

Chapter 2

VAMP Hydrologic Planning and Implementation

This section documents the planning and implementation undertaken by the Hydrology Group of the San Joaquin River Technical Committee (SJRTC) for the 2006 VAMP investigations. Implementation of VAMP is guided by the framework provided in the San Joaquin River Agreement (SJRA) and anticipated hydrologic conditions within the watershed. The planning and implementation activities were reduced due to the 2006 wet hydrology requiring no supplemental water to be provided and not allowing DWR to install the HORB

The Hydrology Group was established for the purpose of forecasting hydrologic conditions and for planning, coordinating, scheduling and implementing the flows required to meet the test flow target in the San Joaquin River near Vernalis. The Hydrology Group is also charged with exchanging information relevant to the forecasted flows, and coordinating with others in the SJRTC, in particular the Biology Group, responsible for planning and implementing the salmon smolt survival study.

Participation in the Hydrology Group is open to all interested parties, with the core membership consisting of the designees of the agencies responsible for the water project operations that would be contributing flow to meet the target flow. In 2006, the agencies belonging to the Hydrology Group included: Merced Irrigation District (Merced), Turlock Irrigation District (TID), Modesto Irrigation District (MID), Oakdale Irrigation District (OID), South San Joaquin Irrigation District (SSJID), San Joaquin River Exchange Contractors (SJRECWA), and the U.S. Bureau of Reclamation (USBR). Though not a water provider, the California Department of Water Resources (DWR) was closely involved with the coordination of operations relating to the potential installation of the HORB and the planning of Delta exports consistent with the VAMP.

2006 VAMP Summary

Relatively full reservoirs as a result of wet conditions in 2005 combined with significant precipitation around the first of the year and again throughout March and into early April resulted in very high flow conditions in the San Joaquin River during the Spring of 2006. The mean daily flow in the San Joaquin River below the Stanislaus River exceeded 10,000 cfs in early March, increasing to 15,000 cfs at the end of March and peaking at 34,700 cfs on April 13. The flow remained above 30,000 cfs until the beginning of May, then slowly receded to around 20,000 cfs by the end of May. Since the flow during April and May exceeded the maximum VAMP target flow of 7,000 cfs no supplemental water was provided by the SJRGA agencies. Additionally, the flow in early April was significantly above the allowable installation flow threshold of 5000 cfs, therefore DWR was unable to install the temporary Head of Old River Barrier (HORB).

The planning and implementation process for the VAMP operation remained nearly unchanged from those of prior VAMP years and that outlined in the SJRA. Daily operation plans were updated on a frequent basis to keep the SJRTC informed of changed conditions. Operation conference calls were not conducted during the 2006 VAMP but contact was maintained with the operating entities to track



reservoir releases. The Technical Committee placed an added emphasis on analyzing the flow and fish movement into Old River absent the HORB. Monitoring of real-time flow data was maintained throughout the planning and implementation phases.

VAMP Background and Description

This section provides information on the background and description of the water operations and factors to be considered when planning for the VAMP each year. Even with the high flow conditions during 2006 these factors continued to be considered in the planning process and implementation.

Table 2-1
VAMP Vernalis Flow and Delta Export Targets

Forecasted Existing Flow (cfs)	VAMP Target Flow (cfs)	Delta Export Target Rates (cfs)
0 to 1,999	2,000	
2,000 to 3,199	3,200	1,500
3,200 to 4,449	4,450	1,500
4,450 to 5,699	5,700	2,250
5,700 to 7,000	7,000	1,500 or 3,000
Greater than 7,000	Provide stable flow to extent possible	1,500, 2,250 or 3,000*

*Suggested rates

The VAMP provides for a 31-day pulse flow (target flow) at the Vernalis gage on the San Joaquin River (Figure 2-1, inside front cover) during the months of April and May, along with a corresponding reduction in State Water Project (SWP) and Central Valley Project (CVP) Sacramento-San Joaquin Delta exports. The VAMP target flow and reduced Delta export are determined based on a forecast of the San Joaquin River flow that would occur during the pulse flow period absent the VAMP (Existing Flow) as shown in Table 2-1. The Existing Flow is defined in the SJRA as “the forecasted flows in the San Joaquin River at Vernalis during the Pulse Flow Period that would exist absent the VAMP or water acquisitions,” including such flows as minimum in-stream flows, water quality or scheduled fishery releases from New Melones Reservoir, flood control releases, uncontrolled reservoir spills, and/or local runoff. Achieving the target flow requires the coordinated operation of the three major San Joaquin River tributaries upstream of Vernalis: the Merced River, the Tuolumne River and the Stanislaus River.

As part of the development of the VAMP experimental design, the VAMP Hydrology and Biology Groups jointly identified a level of variation in San Joaquin River flow and SWP/CVP export rate thought to be within an acceptable range for specific VAMP test conditions. In developing the criteria, the VAMP Hydrology and Biology Groups examined both the ability to effectively monitor and manage flows and exports within various ranges (e.g., the ability to accurately manage and regulate export rates is substantially greater

than the ability to manage San Joaquin River flows) and the flow and export differences among VAMP targets (Table 2-1). Through these discussions, the technical committees agreed that SWP/CVP export rates would be managed to a level of plus or minus 2.5% of a given export rate target. Furthermore, the technical committees agreed that, to the extent possible, it would be desirable that exports be allocated approximately evenly between SWP and CVP diversion facilities.

The ability to manage and regulate the San Joaquin River flow near Vernalis is difficult due to uncertainty and variation in unregulated flows, inaccuracy in real-time flows due to changing channel conditions, lags and delays in transit time, and a variety of other factors. Concern was expressed that variation in San Joaquin River flow on the order of plus or minus 10% would potentially result in overlapping flow conditions between two VAMP targets. To minimize the probability of overlapping flow conditions among VAMP targets, the technical committees explored an operational guideline of plus or minus 5% flow variation at the Vernalis gage; however, system operators expressed concern about the ability to maintain flows within this range. As a result of these discussions and analysis, the Hydrology and Biology Groups agreed to a target range variation of plus or minus 7% of the Vernalis flow target. It was recognized by the Hydrology and Biology Groups that these guidelines are not absolute conditions, but is to be used by the VAMP technical committees to evaluate the potential effect of flow and export variation on the ability to detect and assess variation in juvenile Chinook salmon survival.

Under the SJRA, the Merced, OID, SSJID, SJRECWA, MID and TID members of the San Joaquin River Group Authority (SJRG) agencies have agreed to jointly provide the supplemental water needed to achieve the VAMP target flows, limited to a maximum of 110,000 acre-feet. The Merced supplemental water would be provided on the Merced River from storage in Lake McClure and would be measured at the Cressey gage on the Merced River. The OID and SSJID supplemental water would be provided on the Stanislaus River through diversion reductions and would be measured below Goodwin Dam. The SJRECWA supplemental water would be provided via Salt Slough, West Delta Drain, Boundary Drain and/or Orestimba Creek. The MID and TID supplemental water would be provided on the Tuolumne River from storage in Don Pedro Lake and would be measured at the Tuolumne River below LaGrange Dam gage.

The target flow of 2,000 cubic feet per second (cfs) shown in Table 2-1 does not represent a VAMP experiment target flow data point, but, rather, is used to define the SJRG

supplemental water obligation limit when Existing Flow is less than 2,000 cfs. In preparation of the conceptual framework for the VAMP it was recognized that in extremely dry conditions the San Joaquin River flow and associated exports would be determined in accordance with the existing biological opinions under the Endangered Species Act and the 1994 Bay-Delta Accord. In consideration of these factors, when the Existing Flow is less than 2000 cfs, the target flow will be 2,000 cfs and the USBR, in accordance with the SJRA, shall act to purchase additional water from willing sellers to fulfill the requirements of existing biological opinions.

When the Existing Flow exceeds 7,000 cfs, as was the case in 2006, the Parties will exert their best efforts to maintain a stable flow during the VAMP pulse flow period to the extent reasonably permitted. Under such conditions the SJRTC shall attempt to develop a plan to carryout the studies pursuant to the SJRA.

Table 2-2
San Joaquin Valley Water Year Hydrologic Year
Classifications Used in VAMP

60-20-20 Water Year Classification	VAMP Numerical Indicator
Wet	5
Above Normal	4
Below Normal	3
Dry	2
Critical	1

Based upon hydrologic conditions, the target flow in a given year could either be increased to the next higher value (double-step) or the supplemental water requirement could be eliminated entirely (off-ramp). These potential adjustments to the target flow are dependent on the hydrologic year type as defined by the SWRCB San Joaquin Valley Water Year Hydrologic Classification (60-20-20 classification), which is given a numerical indicator as shown in Table 2-2 to make this determination. A double-step flow year occurs when the sum of the numerical indicators for the previous year's year type and current year's forecasted 90 percent exceedence year type is seven (7) or greater, a general recognition of either abundant reservoir storage levels or a high probability of abundant runoff. An off-ramp year occurs when the sum of the numerical indicators for the two previous years' year types and the current year's forecasted 90 percent exceedence year type is four (4) or less, an indication of extended drought conditions.

Under the SJRA, the maximum amount of supplemental water to be provided to meet VAMP target flows in any given year is 110,000 acre-feet. In a double-step year, the quantity of supplemental water required may be as high as 157,000 acre-feet. In any year in which more than 110,000 acre-feet of supplemental water is needed, the USBR will attempt to acquire the needed additional water on a willing seller basis. In accordance with the SJRA, the SJRGA has agreed to extend a "favored purchaser" offer to the USBR through each current year's VAMP period.

Hydrologic Planning for 2006 VAMP

Hydrology Group Meetings

Beginning in February 2006, and continuing until early April, the Hydrology Group held three planning and coordination meetings (February 21, March 16 and April 11). The March 16 and April 11 meetings were joint meetings of the Hydrology and Biology Groups. At these meetings, forecasts of hydrologic and operational conditions on the San Joaquin River and its tributaries were discussed and refined.

Monthly Operation Forecast

As part of the initial planning efforts in February, a monthly operation forecast was developed by the Hydrology Group to provide an initial estimate of the Existing Flow and VAMP Target Flow. Inflows to the tributary reservoirs used in these forecasts were based on DWR Bulletin 120 runoff forecasts. The monthly operation forecasts used the 90 percent and 50 percent probability of exceedence runoff forecasts to provide a range of estimates. The initial monthly operation forecast was presented at the February 21 Hydrology Group meeting. The 90 percent exceedence forecast was indicating a VAMP target flow of 5,700 cfs and the 50 percent exceedence forecast was indicating a VAMP target flow of 7,000 cfs.

Daily Operation Plan Development

Starting in mid-March, the Hydrology Group began development of a daily operation plan, updating it as hydrologic conditions and operational requirements changed. The purpose of the daily operation plan is to provide a forecast of the Existing Flow which sets the VAMP target flow and to coordinate the tributary operations needed to meet that target. It also provides a forecast of the daily flows expected during the HORB installation period. In years like 2006 where the Existing Flow exceeds the maximum VAMP target flow, the daily operation plan is used to determine to what extent a stable flow can be provided during the VAMP pulse flow period. The daily operation plan calculates an estimated mean daily flow at Vernalis based on estimates of the daily flow at the major

tributary control points, estimates of ungaged flow between those control points and Vernalis, and estimates of flow in the San Joaquin River above the major tributaries.

The following travel times for flows from the tributary measurement points and upper San Joaquin River to the Vernalis gage are used in the development of the daily operation plan. Whole day increments are used because the daily operation plan is developed using mean daily flows.

Flow Travel Times

- a. Merced River at Cressey to Vernalis 3 days
- b. San Joaquin River above Merced River to Vernalis.. 2 days
- c. Tuolumne River below LaGrange Dam to Vernalis ... 2 days
- d. Stanislaus River below Goodwin Dam to Vernalis ... 2 days

By definition, the ungaged flow at Vernalis is the unmeasured flow entering or leaving the system between the Vernalis gage and the upstream measuring points and is calculated as follows:

$$\text{Ungaged flow at Vernalis} = \text{VNS} - \text{GDW}_{\text{lag}} - \text{LGN}_{\text{lag}} - \text{CRS}_{\text{lag}} - \text{USJR}_{\text{lag}}$$

Where:

- VNS = San Joaquin River near Vernalis
- GDW_{lag} = Stanislaus River below Goodwin Dam lagged 2 days
- LGN_{lag} = Tuolumne River below LaGrange Dam lagged 2 days
- CRS_{lag} = Merced River at Cressey lagged 3 days
- USJR_{lag} = San Joaquin River above Merced River lagged 2 days

(USJR is not a gaged flow but is the calculated difference between the gaged flows at the San Joaquin River at Newman (NEW) and the Merced River near Stevinson (MST)).

The forecast of the ungaged flow is the factor with the greatest uncertainty in the development of the daily operation plan. An extensive review of historical ungaged flows has been made to determine if there are any correlations between the ungaged flow and the current hydrologic conditions that could be used to reduce the uncertainty. Unfortunately, no significant correlations were found. However, the review did indicate that the amount of ungaged flow at the beginning of the VAMP pulse flow period is a reasonable estimate of the average ungaged flow for pulse flow period. It is impossible to forecast day-to-day fluctuations of the ungaged flow, so the daily operation plan is developed assuming a constant ungaged flow throughout

the pulse flow period essentially equal to the value entering the pulse flow period.

The VAMP 31-day pulse flow period can occur anytime between April 1 and May 31. Factors that are considered in the determination of the timing of the VAMP pulse flow period include installation of HORB, availability of juvenile salmon at the MRH, and manpower and equipment availability for salmon releases and recapture. Until a specific start date is defined, a default pulse flow period of April 15 to May 15 is used for the VAMP operation planning.

As part of the daily operation plan development, the determination must be made on whether the current year is likely to fall into the “off-ramp” or “double-step” category. As noted earlier, an “off-ramp” condition would occur in critically dry periods when the sum of VAMP numerical indicators for the previous two years and the current year is equal to or less than four. The 60-20-20 water year classifications for 2004 and 2005 were “DRY” (VAMP numerical indicator of two) and “WET” (VAMP numerical indicator of five), respectively. Under these conditions there was no possibility of 2006 being an off-ramp year since the off-ramp criterion was already exceeded without including the current year’s numerical indicator. A “double-step” condition would occur if sum of the VAMP numerical indicators for the previous year and current year is equal to or greater than seven, with the current year’s indicator based on the 90% probability of exceedence forecast of the 60-20-20 water year classification. Due to the previous year being a “WET” year and the wet conditions in the current year, in the early planning it looked likely that 2006 would be a “double-step” year.

The initial daily operation plan was prepared on March 23. This daily operation plan looked at four scenarios based on two hydrologic conditions, dry and average, and two pulse flow periods, April 15 to May 15 and April 22 to May 22. These scenarios forecast “existing flows” ranging from 5,960 cfs to 6,610 cfs, all of which indicate a VAMP target flow of 7,000 cfs. In this forecast Don Pedro Lake on the Tuolumne River and Lake McClure on the Merced River were expected to be making flood control releases and the Stanislaus River was expected to be at its institutional maximum of 1,500 cfs throughout the VAMP pulse flow period. This forecast also indicated that it was likely that the flow would be too high to allow for the safe installation of the Head of Old River Barrier (HORB). By the end of March it was apparent that the flows would be too great to allow for the installation of the HORB, and in all likelihood would continue to increase such that they would exceed the VAMP target flow of 7,000 cfs. Continually increasing runoff forecasts resulted in continually increasing forecasts

**Table 2-3
Summary of Daily Operation Plans**

Phase	VAMP Forecast Date	DWR Runoff Forecast Date	VAMP Target Flow Period	Assumed Ungaged Flow at Vernalis (cfs)	Existing Flow (cfs)	VAMP Target Flow (cfs)	Supplemental Water Requirement (acre-feet)
Planning	3/23/06	3/14/06	April 15 - May 15	500	6,110	7,000	54,610
				1,000	6,610	7,000	23,870
	3/27/06	3/21/06	April 22 - May 22	500	5,960	7,000	63,790
				1,000	6,460	7,000	33,050
			April 15 - May 15	500	6,960	7,000	2,370
			April 22 - May 22	500	6,930	7,000	4,610
	4/3/06	3/28/06	April 15 - May 15	1,000	11,470	na	0
			April 22 - May 22	1,000	11,300	na	0
	4/11/06	4/1/06	April 22 - May 22	1,000	25,880	na	0
	4/18/06	4/11/06	April 22 - May 22	2,000	29,240	na	0
			May 1 - May 31	2,000	27,980	na	0
	4/25/06	4/18/06	May 1 - May 31	2,000	30,000	na	0

**Table 2-4
Real-time Mean Daily Flow Data Sources**

Measurement Location	Data Source
San Joaquin River near Vernalis	USGS, station 11303500 (http://waterdata.usgs.gov/ca/nwis/dv?format=pre&period=31&site_no=11303500)
Stanislaus River below Goodwin Dam	USBR, Goodwin Dam Daily Operation Report (http://www.usbr.gov/mp/cvo/vungvari/gdwdop.pdf)
Tuolumne River below LaGrange Dam	USGS, station 11289650 (http://waterdata.usgs.gov/ca/nwis/dv?format=pre&period=31&site_no=11289650)
Merced River at Cressey	CDEC, station CRS (http://cdec.water.ca.gov/cgi-progs/queryDgroups?s=fw2)
Merced River near Stevinson	CDEC, station MST (http://cdec.water.ca.gov/cgi-progs/queryDgroups?s=fw2)
San Joaquin River at Newman	USGS, station 11274000 (http://waterdata.usgs.gov/ca/nwis/dv?format=pre&period=31&site_no=11274000)

of flood control releases from Don Pedro Lake on the Tuolumne River, Lake McClure on the Merced River and Millerton Lake on the San Joaquin River such that by April 11 the daily operation forecast was looking at an existing flow of approximately 26,000 cfs. Due to the wet conditions and a need for the experiment fish to mature the SJRTC declared a VAMP pulse flow period of May 1 to May 31.

Table 2-3 provides a summary of the daily operation plans developed during the VAMP planning phase. The daily operation plans prepared during the VAMP planning phase are provided in Appendix A-1, Tables 1 through 12.

Tributary Flow Coordination

As previously noted, by early April the forecast existing flow was greater than the maximum VAMP target flow of 7,000 cfs. Under these conditions the tributary operations were coordinated to the degree possible to provide as stable a flow as possible during the VAMP pulse flow period. With this in mind the tributary operations prior to the VAMP were adjusted to the degree possible to maximize the very limited potential operational flexibility during the VAMP pulse flow period.

Table 2-5
2006 Vernalis Adaptive Management Plan (VAMP)
Final Flows and Accounting of Supplemental Water Contributions
 Target flow period: May 1 - May 31 * Target Flow: greater than 7,000 cfs

Date	Merced R. at Cressey (3 day Travel Time to Vernalis)			Tuolumne R. blw LaGrange Dam (2 day Travel Time to Vernalis)			Stanislaus R. blw Goodwin Dam (2 day Travel Time to Vernalis)			Upper SJR	Vernalis Ungaged	San Joaquin River at Vernalis		
	Existing Flow (cfs)	Observed Flow (cfs)	VAMP Supple- mental Water (cfs)	Existing Flow (cfs)	Observed Flow (cfs)	VAMP Supple- mental Water (cfs)	Existing Flow (cfs)	Observed Flow (cfs)	VAMP Supple- mental Water (cfs)	Observed Flow (cfs)	Observed Flow (cfs)	Existing Flow (cfs)	Observed Flow (cfs)	VAMP Supple- mental Water (cfs)
04/01/05	3,130	3,130		6,260	6,260		3,014	3,014		2,580	879	15,000	15,000	
04/02/05	2,980	2,980		6,440	6,440		3,019	3,019		2,680	1,232	16,200	16,200	
04/03/05	3,610	3,610		6,150	6,150		3,039	3,039		2,920	1,866	16,700	16,700	
04/04/05	6,990	6,990		3,650	3,650		3,303	3,303		2,380	1,631	16,900	16,900	
04/05/05	4,910	4,910		4,780	4,780		4,714	4,714		2,156	3,611	18,700	18,700	
04/06/05	4,970	4,970		5,640	5,640		5,776	5,776		8,771	7,757	20,700	20,700	
04/07/05	5,230	5,230		6,660	6,660		6,148	6,148		16,209	3,160	21,800	21,800	
04/08/05	5,190	5,190		7,020	7,020		4,379	4,379		18,238	(1,997)	23,100	23,100	
04/09/05	5,170	5,170		7,010	7,010		3,534	3,534		19,680	(6,587)	27,400	27,400	
04/10/05	5,110	5,110		6,990	6,990		3,504	3,504		19,401	(3,867)	31,000	31,000	
04/11/05	4,630	4,630		7,650	7,650		3,509	3,509		18,763	(3,314)	32,100	32,100	
04/12/05	4,540	4,540		8,100	8,100		3,868	3,868		18,163	(865)	34,200	34,200	
04/13/05	4,490	4,490		8,140	8,140		4,019	4,019		16,756	(332)	34,700	34,700	
04/14/05	4,480	4,480		7,890	7,890		3,995	3,995		15,308	(361)	34,400	34,400	
04/15/05	4,660	4,660		7,780	7,780		4,039	4,039		13,660	145	33,600	33,600	
04/16/05	4,550	4,550		7,740	7,740		4,062	4,062		12,950	1,017	32,700	32,700	
04/17/05	4,170	4,170		7,910	7,910		4,756	4,756		12,930	1,441	31,400	31,400	
04/18/05	4,010	4,010		8,590	8,590		5,495	5,495		12,710	1,088	30,500	30,500	
04/19/05	3,950	3,950		8,630	8,630		5,510	5,510		12,400	454	30,600	30,600	
04/20/05	4,010	4,010		8,820	8,820		5,507	5,507		12,180	(265)	30,700	30,700	
04/21/05	4,030	4,030		8,740	8,740		5,510	5,510		12,060	150	30,700	30,700	
04/22/05	4,010	4,010		8,850	8,850		5,522	5,522		11,980	143	30,600	30,600	
04/23/05	4,000	4,000		8,840	8,840		5,524	5,524		12,000	80	30,400	30,400	
04/24/05	4,000	4,000		8,980	8,980		5,548	5,548		12,060	18	30,400	30,400	
04/25/05	4,000	4,000		9,210	9,210		5,489	5,489		12,250	26	30,400	30,400	
04/26/05	4,170	4,170		9,170	9,170		5,527	5,527		12,210	12	30,600	30,600	
04/27/05	4,180	4,180		9,230	9,230		5,511	5,511		12,080	(49)	30,900	30,900	
04/28/05	4,250	4,250	0	9,180	9,180		5,508	5,508		11,890	93	31,000	31,000	
04/29/05	4,380	4,380	0	9,210	9,210	0	5,513	5,513	0	11,600	9	31,000	31,000	
04/30/05	4,500	4,500	0	9,250	9,250	0	5,514	5,514	0	11,380	42	30,800	30,800	
05/01/05	4,510	4,510	0	9,210	9,210	0	5,161	5,161	0	11,100	27	30,600	30,600	0
05/02/05	4,510	4,510	0	9,190	9,190	0	5,012	5,012	0	10,920	(124)	30,400	30,400	0
05/03/05	4,510	4,510	0	9,220	9,220	0	5,031	5,031	0	10,560	29	30,000	30,000	0
05/04/05	4,500	4,500	0	9,230	9,230	0	4,704	4,704	0	10,340	(32)	29,600	29,600	0
05/05/05	4,270	4,270	0	9,240	9,240	0	4,533	4,533	0	10,110	(221)	29,100	29,100	0
05/06/05	4,040	4,040	0	9,190	9,190	0	4,523	4,523	0	9,950	(284)	28,500	28,500	0
05/07/05	4,020	4,020	0	9,280	9,280	0	4,525	4,525	0	9,750	(383)	28,000	28,000	0
05/08/05	4,010	4,010	0	8,980	8,980	0	4,529	4,529	0	9,530	(333)	27,600	27,600	0
05/09/05	4,170	4,170	0	8,830	8,830	0	5,404	5,404	0	9,400	(395)	27,200	27,200	0
05/10/05	4,170	4,170	0	8,820	8,820	0	4,521	4,521	0	9,370	(259)	26,800	26,800	0
05/11/05	4,160	4,160	0	8,650	8,650	0	4,512	4,512	0	9,240	(1,144)	26,500	26,500	0
05/12/05	4,190	4,190	0	8,530	8,530	0	4,522	4,522	0	9,020	(581)	26,300	26,300	0
05/13/05	4,340	4,340	0	8,890	8,890	0	4,518	4,518	0	8,700	(472)	26,100	26,100	0
05/14/05	4,390	4,390	0	8,980	8,980	0	4,243	4,243	0	8,580	(232)	26,000	26,000	0
05/15/05	4,400	4,400	0	8,900	8,900	0	4,006	4,006	0	8,560	(498)	25,800	25,800	0
05/16/05	4,370	4,370	0	8,660	8,660	0	4,011	4,011	0	8,490	(643)	25,500	25,500	0
05/17/05	4,350	4,350	0	8,650	8,650	0	4,015	4,015	0	8,430	(656)	25,200	25,200	0
05/18/05	4,340	4,340	0	8,520	8,520	0	4,022	4,022	0	8,060	(561)	25,000	25,000	0
05/19/05	4,330	4,330	0	8,550	8,550	0	4,034	4,034	0	7,710	(665)	24,800	24,800	0
05/20/05	4,290	4,290	0	8,300	8,300	0	4,024	4,024	0	7,640	(452)	24,500	24,500	0
05/21/05	4,420	4,420	0	8,120	8,120	0	4,026	4,026	0	7,710	(334)	24,300	24,300	0
05/22/05	4,640	4,640	0	7,880	7,880	0	4,024	4,024	0	8,180	106	24,400	24,400	0
05/23/05	4,540	4,540	0	7,300	7,300	0	3,634	3,634	0	8,650	354	24,500	24,500	0
05/24/05	4,530	4,530	0	7,110	7,110	0	3,406	3,406	0	9,230	96	24,600	24,600	0
05/25/05	4,280	4,280	0	7,120	7,120	0	3,407	3,407	0	9,600	376	24,600	24,600	0
05/26/05	3,530	3,530	0	6,880	6,880	0	3,405	3,405	0	9,810	314	24,600	24,600	0
05/27/05	2,820	2,820	0	6,600	6,600	0	3,404	3,404	0	9,530	143	24,800	24,800	0
05/28/05	2,880	2,880	0	6,260	6,260	0	3,143	3,143	0	8,730	125	24,500	24,500	0
05/29/05	2,870	2,870		5,890	5,890	0	2,907	2,907	0	7,900	536	23,600	23,600	0
05/30/05	2,880	2,880		5,450	5,450	0	2,914	2,914		7,380	1,347	22,300	22,300	0
05/31/05	2,850	2,850		4,930	4,930		2,577	2,577		7,130	1,423	21,000	21,000	0
VAMP Period														
Average (cfs):	4,210	4,210		8,370	8,370		4,270	4,270		9,280	(110)	26,020	26,020	
Supplemental Water (ac-ft):			0			0			0					0

VAMP Period

Observed Flow Sources

Merced River at Cressey (CA DWR B05155): California DWR, Water Data Library, 9/8/06

Tuolumne River below LaGrange Dam near LaGrange (USGS 11289650): USGS, provisional data as of 9/8/06

Stanislaus River below Goodwin Dam: USBR, Goodwin Reservoir Daily Operations Report - OID/SSJID/Tri-Dams, 5/1/06 (April report) and 6/1/06 (May report)

San Joaquin River near Vernalis (USGS 11303500): USGS, provisional data as of 9/8/06

Delta Exports

The VAMP experimental design does not mandate specific magnitudes of reduced export rates when the existing flow at Vernalis is expected to exceed the maximum VAMP target flow rate of 7,000 cfs, but does provide the following suggested export rates.

Vernalis Flow	Suggested Export Rate
Up to 10,000 cfs	1,500 cfs or 3,000 cfs
Up to 15,000 cfs	2,250 cfs
Over 15,000 cfs	3,000 cfs

On April 25, 2006 the projected VAMP operation plan was discussed with the CalFed Operations Group. On April 28 the CalFed Water Operation Management Team (WOMT), which is made up of representatives from the DWR, USBR, USFWS, CDFG and NMFS, settled on a combined State and Federal export rate of 1,500 cfs for the first half of the VAMP pulse flow period (May 3 to May 17) and 6,000 cfs for the second half of the VAMP pulse flow period (May 18 to June 2). The period of reduced export pumping was slightly offset from the VAMP target flow period of May 1 to May 31 to allow both Mossdale releases a full 14 days to migrate through the system prior to changing the export rate.

Implementation

Operation Conference Calls

Due to the high flows in the San Joaquin River and the fact that the operation was being controlled by flood control considerations and not by the VAMP target flow, no operation conference calls were conducted in 2006.

Operation Monitoring

The planning and implementation of the VAMP spring pulse flow operation was accomplished using the best available real-time data from the sources listed in Table 2-4. The real-time flow data used during the implementation of the VAMP flow have varying degrees of quality. The CDEC real-time data has not been reviewed for accuracy or adjusted for rating shifts, whereas the USGS real-time data has had some preliminary review and adjustment. During the VAMP flow period, the real-time flows at Vernalis and in the San Joaquin River tributaries are continuously monitored. Similarly, the computed ungaged flow at Vernalis and the flow in the San Joaquin River upstream of the Merced River are continuously updated.

Results of Operations

The final accounting for the VAMP operation was accomplished using provisional mean daily flow data available from USGS and DWR as of August 1, 2006. Provisional data is data that has been reviewed and adjusted for rating shifts but is still considered preliminary and subject to change. Plots of the real-time and provisional flows at the primary measuring points are provided in Appendix A-2, Figures 1 through 8, to illustrate the differences between the real-time and the provisional data.

The mean daily flow in the San Joaquin River at the Vernalis gage averaged 26,020 cfs during the VAMP target flow period (May 1 – May 31). The flow showed a steady decline throughout the target flow period, ranging from a high of 30,600 cfs on May 1 to a low of 21,000 cfs on May 31, as shown in Figure 2-2. Figure 2-1 also shows the tributary contributions to the flow at Vernalis. Plots of the flow at the Merced River, Tuolumne River and Stanislaus River measurement points are provided in Figure 2-3. A tabulation of the observed mean daily flows during and around the VAMP target flow period is provided in Table 2-5.

The mean daily ungaged flow at Vernalis averaged -110 cfs during the VAMP target flow period, ranging from a minimum of -1,143 cfs to a maximum of 1,427 cfs. A plot of the ungaged flow is provided in Figure 2-4.

As noted previously, Millerton Lake on the San Joaquin River was making flood control releases during the VAMP target flow period. The Millerton Lake flood control operation resulted in a significant contribution of flow to the lower San Joaquin River as shown in Figure 2-5.

As previously stated, the combined CVP and SWP Delta export rate target was set at 1,500 cfs for the first half of the VAMP target flow period and 6,000 cfs for the second half. The observed exports, shown in Figure 2-6, averaged 1,559 cfs during the first half and 5,748 cfs during the second half.

Hydrologic Impacts

The Merced VAMP supplemental water is provided from storage in Lake McClure on the Merced River and the MID/TID VAMP supplemental water is provided from storage in Don Pedro Lake, thereby resulting in potential impacts on reservoir storage as a result of the VAMP operation. Any storage impacts, though, would be offset by any water conservation measures that have been instituted as a result of the SJRA and that result in a reduced reliance on river diversions. The OID/SSJID VAMP supplemental water

is made available from their diversion entitlements and therefore there are no storage impacts in New Melones Reservoir on the Stanislaus River due to the SJRA. Due to the extended nature of the VAMP, a 12-year plan, the storage impacts can potentially carry over from year to year. Reservoir storage impacts are reduced or eliminated when the reservoirs make flood control releases.

Due to the flood control operations in 2005 there were no SJRA storage impacts entering the 2006. No VAMP supplemental water was provided, so the 2006 VAMP operation had no impacts on reservoir storage. With and without SJRA storage and releases in 2006 for Lake McClure and Don Pedro Lake are shown in Figures 2-7 and 2-8, respectively.

Summary of Historical VAMP Operations

2006 marks the seventh year of VAMP operation in compliance with D-1641. A summary of the VAMP target flows for these first seven years is provided in Table 2-6. A

summary of the SJRGA supplemental water contributions is provided in Table 2-7. The SJRTC Hydrology Group monitors the cumulative impact of the SJRA on reservoir storage and stream flows. Plots of storage and flow impacts throughout the seven years of VAMP operation are provided in Appendix B-1, Figures 1 through 4.

Over the first seven years of the program considerable variation has occurred in both the flow entering the system upstream of the Merced River and the ungaged flow within the system. With each update of the daily operation plan throughout the planning and implementation phases the upstream and ungaged flows would vary causing the SJRGA to reduce or increase the contribution of supplemental water in order to support the VAMP target flow. Analysis of the variability in the ungaged flow at Vernalis and the San Joaquin River above Merced River flow and how these affect the forecasting of the existing and supplemental flows is ongoing.

Figure 2-2
2006 VAMP: San Joaquin River near Vernalis
With Lagged Contributions from Primary Sources

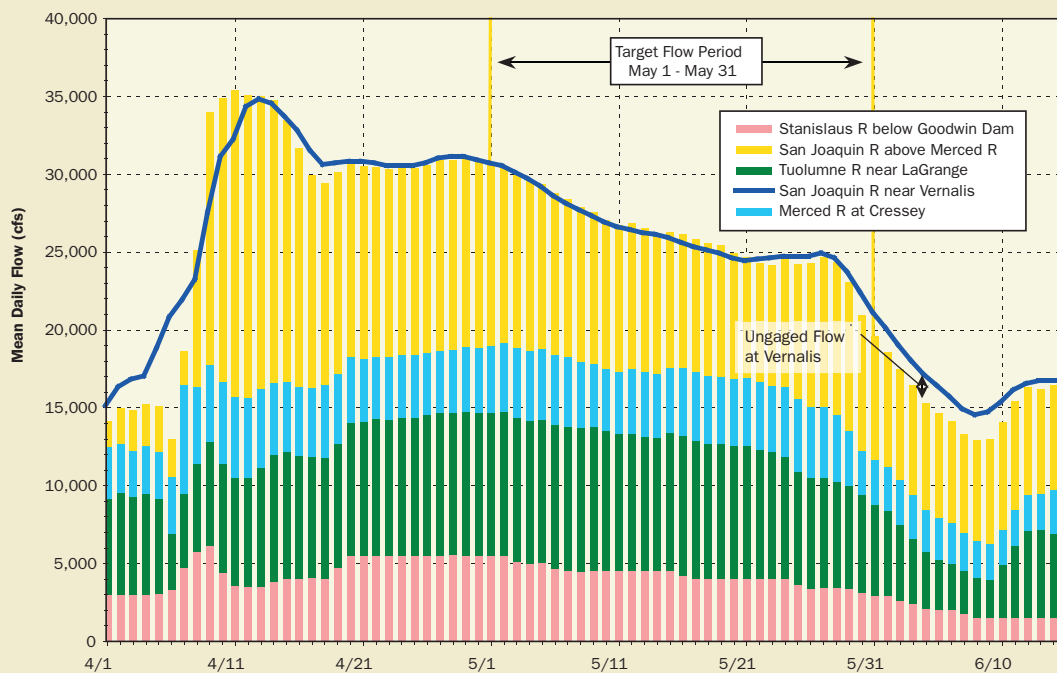


Figure 2-3
2006 VAMP: Flow at Tributary Measurement Points

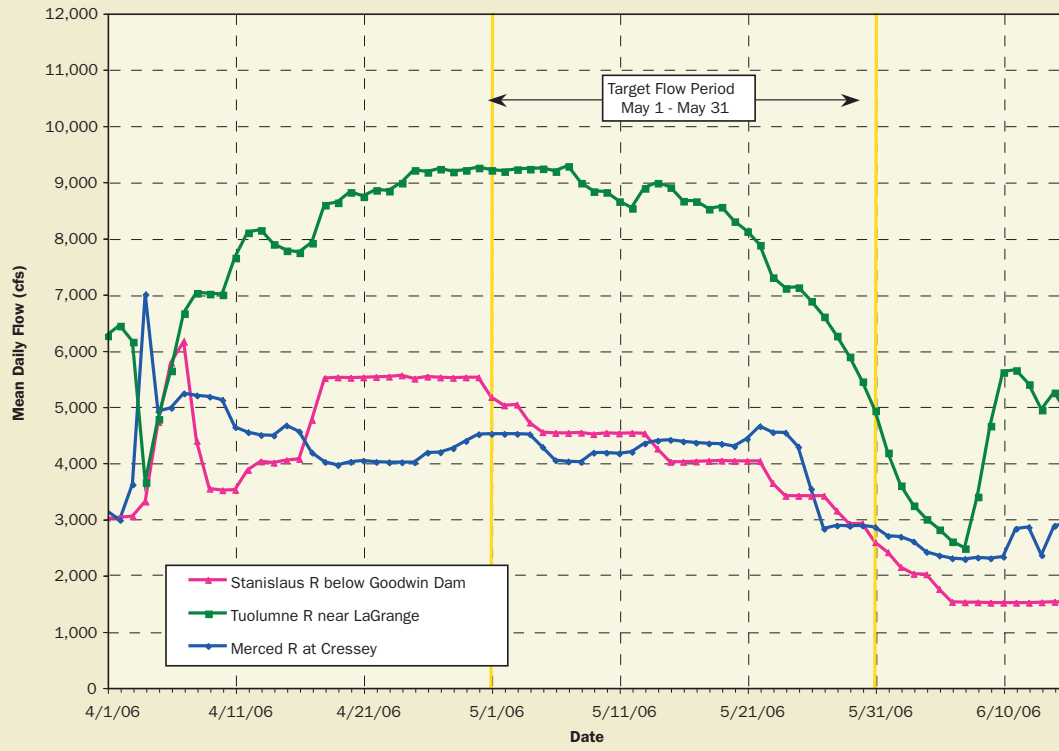


Figure 2-4
2006 VAMP - Ungaged Flow in San Joaquin River at Vernalis

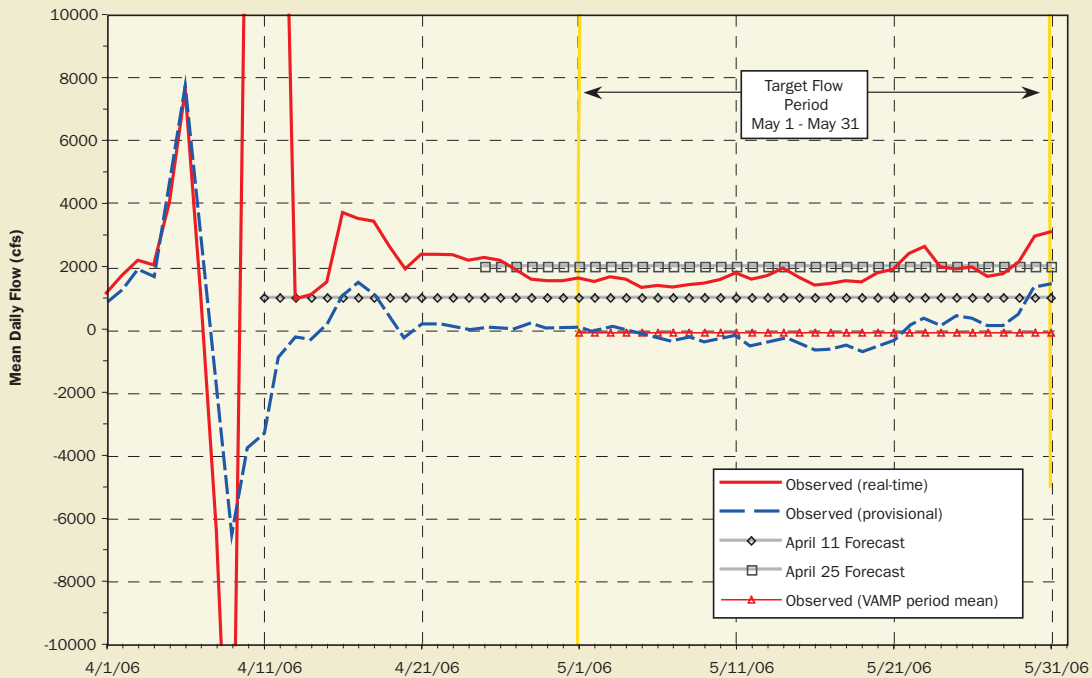


Figure 2-5
2006 VAMP - Upper San Joaquin River Flow

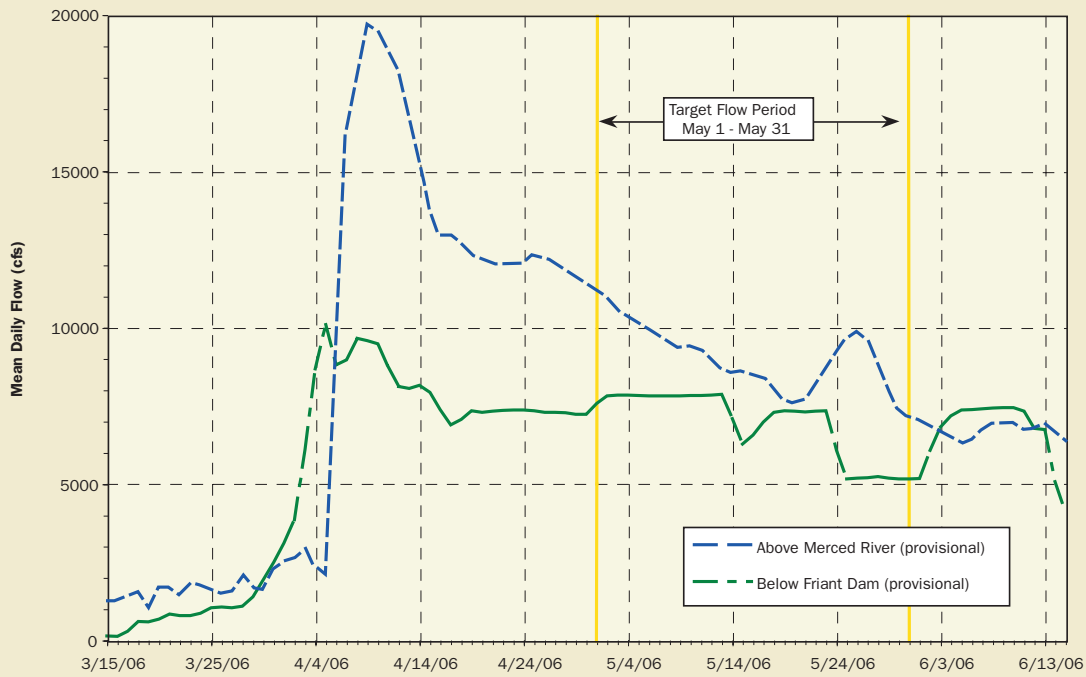


Figure 2-6
2006 VAMP - Federal and State Delta Exports

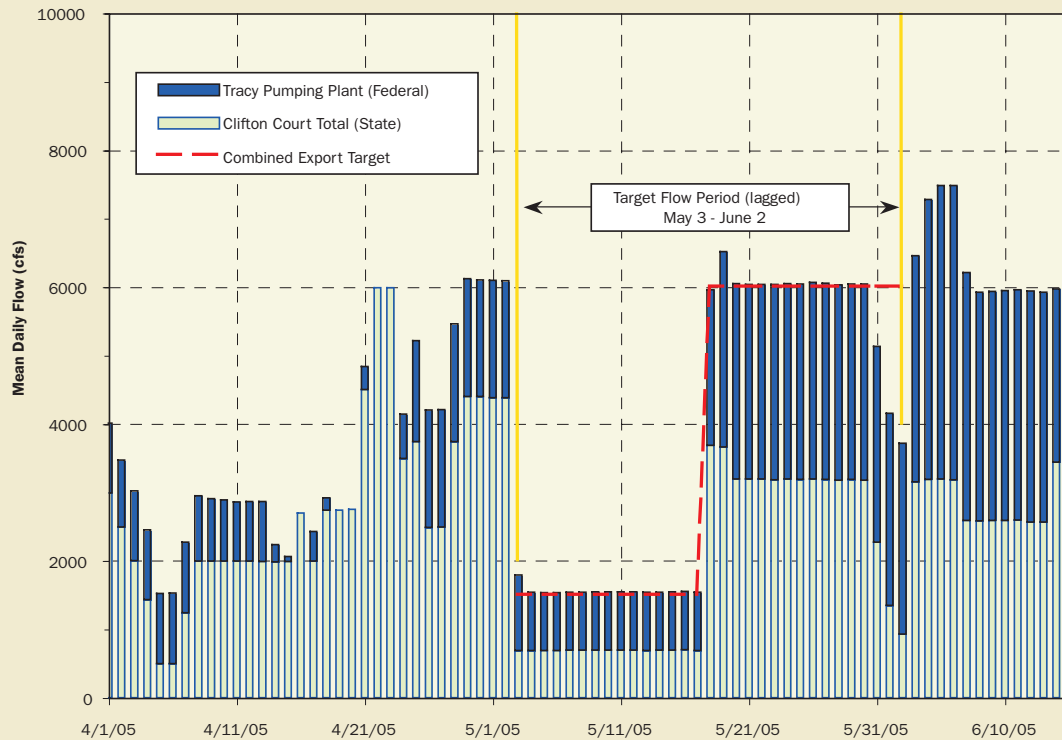


Figure 2-7
 San Joaquin River Agreement Storage and Flow Impacts
 Merced River - Lake McClure Storage and Release - 2006

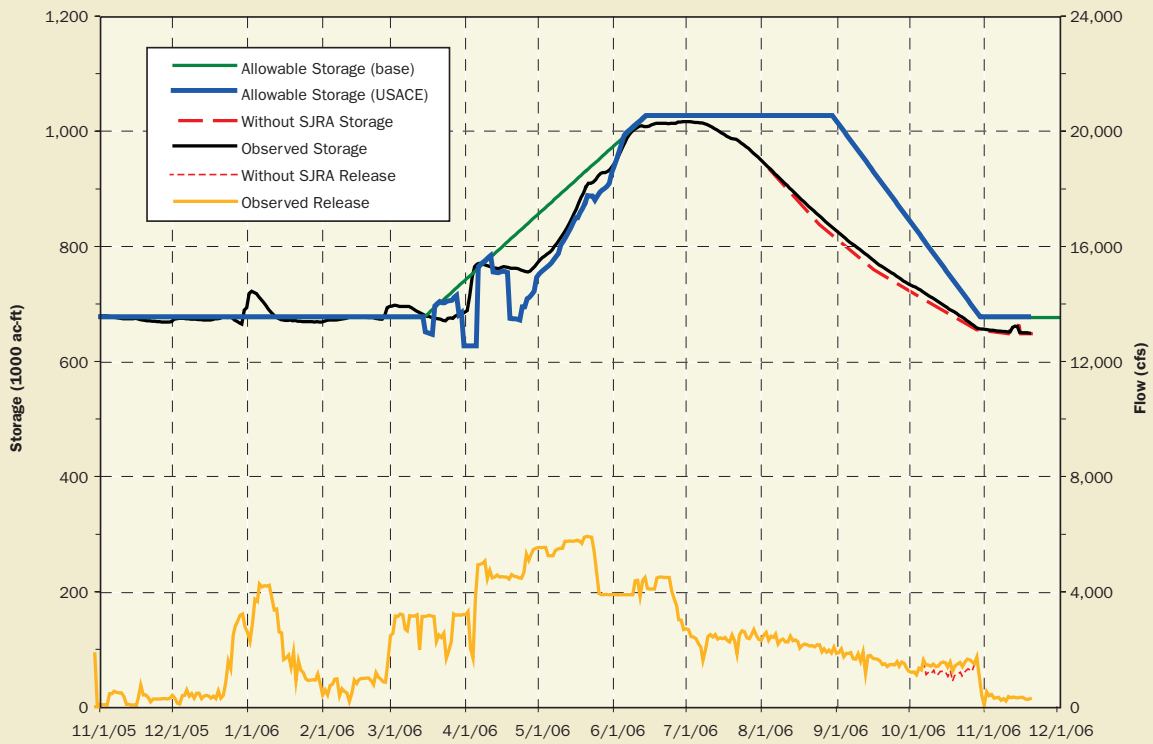


Figure 2-8
 San Joaquin River Agreement Storage and Flow Impacts
 Tuolumne River - New Don Pedro Reservoir Storage and Release - 2006

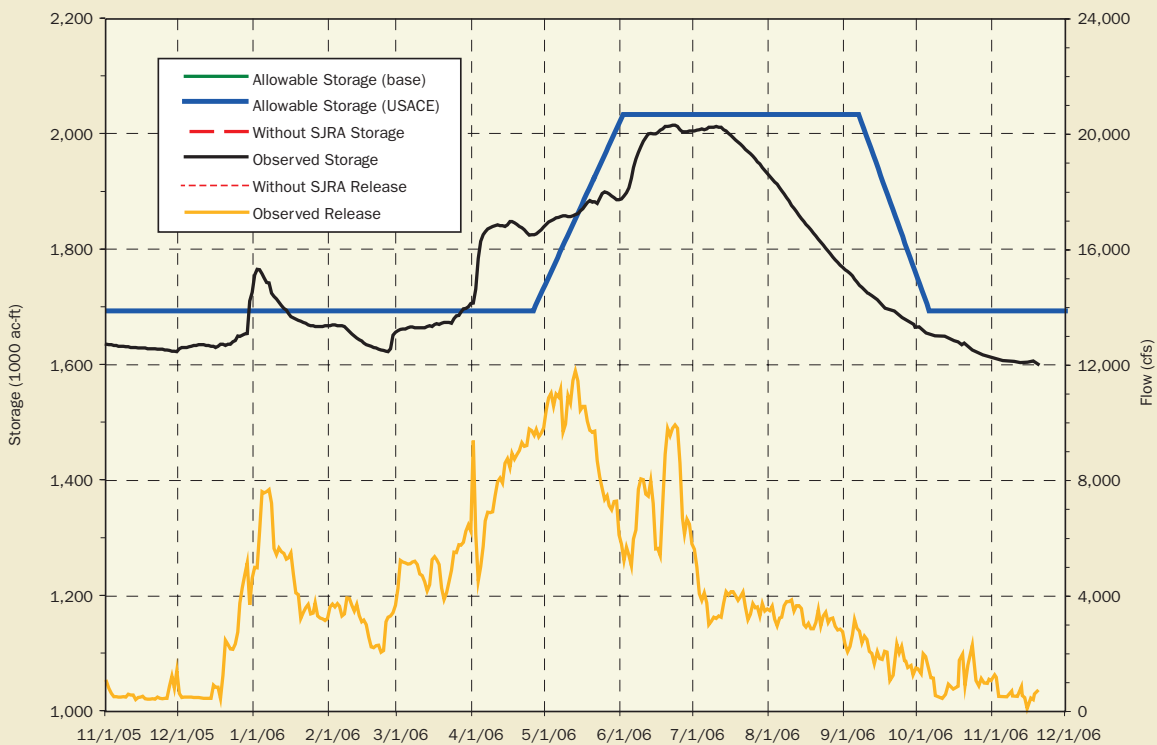


Table 2-6
Summary of VAMP Flows, 2000-2006

Year	60-20-20 Water Year Hydrologic Classification	VAMP Numerical Indicator	VAMP Target Flow (cfs)	Observed VAMP Flow (cfs)	Existing Flow (cfs)	VAMP Supplemental Water (acre-feet)	Delta Export Target (cfs)	Observed Delta Exports (cfs)
2000	Above Normal	4	5,700	5,869	4,800	77,680	2,250	2,155
2001	Dry	2	4,450	4,224	2,909	78,650	1,500	1,420
2002	Dry	2	3,200	3,301	2,757	33,430	1,500	1,430
2003	Below Normal	3	3,200	3,235	2,290	58,065	1,500	1,446
2004	Dry	2	3,200	3,155	2,088	65,591	1,500	1,331
2005	Wet	5	>7,000	10,390	10,390	0	2,250	2,986 [a]
2006	Wet	5	>7,000	26,220/24,262 [b]	26,020	0	1,500/6,000	1,559/5,748 [b]

[a] May 1 through 25 average was 2,260 cfs; exports were increased starting May 26 in conjunction with increasing existing flow; May 26 through 31 average was 6,012 cfs.

[b] "First fish release-recapture period"/"second fish release-recapture period"

Table 2-7
Summary of VAMP Supplemental Water Contributions, 2000-2006

Year	VAMP Supplemental Water (acre-feet)		Supplemental Water (acre feet)					
			Merced ID	OID	SSJID	SJRECWA	MID	TID
2000	77,680	Observed:	46,750	(a)	(b)	8,280	15,200	7,450
	Division Agreement:	45,160	7,300	7,300	7,300	16,920	8,300	
	Deviation:	+ 1590	0	0	+ 980	- 1,720	- 850	
2001	78,650	Observed:	42,120	7,365	7,365	7,740	7,030	7,030
	Division Agreement:	42,150	7,300	7,300	7,300	7,300	7,300	
	Deviation:	- 30	+ 65	+ 65	+ 440	- 270	- 270	
2002	33,430	Observed:	25,840	3,795	3,795	0	0	0
	Division Agreement:	25,000	4,215	4,215	0	0	0	
	Deviation:	+ 840	- 420	- 420	0	0	0	
2003	58,065	Observed:	38,257	5,039	5,039	(c)	4,864.5	4,864.5
	Division Agreement:	38,065	5,000	5,000	5,000	5,000	5,000	
	Deviation:	+ 192	+ 39	+ 39	0	-135.5	-135.5	
2004	65,591	Observed:	42,680	5,880	5,880	(c)	5,575.5	5,575.5
	Division Agreement:	41,500	7,045.5	7,045.5	5,000	5,000	5,000	
	Deviation:	+ 1,180	- 1165.5	- 1165.5	0	+ 575.5	+ 575.5	
2005	0	Observed:	0	0	0	0	0	0
	Division Agreement:	0	0	0	0	0	0	
	Deviation:	0	0	0	0	0	0	
2006	0	Observed:	0	0	0	0	0	0
	Division Agreement:	0	0	0	0	0	0	
	Deviation:	0	0	0	0	0	0	