the Restoration Area) would change the noise environment. Therefore, the noise contribution resulting from Interim and Restoration flows are discussed further and their significance evaluated.

No-Action Alternative

The No-Action Alternative would not involve the reoperation of Friant Dam associated with the release of Interim or Restoration flows; therefore, no project-level impacts would occur. Implementing the No-Action Alternative would not alter the flow regime of the San Joaquin River downstream from Friant Dam, and would not introduce new noise sources (e.g., mobile, stationary, vibration) to the study area or result in temporary substantial ambient noise-level increases at sensitive receptors. As a result, implementation of the No-Action Alternative would result in no impact.

Alternatives A1 through C2

Project-level impacts to the noise environment under the action alternatives would occur within the Restoration Area, as described below.

Impact NOI-6 (Alternatives A1 through C2): *Effects of the Reoperation of Friant Dam on the Noise Environment – Project-Level*. Implementing any of the action alternatives would increase ambient noise levels downstream from Friant Dam as a result of the associated release of Interim or Restoration flows, and subsequent increases in recreational activities, especially in newly watered areas with public access. However, the increase in noise levels resulting from increased flow, traffic, and human activities would not be substantial, and furthermore, noise associated with flowing water is not unpleasant and the noise of human voices, increased traffic, and associated recreational activities is short-term, seasonal, intermittent, and site-specific. Thus, this impact would be **less than significant**.

The reoperation of Friant Dam would have incremental noise impacts associated with the flow of water and increased recreation opportunities. Releases of water downriver would generate noise associated with oscillating waves crashing over rocks, rustling of vegetation as water flows through it, and rushing water flowing down stretches with steeper slope gradients. Noise associated with flowing water is considered generally soothing and pleasant. Increased recreation opportunities would generate noise associated with human voices and traffic increases along roadways to access the river. Traffic increases would be incremental and would not be expected to cause average daily traffic volumes to increase substantially along roadways with river access. The sound of human voices may be intrusive to adjacent sensitive receptors; however, it would be short-term, seasonal, intermittent, and site-specific. Therefore, noise impacts associated with the project would be less than significant.

Chapter 18.0 Paleontological Resources

Paleontological resources (fossils) are the remains or traces of prehistoric animals and plants. This chapter describes environmental and regulatory settings for scientifically important fossil remains, as well as environmental consequences and mitigation measures, as they pertain to implementation of the program alternatives. No restoration, water management, or water recapture actions involving construction-related ground disturbance are proposed upstream from Friant Dam, in the Delta, or in CVP/SWP water service areas. Therefore, no effects on paleontological resources within the 30-year planning horizon are expected in these areas. For that reason, those geographic areas are not discussed further in this chapter.

18.1 Environmental Setting

Because paleontological resources could be affected only by earth-moving activities, this section discusses only those areas where earth-moving activities of the action alternatives may occur. These geographic areas include the Restoration Area and the San Joaquin River from the Merced River to the Delta. Because both geographic areas are part of the San Joaquin Valley, they are described together in a regional context. In some cases, it is necessary to describe the Restoration Area in greater detail.

18.1.1 Physiographic Environment

The project site is located in the San Joaquin Valley. The San Joaquin Valley and the Sacramento Valley comprise the Great Valley, commonly referred to as the Central Valley, of California. The Great Valley geomorphic province is located between the Sierra Nevada geomorphic province on the east and the Coast Range geomorphic province on the west as described in Chapter 10.0, “Geology and Soils.”

The Great Valley is composed of thousands of feet of sedimentary deposits that have undergone periods of subsidence and uplift over millions of years. During the Jurassic (approximately 206 million years Before Present (B.P.)) and Cretaceous (approximately 144 million years B.P.) periods of the Mesozoic era, the Great Valley existed in the form of an ancient ocean. By the end of the Mesozoic era, the northern portion of the Great Valley began to fill with sediment as tectonic forces caused uplift of the basin. Geologic evidence suggests that the Sacramento Valley and San Joaquin Valley gradually separated into two separate water bodies as uplift and sedimentation continued. By the time of the Miocene epoch (approximately 24 million years B.P.), sediments deposited in the Sacramento Valley were mostly of terrestrial origin. In contrast, the San Joaquin Valley continued to be inundated with water for another 20 million years, as indicated by marine sediments dated to the late Pliocene epoch (approximately 5 million years B.P.). Most of the surface of the Great Valley is covered with Holocene (i.e., less than 11,000 years B.P.) and Pleistocene (11,000 to 1.5 million years B.P.) alluvium. This alluvium is composed of sediments from the Sierra Nevada to the east and the Coast Ranges to the west that were carried by water and deposited on the valley floor. Siltstone, claystone, and sandstone are the primary types of sedimentary deposits.

The project area where earth-moving activities could occur is located in Merced, Madera, and Fresno counties and in the following U.S. Geological Survey 7.5-minute quadrangles (mapped at 1:24,000 scale): Arena, Biola, Bliss Ranch, Delta Ranch, Firebaugh, Firebaugh NE, Fresno N, Friant, Gravelly Ford, Gregg, Gustine, Herndon, Lanes Bridge, Mendota Dam, Millerton Lake W, Newman, Oxalis, Poso Farms, San Luis Ranch, Sandy Mush, Santa Rita Bridge, Stevinson, Tranquility, and Turner Ranch.

18.1.2 Regional Geologic Setting

Geologic history and conditions are relevant to the evaluation of paleontological resources because they influence the type of fossils that may be found (i.e., aquatic vs. terrestrial organisms) and the probability that any prehistoric remains would be subject to fossilization rather than normal decay. The depositional history of the San Joaquin Valley during the late Quaternary included several cycles related to fluctuations in regional and global climate that caused alternating periods of deposition followed by periods of subsidence and erosion. Thus, the San Joaquin Valley during the Pleistocene consisted of stages of wetlands and floodplain creation as tidewaters rose in the valley from the west, areas of erosion when tidewaters receded, and alluvial fan deposition from streams emanating from the adjacent mountain ranges (Bartow 1991).

18.1.3 Local Geologic Setting

Geologic mapping by Wagner et al. (1991) and Matthews and Burnett (1966) indicates that the project components are located in the following rock formations: Dos Palos Alluvium (floodbasin/stream channel deposits) and Modesto Formation (fan deposits). In addition, earth-moving activities within 0.5 mile of the San Joaquin River channel could also include the Turlock Lake Formation (Pleistocene nonmarine). Each of these formations is discussed in greater detail below.

Dos Palos Alluvium

This formation consists of Holocene-age deposits of unweathered, unconsolidated arkosic gravel, sand, silt, and clay covering the flood basin of the low San Joaquin River. The Dos Palos Alluvium generally occurs in a northwest-trending belt in the San Joaquin Valley between the Coast Range and Sierra Nevada alluvial fans. The arkosic composition of this formation indicates that the sediments originated from plutonic rocks of the Sierra Nevada and were deposited during overflow and channel migration of the San Joaquin River and associated sloughs (Lettis 1982).

Construction activities in portions of the stream channel or within 0.5 mile on either side of portions of the stream channel of Reaches, 3, 4, and 5, the southern portion of Reach 2, and the San Joaquin River between the Merced River and the Delta would occur in the Dos Palos Alluvium. The stream channel of Reach 1 occurs entirely in the Dos Palos Alluvium.

Modesto Formation

Piper et al. (1939) were the first to publish detailed geologic maps in the southern Sacramento/northern San Joaquin Valley areas, and they designated the older alluvial Pleistocene deposits as the Victor Formation. However, in 1959, Davis and Hall (1959) proposed a subdivision of the Victor Formation into the Turlock Lake (oldest), Riverbank (middle), and Modesto (youngest) formations. The type section of Modesto was designated along the south bluff of the Tuolumne River south of Modesto. Marchand and Allwardt (1981) proposed that the name Victor Formation be abandoned and that the Turlock Lake, Riverbank, and Modesto formations be adopted as formal nomenclature for Quaternary deposits in the Sacramento and San Joaquin valleys. Most researchers now follow this recommendation.

The Modesto Formation forms ancient alluvial fans of major rivers along the axis of the Central Valley, such as the San Joaquin, and is widely distributed throughout the San Joaquin and Sacramento valleys. It can be divided into upper and lower members. Researchers differ as to the age of this formation: Marchand and Allwardt (1981) placed the age between approximately 12,000 and 42,000 years B.P., and Atwater (1982) placed the age from 9,000 to 73,000 years B.P. The upper member is composed primarily of unconsolidated, unweathered coarse sand and sandy silt. This unit may range in age from 9,000 to 26,000 years B.P. The lower member of the Modesto Formation is composed of consolidated, slightly weathered, well-sorted silt and fine sand, silty sand, and sandy silt. Age estimates for the lower member range from 29,000 to 73,000 year B.P.

Construction activities in portions of the stream channel or within 0.5 mile on either side of the stream channel of Reaches, 3, 4, and 5, the northern portion of Reach 2, and all of the Flood Bypass System would occur in the Modesto Formation.

Turlock Lake Formation

The Turlock Lake Formation consists of arkosic alluvium that includes fine sand and silt at the base, grading upward into coarse sand and coarse pebbly sand or gravel. The type section consists of a series of exposures in roadcuts in a hill in Turlock Lake State Park. The sediments of the Turlock Lake Formation originated from the Sierra Nevada and have been divided into upper and lower members. The lower member is exposed in small areas near the major river valleys, such as the San Joaquin. The lower member includes gravel and coarse sand that overlies finer, well-sorted sand, silt, and clay of possible lacustrine (lake) origin. The age of the lower member probably exceeds 730,000 years B.P. The upper unit is found topographically above the lower unit and includes gravel beds and silt and fine sand that may be lacustrine in origin. The age of the upper member is estimated to be approximately 600,000 years B.P. (Marchand and Allwardt 1981).

Although the stream channel of Reach 1 occurs entirely in the Dos Palos Alluvium, construction activities within 0.5 mile of the channel would occur in the Turlock Lake Formation.

18.1.4 Paleontological Resource Inventory Methods

A stratigraphic inventory and paleontological resource inventory were completed to develop a baseline paleontological resource inventory of the project site and surrounding area by rock unit and to assess the potential paleontological productivity of each rock unit. Research methods included a review of published and unpublished literature. These tasks complied with Society of Vertebrate Paleontology (SVP) (1995) guidelines.

Published and unpublished geological and paleontological literature and maps were reviewed to document the number and locations of previously recorded fossil sites from rock units exposed in and near the project site and the surrounding region, as well as the types of fossil remains each rock unit has produced. The literature review was supplemented by an archival search conducted at the University of California, Museum of Paleontology (UCMP) in Berkeley, California, on January 12, 2009. Because most of the San Joaquin River where the action alternatives would occur lies on private property, a field reconnaissance survey was not possible.

18.1.5 Paleontological Resource Assessment Criteria

The potential paleontological importance of the project site can be assessed by identifying the paleontological importance of exposed rock units in and surrounding the Restoration Area. Because the aerial distribution of a rock unit can be easily delineated on a topographic map, this method is conducive to delineating parts of the project site that are of higher and lower sensitivity for paleontological resources and to delineating parts of the project that may require monitoring during construction.

A paleontologically important rock unit is one that (1) has a high potential paleontological productivity rating, and (2) is known to have produced unique, scientifically important fossils. The potential paleontological productivity rating of a rock unit exposed at the project site refers to the abundance/densities of fossil specimens and/or previously recorded fossil sites in exposures of the unit in and near the project site. Exposures of a specific rock unit at the project site are most likely to yield fossil remains representing particular species in quantities or densities similar to those previously recorded from the unit in and near the project site.

An individual vertebrate fossil specimen may be considered unique or significant if it is identifiable and well preserved and it meets one of the following criteria:

- Is a type specimen (i.e., the individual from which a species or subspecies has been described)
- Is a member of a rare species
- Is a species that is part of a diverse assemblage (i.e., a site where more than one fossil has been discovered) wherein other species are also identifiable and important information regarding life history of individuals can drawn or

- Is a skeletal element different from, or a specimen more complete than, those now available for its species or

- Is a complete specimen (i.e., all or substantially all of the entire skeleton is present)

For example, identifiable vertebrate marine and terrestrial fossils are generally considered scientifically important because they are relatively rare. The value or importance of different fossil groups varies, depending on the age and depositional environment of the rock unit that contains the fossils, their rarity, the extent to which they have already been identified and documented, and the ability to recover similar materials under more controlled conditions (such as for a research project). Marine invertebrates are generally common, the fossil record is well developed and well documented, and they would generally not be considered a unique paleontological resource.

In its standard guidelines for assessment and mitigation of adverse impacts on paleontological resources, the SVP (SVP 1995) established three categories of sensitivity for paleontological resources: high, low, and undetermined. Areas where fossils have been previously found are considered to have a high sensitivity and a high potential to produce fossils. Areas that are not sedimentary in origin and that have not been known to produce fossils in the past typically are considered to have low sensitivity. Areas that have not had any previous paleontological resource surveys or fossil finds are considered to be of undetermined sensitivity until surveys and mapping are performed to determine their sensitivity. After reconnaissance surveys, observation of exposed cuts, and possibly subsurface testing, a qualified paleontologist can determine whether the area should be categorized as having high or low sensitivity.

The following tasks were completed to establish the paleontological importance of each rock unit exposed at or near the project site:

- The potential paleontological productivity of each rock unit was assessed, based on the density of fossil remains previously documented in the rock unit.

- The potential for a rock unit exposed at the project site to contain a unique paleontological resource was considered.

18.1.6 Resource Inventory Results

Regional and local surficial geologic mapping and correlation of the various geologic units in the vicinity of the project site have been provided at a scale of 1:250,000 by Wagner et al. (1991) and a scale of 1:65,000 by Marchand and Allwardt (1981). The following is an inventory and assessment of paleontological resources by rock unit.

Dos Palos Alluvium – Holocene

By definition, to be considered a fossil, a specimen must be more than 11,000 years old. Because sediments of the Dos Palos Alluvium are less than 11,000 years old, these sediments would not contain paleontological resources.

Modesto Formation – Pleistocene

Vertebrate mammalian fossils have proved helpful in determining the relative age of alluvial fan sedimentary deposits (Louderback 1951, Savage 1951, Albright 2000). The Pleistocene epoch, known as the "great ice age," began approximately 1.8 million years ago. Mammalian inhabitants of the Pleistocene alluvial fan and floodplain included mammoths, mastodons, horses, camels, ground sloths, and pronghorn antelopes.

Surveys of late Cenozoic land mammal fossils in northern California have been provided by Hay (1927), Stirton (1939), Savage (1951), Lundelius et al. (1983), and Jefferson (1991a, 1991b). On the basis of his survey of vertebrate fauna from the nonmarine late Cenozoic deposits of the San Francisco Bay region, Savage (1951) concluded that two major divisions of Pleistocene-age fossils could be recognized: the Irvingtonian (older Pleistocene fauna) and the Rancholabrean (younger Pleistocene and Holocene fauna). These two divisions of Quaternary Cenozoic vertebrate fossils are widely recognized today in the field of paleontology. The age of the later Pleistocene, Rancholabrean fauna was based on the presence of bison and on the presence of many mammalian species that are inhabitants of the same area today. In addition to bison, larger land mammals identified as part of the Rancholabrean fauna include mammoths, mastodons, camels, horses, and ground sloths.

Remains of land mammals have been found in the project region at various localities in alluvial deposits referable to the Modesto Formation. Jefferson (1991a, 1991b) compiled a database of California late Pleistocene vertebrate fossils from published records, technical reports, unpublished manuscripts, information from colleagues, and inspection of museum paleontological collections at more than 40 public and private institutions. He listed a number of sites in Merced, Fresno, and Madera counties that have yielded Rancholabrean vertebrate fossils that could be referable to the Modesto Formation.

The results of a records search of the UCMP Paleontology Collections database indicate that the vertebrate fossil locality closest to the Restoration Area is V-6806, approximately 4 miles northeast of Reach 5, west of the town of Stevinson. This site in the Modesto Formation yielded four specimens, a Rancholabrean-age horse, bison, camel, and Harlan's ground sloth. Reach 2 is located approximately 6 miles north of the Tranquility site (UCMP V-4401), which has yielded more than 130 Rancholabrean-age fossils of fish, turtles, snakes, birds, moles, gophers, mice, wood rats, voles, jack rabbits, coyote, red fox, grey fox, badger, horse, camel, pronghorn antelope, elk, deer, and bison from sediments referable to the Modesto Formation. Vertebrate fossils have been recovered from sediments of nearly every major city in the San Joaquin Valley, including Stockton, Tracy, Lodi, Modesto, Lathrop, Fresno, and Merced.

Turlock Lake Formation – Pleistocene

The Fairmead Landfill site contains Irvingtonian-age fossils that were originally discovered in 1993 during excavation activities for a new Madera County landfill. The Fairmead Landfill is approximately 12 miles northeast of the Chowchilla Bypass portion of the Restoration Area. Since 1993, more than 3,000 fossil specimens from 35 different species have been recovered, including mammoth, ground sloth, giant short-faced bear, saber tooth cat, wolf, deer, camel, horse, antelope, rodents, birds, reptiles, fish, and prehistoric vegetation. Other vertebrate fossils have been reported from various locations in the Central Valley from sediments referable to the Turlock Lake Formation.

18.2 Regulatory Setting

Paleontological resources on public lands are afforded protection under PRC Section 5097.5. No laws or regulations protect paleontological resources located on private land.

18.3 Environmental Consequences and Mitigation Measures

The purpose of this section is to provide information about the environmental consequences of the program alternatives on paleontological resources. This section describes the methodology, criteria for determining significance of effects, and environmental consequences and mitigation measures associated with effects of each of the program alternatives. The impacts assessment provided below is consistent with the standard guidelines for assessment and mitigation of adverse impacts on paleontological resources provided by SVP, as previously described (SVP 1995). The program alternatives evaluated in this chapter are described in detail in Chapter 2.0, “Description of Alternatives,” and summarized in Table 18-1. The potential impacts to paleontological resources and associated mitigation measures are summarized in Table 18-2.

Table 18-1.
Actions Included Under Action Alternatives

Level of NEPA/CEQA Compliance	Actions[1]		Action Alternative A1	A2	B1	B2	C1	C2
Project-Level	Reoperate Friant Dam and downstream flow control structures to route Interim and Restoration flows		✓	✓	✓	✓	✓	✓
	Recapture Interim and Restoration flows in the Restoration Area		✓	✓	✓	✓	✓	✓
	Recapture Interim and Restoration flows at existing CVP and SWP facilities in the Delta		✓	✓	✓	✓	✓	✓
Program-Level	Common Restoration actions[2]		✓	✓	✓	✓	✓	✓
	Actions in Reach 4B1 to provide at least:	475 cfs capacity	✓	✓	✓	✓	✓	✓
		4,500 cfs capacity with integrated floodplain habitat		✓		✓		✓
	Recapture Interim and Restoration flows on the San Joaquin River downstream from the Merced River at:	Existing facilities on the San Joaquin River			✓	✓	✓	✓
		New pumping infrastructure on the San Joaquin River					✓	✓
	Recirculation of recaptured Interim and Restoration flows		✓	✓	✓	✓	✓	✓

Notes:
[1] All alternatives also include the Physical Monitoring and Management Plan and the Conservation Strategy, which include both project- and program-level actions intended to guide implementation of the Settlement.
[2] Common Restoration actions are physical actions to achieve the Restoration Goal that are common to all action alternatives and are addressed at a program level of detail.

Key:
CEQA = California Environmental Quality Act
cfs = cubic feet per second
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
NEPA = National Environmental Policy Act
PEIS/R = Program Environmental Impact Statement/Report
SWP = State Water Project

Table 18-2.
Summary of Environmental Consequences and Mitigation Measures – Paleontological Resources

Impacts	Alternative	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance After Mitigation
Paleontological Resources: Program-Level				
PAL-1: Possible Damage to or Destruction of Unique Paleontological Resources	No-Action	Too Speculative for Meaningful Consideration	--	Too Speculative for Meaningful Consideration
	A1	PS	PAL-1: Stop Work if Paleontological Resources Are Encountered During Earthmoving Activities and Implement Recovery Plan	LTS
	A2	PS		LTS
	B1	PS		LTS
	B2	PS		LTS
	C1	PS		LTS
	C2	PS		LTS
Paleontological Resources: Project-Level				
PAL-2: Possible Damage to or Destruction of Unique Paleontological Resources	No-Action	No Impact	--	No Impact
	A1	No Impact	--	No Impact
	A2	No Impact	--	No Impact
	B1	No Impact	--	No Impact
	B2	No Impact	--	No Impact
	C1	No Impact	--	No Impact
	C2	No Impact	--	No Impact

Key:
-- = not applicable
LTS = less than significant
PS = potentially significant

18.3.1 Significance Criteria

The thresholds of significance for impacts are based on the environmental checklist in Appendix G of the State CEQA Guidelines, as amended. These thresholds also encompass the factors taken into account under the NEPA to determine the significance of an action in terms of its context and the intensity of its impacts. The program alternatives under consideration were determined to result in a significant impact related to paleontological resources if they would directly or indirectly destroy a unique paleontological resource or site.

For the purposes of this PEIS/R, a unique resource or site is one that is considered to have a paleontologically important rock unit. As previously described, a paleontologically important rock unit is one that (1) has a high potential paleontological productivity rating, and (2) is known to have produced unique, scientifically important fossils.

18.3.2 Program-Level Impacts and Mitigation Measures

The section provides a program-level evaluation of the direct and indirect effects of program alternatives on paleontological resources. These alternatives could affect paleontological resources during construction activities that involve ground disturbance.

No-Action Alternative

For paleontological resources, the No-Action Alternative includes the reasonably foreseeable future actions to be implemented in the study area, as described in Chapter 2.0, "Description of Alternatives."

Impact PAL-1 (No-Action Alternative): ***Possible Damage to or Destruction of Unique Paleontological Resources – Program-Level.*** There would be no Settlement-related impact on paleontological resources under the No-Action Alternative. Several of the reasonably foreseeable projects included under the No-Action Alternative would have construction or ground-disturbing activities within the study area. However, the site-specific locations of these projects in relation to unique paleontological resources are unknown at this time. Therefore, this impact is **too speculative for meaningful consideration**.

Alternatives A1 through C2

The action alternatives would involve construction and ground-disturbing activities within the Restoration Area and, therefore, have the potential to impact unique paleontological resources, as described below. Construction-related differences among the action alternatives are that (1) Alternatives A2, B2, and C2 include additional actions that would increase the Reach 4B1 channel capacity to 4,500 cfs (compared to 475 cfs with other action alternatives) and, thus, would involve more and/or greater construction activities than other alternatives, and (2) Alternatives C1 and C2 also include construction of new pumping infrastructure along the San Joaquin River from the Merced River to the Delta, and a conveyance tie-in to existing water conveyance facilities.

At the program level, impact conclusions and mitigation measures for impacts on paleontological resources from the action alternatives are the same for all action alternatives and dependent on site- and action-specific details that are unknown or conceptual at this time.

Overall, Alternative A1 would have the least potential impacts on paleontological resources, and Alternative C2 would have the greatest potential impacts on paleontological resources. All action alternatives would have greater potential for impacts on paleontological resources than the No-Action Alternative.

Impact PAL-1 (Alternatives A1 through C2): ***Possible Damage to or Destruction of Unique Paleontological Resources – Program-Level.*** Construction activities in the Modesto or Turlock Lake formations could damage or destroy unique paleontological resources in the Restoration Area (all action alternatives) or along the San Joaquin River between the Merced River and the Delta (Alternatives C1 and C2). This impact would be **potentially significant**.

Alternatives A1 through C2 include construction and ground-disturbing activities in the Restoration Area. Portions of the Restoration Area are underlain by Holocene-age (less than 11,000 years old) alluvium. Construction activities that occur in Holocene alluvium (including the Los Banos Alluvium) would have no impact on paleontological resources.

However, the remainder of the Restoration Area is underlain by Pleistocene-age sediments of the Modesto and Turlock Lake formations, which are considered paleontologically sensitive rock units under SVP guidelines (SVP 1995). Numerous vertebrate fossil specimens have been recovered or recorded from the Modesto and Turlock Lake formations throughout the San Joaquin Valley and near the Restoration Area. Consequently, potential exists for uncovering additional, similar fossil remains during construction-related earthmoving activities in the Restoration Area.

Alternatives C1 and C2 also include construction of new pumping infrastructure along the San Joaquin River from the Merced River to the Delta, and a conveyance tie-in to existing water conveyance facilities. This area is underlain by the Dos Palos Alluvium, which is not considered a paleontologically sensitive rock unit under SVP guidelines (SVP 1995). Therefore, no additional impacts to paleontological resources would occur under Alternatives C1 and C2.

The potential for damage to unique paleontological resources during earthmoving activities in the Restoration Area under all action alternatives is a potentially significant impact.

Mitigation Measure PAL-1 (Alternatives A1 through C2): ***Stop Work if Paleontological Resources Are Encountered During Earthmoving Activities and Implement Recovery Plan – Program-Level.*** To minimize potential adverse impacts on unique, scientifically important paleontological resources during earthmoving activities, Mitigation Measure PAL-1 would be implemented the project proponent during construction for any action implemented under the Settlement to reduce possible damage to unique paleontological resources, as described below.

If paleontological resources are discovered during earthmoving activities, the construction crew would immediately cease work in the vicinity of the find. A qualified paleontologist would be retained to evaluate the resource and prepare a recovery plan in accordance with SVP guidelines (SVP 1995). The recovery plan may include a field survey, construction monitoring, sampling and data recovery procedures, museum storage coordination for any specimen recovered, and a report of findings. Recommendations in the recovery plan would be implemented before construction activities could resume at the site where the paleontological resources were discovered.

Implementing this mitigation measure would reduce potentially significant impacts related to potential damage to unique paleontological resources to a less-than-significant level because if resources were encountered, fossil specimens would be recovered and recorded and would undergo appropriate curation. This impact would be **less than significant** after mitigation.

18.3.3 Project-Level Impacts and Mitigation Measures

This section provides a project-level evaluation of the direct and indirect effects of reooperating Friant Dam and recapturing water on paleontological resources. Because no construction activities are associated with reoperating Friant Dam and recapturing water, there would be no impacts on unique paleontological resources. Although additional flow releases could cause some erosion that could expose paleontological resources, this impact mechanism is highly speculative and high natural flows in the past have not exposed any paleontological resources; consequently, this potential impact is not discussed further.

No-Action Alternative

At the project level, there would be no Settlement-related impacts on paleontological resources under the No-Action Alternative. Potential impacts related to the reasonably foreseeable projects included under the No-Action Alternative are presented below.

Impact PAL-2 (No-Action Alternative): ***Possible Damage to or Destruction of Unique Paleontological Resources – Project-Level.*** The reasonably foreseeable projects included under the No-Action Alternative would involve no construction or ground-disturbing activities within the Restoration Area or downstream along the San Joaquin River. Therefore, there would be **no impact**.

Alternatives A1 Through C2

Project-level actions under Alternatives A1 through C2 would not involve ground-disturbing activities. Therefore, there would be no project-level impacts on paleontological resources under the action alternatives.

Impact PAL-2 (Alternatives A1 Through C2): ***Possible Damage to or Destruction of Unique Paleontological Resources – Project-Level.*** Project-level actions under the action alternatives would not involve construction or ground-breaking activities. Therefore, there would be **no impact**.

Chapter 19.0 Power and Energy

This chapter describes the environmental and regulatory settings of power and energy, as well as environmental consequences and mitigation measures, as they pertain to implementation of the Settlement. The discussion of power and energy existing conditions and the potential impacts of the program alternatives on power and energy encompasses the San Joaquin River upstream from Friant Dam, as well as CVP/SWP water service areas and associated facilities. Implementation of the Settlement is not anticipated to cause impacts to power and energy outside of these areas; therefore, the Restoration Area, the San Joaquin River downstream from the Merced River confluence, and the Delta were eliminated from detailed environmental analysis.

19.1 Environmental Setting

The San Joaquin River watershed upstream from Friant Dam is extensively developed for hydroelectric generation. Hydropower is also generated by the Friant Power Authority (FPA) at the Friant Power Project (FPP) through releases from Friant Dam to the Friant-Kern Canal, Madera Canal, and San Joaquin River. In total, the San Joaquin River basin has 19 powerhouses with an installed capacity of almost 1,300 megawatts (MW), which represents approximately 9 percent of the hydropower generation capacity in California.

19.1.1 San Joaquin River Upstream from Friant Dam

All hydropower facilities in the upper San Joaquin River basin upstream from Friant Dam are components of one of the following three hydropower projects/systems:

- Kerckhoff Hydroelectric Project – owned by PG&E
- Crane Valley Hydroelectric Project – owned by PG&E
- Big Creek Hydroelectric System (seven projects) – owned by Southern California Edison (SCE)

Both the PG&E and SCE systems consist of a series of reservoirs that provide water for downstream powerhouses. The PG&E Kerckhoff Hydroelectric Project accounts for approximately 5 percent of PG&E´s hydroelectric generation capacity, and 15 percent of the generation capacity in the upper San Joaquin River basin. The Kerckhoff No. 2 Powerhouse discharges into the upper reaches of Millerton Lake which can affect power production of the plant. The powerhouse operates at a normal maximum gross head (water surface elevation) of 421 feet and has a capacity of 155 MW.

The Kerckhoff No. 1 Powerhouse is normally referred to as the Kerckhoff Powerhouse. The powerhouse operates at a normal maximum gross head of 350 feet and has a capacity of 38 MW. The Kerckhoff Powerhouse is typically operated only when flows exceed the capacity of the Kerckhoff No. 2 Powerhouse, or when the Kerckhoff No. 2 Powerhouse cannot be operated because of maintenance, flood conditions in Millerton Lake, or required releases into the river.

Since the Crane Valley Hydroelectric Project and Big Creek Hydroelectric System are upstream from the influence of Millerton Lake and would not be affected by Settlement implementation, they will not be discussed further.

19.1.2 Central Valley Project/State Water Project Water Service Areas

The following sections describe power generation and pumping facilities within the CVP and SWP service areas.

Central Valley Project Friant Division Water Service Area and Facilities

The FPP consists of three powerhouses located on the downstream side of Friant Dam (Figure 19-1); Friant-Kern, Madera Powerhouse, and River Outlet powerhouses. These powerhouses are not associated with the CVP. The combined installed capacity of the three powerhouses, owned and operated by the FPA, is 30.6 MW, representing less than 3 percent of the generation capacity in the San Joaquin River basin upstream from Friant Dam. The River Outlet Powerhouse generates electricity from water released to the San Joaquin River. The other two powerhouses generate electricity from water released to the irrigation canals. The FPP powerhouses are included in FERC Project No. 2892, originally licensed in 1982. The FERC project number, name, license date, installed generation, and features of the FPP are summarized in Tables 19-1 and 19-2. Generation capacity, dates of installation, and annual reported energy generation from 1986 through 2007 for the FPP facilities at Friant Dam are summarized in Table 19-3.

The Friant-Kern Powerhouse generates hydroelectricity as water is released through outlets in the left abutment to the Friant-Kern Canal. It houses a single horizontal Kaplan-type turbine/generator assembly. The powerhouse operates at a normal maximum head of 105 feet and has a rated operating capacity of 18.4 MW. The turbine speed is 180 revolutions per minute (rpm) and the turbine has a butterfly-type shutoff valve.

The Madera Powerhouse generates hydroelectricity as water is released through outlets in the right abutment to the Madera Canal. It houses a single horizontal Kaplan-type turbine/generator assembly. The powerhouse operates at a normal maximum head of 126 feet and has a rated operating capacity of 9.8 MW. The turbine speed is 277 rpm and the turbine has a butterfly-type shutoff valve.

The River Outlet Powerhouse, located at the base of the dam adjacent to the spillway, generates hydroelectricity as water is released to the San Joaquin River through river outlets. It houses a single horizontal Francis-type turbine/generator assembly. The powerhouse operates at a normal maximum head of 273 feet, has a rated operating capacity of 2.4 MW, and a turbine speed of 600 rpm.

Figure 19-1.
Friant Power Project Facilities

Table 19-1.
Hydropower Projects at Friant Dam

FERC Project No.	FERC Project Name	License Issued	License Expires	River or Creek	Owner	Total Installed Capacity (MW)
02892	Friant	9/30/1982	8/31/2032	San Joaquin River	FPA	30.6

Source: FERC 2008
Key:
FERC = Federal Energy Regulatory Commission
FPA = Friant Power Authority
MW = megawatt

Table 19-2.
Summary of Hydroelectric Project Features at Friant Dam

Item	Friant Power Project
No. of Storage Reservoirs	1[1]
Additional Regulating Reservoirs[2]	N/A
Total Volume of Storage (TAF)	520.5
No. of Powerhouses	3
Total Installed Capacity (MW)	30.6
Miles of Conveyance (tunnel, penstock, flume, etc.) [3]	N/A

Source: Reclamation and DWR 2005
Notes:
[1] Millerton Lake (Friant Dam) is the storage reservoir that provides head and flow to the Friant Power Project, but the reservoir is not owned by the Friant Power Authority.
[2] Diversion dam reservoirs not included in count of additional regulating reservoirs.
[3] Conveyance length approximately measured in GIS.
Key:
GIS = geographic information system
MW = megawatt
N/A = not applicable
TAF = thousand acre-feet

Table 19-3.
Historical Hydroelectric Generation at Friant Power Project

Item	Friant Power Authority		
	Friant-Kern Canal	Madera Canal	River Outlet
Number and Type of Units	1 – Kaplan	1 – Kaplan	1 – Francis
Capacity (megawatt)	16	8.3	2
Year Constructed	1986	1985	1985
Reported Annual Generation (megawatt-hour)[1, 2]			
1986	57,379	30,853	11,191
1987	13,394	6,288	7,554
1988	19,202	5,934	9,340
1989	22,238	7,382	10,940
1990	15,442	6,354	12,492
1991	28,805	9,990	13,313
1992	23,032	8,160	13,010
1993	74,090	29,008	12,832
1994	25,145	8,916	14,632
1995	89,244	35,843	14,901
1996	80,371	30,464	14,331
1997	63,653	29,570	10,945
1998	59,539	34,679	17,577
1999	70,128	23,723	14,565
2000	71,520	23,526	13,249
2001	35,541	13,627	11,261
2002	43,262	13,686	13,250
2003	58,694	18,203	14,257
2004	39,156	11,437	14,430
2005	81,349	24,127	11,858
2006	78,866	25,504	13,221
2007	15,497	7,414	13,684
Minimum 1986-2007	13,394	5,934	7,554
Maximum 1986-2007	89,244	35,843	17,577
Average 1986-2007	**48,434**	**18,395**	**12,856**

Source: FERC 2008

Notes:

[1] Data source – Friant Power Authority.

[2] First full year of generation for the Friant Power Project was 1986.

A small powerhouse owned by Orange Cove ID using water supplied to the San Joaquin Hatchery is also located at Friant Dam, but is not part of the FPP. This powerhouse is also not associated with the CVP. In March 2008, Orange Cove ID informed FERC of a partnership with the FPA to add a new 1.8 MW powerhouse, under an existing FERC license authorized in October 13, 2006. FPA and Orange Cove ID later filed an amendment to their existing license to construct a new powerhouse at a different location, and to increase installed capacity from 1.8 to 7.0 MW and hydraulic capacity from 130 to 370 cfs. The amendment of license application was filed by FERC on February 22, 2010, and supplemented on May 13, 2010 (FERC 2010). FPA issued a Negative Declaration on May 26, 2010, followed by a Notice of Determination in July 2010.

The Madera-Chowchilla Water and Power Authority (MCWPA) owns and operates four powerhouses also not associated with the CVP at various locations along the Madera Canal. The powerhouses are Site 980, with a capacity of 2.124 MW; Site 1174, with a capacity of 0.605 MW; Site 1923 with a licensed capacity of 0.916 MW; and Site 1302 with a capacity of 0.4 MW. Sites 980, 1174, 1302, and 1923 are located approximately 18.5, 22, 24.5, and 36 miles downstream from Friant Dam along the Madera Canal. The FERC project numbers, names, license dates, and installed generation for hydropower projects along the Madera Canal are summarized in Table 19-4.

Table 19-4.
Hydropower Projects Along the Madera Canal

FERC Project No.	FERC Project Name	License Issued	License Expires	River or Creek	Owner	Total Installed Capacity (MW)
2958	Madera Canal	6/8/1982	5/31/2032	Madera Canal	MCWPA	3.645
5765	Madera Canal	9/8/1983	8/31/2033	Madera Canal	MCWPA	0.4

Source: FERC 2008

Key:
FERC = Federal Energy Regulatory Commission
MCWPA = Madera-Chowchilla Water and Power Authority
MW = megawatt

In addition to the generation described above, energy demand in the Friant Division water service area is met through both PG&E and SCE. Energy generation and consumption is divided into seven sectors as described in the *California Energy Commission Adopted Forecast*, including residential, commercial, industrial, mining, agricultural, utility, and street lighting (CEC 2009). Total 2005 agricultural energy consumption in California was 5,407 gigawatt hours (GWh) within PG&E service areas, and 4,559 GWh within SCE service areas. The combined agricultural energy consumption in 2005 for PG&E and SCE was 9,966 GWh.

Other Central Valley Project Service Area and Facilities

The CVP has 11 CVP hydroelectric powerplants, which have a maximum operating capability of 2,079 MW when all reservoirs are full and maximizing releases for power. CVP pumping plants that move water from the Delta to CVP service areas in the Central Valley include Jones Pumping Plant, O’Neill Pumping-Generating Plant, Gianelli

Pumping-Generating Plant, and Dos Amigos Pumping Plant. The Banks Pumping Plant, a SWP facility, has a Federal share in energy consumption. Jones Pumping Plant and Gianelli Pumping-Generating Plant consume the most energy annually of these facilities. The capacities and historical annual power generation from calendar year 2001 through 2007 of these 11 powerplants are shown in Table 19-5.

Table 19-5.
Central Valley Project Powerplants, Capacities, and Historical Annual Generation

CVP Powerplants	Capacity (MW)	Net Annual Generation in 1 Calendar Year (megawatt-hour)						
		2001	2002	2003	2004	2005	2006	2007
Shasta Powerplant	676	1,647,122	1,869,359	2,235,472	2,082,197	1,902,107	2,648,325	1,914,175
Trinity Powerplant	140	403,236	370,216	560,571	582,907	404,581	653,440	364,532
Judge Francis Carr Powerplant	150[1]	382,884	314,895	484,473	479,857	234,147	616,389	291,940
Spring Creek Powerplant	180	452,123	382,714	576,592	562,701	344,369	822,236	271,582
Keswick Powerplant	105	394,142	420,859	476,192	452,204	395,565	531,167	419,597
Lewiston Powerplant	0.35	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Folsom Powerplant	207	302,958	429,019	581,742	457,231	755,782	894,078	371,369
Nimbus Powerplant	17	41,637	54,156	67,832	51,987	72,311	77,728	41,262
New Melones Powerplant	383	380,309	370,996	364,414	335,355	372,876	910,222	469,679
O'Neill Pumping-Generating Plant	14.4	5,957	6,671	2,802	5,964	56	28	5,404
William R. Gianelli Pumping-Generating Plant (Federal share)	202	91,856	103,442	88,023	176,083	116,744	130,719	126,409

Source: Reclamation 2008

Note:

[1] Tunnel restriction limits installed capacity of 154 megawatts.

Key:
CVP = Central Valley Project
MW = megawatt
N/A = Records not available

Shasta Lake and Vicinity. The Shasta Division of the CVP contains Shasta Dam, Lake, and Powerplant, and Keswick Dam, Reservoir, and Powerplant; it captures water of the Sacramento River basin. Shasta Powerplant is located just below Shasta Dam. Water from the dam is released through five 15-foot-diameter penstocks leading to the five main generating units and two station service units. Shasta Powerplant is a peaking plant and generally runs when demand for electricity is high. Its power is dedicated first to meeting the requirements of CVP facilities. The remaining energy is marketed to various preferred customers in Northern California. The 2007 net annual generation of Shasta Powerplant was 1,914,175 megawatt-hours (MWh).

Since 1987, downstream water temperature requirements forced Reclamation to release water through the river outlet works, bypassing Shasta Powerplant and greatly reducing hydroelectric generation. In 1997, Reclamation constructed a selective withdrawal structure at Shasta Dam, known as a temperature control device (TCD), to control release water temperatures to improve salmon spawning and rearing habitat. This multilevel intake structure, installed in front of the existing power penstock intake structure on the face of Shasta Dam, enables operators to withdraw water from selected levels of Shasta Reservoir. During spring, when the temperature of the surface water is coolest, operators release water from the highest level of the TCD. During summer and fall, when surface water has warmed, water is withdrawn through the device from mid- and low-level intakes. With the TCD, Reclamation can control the temperature of water released from Shasta Reservoir without sacrificing power production. To conserve cold water in Shasta Reservoir, withdrawals are made from the highest elevation possible while meeting the downstream water temperature targets established by the Sacramento River Temperature Task Group (SRTTG).

Upper Sacramento River. CVP powerplants located downstream from Shasta Reservoir but upstream from RBDD are the Trinity, Lewiston, Judge Francis Carr, and Spring Creek powerplants of the Trinity River Division and Keswick Powerplant of the Shasta Division. The Trinity River Division captures headwaters from the Trinity River basin and diverts the surplus water to the Sacramento River.

Trinity Dam stores water from the Trinity River in Trinity Reservoir and makes releases to the Trinity River through the Trinity Powerplant. Downstream, Lewiston Dam diverts water from the Trinity River through the Lewiston Powerplant into the Clear Creek Tunnel and through Judge Francis Carr Powerplant to Whiskeytown Reservoir. Some Whiskeytown Reservoir releases are made through the Spring Creek Power Conduit and Powerplant into Keswick Reservoir in the Shasta Division. The remainder of the releases from Whiskeytown Reservoir is made to Clear Creek. Releases from Keswick Reservoir are made through the Keswick Powerplant to the Sacramento River. The following are Trinity Division hydropower facilities:

- Trinity Powerplant, a peaking plant located at Trinity Dam, operates mostly during times of peak power demand. It has two units with a maximum capacity of 140 MW.

- Lewiston Powerplant at Lewiston Dam is operated in conjunction with spillway gates to maintain minimum flow in the Trinity River downstream from the dam. It has one unit with a maximum capacity of 0.350 MW.

- Judge Francis Carr Powerplant is a peaking plant at the outlet of Clear Creek Tunnel with two units and a total generation capacity of 184 MW.

- Spring Creek Powerplant, at the downstream end of the Spring Creek Tunnel, has two units and a maximum capacity of 200 MW.

Keswick Powerplant, which belongs to the Shasta Division, is located at Keswick Dam, and has three generating units with a total capacity of 105 MW. Keswick Powerplant is a run-of-the-river plant, creating Shasta Powerplant’s afterbay, and providing uniform flows to the Sacramento River.

Lower Sacramento River and Delta. The two CVP powerplants located between RBDD and the Delta are the Folsom and Nimbus powerplants. Both powerplants belong to the Folsom Unit on the American River.

Folsom Powerplant is a peaking powerplant located at the foot of Folsom Dam on the north side of the American River. Water from the dam is released through three 15-foot-diameter penstocks to three generating units. Folsom Dam was constructed by USACE and, on completion, was transferred to Reclamation for coordinated operation as an integral part of the CVP. Folsom Powerplant is an integral component of Folsom Lake flood management operations to augment early flood releases. Folsom Powerplant provides a large degree of local voltage control and is increasingly relied on to support local loads during system disturbances.

Nimbus Dam forms Lake Natoma to act as an afterbay for Folsom Powerplant. It allows dam operators to coordinate power generation and flows in the lower American River channel during normal reservoir operations. Lake Natoma has a surface area of 500 acres and its elevation fluctuates between 4 to 7 feet daily. Nimbus Powerplant, with two units and a maximum capacity of 13.5 MW, is a run-of-the-river plant and provides station service backup for Folsom Powerplant.

Central Valley Project South-of-Delta Service Areas. The CVP powerplants located in the CVP south-of-Delta service area include New Melones Powerplant of the New Melones Unit of the CVP East Side Division, and the Gianelli and O'Neill pumping-generating plants of the San Luis Unit of the CVP West San Joaquin Division. The latter two plants, with dual functions of generating electricity and pumping water, are jointly owned by Reclamation and DWR.

New Melones Dam was completed in 1979, and inundated the original Melones Dam and created New Melones Reservoir on the Stanislaus River. New Melones Powerplant, located on the north bank, immediately downstream from the dam, is a peaking plant. The powerplant contains two units and has a maximum capacity of 300 MW.

The San Luis Unit, part of both the CVP and SWP, was authorized in 1960. Reclamation and the State of California constructed and operate this unit jointly; 45 percent of the total cost was contributed by the Federal Government and the remaining 55 percent by the State of California. The joint-use facilities are O'Neill Dam and Forebay, B.F. Sisk (San Luis) Dam, San Luis Reservoir, Gianelli Pumping-Generating Plant, Dos Amigos Pumping Plant, Los Banos and Little Panoche reservoirs, and San Luis Canal from O'Neill Forebay to Kettleman City, together with the necessary switchyard facilities. The Federal-only portion of the San Luis Unit includes the O'Neill Pumping-Generating Plant and Intake Canal, Coalinga Canal, Pleasant Valley Pumping Plant, and San Luis Drain.

San Luis Reservoir serves as the major storage reservoir, and O'Neill Forebay acts as an equalizing basin for the upper stage dual-purpose pumping-generating plant. O’Neill Pumping-Generating Plant takes water from the Delta-Mendota Canal and discharges it into the O'Neill Forebay, where the California Aqueduct flows directly. The Gianelli Pumping-Generating Plant lifts water from the O'Neill Forebay and discharges it into San

Luis Reservoir. During releases from the reservoir, these plants generate electric power by reversing flow through the turbines. Water for irrigation is released into the San Luis Canal and flows by gravity to Dos Amigos Pumping Plant where it is lifted more than 100 feet to permit gravity flow to its terminus at Kettleman City. The SWP canal system continues to southern coastal areas.

The O'Neill Pumping-Generating Plant consists of an intake channel, leading off the Delta-Mendota Canal, and six pumping-generating units. Normally, these units operate as pumps to lift water from 45 to 53 feet into the O'Neill Forebay; each unit can discharge 700 cfs and has a rating of 6,000 horsepower (hp). Water is occasionally released from the forebay to the Delta-Mendota Canal, and these units then operate as generators; each unit has a generating capacity of about 4.2 MW.

Gianelli Pumping-Generating Plant, the joint Federal-State facility located at San Luis Dam, lifts water by pump turbines from the O'Neill Forebay into San Luis Reservoir. During the irrigation season, water is released from San Luis Reservoir back through the pump-turbines to the forebay, and energy is reclaimed. Each of the eight pumping-generating units has a capacity of 63,000 hp as a motor and 53 MW as a generator. As a pumping plant to fill San Luis Reservoir, each unit lifts 1,375 cfs at a design dynamic head of 290 feet. As a generating plant, each unit passes 2,120 cfs at a design dynamic head of 197 feet.

Table 19-6 shows the calendar year 2007 energy consumption of each of the plants. Reclamation constructed and operates the Jones Pumping Plant. Banks Pumping Plant is an SWP facility (constructed and operated by DWR, as discussed later in this chapter); however, Reclamation has access to its pumping capacity through a JPOD. The remaining plants, described previously, are joint-use facilities between the two agencies under the San Luis Unit.

Table 19-6.
Central Valley Project Pumping Plants and Consumption in 2007

CVP Pumping Plants	Energy Used in Calendar Year 2007 (megawatt-hour)
C.W. “Bill” Jones Pumping Plant	593,490
O’Neill Pumping-Generating Plant	75,377
William R. Gianelli Pumping-Generating Plant	510,019
Dos Amigos Pumping Plant	145,502
Banks Pumping Plant – Federal Share	39,647
Total	1,064,035

Source: Reclamation 2007
Key:
CVP = Central Valley Project

Jones Pumping Plant, formerly Tracy Pumping Plant, is a component of the CVP Delta Division. Construction of the plant started in 1947 and was completed in 1951 with an inlet channel, pumping plant, and discharge pipes. Delta water is lifted 197 feet up and carried about 1 mile into the DMC. Each of the six pumps at Jones Pumping Plant is powered by a 22,500 hp motor and is capable of pumping 767 cfs. Power to run the pumps is supplied by the CVP powerplants. The intake canal includes the Jones Pumping Plant fish screen, which was built to intercept downstream migrant fish to be returned to the main channel.

Dos Amigo Pumping Plant is a joint CVP/SWP facility, located 17 miles south of O'Neill Forebay on the San Luis Canal. It lifts water 113 feet to permit gravity flow to the terminus of San Luis Canal at Kettleman City. The plant contains six pumping units, each capable of delivering 2,200 cfs at 125 feet of head.

State Water Project Service Area and Facilities

The SWP has eight hydroelectric powerplants, including the Alamo, Devil Canyon, Mojave Siphon, Warne, and William R. Gianelli generating plants and the Hyatt-Thermalito powerplant complex. The SWP also has 17 pumping plants.

Table 19-7 summarizes powerplant capacity and historical annual generation in calendar year 2005 for each plant. Table 19-8 shows the power consumption in calendar year 2005 for each pumping plant.

**Table 19-7.
State Water Project Powerplants, Capacities, and Historical Power Generation in 2005**

SWP Powerplants	Capacity (megawatt)	Energy Generated in Calendar Year 2005 (megawatt-hour)
Alamo Powerplant	17	105,003
Devil Canyon Powerplant	276	1,152,752
Hyatt-Thermalito Powerplant Complex[1]	762	1,833,559
Mojave Siphon Powerplant	33	72,525
Warne Powerplant	74	284,261
William R. Gianelli Pumping-Generating Plant (SWP share)	222	125,080

Source: DWR 2006

Note:

[1] Hyatt-Thermalito complex includes the Edward Hyatt Pumping-Generating Plant, Thermalito Diversion Dam Powerplant, and Thermalito Pumping-Generating Plant.

Key:

SWP = State Water Project

Table 19-8.
State Water Project Power Consumption in 2005

SWP Pumping Plants and Powerplants	Energy Used in Calendar Year 2005 (megawatt-hour)
Alamo Power Plant (station service)	95
Badger Hill Pumping Plant	20,871
Banks Pumping Plant	1,133,692
Barker Slough Pumping Plant	9,524
Bluestone Pumping Plant	18,622
Buena Vista Pumping Plant	412,128
Cherry Valley Pumping Plant	81
Chrisman Pumping Plant	966,247
Cordelia Pumping Plant	9,872
Crafton Hills Pumping Plant	1,786
Del Valle Pumping Plant	153
Devil Canyon Powerplant (station service)	39
Devil’s Den Pumping Plant	19,549
Dos Amigos Pumping Plant (SWP share)	454,022
Edmonston Pumping Plant	3,534,110
Gianelli Pumping-Generating Plant (SWP share)	363,023
Greenspot Pumping Plant	2,350
Hyatt-Thermalito Pumping-Generating Plant (pumpback and station service)	4,200
Las Perillas Pumping Plant	8,028
Mojave Siphon Powerplant (station service)	30
North Bay Interim Pumping Plant	0
Oso Pumping Plant	134,449
Pearblossom Pumping Plant	645,638
Pine Flat Power Plant	767
Polonio Pass Pumping Plant	19,653
South Bay Pumping Plant	90,279
Teerink Pumping Plant	438,400
Warne Power Plant (station service)	1,541

Source: DWR 2006

Key:
SWP = State Water Project

State Water Project Generation Facilities. Among the eight hydroelectric powerplants, three powerplants are located in the Lake Oroville vicinity and the remaining in the south-of-Delta area.

Lake Oroville, the SWP's largest reservoir, stores winter and spring runoff from the Feather River watershed, and releases water for SWP needs. These releases generate power at three powerplants: Edward Hyatt Pumping-Generating Plant, Thermalito Diversion Dam Powerplant, and Thermalito Pumping-Generating Plants (Oroville Facilities). DWR schedules hourly releases through the Oroville Facilities to maximize the amount of energy produced when power values are highest. Because the downstream water supply does not depend on hourly releases, water released for power in excess of local and downstream requirements is conserved by pumpback operation during off-peak times into Lake Oroville. Energy prices primarily dictate hourly operations for the power generation facilities.

The remaining five SWP powerplants are the jointly owned Gianelli Pumping-Generating Plant, Alamo Powerplant, Devil Canyon Powerplant, Warne Powerplant, and Mojave Siphon Powerplant. They generate about one-sixth of the total energy used by the SWP. Alamo Powerplant uses the 133-foot head between Tehachapi Afterbay and Pool 43 of the California Aqueduct to generate electricity. The Mojave Siphon Powerplant generates electricity from water flowing downhill after its 540-foot lift by Pearblossom Pumping Plant. The Devil Canyon Powerplant generates electricity with water from Silverwood Lake with over 1,300 feet of head, the largest head in the SWP system. The Warne Powerplant uses the 725-foot drop from the Peace Valley Pipeline to generate electricity with its Pelton wheel turbines.

State Water Project Pumping Facilities. Among the SWP pumping plants, plants that have historically consumed most of the energy are Gianelli Pumping-Generating Plant (SWP share), Banks Pumping Plant, Dos Amigos Pumping Plant (SWP share), Ira J. Chrisman Pumping Plant, and A.D. Edmonston Pumping Plant.

The Banks Pumping Plant is located 2.5 miles southwest of the Clifton Court Forebay on the California Aqueduct. The plant is the first pumping plant for the California Aqueduct and the South Bay Aqueduct. It provides the necessary head for water in the California Aqueduct to flow for approximately 80 miles south past the O'Neill Forebay and San Luis Reservoir to the Dos Amigos Pumping Plant (another jointly owned facility, as previously described). The Banks Pumping Plant initially flows into Bethany Reservoir, where the South Bay Aqueduct truly begins. The design head is 236 to 252 feet, and installed capacity is 10,670 cfs with 333,000 hp.

Along the California Aqueduct, the Pearblossom, Chrisman, and Edmonston pumping plants have historically consumed the highest amount of energy. The Pearblossom Pumping Plant lifts water about 540 feet and discharges the water at elevation 3,479, the highest point along the entire California Aqueduct. The Chrisman and Edmonston pumping plants provide 524 and 1,970 feet of lift, respectively, to convey California Aqueduct water across the Tehachapi Mountains.

19.2 Regulatory Setting

Power and energy are regulated by the Federal and State governments. The FERC regulates both Federal and non-Federal power projects. Friant Dam and Millerton Lake will continue to be operated for flood control in accordance with rules and regulations prescribed by the CFR Title 33, Part 208, and Report on Reservoir Regulation for Flood Control, Friant Dam and Millerton Lake, San Joaquin River, California (USACE 1955).

The California Public Utilities Commission (CPUC) regulates privately owned electric, natural gas, telecommunications, water, railroad, rail transit, and passenger transportation companies. CPUC maintains several O&M standards with which hydroelectric power supplies must comply. General Order No. 167, Subsections 8.2 and 15.1.1, requires filing of the Initial Certification of Compliance with the Operation Standards for each generating unit and recertification every other year. General Order No. 167, Subsections 7.2 and 15.1.1, requires filing of the Initial Certification of Compliance with the Maintenance Standards for each generating unit and recertification every other year. General Order No. 167, Subsections 6.3 and 15.1.1, requires filing of the Hydroelectric Logbook Verified Statement for each generating unit and recertification every other year. The California Independent System Operator Corporation is an impartial operator of the statewide wholesale power grid with responsibility for system reliability through scheduling available transmission capacity.

Other water quality, ecosystem, flood control, and water system operating criteria described in other sections also affect how hydroelectric projects are operated.

19.3 Environmental Consequences and Mitigation Measures

The purpose of this section is to provide information about the environmental consequences of the alternatives on hydropower generation, energy use, and impacts on existing hydropower facilities. This section describes the analytical methodology used to calculate, for all alternatives, the hydropower generation and energy consumption required in CVP and SWP existing hydropower facilities. This includes the FPA facilities at Friant Dam, and major hydropower and pumping facilities in the CVP and SWP water service areas. This section also describes criteria for determining significant impacts, and impacts and mitigation measures associated with the program alternatives. The program alternatives evaluated in this chapter are described in detail in Chapter 2.0, “Description of Alternatives,” and summarized in Table 19-9. The potential impacts to power and energy and associated mitigation measures are summarized in Table 19-10.

Table 19-9.
Actions Included Under Action Alternatives

Level of NEPA/CEQA Compliance	Actions[1]		A1	A2	B1	B2	C1	C2
Project-Level	Reoperate Friant Dam and downstream flow control structures to route Interim and Restoration flows		✓	✓	✓	✓	✓	✓
	Recapture Interim and Restoration flows in the Restoration Area		✓	✓	✓	✓	✓	✓
	Recapture Interim and Restoration flows at existing CVP and SWP facilities in the Delta		✓	✓	✓	✓	✓	✓
Program-Level	Common Restoration actions[2]		✓	✓	✓	✓	✓	✓
	Actions in Reach 4B1 to provide at least:	475 cfs capacity	✓	✓	✓	✓	✓	✓
		4,500 cfs capacity with integrated floodplain habitat		✓		✓		✓
	Recapture Interim and Restoration flows on the San Joaquin River downstream from the Merced River at:	Existing facilities on the San Joaquin River			✓	✓	✓	✓
		New pumping infrastructure on the San Joaquin River					✓	✓
	Recirculation of recaptured Interim and Restoration flows		✓	✓	✓	✓	✓	✓

Action Alternative: A1, A2, B1, B2, C1, C2

Notes:
[1] All alternatives also include the Physical Monitoring and Management Plan and the Conservation Strategy, which include both project- and program-level actions intended to guide implementation of the Settlement.
[2] Common Restoration actions are physical actions to achieve the Restoration Goal that are common to all action alternatives and are addressed at a program level of detail.

Key:
CEQA = California Environmental Quality Act
cfs = cubic feet per second
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
NEPA = National Environmental Policy Act
PEIS/R = Program Environmental Impact Statement/Report
SWP = State Water Project

Table 19-10.
Summary of Impacts and Mitigation Measures – Power and Energy

Impacts	Alternative	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance After Mitigation
Power and Energy: Program-Level				
PWR-1: Decrease in CVP and SWP Energy Generation	No-Action	LTS and Beneficial	--	LTS and Beneficial
	A1	No Impact	--	No Impact
	A2	No Impact	--	No Impact
	B1	LTS and Beneficial	--	LTS and Beneficial
	B2	LTS and Beneficial	--	LTS and Beneficial
	C1	LTS and Beneficial	--	LTS and Beneficial
	C2	LTS and Beneficial	--	LTS and Beneficial
PWR-2: Increase in CVP and SWP Energy Consumption	No-Action	LTS	--	LTS
	A1	No Impact	--	No Impact
	A2	No Impact	--	No Impact
	B1	LTS	--	LTS
	B2	LTS	--	LTS
	C1	LTS	--	LTS
	C2	LTS	--	LTS
PWR-3: Increased Energy Consumption as a Result of Construction Activities	No-Action	LTS	--	LTS
	A1	LTS	--	LTS
	A2	LTS	--	LTS
	B1	LTS	--	LTS
	B2	LTS	--	LTS
	C1	LTS	--	LTS
	C2	LTS	--	LTS
PWR-4: Increased Energy Consumption Within Friant Division	No-Action	No Impact	--	No Impact
	A1	No Impact	---	No Impact
	A2	No Impact	---	No Impact
	B1	No Impact	---	No Impact
	B2	No Impact	---	No Impact
	C1	No Impact	---	No Impact
	C2	No Impact	---	No Impact
Power and Energy: Project-Level				
PWR-5: Decrease in CVP and SWP Energy Generation	No-Action	LTS and Beneficial	--	LTS and Beneficial
	A1	LTS and Beneficial	--	LTS and Beneficial
	A2	LTS and Beneficial	--	LTS and Beneficial
	B1	LTS and Beneficial	--	LTS and Beneficial
	B2	LTS and Beneficial	--	LTS and Beneficial
	C1	LTS and Beneficial	--	LTS and Beneficial
	C2	LTS and Beneficial	--	LTS and Beneficial
PWR-6: Increase in CVP and SWP Energy Consumption	No-Action	LTS	--	LTS
	A1	LTS	--	LTS
	A2	LTS	--	LTS
	B1	LTS	--	LTS
	B2	LTS	--	LTS
	C1	LTS	--	LTS
	C2	LTS	--	LTS

Table 19-10.
Summary of Impacts and Mitigation Measures – Power and Energy (contd.)

Impacts	Alternative	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance After Mitigation
PWR-7: Change in Energy Generation at Friant Dam	No-Action	LTS	--	LTS
	A1	LTS	--	LTS
	A2	LTS	--	LTS
	B1	LTS	--	LTS
	B2	LTS	--	LTS
	C1	LTS	--	LTS
	C2	LTS	--	LTS
PWR-8: Increased Energy Consumption Within Friant Division	No-Action	LTS	--	LTS
	A1	LTS	--	LTS
	A2	LTS	--	LTS
	B1	LTS	--	LTS
	B2	LTS	--	LTS
	C1	LTS	--	LTS
	C2	LTS	--	LTS

Key:
-- = not applicable
CVP = Central Valley Project
LTS = less than significant
SWP = State Water Project

19.3.1 Impact Assessment Methodology

The CEQ regulations and the State CEQA guidelines describe the NEPA and CEQA requirements for describing the potential environmental consequences of alternatives in an EIS and EIR, respectively. The NEPA and CEQA requirements guide the assessments presented in this chapter. CEQA Guidelines Appendix F addresses Energy Conservation and NEPA requires that energy requirements and conservation potential are evaluated. This impact assessment is based on quantitative data regarding changes to hydropower resources that could occur under the program alternatives within geographic areas that compose the study area.

The hydropower assessment for the San Joaquin River upstream from Friant Dam used the Friant Dam Hydropower Generation Model (FDHGM) to compute generation from the Friant Dam powerplants on the Friant-Kern and Madera canals, and on the outlets to the San Joaquin River. FDHGM is a monthly time step model that uses Millerton Lake water operations data from the CalSim model.

Potential changes in flows at other power facilities along the Madera and Friant-Kern canals, as described in Section 19.1.2, depend on local operational decisions not under the control of the SJRRP. These facilities are not included in the hydropower analysis.

No hydropower impact assessment was performed for the San Joaquin River from Friant Dam to the Merced River. The facilities in this section include a number of small pumps probably used to divert water for irrigation purposes. The number, size, and use of these pumps are not known. The flow changes in the SJRRP are not expected to have an impact on the usage of the pumps.

All major hydropower facilities for the San Joaquin River from Merced River to the Delta, in the Sacramento-San Joaquin Delta and in the CVP and SWP water service areas are included in the CalSim model. Water operations from the CalSim model were used in two Common Assumptions power tools, Long_Term_Gen and SWP_Power, to quantify the CVP and SWP hydropower generation and energy consumption. These three areas are considered because their combined impact at all included facilities is more important than the impact at any single facility.

Water operations outside of the CVP and SWP facilities such as the Cross Valley Canal and within the Friant Service Area are not determined by the Restoration process and were not included in the CalSim modeling. Potential hydropower impacts were not determined for these areas due to the lack of operational information.

Increased energy consumption within Friant Division assumes no recapture of Interim and Restoration flows and that the contractors make up that loss of water through increased groundwater pumping.

19.3.2 Significance Criteria

The thresholds of significance for impacts to power and energy are based on the environmental checklist in Appendix G of the State CEQA Guidelines, as amended. These thresholds also encompass the factors taken into account under NEPA to determine the significance of an action in terms of its context and the intensity of its impacts. An alternative would be considered to have a potentially significant impact on regional hydropower production if the change in the average monthly energy generation or consumption (over the 82-year period of simulation) by the CVP/SWP is greater than 5 percent, as shown in Table 19-11. A threshold of 5 percent was selected as the threshold of significance for hydroelectric generation for several reasons, including seasonal and annual hydrologic variability, short-term operations decisions that might affect water level in storage, and regional power market demands and prices that might dictate hydropower facilities operations. All these factors could contribute to potentially substantial variations in hydropower generation on a monthly or annual basis. As a result, generation variations of less than 5 percent are not considered significant. A threshold of 5 percent was also selected as the threshold of significance for increased energy consumption within the Friant Division. A 5 percent significance threshold was selected for several reasons including annual hydrologic variability that result in variability in groundwater need, regional power market demands, and variation in crop selection. Significance conclusions are relative to both the existing conditions (2005 level of development) and future conditions (2030 level of development), unless stated otherwise.

Table 19-11.
Impact Indicators and Significance Criteria for Energy Generation and Usage

Impact Indicator	Significance Criterion
CVP and SWP Energy Generation	Decrease in average annual energy generation by the CVP/SWP systems of more than 5 percent.
CVP and SWP Energy Consumption	Increase in average annual energy consumption by the CVP/SWP systems of more than 5 percent.
Construction Related Energy Consumption	A substantial increase in energy consumption to the extent that energy generation capacity is exceeded based on currently available projections or unacceptable demands are placed on energy supply and distribution systems.
Energy Consumption Within Friant Division	Increase in average annual energy consumption by the Friant Division of more than 5 percent relative to overall consumption by the agricultural sector for regional utility providers PG&E and SCE

Key:
CVP = Central Valley Project
PG&E = Pacific Gas and Electric
SCE = Southern California Edison
SWP = State Water Project

19.3.3 Program-Level Impacts and Mitigation Measures

Program-level impacts of the action alternatives are associated with the additional power consumption that could be generated through recapture of Interim and Restoration flows in the San Joaquin River downstream from Friant Dam, operation of new infrastructure to increase pumping capacity on the San Joaquin River in Alternatives C1 and C2, and energy consumption related to construction activities. Impacts under the No-Action Alternative are also presented below.

Impacts of all action alternatives related to the release and recapture of Interim and Restoration flows at existing facilities in the Restoration Area and in the Delta are described as project-level impacts in Section 19.3.4.

No-Action Alternative

Under the No-Action Alternative, the Settlement would not be implemented. The No-Action Alternative includes conditions as they would exist in the study area at the end of the PEIS/R planning horizon (2030), including those projects and programs considered reasonably foreseeable by that time. There are no actions under the No-Action Alternative which would cause an increase in energy consumption as a result of construction activities, or within the Friant Division.

Impact PWR-1 (No-Action Alternative): ***Decrease in CVP and SWP Energy Generation – Program-Level.*** Simulated annual average CVP/SWP energy generation is shown in Table 19-12. Under the No-Action Alternative, energy generation at CVP and SWP power plants would increase by 1 percent from the existing condition. This impact would be **less than significant** and **beneficial**.

Table 19-12.
Simulated Annual Average Hydropower for No-Action Alternative

Impact Indicator	Existing Condition (GWh)	No-Action Alternative	
		(GWh)	(%) Change
CVP/SWP Energy Generation	9,855	9,915	1%
CVP/SWP Energy Consumption	10,547	11,086	5%
Energy Generation at Friant Dam	89	89	0%

Note:
Simulation period: 1922-2003.
Key:
GWh = gigawatt-hour

Impact PWR-2 (No-Action Alternative): ***Increase in CVP and SWP Energy Consumption – Program-Level.*** Simulated annual average CVP/SWP energy consumption is shown in Table 19-12. Under the No-Action Alternative, energy consumption at CVP and SWP power plants would increase by 5 percent from the existing condition. This impact would be **less than significant**.

Alternatives A1 and A2

Alternatives A1 and A2 would result in project-level changes in energy consumption and generation, as described in Section 19.3.4. Program-level impacts would occur under Alternatives A1 and A2 associated with construction activities, as described below, and would not result in changes to CVP and SWP energy consumption or generation.

Impact PWR-1 (Alternatives A1 and A2): ***Decrease in CVP and SWP Energy Generation – Program-Level.*** Energy generation at CVP and SWP power plants would not be affected by program-level actions under Alternatives A1 and A2. There would be **no impact**.

Impact PWR-2 (Alternatives A1 and A2): ***Increase in CVP and SWP Energy Consumption – Program-Level.*** Energy consumption at CVP and SWP power plants would not be affected by program-level actions under Alternatives A1 and A2. There would be **no impact**.

Impact PWR-3 (Alternatives A1 and A2): ***Increased Energy Consumption as a Result of Construction Activities – Program-Level.*** The action alternatives would result in intermittent construction activities (e.g., constructing the Mendota Pool bypass, fish screens, and seasonal barriers; establishing low-flow channels; augmenting riffles; modifying gravel pits; constructing levees). These construction activities would cause irreversible and irretrievable commitments of nonrenewable energy resources such as gasoline and diesel fuel needed for construction activities. Alternative A2 would require increased levels of construction activities to increase Reach 4B1 channel capacity to at least 4,500 cfs (compared to at least 475 cfs with Alternative A1). At the program-level, the impact conclusion for energy consumption related to construction activities from Alternative A2 would be similar to that for Alternative A1. The extent to which the action alternatives would increase energy consumption would be limited, as the work is temporary and requires a relatively small area. Therefore, the change in energy consumption during construction for Alternatives A1 and A2 would not be substantial, and this impact would be **less than significant**.

Impact PWR-4 (Alternatives A1 and A2): *Increased Energy Consumption Within Friant Division– Program-Level.* Energy consumption within Friant Division would not be affected by program-level actions. There would be **no impact**.

Alternatives B1 and B2

Program-level impacts under Alternatives B1 and B2 would occur to CVP/SWP power generation and power consumption, as shown in Table 19-13. Changes in energy generation at Friant Dam would be project-level, and are discussed in Section 19.3.4.

Table 19-13.
Simulated Annual Average Hydropower for Alternatives B1 and B2

Impact Indicator	Existing Condition	Alternatives B1 and B2		No Action	Alternatives B1 and B2	
	(GWh)	(GWh)	(%) Change	(GWh)	(GWh)	(%) Change
CVP/SWP Energy Generation	9,855	9,885	<1%	9,915	9,935	<1%
CVP/SWP Energy Consumption	10,547	10,653	1%	11,086	11,165	1%
Energy Generation at Friant Dam	89	74	-17%	89	74	-17%

Note:
Simulation period: 1922-2003
Key:
GWh = gigawatt-hour

Impact PWR-1 (Alternatives B1 and B2): *Decrease in CVP and SWP Energy Generation – Program-Level.* Simulated annual average CVP/SWP energy generation is shown in Table 19-13. Under Alternatives B1 and B2, energy generation at CVP and SWP power plants would increase by less than 1 percent in both the existing and future levels of demand. This impact would be **less than significant** and **beneficial**.

Impact PWR-2 (Alternatives B1 and B2): *Increase in CVP and SWP Energy Consumption – Program-Level.* Simulated annual average CVP/SWP energy consumption is shown in Table 19-13. Under Alternatives B1 and B2, energy consumption at CVP and SWP power plants would increase by 1 percent in both the existing and future levels of demand. This impact would be **less than significant**.

Impact PWR-3 (Alternatives B1 and B2): *Increased Energy Consumption as a Result of Construction Activities – Program Level.* Alternative B1 would require the same level of construction as Alternative A1, and Alternative B2 would require the same level of construction as Alternative A2. Program-level impact conclusions for energy consumption related to construction activities for Alternatives B1 and B2 would therefore be the same as those for Alternatives A1 and A2 respectively. This impact would be **less than significant**.

Impact PWR-4 (Alternatives B1 and B2): ***Increased Energy Consumption Within Friant Division– Program-Level.*** Energy consumption within Friant Division would not be affected by program-level actions. There would be **no impact**.

Alternatives C1 and C2

Program-level impacts under Alternatives C1 and C2 would occur to CVP/SWP power generation and power consumption, as shown in Table 19-14. Changes in energy generation at Friant Dam would be project-level, and are discussed in Section 19.3.4.

Table 19-14.
Simulated Annual Average Hydropower for Alternatives C1 and C2

Impact Indicator	Existing Condition	Alternatives C1 and C2		No Action	Alternatives C1 and C2	
	(GWh)	(GWh)	(%) Change	(GWh)	(GWh)	(%) Change
CVP/SWP Energy Generation	9,855	9,882	<1%	9,915	9,931	<1%
CVP/SWP Energy Consumption	10,547	10,646	1%	11,086	11,163	1%
Energy Generation at Friant Dam	89	74	-17%	89	74	-17%

Note: Simulation period: 1922-2003.
Key:
GWh = gigawatt-hour

Impact PWR-1 (Alternatives C1 and C2): ***Decrease in CVP and SWP Energy Generation – Program-Level.*** Simulated annual average CVP/SWP energy generation is shown in Table 19-14. Under Alternatives C1 and C2, energy generation at CVP and SWP power plants would increase by less than 1 percent in both the existing and future levels of demand. This impact would be **less than significant** and **beneficial**.

Impact PWR-2 (Alternatives C1 and C2): ***Increase in CVP and SWP Energy Consumption – Program-Level.*** Simulated annual average CVP/SWP energy consumption is shown in Table 19-14. Under Alternatives C1 and C2, energy consumption at CVP and SWP power plants would increase by 1 percent in both the existing and future level of demand. This impact would be **less than significant**.

Impact PWR-3 (Alternatives C1 and C2): ***Increased Energy Consumption as a Result of Construction Activities – Program Level.*** Program-level construction activities for Alternative C1 include all construction activities described for Alternatives A1 and B1, and Alternative C2 includes all construction activities described for Alternatives A2 and B2. Alternatives C1 and C2 would have greater construction impacts because they would include the construction of a new pumping station on the lower San Joaquin River and a conveyance tie-in to existing water conveyance facilities. The additional construction under Alternatives C1 and C2 would require irreversible and irretrievable commitments of a greater amount of nonrenewable energy resources such as gasoline and diesel fuel needed for construction activities compared with Alternatives A1 through B2. However, at the program-level, the impact conclusion for energy consumption related to construction activities from Alternatives C1 and C2 would be similar to those described for Alternatives A1 through B2. The extent to which these alternatives would result in increased energy consumption would be limited, as the work is temporary and requires a relatively small area. Therefore, the change in energy consumption during construction for Alternatives C1 and C2 would not be substantial, and this impact would be **less than significant**.

Impact PWR-4 (Alternatives C1 and C2): ***Increased Energy Consumption Within Friant Division– Program-Level.*** Energy consumption within Friant Division would not be affected by program-level actions. There would be **no impact**.

19.3.4 Project-Level Impacts and Mitigation Measures

Project-level impacts would result from the release and recapture of Interim and Restoration flows, and would occur under all action alternatives.

No-Action Alternative

Program-level impacts under the No-Action Alternative include those described above in Section 19.3.3. Additional project-level impacts would occur at Friant Dam, as described below.

Impact PWR-7 (No-Action Alternative): ***Change in Energy Generation at Friant Dam – Project-Level.*** Simulated annual average energy generation at Friant Dam is shown in Table 19-12. Under the No-Action Alternative, energy generation at Millerton power plants would not change from the existing condition. This impact would be **less than significant**.

Impact PWR-8 (No-Action Alternative): ***Increased Energy Consumption Within Friant Division– Project-Level.*** Under the No-Action Alternative, increased depths to groundwater within the Friant Division by 2030 (as described in Chapter 13.0, "Hydrology – Groundwater") would increase energy consumption within the Friant Division. The maximum potential increase in energy consumption within the Friant Division due to groundwater depth would be 0.4 GWh, or less than 5 percent of the overall consumption by the agricultural sector for regional utility providers PG&E and SCE. Therefore this impact would be **less than significant**.

Alternatives A1 and A2

Project-level actions that would impact power and energy under Alternatives A1 through A2 include the reoperation of Friant Dam, and recapture of Interim and Restoration flows in the Delta using existing facilities, operated under existing operating criteria. Additional energy consumption could also occur due to increased groundwater pumping within the Friant Division in response to reduced surface water supplies as a result of the release of Interim and Restoration flows. Simulated annual average hydropower under Alternatives A1 and A2 are shown in Table 19-15.

Table 19-15.
Simulated Annual Average Hydropower for Alternatives A1 and A2

Impact Indicator	Existing Condition	Alternatives A1 and A2		No Action	Alternatives A1 and A2	
	(GWh)	(GWh)	(%) Change	(GWh)	(GWh)	(%) Change
CVP/SWP Energy Generation	9,855	9,884	<1%	9,915	9,935	<1%
CVP/SWP Energy Consumption	10,547	10,648	1%	11,086	11,165	1%
Energy Generation at Friant Dam	89	74	-17%	89	74	-17%

Note: Simulation period: 1922-2003

Key:
GWh = gigawatt-hour

Impact PWR-5 (Alternatives A1 and A2): *Decrease in CVP and SWP Energy Generation – Project-Level.* Simulated annual average CVP/SWP energy generation is shown in Table 19-15. Under Alternatives A1 and A2, energy generation at CVP and SWP power plants would increase by less than 1 percent in both the existing and future level of demand. This impact would be **less than significant** and **beneficial**.

Impact PWR-6 (Alternatives A1 and A2): *Increase in CVP and SWP Energy Consumption – Project-Level.* Simulated annual average CVP/SWP energy consumption is shown in Table 19-15. Under Alternatives A1 and A2, energy consumption at CVP and SWP power plants would increase by 1 percent in both the existing and future level of demand. This impact would be **less than significant**.

Impact PWR-7 (Alternatives A1 and A2): *Change in Energy Generation at Friant Dam – Project-Level.* Simulated annual average Millerton energy generation under Alternatives A1 and A2 is shown in Table 19-15. Under Alternatives A1 and A2, energy generation at Friant Dam power plants would decrease by 17 percent in both the existing and future level of demand. This impact would be **less than significant**.

As shown in Table 19-15, the 17-percent decrease in average annual hydropower generation at Friant Dam, including plants on the Friant-Kern and Madera canals and San Joaquin River outlet, would not lead to a change in regional hydropower generation of more than 5 percent under any action alternatives. Therefore, this impact would be less than significant.

Impact PWR-8 (Alternatives A1 and A2): *Increased Energy Consumption Within Friant Division– Project-Level.* Under Alternatives A1 and A2, surface water deliveries to Friant Division long-term contractors would be reduced, increasing the need to pump groundwater and thereby increasing energy consumption within the Friant Division. The maximum potential increase in energy consumption within the Friant Division due to increased groundwater pumping would be less than 5 percent of the overall consumption by the agricultural sector for regional utility providers PG&E and SCE. Therefore this impact would be **less than significant**.

The maximum potential increase in groundwater pumping, and therefore in energy consumption, would occur if none of the water released as Interim and Restoration flows was recaptured downstream and recirculated to the Friant Division. The maximum potential increase in annual energy consumption under the action alternatives would be up to 234 GWh under both 2005 and 2030 conditions. Energy consumption for the agricultural sector in PG&E and SCE combined was 9,966 GWh in 2005. Assuming growth projections forecasted by CEC for the period from 2010 to 2020 (CEC 2009) persist until 2030, energy consumption for the agricultural sector for both of those utilities in 2030 is expected to be 11,089 GWh. The expected increase in energy consumption within the Friant Division due to increased groundwater pumping would be less than 5 percent of the overall consumption by the agricultural sector for regional utility providers PG&E and SCE. Therefore this impact would be less than significant.

Table 19-16.
Average Annual Simulated Difference in Groundwater Pumping Energy Consumption Percent Change for All Alternatives

	Existing Level (2005)[1]				Future Level (2030)[1]			
	Existing Condition[3] (GWh)	Alt A (GWh)	Alt B (GWh)	Alt C (GWh)	No-Action Alt (GWh)	Alt A (GWh)	Alt B (GWh)	Alt C (GWh)
Friant Division Energy Consumption for Groundwater Pumping[2,3,4] (GWh)	543.5	777.8	770.3	751.9	543.8	777.8	767.8	740.9
Change Friant Division Energy Consumption for Groundwater Pumping from Existing Conditions/No-Action Alternative[2,3,4] (GWh)	0	234.3	226.9	208.4	0.4	234.0	223.9	197.1

Notes:
[1] Simulation period: October 1921 – September 2003.
[2] Additional energy effects from change in depth to existing pumping quantities were not included for City of Lindsay, City of Orange Cove, Fresno County Water Works District No. 18, and Madera County. Only the change in energy from additional pumping and change in depth was considered.
[3] Based on existing groundwater pumping determined from Burt 2005, except for City of Fresno, which came from West Yost Associates Consulting Engineers 2008.
[4] Change in groundwater pumping quantities and depth to groundwater were determined as described in Chapter 13.0,"Hydrology - Groundwater."
Key:
Alt = Alternative
GWh = gigawatt hour

Alternatives B1 Through C2

Project-level impacts under Alternatives B1 through C2 would be similar to those described for Alternatives A1 and A2. The demand for energy for groundwater pumping could be reduced through recapture of Interim and Restoration flows along the San Joaquin River between Merced River and the Delta at existing facilities (Alternatives B1 through C2) or at new pumping facilities (Alternatives C1 through C2). As shown in Table 19-16, the offset demand for energy under these alternatives could reduce the maximum potential energy demand within the Friant Division to 226.9 GWh

(Alternatives B1 and B2) and 223.9 GWh (Alternatives C1 and C2). Energy consumed for the recapture of Interim or Restoration flows at existing facilities under Alternatives B1 and B2 would be program-level effects, as shown in Table 19-13 and as previously described. Energy consumed for the recapture of Interim or Restoration flows at new pumping infrastructure under Alternatives C1 and C2 would also be program-level effects, as shown in Table 19-14 and as previously described.

Chapter 20.0 Public Health and Hazardous Materials

This chapter describes the environmental and regulatory settings of public health and hazardous materials from both natural and human caused sources, as well as environmental consequences and mitigation measures, as they pertain to implementation of the program alternatives. The program alternatives could affect public health and result in exposure to hazardous materials during the modification or construction of facilities or during other ground-disturbing activities in the Restoration Area and along the San Joaquin River from the Merced River to the Delta. Effects to public health and hazardous materials related to the project-level actions could occur in these areas as well as in the San Joaquin River upstream from Friant Dam and in the Delta. No activities have the potential to affect public health and hazardous materials in the CVP/SWP water service areas; therefore, this geographic region is not discussed further in this section.

20.1 Environmental Setting

The environmental setting is described in terms of anthropogenic (from or influenced by humans) hazards, West Nile virus (WNV), Valley Fever, naturally occurring asbestos, oil and gas wells, wildland fire, and aircraft safety.

20.1.1 Anthropogenic Hazards

The following sections describe anthropogenic hazards in the Restoration Area and along the San Joaquin River from the Merced River to the Delta.

San Joaquin River from Friant Dam to Merced River

Anthropogenic sources of hazardous materials and waste may exist in both the agricultural and urbanized portions of the Restoration Area and potential borrow sites. Contaminated sites generally are the result of unregulated spills of hazardous materials, such as gasoline or industrial chemicals, which result in unacceptable levels of toxic substances in soil or water that pose risks to human health and safety. Contamination also may result from ongoing land uses that generate substantial amounts of hazardous wastes, such as mines and landfills.

The hazardous waste sites listed below were located within 1,500 feet of the centerline of the San Joaquin River in the Restoration Area as compiled from the California Department of Toxic Substances Control's (DTSC's) *Cortese List*, SWRCB's Geotracker (2008), and EPA's Enviromapper databases.

Areas currently or historically used for agricultural purposes, such as a large portion of the Restoration Area, are likely to have received pesticide, herbicide, and fertilizer applications. Therefore, it should be assumed that all geographic areas discussed below are potentially contaminated with residual agricultural chemicals.

Reach 1. In addition to these two sites for which remediation has been completed, two sites in Reach 1 are known to contain hazardous materials and are considered to have "open" SWRCB cleanup status. Palm Bluffs Corporate, located at 7690 Palm Avenue, Fresno, is listed as a land disposal site. Southern Pacific Transportation Company, located at 17390 Friant Road, Friant, is listed for potential chromium and other metals contamination.

Reach 2. One site in Reach 2 is listed in the above-mentioned databases. Mendota Landfill is considered by SWRCB to have open status and potential volatile organic compound contamination.

Reach 3. The SWRCB lists eight sites for which remediation has been completed. The following sites in Reach 3 are known to contain hazardous materials and are undergoing site assessment:

- Ag and Industrial Supplies leaking underground storage tank (LUST) cleanup site (gasoline) at 7377 River Drive, Firebaugh
- Italo's Mini Mart LUST cleanup site (gasoline) at 785 N Street, Firebaugh
- Ramirez property LUST cleanup site (diesel) at 1435 Ninth Street, Firebaugh
- Calpine Containers LUST cleanup site (gasoline) at 1440 M Street, Firebaugh

Reaches 4 and 5. No sites listed in the above-mentioned databases are located in Reaches 4 and 5.

Chowchilla Bypass and Tributaries. No sites listed in the above-mentioned databases are located in the Chowchilla Bypass portion of the Restoration Area. Contaminated sites, however, are likely to occur near tributaries of Chowchilla Bypass. Adverse effects on surface water quality that may result from contamination at sites adjacent to the tributaries are discussed in Chapter 14.0, "Hydrology – Surface Water Quality."

Eastside Bypass, Mariposa Bypass, and Tributaries. No sites listed in the above-mentioned databases are located in the Eastside and Mariposa bypasses portions of the Restoration Area. Adverse effects on surface water quality that may result from contamination at sites adjacent to the tributaries are discussed in Chapter 14.0, "Hydrology – Surface Water Quality."

San Joaquin River from Merced River to the Delta

Ground-disturbing activities could occur on the San Joaquin River between the Merced River and the Delta due to construction of new infrastructure for the recapture of Interim and Restoration flows under some action alternatives. Anthropogenic hazards may occur on the west side of the San Joaquin River below the Merced River confluence. If present, contaminated sites would be identified when the location of the new infrastructure is chosen.

20.1.2 West Nile Virus

All mosquito species are potential vectors of organisms that can cause disease to pets, domestic animals, wildlife, and humans. Public concern regarding West Nile virus (WNV), a disease transmitted to humans, has increased since the virus was first detected in the United States in 1999. A mosquito acquires WNV by feeding on the blood of infected birds.

All species of mosquitoes require standing water to complete their growth cycle; therefore, any standing body of water represents a potential mosquito breeding area. Water quality also affects the productivity of potential mosquito breeding areas. Typically, greater numbers of mosquitoes are produced in water bodies with poor circulation, higher temperatures, and higher organic content (i.e., poor water quality) than in water bodies having good circulation, lower temperatures, and lower organic content. In addition, irrigation and flooding practices may influence the level of mosquito production associated with a water body. Typically, greater numbers of mosquitoes are produced in water bodies with water levels that slowly increase or recede than in water bodies with water levels that are stable or that fluctuate rapidly. Mosquito larvae prefer stagnant water and the protected microhabitats provided by stems of emergent vegetation.

The life cycle of the mosquito consists of four stages: egg, larva, pupa, and adult (CDPH 2008). The egg, larva, and pupa stages are completed in calm, standing water in permanent, seasonal, or intermittent waters, including seasonal and permanent wetlands, and even in small isolated waters, such as drying pools of ephemeral drainages, tire ruts, and containers. Larvae hatch from eggs in water and feed on organic matter and microorganisms, such as bacteria. Fish and predatory insects feed on mosquito larvae and greatly reduce their abundance in permanent bodies of water. Depending on average temperatures, it may take from 4 days to 1 month for the mosquito to mature from egg to adult; development accelerates with warmer temperatures.

Adults may remain close to where they hatched or may disperse from several hundred yards to several miles, depending on the species (Walton 2003, ACMAD 2000). Female mosquitoes require meals of blood for protein so that they can produce eggs (CDPH 2008). Hosts that can supply blood include reptiles, amphibians, mammals (including humans), and birds. Most adult females live for approximately 2 weeks, although some may survive longer, and those that emerge late in the season may hibernate through winter to begin laying eggs in spring.

Although most people infected with WNV experience no symptoms, approximately 20 percent will develop West Nile Fever. West Nile Fever symptoms, which may last from a few days to several weeks, include fever, fatigue, body aches, headache, skin rash on the trunk of the body, and swollen lymph glands.

Approximately 1 in 150 people, who are exposed to WNV, usually those over the age of 50 or considered to be immunocompromised, will develop severe West Nile Disease. Severe West Nile Disease symptoms include West Nile encephalitis (inflammation of the brain), West Nile meningitis (inflammation of the membrane around the brain and spinal cord), and West Nile poliomyelitis (inflammation of the brain and surrounding membrane). In 2008, of the 411 persons in California infected with WNV and reported to the U.S. Centers for Disease Control and Prevention (CDC), 267 developed encephalitis or meningitis, 135 developed fever, and 13 died (CDC 2008a). It is important to note that these statistical data include only those cases reported to the CDC or California Department of Public Health (CDPH). Because most people infected do not experience symptoms and those who do experience symptoms may not seek medical attention, the epidemiological information discussed above by no means includes all cases of WNV infection.

All counties in the Restoration Area or downstream from the Delta have reported cases of WNV (CDPH et al. 2009). Mosquito habitat for all the species' lifecycles is located in this geographic region within several miles of wetted portions of the San Joaquin River, bypasses, and tributaries. These habitats are also occupied by predatory fish and insects.

20.1.3 Naturally Occurring Asbestos

Naturally occurring asbestos, which was determined to be a toxic air contaminant in 1986 by the California Air Resources Board, is located in many parts of California and is commonly associated with ultramafic rocks (Clinkenbeard et al. 2002). Asbestos is the common name for a group of naturally occurring fibrous silicate minerals that can separate into thin but strong and durable fibers. People exposed to low levels of asbestos may be at elevated risk (e.g., above background rates) for lung cancer and mesothelioma (a cancer of the protective lining that surrounds the lungs).

The California Geological Survey (formerly the California Division of Mines and Geology) has prepared the *General Location Guide for Ultramafic Rocks in California — Areas More Likely to Contain Naturally Occurring Asbestos*. Although geologic conditions are more likely for asbestos formation in or near these areas, the presence of asbestos there is uncertain. According to the guide, the action alternative site is located in counties that contain ultramafic rock (Fresno and Madera Counties), but not in specific areas known to contain naturally occurring asbestos (Churchill and Hill 2000).

20.1.4 Valley Fever

Valley Fever is an infection, usually targeting the lungs, which results from inhalation of the fungus (*Coccidioides immitis*). These spores live in soil and generally are limited to areas of the southwestern United States, Mexico, and parts of Central and South America. It can be contracted only from inhalation of spores; it cannot be passed from an infected person to an uninfected person. In California, it is most commonly found in the Central Valley. Spores can enter the air when ground-moving activities, including natural disasters such as earthquakes or excavation activities, disturb spore-bearing soil. Approximately 60 percent of exposed people experience symptoms. Infection can cause flu-like symptoms, and if it is disseminated to organs other than the lungs, it can lead to severe pneumonia, meningitis, and death (CDC 2008b).

The CDC considers Valley Fever to be endemic in California. Because this disease is considered to be particularly prevalent in California's Central Valley, it is likely that the spores which cause *Coccidioidomycosis* are present in the Restoration Area and other areas of potential construction and could be disturbed and become airborne during earth-moving activities.

20.1.5 School Safety

The following sections describe schools within the Restoration Area and along the San Joaquin River from the Merced River to the Delta.

San Joaquin River from Friant Dam to Merced River

School-aged children are considered to be particularly sensitive to adverse effects resulting from exposure to hazardous materials, substances, or waste. Public Resources Code Section 21151.4 requires that project proponents evaluate projects proposed within a quarter-mile of a school to determine whether release of hazardous air emissions or hazardous substances, resulting from implementation of any of the action alternatives, would pose a human health or safety hazard. Hazardous substances existing naturally (e.g., *Coccidioidomycosis* spores) or from anthropogenic sources (e.g., LUST sites) could be emitted within a quarter-mile of a school resulting from ground-disturbing activities. Schools located within the Restoration Area are listed in Table 20-1.

Table 20-1.
Schools Located within the Restoration Area

Reach [1]	Schools within a Quarter Mile of the Reach
Reach 1	Alview Elementary School
	Friant Elementary School
	Liddell Elementary School
	River Bluff Elementary School
	Valley Oak Elementary School
Reach 3	El Puente High School
	Firebaugh Head Start
	Firebaugh High School
	Firebaugh Middle School
	Firebaugh Migrant Head Start
	Hazel M. Bailey Primary School
	Mills Intermediate School
	St. Joseph High School
	St. Joseph School

Note:
No schools are located within a quarter-mile of Reaches 2, 4, 5, or the bypasses

San Joaquin River from Merced River to the Delta

Because the location of construction activities under the action alternatives outside of the Restoration Area is unknown and the potential area in which construction could occur is large, an attempt to identify every school that could be affected was considered to be unreasonable at a program level. In accordance with Public Resources Code Section

21151.4, schools within a quarter-mile of project features must be identified when construction sites are identified at a project level of detail.

20.1.6 Oil and Gas Wells

A well is abandoned when oil or gas production ends at the well or when it is determined to be a dry-hole (i.e., no oil or gas exists). Proper abandonment procedures involve plugging the well by placing cement in the well bore or casing at certain intervals, as specified in California laws and regulations. The plug is intended to seal the well bore or casing and prevent fluid from migrating between underground rock layers.

Health and safety hazards may occur if ground-moving activities disrupt active, idle, or abandoned wells. Disruption could potentially result in soil and groundwater contamination, oil and methane seeps, fire hazards, and air quality degradation (DOC 2007, 2008).

San Joaquin River from Friant Dam to Merced River

The California Department of Conservation, Division of Oil, Gas, and Geothermal Resources (DOGGR) has inventoried abandoned wells located in the Restoration Area (DOC 2008). In addition to wells identified by DOGGR, confidential wells (e.g., exploratory wells) may be located along the reaches in the Restoration Area. Wells are granted confidentiality for up to 2 years. Confidential wells and other wells not listed may be found during site surveying for earth-moving activities. Table 20-2 shows the number of known abandoned oil and gas wells within the Restoration Area.

Table 20-2.
Known Abandoned Oil and Gas Wells

River and Bypass Reaches	Number of Known Abandoned Oil and Gas Wells
San Joaquin River – Reach 1	1
San Joaquin River – Reach 2	9
San Joaquin River – Reach 3	4
San Joaquin River – Reach 4	6
San Joaquin River – Reach 5	0
Fresno Slough/James Bypass	9
Chowchilla Bypass and Tributaries	8
Eastside Bypass, Mariposa Bypass, and Tributaries	1

Source: California Department of Conservation, Division of Oil, Gas, and Geothermal Resources 2008

San Joaquin River from Merced River to the Delta

Because the location of construction activities under the action alternatives outside of the Restoration Area is unknown and the potential area in which construction could occur is large, an attempt to identify every well was considered to be unreasonable at a program level. Wells will be identified when construction sites are identified at a project level of detail.

20.1.7 Wildland Fire

Wildland fires pose a hazard to both persons and property in many areas of California. The severity of wildland fires is influenced primarily by vegetation, topography, and weather (temperature, humidity, and wind). California Department of Forestry and Fire Protection (CAL FIRE) developed a fire hazard severity scale that considers vegetation, climate, and slope to evaluate the level of wildfire hazard in all State Responsibility Areas. The designation of State Responsibility Areas and Local Responsibility Areas (LRA) is used to identify responsibility for providing basic wildland fire protection assistance, and to identify three levels of fire hazard severity zones (moderate, high, and very high) to indicate the severity of fire hazard in a particular geographic area (CAL FIRE 2007).

The San Joaquin River Reaches 2 through 5, all bypasses and tributaries, and Lower San Joaquin River are located in a Local Responsibility Area and a moderate or an unzoned Fire Hazard Severity Zone.

20.1.8 Aircraft Safety

Collisions between aircraft and wildlife can compromise the safety of passengers and flight crews. Damage to an aircraft resulting from a wildlife collision can range from a small dent in the wing to catastrophic engine failure, destruction of the aircraft, and potential loss of life. Airports within 2 nautical miles of a project area may be affected by land use changes that attract hazardous wildlife. Natural or constructed areas found in the Restoration Area, such as poorly drained locations, detention/retention ponds, odor-causing rotting organic matter (putrescible waste), detention/retention ponds, disposal operations, wastewater treatment plants, and agricultural or aquaculture activities can provide wildlife habitat.

According to the Federal Aviation Administration (FAA) (FAA 2007), the following groups of species, found in the Restoration Area, are hazardous to airport operations: waterfowl, wading birds, and shorebirds; gulls; sparrows, larks, and finches; raptors; swallows; blackbirds and starlings; corvids; and columbids.

Airports and airstrips within 2 miles of each river reach are shown in Table 20-3.

Table 20-3.
Airports and Airstrips within 2 Miles of River and Bypass Reaches

River Reach	Airports and Airstrips Located within 2 Miles
Reach 1	Arnold Ranch
	Sierra Sky Park
Reach 2	Mendota Airport
Reach 3	Firebaugh Airport
Reach 4	Triangle T Ranch
	Willis Ranch
Reach 5	Gustine
	Stevinson Strip
Fresno Slough/James Bypass	Mendota Airport
Chowchilla Bypass and Tributaries	Emmett Field
	Red Top
	Triangle T Ranch
Eastside Bypass, Mariposa Bypass, and Tributaries	none
San Joaquin River Merced River to the Delta	Ahlem Farms
	Westley
	Yandell Ranch

Source: Federal Aviation Administration 2007

20.2 Regulatory Setting

This section discusses the regulatory setting for public health and hazardous materials in the study area.

20.2.1 Federal

Federal laws and regulations pertaining to public health and hazardous materials in the study area are summarized briefly below.

Hazardous Materials Handling

At the Federal level, the principal agency regulating the generation, transport, and disposal of hazardous substances is EPA, under the authority of the Resource Conservation and Recovery Act (RCRA). The RCRA established an all-encompassing Federal regulatory program for hazardous substances that is administered by EPA. Under the RCRA, EPA regulates the generation, transportation, treatment, storage, and disposal of hazardous substances. The RCRA was amended in 1984 by the Hazardous and Solid Waste Amendments of 1984, which specifically prohibits the use of certain techniques to dispose of various hazardous substances. The Federal Emergency Planning and Community Right to Know Act of 1986 imposes hazardous-materials planning requirements to help protect local communities in the event of accidental release of hazardous substances. EPA has delegated much of the RCRA requirements to the DTSC.

Worker Safety Requirements

The U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), is responsible at the Federal level for ensuring worker safety. OSHA sets Federal standards for implementing workplace training, exposure limits, and safety procedures for the handling of hazardous substances (as well as other hazards). OSHA also establishes criteria by which each state can implement its own health and safety program.

Regulation of Polychlorinated Biphenyls

The Toxic Substances Control Act (TSCA) of 1976 (USC Title 15, Section 2605) banned the manufacture, processing, distribution, and use of PCBs in totally enclosed systems. The EPA Region 9 PCB Program regulates remediation of PCBs in several states, including California. Title 40 of the CFR, Section 761.30(a)(1)(vi)(A) states that all owners of electrical transformers containing PCBs must register their transformers with EPA. Specified electrical equipment manufactured between July 1, 1978, and July 1, 1998, that does not contain PCBs must be marked by the manufacturer with the statement "No PCBs" (Section 761.40[g]). Transformers and other items manufactured before July 1, 1978, and containing PCBs must be marked as such.

Asbestos

The CAA was enacted in 1970. The most recent major amendments by Congress were made in 1990. The CAA required EPA to establish primary and secondary national ambient air quality standards. It also required each state to prepare an air quality control plan, referred to as a State Implementation Plan. Section 112 of the CAA defines "hazardous air pollutants" and sets threshold limits. Asbestos-containing substances are regulated by EPA under the CAA. Additional information about the CAA is presented in Chapter 4.0, "Air Quality."

Airport and Airspace Safety

Part 77 of the Federal Aviation Regulations (FAR), "Objects Affecting Navigable Airspace," has been adopted as a means of monitoring and protecting the airspace required for safe operation of aircraft and airports. Objects that exceed certain specified height limits constitute airspace obstructions. FAR Section 77.13 requires that the FAA be notified of proposed construction or alteration of certain objects in a specified vicinity of an airport.

20.2.2 State of California

State laws and regulations pertaining to public health and hazardous materials in the study area are summarized briefly below.

Hazardous Materials Handling

The California Hazardous Materials Release Response Plans and Inventory Law of 1985 (Business Plan Act) requires preparation of hazardous materials business plans and disclosure of hazardous materials inventories. A business plan includes an inventory of hazardous materials handled, facility floor plans showing where hazardous materials are stored, an emergency response plan, and provisions for employee training in safety and emergency response procedures (California Health and Safety Code, Division 20, Chapter 6.95, Article 1). Statewide, DTSC has primary regulatory responsibility for managing hazardous materials, with delegation of authority to local jurisdictions that enter into agreements with the State. Local agencies administer these laws and regulations.

Worker Safety Requirements

California Occupational Safety and Health Administration (Cal/OSHA) assumes primary responsibility for developing and enforcing workplace safety regulations in California. Cal/OSHA regulations pertaining to the use of hazardous materials in the workplace (Title 8 of the CCR) include requirements for safety training, availability of safety equipment, accident and illness prevention programs, hazardous substance exposure warnings, and preparation of emergency action and fire prevention plans.

Emergency Response to Hazardous Materials Incidents

California has developed an emergency response plan to coordinate emergency services provided by Federal, State, and local governments and private agencies. Response to hazardous material incidents is one part of this plan. The plan is managed by the Governor's Office of Emergency Services (OES), which coordinates the responses of other agencies, including the Cal/EPA, California Highway Patrol (CHP), DFG, and Central Valley RWQCB.

Hazardous Materials Transport

The U.S. Department of Transportation (DOT) regulates transportation of hazardous materials between states. State agencies with primary responsibility for enforcing Federal and State regulations and responding to hazardous materials transportation emergencies are the CHP and Caltrans. Together, these agencies determine container types used and license hazardous waste haulers for transportation of hazardous waste on public roads.

The DOT Federal Railroad Administration (FRA) enforces the hazardous materials regulations, which are promulgated by the Pipeline and Hazardous Materials Safety Administration for rail transportation. These regulations include requirements that railroads and other transporters of hazardous materials, including shippers, have and adhere to security plans and train their employees involved in offering, accepting, or transporting hazardous materials on both safety and security matters.

California Accidental Release Prevention Program

The goal of the California Accidental Release Prevention Program is to reduce the likelihood and severity of consequences of extremely hazardous materials releases. Any business that handles regulated substances (chemicals that pose a major threat to public health and safety or the environment because they are highly toxic; flammable; or explosive, including ammonia, chlorine gas, hydrogen, nitric acid, and propane) is required to prepare a risk management plan. A risk management plan describes current and past practices and releases, what the impact of releases may be, and what the business does or plans to do to prevent releases and minimize their impact if they occur.

Government Code Section 65962.5 (Cortese List)

The provisions of Government Code Section 65962.5 are commonly referred to as the "Cortese List" (after the legislator who authored the legislation that enacted it). The *Cortese List* is a planning document used by State and local agencies to comply with CEQA requirements in providing information about the location of hazardous materials release sites. Government Code Section 65962.5 requires Cal/EPA to develop an updated *Cortese List* annually at minimum. DTSC is responsible for a portion of the information contained in the *Cortese List*. Other California State and local government agencies are required to provide additional hazardous material release information for the *Cortese List*.

Multi-Hazard Mitigation Plan

OES issued the State of California Multi-Hazard Mitigation Plan (Multi-Hazard Mitigation Plan) (OES 2007) in October 2007. The Federal Disaster Mitigation Act required all State emergency services agencies to issue such plans by November 1, 2004, for the states to receive Federal grant funds for disaster assistance and mitigation under the Stafford Act (44 CFR 201.4).

Public Resources Code and Title 14, Chapter 4 of the California Code of Regulations

DOGGR is responsible for Section 3000 et seq. of the PRC and Title 14, Chapter 4 of the CCR, which regulates Statewide oil and gas activities by supervising the drilling, operation, maintenance, plugging, and abandonment of onshore and offshore oil, gas, and geothermal wells. In addition, DOGGR's programs include well permitting and testing; safety inspections; oversight of production and injection projects; environmental lease inspections; idle-well testing; inspecting oilfield tanks, pipelines, and sumps; hazardous and orphan well plugging and abandonment contracts; and subsidence monitoring.

20.2.3 Regional and Local

The plans discussed below pertain to public health and hazardous materials in the study area.

General Plans

The Fresno County General Plan (Fresno County 2000), the Madera County General Plan (Madera County 1995), and the Merced County General Plan (Merced County 2000) identify goals and policies that describe approaches to public health and hazardous materials used by each county.

20.3 Environmental Consequences and Mitigation Measures

This section describes the effects that the program alternatives would have on public health and potential risks caused by exposure to hazardous materials, with the focus of the analysis within the Restoration Area and along the San Joaquin River between the Merced River and the Delta. The program alternatives evaluated in this chapter are described in detail in Chapter 2.0, “Description of Alternatives,” and summarized in Table 20-4. The potential impacts to public health and hazardous materials and associated mitigation measures are summarized in Table 20-5.

Table 20-4.
Actions Included Under Action Alternatives

Level of NEPA/CEQA Compliance	Actions[1]		Action Alternative					
			A1	A2	B1	B2	C1	C2
Project-Level	Reoperate Friant Dam and downstream flow control structures to route Interim and Restoration flows		✓	✓	✓	✓	✓	✓
	Recapture Interim and Restoration flows in the Restoration Area		✓	✓	✓	✓	✓	✓
	Recapture Interim and Restoration flows at existing CVP and SWP facilities in the Delta		✓	✓	✓	✓	✓	✓
Program-Level	Common Restoration actions[2]		✓	✓	✓	✓	✓	✓
	Actions in Reach 4B1 to provide at least:	475 cfs capacity	✓	✓	✓	✓	✓	✓
		4,500 cfs capacity with integrated floodplain habitat		✓		✓		✓
	Recapture Interim and Restoration flows on the San Joaquin River downstream from the Merced River at:	Existing facilities on the San Joaquin River			✓	✓	✓	✓
		New pumping infrastructure on the San Joaquin River					✓	✓
	Recirculation of recaptured Interim and Restoration flows		✓	✓	✓	✓	✓	✓

Notes:

[1] All alternatives also include the Physical Monitoring and Management Plan and the Conservation Strategy, which include both project- and program-level actions intended to guide implementation of the Settlement.

[2] Common Restoration actions are physical actions to achieve the Restoration Goal that are common to all action alternatives and are addressed at a program level of detail.

Key:
CEQA = California Environmental Quality Act
cfs = cubic feet per second
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
NEPA = National Environmental Policy Act
PEIS/R = Program Environmental Impact Statement/Report
SWP = State Water Project

**Table 20-5.
Summary of Environmental Consequences and Mitigation Measures –
Public Health and Hazardous Materials**

Impacts	Alternative	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance After Mitigation
Public Health and Hazardous Materials: Program-Level				
PHH-1: Exposure of Construction Workers and Others to Hazardous Materials	No-Action	No Impact	--	No Impact
	A1	PS	PHH-1: Conduct Phase I Environmental Site Assessments	LTS
	A2	PS		LTS
	B1	PS		LTS
	B2	PS		LTS
	C1	PS		LTS
	C2	PS		LTS
PHH-2: Creation of a Substantial Hazard to the Public or the Environment Through the Use of Hazardous Materials	No-Action	No Impact	--	No Impact
	A1	LTS	--	LTS
	A2	LTS	--	LTS
	B1	LTS	--	LTS
	B2	LTS	--	LTS
	C1	LTS	--	LTS
	C2	LTS	--	LTS
PHH-3: Exposure to Naturally Occurring Asbestos	No-Action	No Impact	--	No Impact
	A1	No Impact	--	No Impact
	A2	No Impact	--	No Impact
	B1	No Impact	--	No Impact
	B2	No Impact	--	No Impact
	C1	No Impact	--	No Impact
	C2	No Impact	--	No Impact
PHH-4: Exposure to Diseases	No-Action	No Impact	--	No Impact
	A1	PS	PHH-4: Implement Workplace Precautions against West Nile Virus and Valley Fever	LTS
	A2	PS		LTS
	B1	PS		LTS
	B2	PS		LTS
	C1	PS		LTS
	C2	PS		LTS
PHH-5: Creation of a Substantial Hazard to School Safety	No-Action	No Impact	--	No Impact
	A1	PS	PHH-5: Minimize Hazards to School Safety	LTS
	A2	PS		LTS
	B1	PS		LTS
	B2	PS		LTS
	C1	PS		LTS
	C2	PS		LTS
PHH-6: Creation of a Substantial Hazard from Idle and Abandoned Wells	No-Action	No Impact	--	No Impact
	A1	PS	PHH-6: Minimize Hazards from Idle and Abandoned Wells	LTS
	A2	PS		LTS
	B1	PS		LTS
	B2	PS		LTS
	C1	PS		LTS
	C2	PS		LTS

**Table 20-5.
Summary of Environmental Consequences and Mitigation Measures – Public Health and Hazardous Materials (contd.)**

Impacts	Alternative	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance After Mitigation
Public Health and Hazardous Materials: Program-Level (contd.)				
PHH-7: Creation of a Substantial Hazard from Wildland Fires	No-Action	No Impact	--	No Impact
	A1	LTS	--	LTS
	A2	LTS	--	LTS
	B1	LTS	--	LTS
	B2	LTS	--	LTS
	C1	LTS	--	LTS
	C2	LTS	--	LTS
PHH-8: Creation of a Substantial Hazard to Aircraft Safety	No-Action	No Impact	--	No Impact
	A1	LTS	--	LTS
	A2	LTS	--	LTS
	B1	LTS	--	LTS
	B2	LTS	--	LTS
	C1	LTS	--	LTS
	C2	LTS	--	LTS
Public Health and Hazardous Materials: Project-Level				
PHH-9: Exposure to Diseases in the San Joaquin River upstream from Friant Dam, in the Restoration Area, and in the San Joaquin River from Merced River to the Delta	No-Action	No Impact	--	No Impact
	A1	PS	PHH-9: Coordinate with and Support Vector Control District(s)	LTS
	A2	PS		LTS
	B1	PS		LTS
	B2	PS		LTS
	C1	PS		LTS
	C2	PS		LTS
PHH-10: Exposure to Diseases in the Delta	No-Action	No Impact	--	No Impact
	A1	LTS	--	LTS
	A2	LTS	--	LTS
	B1	LTS	--	LTS
	B2	LTS	--	LTS
	C1	LTS	--	LTS
	C2	LTS	--	LTS

Key:
-- = not applicable
LTS = less than significant
PS = potentially significant

20.3.1 Impact Assessment Methodology

This analysis considers the range and nature of foreseeable hazardous materials use, storage, and disposal resulting from implementing any of the action alternatives and No-Action Alternative and identifies the primary ways that these hazardous materials could expose individuals or the environment to health and safety risks. Compliance with applicable Federal, State, and local health and safety laws and regulations during construction activities would generally protect the health and safety of the public. State and local agencies would be expected to continue to enforce applicable requirements to the extent that they do so now.

Literature, including documents published by Federal, State, county, and city agencies that document potential hazardous conditions in the Restoration Area and along the San Joaquin River from the Merced River to the Delta, were reviewed for this analysis. The information obtained from these sources was reviewed and summarized to establish existing conditions and to identify potential environmental effects based on the standards of significance presented in this section. In determining the level of significance, the analysis assumes that development and construction activities would comply with relevant Federal, State, and local regulations.

20.3.2 Significance Criteria

The thresholds of significance of impacts are based on the environmental checklist in Appendix G of the State CEQA Guidelines, as amended. These thresholds also encompass the factors taken into account under NEPA to determine the significance of an action in terms of its context and the intensity of its impacts. The program alternatives under consideration were determined to result in a significant impact related to public health and the potential risk of exposure to hazardous materials if they would do any of the following:

- Create a substantial hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials.
- Create a substantial hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment.
- Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school.
- Be located on a site that is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would create a substantial hazard to the public or the environment.
- Result in a safety hazard for people residing or working in the study area.
- Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan.
- Expose people or structures to a substantial risk of loss, injury, or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands.
- Expose people to new or increased risk from disease vectors.

20.3.3 Program-Level Impacts and Mitigation Measures

This section provides an evaluation of the program-level direct and indirect effects of program alternatives on public health and the potential risk of exposure to hazardous materials. The action alternatives would occur in the Restoration Area or along the San Joaquin River between the Merced River and the Delta. The action alternatives could affect public health and result in exposure to hazardous materials during the modification or construction of facilities or during other ground-disturbing restoration activities. No construction activities would occur upstream from Friant Dam, in the Delta, or in the CVP/SWP water service areas. No effects to public health or exposure to hazardous materials would occur in these three areas. Therefore, no Settlement-related effects on current public health or existing risk from exposure to hazardous materials are expected in the 30-year planning horizon would occur. For these reasons, these three geographic regions are not discussed further in this section.

The program-level evaluation of effects on public health and the potential risk of exposure to hazardous materials also considered the potential effects of recapture of Interim and Restoration flows using existing facilities on the San Joaquin River between the Merced River and the Delta and using potential new pumping infrastructure in this segment of the river (Alternatives C1 and C2).

No-Action Alternative

For public health and hazardous materials, the No-Action Alternative includes the nine reasonably foreseeable future actions related to water resource management, to be implemented in the Delta and San Joaquin Valley regions described in Chapter 2.0, “Description of Alternatives.”

Impact PHH-1 (No-Action Alternative): ***Exposure of Construction Workers and Others to Hazardous Materials – Program-Level.*** Construction workers working on currently active projects or future projects undertaken in this area would continue to be exposed to existing hazardous materials; petroleum hydrocarbons, pesticides, herbicides, and fertilizers; contaminated debris; elevated levels of chemicals that could be hazardous; or hazardous substances that could be inadvertently spilled or otherwise spread. However, implementation of the No-Action Alternative would not increase the exposure of construction workers and others to hazardous materials. There would be **no impact**.

Settlement-related actions and construction activities would not occur under the No-Action Alternative. Existing construction, ground-disturbing, and agricultural spraying activities would continue to occur into the future. These effects include exposure of construction workers or others in the area to existing hazardous materials, including asbestos; petroleum hydrocarbons, pesticides, herbicides, and fertilizers; contaminated debris; elevated levels of chemicals that could be hazardous; or hazardous substances in addition to their current exposure to risk. Therefore, implementation of the No-Action Alternative would not increase the exposure of construction workers and others to hazardous materials. There would be no impact relative to existing conditions.

Impact PHH-2 (No-Action Alternative): ***Creation of a Substantial Hazard to the Public or the Environment Through the Use of Hazardous Materials – Program-Level*** The No-Action Alternative would not involve construction or ground-disturbing activities involving the storage, use, or transport of hazardous materials and would not have the potential to create a substantial hazard to the public or the environment in this area in addition to their creation by existing ongoing operations. There would be **no impact**.

No Settlement-related actions or construction activities would be conducted under the No-Action Alternative other than the ongoing projects. Reasonably foreseeable projects included under the No-Action Alternative would not involve construction or ground-disturbing activities involving the storage, use, or transport of hazardous materials and would not have the potential to create a substantial hazard to the public or the environment in this area in addition to their creation by existing ongoing operations. There would be no impact relative to existing conditions.

Impact PHH-3 (No-Action Alternative): ***Exposure to Naturally Occurring Asbestos – Program-Level.*** As shown in the General Location Guide for Ultramafic Rocks in California — Areas More Likely to Contain Naturally Occurring Asbestos (DOC 2000), the closest location of naturally occurring asbestos is greater than 5 miles away. Therefore, because naturally occurring asbestos is not expected to occur, implementation of the No-Action Alternative would not have the potential to expose construction workers or others to naturally occurring asbestos. There would be **no impact**.

Impact PHH-4 (No-Action Alternative): ***Exposure to Diseases – Program-Level.*** There would be no increased risk of exposure to WNV or Valley Fever resulting from reasonably foreseeable future projects included under the No-Action Alternative. Therefore, impacts related to exposing construction workers or others to diseases would not occur. There would be **no impact**.

Prominent areas for WNV to occur include wetted portions of the San Joaquin River that provide mosquito habitat. Exposure to Valley Fever can occur during earth-moving activities, which release spores living in the soil. The No-Action Alternative would not involve construction or improvement activities in addition to ongoing operations or operation planned for the future, including earth-moving activities, which would preclude the potential for construction workers and others to be exposed to WNV or Valley Fever. No impact would occur.

Impact PHH-5 (No-Action Alternative): ***Creation of a Substantial Hazard to School Safety – Program-Level.*** Although schools are located within one-quarter mile of the San Joaquin River in the Restoration Area and downstream along the San Joaquin River to the Delta, the reasonably foreseeable projects included under the No-Action Alternative would not add to ongoing operations within one-quarter mile of a school. Therefore, impacts related to the creation of hazards to school safety would not occur. There would be **no impact**.

The No-Action Alternative would not involve any Settlement-related actions in addition to ongoing operations or operations planned in the future. Although schools are located within one-quarter mile of the San Joaquin River in the Restoration Area and downstream along the San Joaquin River to the Delta, the No-Action Alternative would not have the potential to create a new or increased hazard to school safety in this area because construction or improvement activities would not occur under this alternative. No impact would occur.

Impact PHH-6 (No-Action Alternative): ***Creation of a Substantial Hazard from Idle and Abandoned Wells – Program-Level.*** The No-Action Alternative would not include any ground-disturbing activities that could disrupt active, idle, or abandoned wells in the Restoration Area. Therefore, impacts related to the creation of hazards from idle and abandoned wells would not occur. There would be **no impact**.

The No-Action Alternative would not involve any Settlement-related actions in addition to ongoing operations and operations planned in the future. For this reason, ground-disturbing activities that could disrupt an active, idle, or abandoned well would not occur. As a result, implementing the No-Action Alternative would not have the potential to create a new or increased hazard from idle and abandoned wells. No impact would occur.

Impact PHH-7 (No-Action Alternative): ***Creation of a Substantial Hazard from Wildland Fires – Program-Level.*** The No-Action Alternative would not include any activities that would increase the risk of sparking a wildland fire. Therefore, impacts related to the creation of hazards associated with wildland fires would not occur. There would be **no impact**.

The No-Action Alternative would not involve any Settlement-related actions. Construction activities that could potentially spark a wildland fire also would not be increased by reasonably foreseeable future projects included in the No-Action Alternative. As a result, implementing the No-Action Alternative would not have the potential to create a new or increased hazard associated with wildland fires. No impact would occur.

Impact PHH-8 (No-Action Alternative): ***Creation of a Substantial Hazard to Aircraft Safety – Program -Level.*** The No-Action Alternative would not include any Settlement actions that could create a new or increased hazard to aircraft safety. Reasonably foreseeable future actions included in the No-Action Alternative also would not create a new or increased hazard to aircraft safety. Therefore, impacts related to the creation of a new or increased hazard to aircraft safety would not occur. There would be **no impact**.

The No-Action Alternative would not include any Settlement-related actions that could create a new or increased hazard to aircraft safety. The reasonably foreseeable projects included in the No-Action Alternative would not involve construction activities and improvements that could create a new or increased hazard to aircraft safety in the Restoration Area or along the San Joaquin River between the Merced River and the Delta. As a result, implementing the No-Action Alternative would not have the potential to create a new or increased hazard to aircraft safety. No impact would occur.

Alternatives A1 and B1

Program-level impacts under Alternatives A1 and B1 would be associated with construction activities in the Restoration Area, as described below.

Impact PHH-1 (Alternatives A1 and B1): ***Exposure of Construction Workers and Others to Hazardous Materials – Program-Level.*** Construction and other ground-disturbing activities would occur in the Restoration Area under Alternatives A1 and B1. As a result, implementing these alternatives could expose construction workers and others to existing hazardous materials that could be inadvertently spilled or otherwise spread. This impact would be **potentially significant**.

Alternatives A1 and B1 would involve construction and ground-disturbing activities in the Restoration Area. These activities could expose construction workers or others to existing hazardous materials at specific project sites. Hazardous materials could include asbestos; petroleum hydrocarbons, pesticides, herbicides, and fertilizers; contaminated debris; elevated levels of chemicals that could be hazardous; or hazardous substances. In addition, Alternatives A1 and B1 would involve construction and other activities in agricultural or urban areas, which are more likely to contain hazardous materials. Therefore, implementation of Alternatives A1 and B1 in the Restoration Area would have the potential to expose construction workers and others to hazardous materials. This impact would be potentially significant.

Mitigation Measure PHH-1 (Alternatives A1 and B1): ***Conduct Phase I Environmental Site Assessments – Program-Level.*** Project proponents of subsequent site-specific projects will conduct a Phase I Environmental Site Assessment to determine the presence of any hazardous materials at all construction sites at which ground-disturbing activities would occur. Project proponents of subsequent site-specific projects will implement all the recommended actions and measures identified in the Phase I Environmental Site Assessment.

Implementation of this mitigation measure would reduce this impact to a less-than-significant level. This impact would be **less than significant** with mitigation.

Impact PHH-2 (Alternatives A1 and B1): ***Creation of a Substantial Hazard to the Public or the Environment Through the Use of Hazardous Materials – Program-Level.*** Alternatives A1 and B1 would include construction and improvement activities that could involve the storage, use, and transport of hazardous materials in the Restoration Area. However, the use, storage, disposal, and transport of hazardous materials are regulated by State and local jurisdictions. Therefore, the risk of upset would be unlikely with project construction and improvement activities. This impact would be **less than significant**.

Alternatives A1 and B1 would involve the use of hazardous materials in varying amounts during construction and other activities. Materials typically used during construction that could contain hazardous substances include paints, solvents, cements, glues, and fuels. Construction workers (particularly untrained personnel) could be exposed to hazards and hazardous materials as a result of improper handling or use during construction activities; transportation accidents; or fires, explosions, or other emergencies. Construction workers also could be exposed to hazards associated with accidental releases of hazardous materials, which could result in adverse health effects. The use, storage, and transport of hazardous materials are regulated by Federal, State, and local agencies, and compliance with relevant laws is required during project construction and operation.

Transportation of hazardous materials on area roadways is regulated by the CHP and Caltrans. Hazardous materials regulations, which are codified in CCR Titles 8, 22, and 26, and their enabling legislation set forth in Chapter 6.5 (Section 25100 et seq.) of the California Health and Safety Code, were established at the State level to ensure compliance with Federal regulations to reduce the risk to human health and the environment from the routine use of hazardous substances. These regulations must be implemented by businesses, as appropriate, and are monitored by the State (e.g., Cal/OSHA in the workplace, DTSC for hazardous waste, and ARB for lead) and/or local jurisdictions (i.e., Merced County Department of Environmental Health (MCDEH), Madera County Department of Environmental Health (MCEH), Fresno County Department of Public Health, Environmental Health Division (FCDPH)).

All construction would be required to comply with Cal/EPA's Unified Program; regulated activities would be managed by MCDEH, MCEH, and/or FCDPH in accordance with the regulations for their respective jurisdiction's Unified Program (e.g., hazardous materials release response plans and inventories, California Uniform Fire Code hazardous material management plans and inventories). Such compliance would reduce the potential for accidental release of hazardous materials during construction and improvement activities. As a result, compliance with each county's Unified Program would lessen the risk of exposure of construction workers to accidental release of hazardous materials.

Workplace regulations addressing the use, storage, and disposal of hazardous materials included in CCR Title 8 also would apply to project construction and improvement activities. Compliance with these regulations would be monitored by local agency, such as MCDEH, MCEH, and FCDPH when they perform inspections for flammable and hazardous materials storage. Other mechanisms in place to enforce the Title 8 regulations include compliance audits and reporting to State and local agencies. Implementation of the workplace regulations would further reduce the potential for hazardous materials releases during project construction and improvement activities.

Because the project would implement and comply with Federal, State, and local hazardous materials regulations monitored by the State (e.g., Cal/OSHA, DTSC, CHP) and/or local jurisdictions (e.g., MCDEH, MCEH, FCDPH), impacts related to creation of substantial hazards to the public through routine transport, use, disposal, and risk of upset would be unlikely with project construction and improvement activities. Therefore, this impact would be less than significant.

Impact PHH-3 (Alternatives A1 and B1): ***Exposure to Naturally Occurring Asbestos – Program-Level.*** Alternatives A1 and B1 would not include construction or improvement activities located near areas potentially containing naturally occurring asbestos. Therefore, impacts related to exposing construction workers or others to naturally occurring asbestos would not occur. There would be **no impact**.

Impact PHH-4 (Alternatives A1 and B1): ***Exposure to Diseases – Program-Level.*** Alternatives A1 and B1 would include construction and improvement activities located in areas with a risk of exposure to WNV and Valley Fever. Therefore, impacts related to exposing construction workers and others to diseases have the potential to occur. This impact would be **potentially significant**.

Alternatives A1 and B1 would involve construction and other Restoration activities in the area located along the San Joaquin River between Friant Dam and the Merced River, which includes areas with an increased risk of exposure to WNV and Valley Fever. Prominent areas for WNV to occur include wetted portions of the San Joaquin River that provide mosquito habitat. Exposure to Valley Fever can occur during earth-moving activities, which release spores living in the soil. Alternatives A1 and B1 would involve construction and improvement activities, particularly earth-moving activities that could expose construction workers and others to WNV or Valley Fever. This impact would be potentially significant.

Mitigation Measure PHH-4 (Alternatives A1 and B1): ***Implement Workplace Precautions against West Nile Virus and Valley Fever – Program-Level.*** Project proponents of subsequent site-specific projects will implement the following workplace precautions against WNV and Valley Fever at construction sites:

- Inspect work areas, eliminate sources of standing water that could potentially provide breeding habitat for mosquitoes. For example, eliminate uncovered, upright containers that could accumulate water; store open containers in the work area; and fill or drain potholes and other areas where water is likely to accumulate.
- Conduct employee training that covers the potential hazards and risks of WNV and Valley Fever exposure and protection, including proper construction apparel. Employees will be instructed not to touch any dead birds with their bare hands.
- Provide dust masks for worker use at construction sites during ground-disturbing activities.
- Provide insect repellent for worker use at construction sites with a minimum of 23.8 percent diethyl(meta)toulamide (DEET).
- Notify the appropriate city or county health department of dead birds seen on the construction site.

Implementation of this mitigation measure would reduce this impact to a less-than-significant level. This impact would be **less than significant** with mitigation.

Impact PHH-5 (Alternatives A1 and B1): ***Creation of a Substantial Hazard to School Safety – Program-Level.*** Alternatives A1 and B1 could involve construction and other activities located within one-quarter mile of schools located in the Restoration Area. Therefore, impacts related to the creation of hazards to school safety could occur. This impact would be **potentially significant**.

Alternatives A1 and B1 would involve construction and other activities in areas located along the San Joaquin River between Friant Dam and the Merced River and could occur within one-quarter mile of a school. A total of 14 schools are located within one-quarter mile of the Restoration Area. An appropriate SWPPP would be prepared and implemented for each of Alternatives A1 and B1 actions. The SWPPP would include spill prevention and contingency measures, including measures to prevent or clean up spills of hazardous waste, and hazardous materials used for equipment operation and emergency procedures for responding to spills. Depending on the extent, substance, and location of a spill, health concerns related to exposure of hazardous materials on school-aged children could occur. As a result, implementing Alternatives A1 and B1 could result in health and safety impacts. This impact would be potentially significant.

Mitigation Measure PHH-5 (Alternatives A1 and B1): ***Minimize Hazards to School Safety – Program-Level.*** Project proponents of subsequent site-specific projects will notify all schools, or the related school district, located within one-quarter mile of a construction area regarding the construction activities that would occur and when, the type of potential hazards that could be encountered, and provide guidance to the school(s) on the potential effects that the hazards could have on school children.

In combination with the spill prevention and contingency measures in the SWPPP, implementation of this mitigation measure would reduce impacts associated with hazardous materials emissions related to schools within one-quarter mile of proposed project construction activities to a less-than-significant level because under CEQA, the notification process is considered to satisfy the requirements of CEQA (PRC Section 21151.4). The SWPPP describes how the project proponent or its contractor would respond to a spill and the prior notification of the school district would allow individual schools to prepare the appropriate contingency plans, ensure avoidance, or take other relevant actions to protect school-aged children from exposure to hazardous substances. This impact would be **less than significan**t with mitigation.

Impact PHH-6 (Alternatives A1 and B1): ***Creation of a Substantial Hazard from Idle and Abandoned Wells – Program-Level.*** Alternatives A1 and B1 would involve ground-disturbing activities in the Restoration Area that could disrupt active, idle, or abandoned wells. Therefore, impacts related to the creation of hazards from idle and abandoned wells could occur. This impact would be **potentially significant**.

Alternatives A1 and B1 would involve construction and improvement activities in the Restoration Area. Eight abandoned wells are known to be located in the Restoration Area, but records of their exact locations do not exist. For this reason, ground-disturbing activities associated with implementing Alternatives A1 and B1, particularly restoration actions, could disrupt active, idle, or abandoned wells. As a result, implementing

Alternatives A1 and B1 would have the potential to create a hazard, particularly to construction workers, from unknown idle or abandoned wells in the Restoration Area. This impact would be potentially significant.

Mitigation Measure PHH-6 (Alternatives A1 and B1): ***Minimize Hazards from Idle and Abandoned Wells – Program-Level.*** Project proponents of subsequent site-specific projects will survey all project sites for unknown idle and abandoned wells before initiating ground-disturbing activities. If the survey discovers an idle or abandoned well, ground-disturbing activities will not occur within 100 feet of the well, if feasible. If ground-disturbing activities need to occur within 100 feet of the abandoned well, project proponents of subsequent site-specific projects will either cover, fence, or otherwise clearly mark the well location and take measures to reduce hazards to workers and/or ensure that the well has been abandoned in accordance with State and local regulations, whichever is appropriate for the site and construction project. FCDPH, MCDEH, or MCEH will be notified, as appropriate.

Implementation of this mitigation measure would reduce this impact to a less-than-significant level. This impact would be **less than significant** with mitigation.

Impact PHH-7 (Alternatives A1 and B1): ***Creation of a Substantial Hazard from Wildland Fires – Program-Level.*** Alternatives A1 and B1 would involve construction and other activities in the Restoration Area that could potentially spark a wildland fire in the project or adjacent areas. Because, all project areas are located in moderate or unzoned fire hazard zones, restoration actions would not cause a substantial risk of starting a wildland fire. This impact would be **less than significant**.

Alternatives A1 and B1 would involve construction and restoration activities in the Restoration Area. Operation of equipment during construction activities could potentially spark a wildland fire on a project site or adjacent area. However, the entire Restoration Area is designated as a moderate or unzoned Fire Hazard Severity Zone. Fire Hazard Severity Zones are distinguished by the various mitigation strategies that need to be applied to reduce risks associated with wildland fires. The CAL FIRE Fire and Resource Assessment Program maps were prepared using data and models that describe development patterns, potential fuels over a 30-year growth horizon, and burn probabilities to quantify the likelihood and nature of exposure of new structures built in designated fire hazard zones to wildland fire. The Moderate Fire Hazard Severity Zone is similar to the Very High Fire Hazard Severity Zone except that one or more of the criteria used to identify the zones (e.g., access, topography, vegetation, and water) pose less of a constraint in the moderate zone than in the very high zone. For an unzoned fire hazard area, criteria used to identify the zones do not pose a constraint to reduce risks associated with wildland fires.

Because a portion of the Restoration Area is located in a Moderate Fire Hazard Severity Zone, construction activities could pose a threat of wildland fire. However, OSHA's fire protection and prevention standard (29 CFR 1926.150 - Subpart F) requires an "employer … (to) be responsible for the development of a fire protection program to be followed throughout all phases of the construction and demolition work, and … (to) provide for the firefighting equipment as specified.... As fire hazards occur, there will be no delay in providing the necessary equipment.” Because project proponents of subsequent site-specific projects would adopt reasonable wildland fire mitigation strategies associated with the Moderate Fire Hazard Severity Zone and have the firefighting equipment required by OSHA during all phases of construction, the potential for construction activities to spark an uncontrollable wildland fire is considered remote. This impact would be less than significant.

Impact PHH-8 (Alternatives A1 and B1): ***Creation of a Substantial Hazard to Aircraft Safety – Program-Level.*** Alternatives A1 and B1 would involve construction activities and improvements in the Restoration Area. However, these activities and improvements would not affect aircraft flight patterns or affect operations at an airport or airstrip. Therefore, implementing Alternatives A1 and B1 would not create a hazard to aircraft safety in the Restoration Area. This impact would be **less than significant**.

Alternatives A1 and B1 would involve construction activities and improvements in the Restoration Area. However, these construction activities and improvements would not have the potential to affect aircraft flight patterns or affect operations at an airport or airstrip. Specifically, implementation of the Alternatives A1 and B1 would not involve constructing tall structures or operating tall construction equipment (e.g., a crane) that could pose a hazard to airplanes. As a result, implementing Alternatives A1 and B1 would not create a hazard to aircraft safety in this area. This impact would be less than significant.

Alternatives A2 and B2

Program-level impacts under Alternatives A2 and B2 would be similar to program-level impacts under Alternatives A1 and B1. The difference among these action alternatives is that Alternatives A2 and B2 include additional actions that would increase Reach 4B1 channel capacity to 4,500 cfs (compared to 475 cfs with Alternatives A1 and B1), and thus greater construction activities than in Alternatives A1 and B1.

At the program level, impact conclusions and mitigation measures for public health and hazardous materials impacts of Alternatives A2 and B2 are the same as for Alternatives A1 and B1 and dependent on site- and action-specific details that are unknown at this time. However, Alternatives A2 and B2 would have the greater potential public health and hazardous materials impacts due to greater levels of construction in Reach 4B1. All action alternatives would have greater potential public health and hazardous materials impacts than the No-Action Alternative.

Alternative C1

Program-level impacts under Alternative C1 would be similar to program-level impacts under Alternative B1, except that Alternative C1 includes possible construction of new pumping infrastructure in the San Joaquin River downstream from the Merced River, and thus greater construction activities than in Alternative A1 and B1.

At the program level, impact conclusions and mitigation measures for public health and hazardous materials impacts from Alternative C1 are the same as for Alternatives B1 and dependent on site- and action-specific details that are unknown at this time. However, Alternative C1 would have the greater potential public health and hazardous materials impacts, and these impacts would also occur along the San Joaquin River from the Merced River to the Delta due to construction of new pumping infrastructure. All action alternatives would have greater potential public health and hazardous materials impacts than the No-Action Alternative.

Alternative C2

Program-level impacts under Alternative C2 would include those program-level impacts described under Alternative B2, except that Alternative C2 includes the possible construction of new pumping infrastructure in the San Joaquin River downstream from the Merced River (as described for Alternative C1), and thus greater construction activities than in Alternative B2. At the program level, impact conclusions and mitigation measures for public health and hazardous materials impacts from Alternative C2 are the same as for Alternatives A2 and B2 and dependent on site- and action-specific details that are unknown at this time. However, Alternative C2 would have the greater potential public health and hazardous materials impacts, and these impacts would also occur along the San Joaquin River from the Merced River to the Delta due to construction of new pumping infrastructure. All action alternatives would have greater potential public health and hazardous materials impacts than the No-Action Alternative.

20.3.4 Project-Level Impacts and Mitigation Measures

This section provides an evaluation of the project-level direct and indirect public health and hazardous materials effects of the reoperation of Friant Dam. The reoperation of Friant Dam would increase water volume and change the timing of water flows in the San Joaquin River. These changes could affect public health by increasing the amount of free-standing water, which could increase the amount of mosquito habitat and exposure to diseases. The other public health and hazardous materials effects identified previously as program-level impacts (i.e., exposure to hazardous materials, use of hazardous materials, exposure to naturally occurring asbestos, creation of school safety hazards, creation of hazards related to idle and abandoned wells, creation of wildland fire hazards, creation of aircraft safety hazards) would not occur in the Restoration Area or along the San Joaquin River from the Merced River to the Delta due to project-level actions. For that reason, only the potential exposure to diseases is discussed as a project-level impact. Because water surface elevations and potential mosquito habitat in Millerton Lake and in the San Joaquin River from Friant Dam to the Delta would be affected by the reoperation of Friant Dam, the potential effect in these geographic regions is discussed below.

The project-level evaluation of effects on public health and potential release of hazardous materials included consideration of the potential effects resulting from the recapture of Interim Flows at existing facilities in the Restoration Area and in the Delta, and from the recapture of Restoration Flows using existing Delta facilities. No public health risks or increased risk of the release of hazardous materials were identified. Therefore, the effects of these actions are not discussed further.

Actions identified in the Physical Monitoring and Management Plan (see Appendix D) as potential immediate actions to address nonattainment of management objectives also were evaluated at a project level. Potential immediate actions are related to flow, seepage, capacity, native vegetation, and spawning gravel. Immediate flow management actions include acquiring additional water from willing sellers, reoperating Friant Dam to reduce flows, monitoring sites, preparing reports documenting monitoring, and removing obstructions/debris from channels in the Restoration Area. Monitoring and reporting actions were considered inconsequential on public health and are not discussed further.

Other actions evaluated at a project level would not result in any change to public health conditions. These include reoperation of Mendota Dam, Chowchilla Bypass Bifurcation Structure, Eastside Bypass Bifurcation Structure, Mariposa Bypass Bifurcation Structure, and the Hills Ferry Barrier. The proposed changes to the operation of these structures would have no effect on public health. Actions to obtain encroachment permits, water transfers, and long-term water rights also would not affect public health nor result in an increased risk of the release of hazardous materials. However, the product of these authorizations (the reoperation of Friant Dam to release Interim and Restoration flows in the Restoration Area) may affect public health. Therefore, the effects of Interim and Restoration flows are discussed further and their significance evaluated.

No-Action Alternative

No project-level impacts would occur under the No-Action Alternative, as described below.

Impact PHH-9 (No-Action Alternative): ***Exposure to Diseases in the San Joaquin River upstream from Friant Dam, in the Restoration Area, and in the San Joaquin River from Merced River to the Delta – Project-Level.*** Under the No-Action Alternative, the reoperation of Friant Dam would not occur, so releases from Friant Dam and water elevations in Millerton Lake would remain comparable to existing conditions. Because water elevations at Millerton Lake would not be altered, the overall extent of calm, standing water in dense vegetation, which is breeding habitat for mosquitoes, would not be increased upstream from Friant Dam or downstream to the Delta. Therefore, implementing the No-Action Alternative would not increase mosquito abundance or the potential for exposure of people to mosquito-borne viruses (e.g., WNV) in the San Joaquin River upstream from Friant Dam. There would be **no impact**.

Breeding habitat for mosquitoes would not be increased in the San Joaquin River upstream from Friant Dam, the Restoration Area, or the Merced River to the Delta or the Delta. Therefore, implementing the No-Action Alternative would not increase mosquito abundance or the potential for exposure of people to mosquito-borne viruses (e.g., WNV). No impact would occur.

Impact PHH-10 (No-Action Alternative): ***Exposure to Diseases in the Delta – Project-Level.*** Under the No-Action Alternative, the overall extent of calm, standing water in dense vegetation, which is breeding habitat for mosquitoes, would not be increased in the Delta. There would be **no impact**.

Alternatives A1 Through C2

Project-level impacts under Alternatives A1 and B1 are described below.

Impact PHH-9 (Alternatives A1 Through C2): *Exposure to Diseases in the San Joaquin River upstream from Friant Dam, in the Restoration Area, and in the San Joaquin River from Merced River to the Delta – Project-Level.* Implementing any one of the action alternatives would involve the reoperation of Friant Dam, which could increase the surface area of calm, free-standing water in Millerton Lake, providing mosquito breeding habitat and potentially increasing exposure of the public to diseases. Additionally, reoperation of Friant Dam could provide additional mosquito breeding habitat and potentially increase exposure of the public to diseases upstream from Friant Dam. This impact would be **potentially significant**.

Under any of the action alternatives, the Millerton Lake water levels would be drawn down earlier in spring and may reach the minimum pool elevation earlier in summer. This additional drawdown would result in exposure of a zone around the shoreline earlier in the year and for a longer duration each year than under current conditions. These exposed areas may contain isolated, calm water, and thus, breeding habitat for mosquitoes may be increased or enhanced. Therefore, implementing any one of the action alternatives could increase mosquito abundance and the potential for exposure of people to mosquito-borne viruses (e.g., WNV). There is no difference in the degree of impact between action alternatives.

Implementing any one of the action alternatives would also involve the reoperation of Friant Dam, which would increase water volume and change the timing of water flows in the San Joaquin River below Friant Dam. It would also substantially increase the frequency and duration of inundation of channel and floodplain areas in the Restoration Area. This additional inundation could increase the overall extent of calm, standing water in dense vegetation, thereby increasing or enhancing breeding habitat for mosquitoes. Much of the Restoration Area and along the San Joaquin River from the Merced River to the Delta is recognized as a breeding ground for mosquitoes, and cases of WNV have been reported. Therefore, implementing any one of the action alternatives could increase mosquito abundance and the potential for exposure of people to mosquito-borne viruses (e.g., WNV) in the San Joaquin River from Friant Dam to the Merced River.

Implementing any one of the action alternatives would also increase flow in the San Joaquin River from the Merced River to the Delta in most years. This portion of the San Joaquin River already has perennial flow, and during most of the year, the increase in flow would not substantially increase flow volume in this segment of the river or the area of inundated floodplain. However, during spring of some years, increased flow could increase the overall amount of calm, free-standing water in this segment of the river, providing additional mosquito breeding habitat and potentially increasing exposure of the public to diseases.

Much of the area along the San Joaquin River upstream from Friant Dam and downstream to the Delta is recognized as a breeding ground for mosquitoes, and cases of WNV have been reported. Therefore, actions that increase or enhance breeding habitat for mosquitoes (primarily calm, standing water in dense vegetation) could potentially increase exposure of the public to diseases. This impact would be potentially significant.

Mitigation Measure PHH-9 (Alternatives A1 Through C2): *Coordinate with and Support Vector Control District(s) – Project-Level.* Reclamation will coordinate with and support FCDPH-Vector Control, Merced County Mosquito Abatement District, and the Madera County Mosquito and Vector Control District with implementation of their vector control activities in response to project-level actions as appropriate and feasible. Support will include but not be limited to the following actions:

- Coordinate with FCDPH-Vector Control, Merced County Mosquito Abatement District, and the Madera County Mosquito and Vector Control District to inform vector control districts regarding project implementation, and to provide information requested to support vector control activities along waterways affected by project-level actions. Provide FCDPH-Vector Control, Merced County Mosquito Abatement District, and Madera County Mosquito and Vector Control District alternative access as needed for vector monitoring and control in the Restoration Area where the program would eliminate existing access.

- Implement applicable best management practices from the California Department of Public Health's Best Management Practices for Mosquito Control on California State Properties (CDPH 2008).

- Provide public information for the community regarding control measures being implemented in the Restoration Area, the risk of mosquito-borne disease transmission, and personal protective measures.

Implementation of this mitigation measure would reduce this impact to a less-than-significant level. This impact would be **less than significant** with mitigation.

Impact PHH-10 (Alternatives A1 Through C2): *Exposure to Diseases in the Delta – Project-Level.* Implementing any one of the action alternatives would involve the reoperation of Friant Dam, which would increase the volume of water flow entering the Delta from the San Joaquin River. However, the increase in releases from Friant Dam into the San Joaquin River would not cause a considerable increase in the extent or duration of inundated area in the Delta, and thus would not create considerable additional mosquito breeding habitat. This impact would be **less than significant**.

Much of the Delta is recognized as a breeding ground for mosquitoes, and cases of WNV have been reported. Therefore, actions that increase or enhance breeding habitat for mosquitoes (primarily calm, standing water in dense vegetation) could potentially increase exposure of the public to diseases.

Implementing any one of the action alternatives would involve the reoperation of Friant Dam, which would increase water volume entering the Delta from the San Joaquin River. However, this increase would be small relative to the total volume of water entering the Delta, and most Delta waterways are bordered by levees with relatively steep banks. Thus, the reoperation of Friant Dam under the action alternatives would not cause a considerable increase in the extent of calm, free-standing water and would not create considerable additional mosquito breeding habitat. Therefore, the Interim and Restoration flows would be unlikely to neither increase mosquito abundance nor increase the exposure of people to mosquito-borne diseases. This impact would be less than significant.

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