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M E M O R A N D U M

TO: Tim O'Laughlin

FROM: Daniel B. Steiner

SUBJECT: Analysis of Bay Institute Proposed Vernalis Flows

DATE: May 3, 2005

By earlier memorandum[1] I described results concerning an analysis of the Bay Institute's proposed Vernalis flow objectives for the periods February-April 14 and May 16-June 30. That memorandum analyzed the proposed flow objectives against the "Current Conditions" hydrology that was presented at the State Water Resources Control Board's workshop during March. This memorandum describes an analysis of the Bay Institute's proposed flow objectives in comparison to flow conditions that are simulated for the "Current Conditions – No Caps IPO" scenario.[2] The difference between the two "base" scenarios is that the Current Conditions base scenario included numerous instances of non-compliance of the flow and water quality objectives at Vernalis due to release constraints of the New Melones Interim Plan of Operations (IPO). In the study representing the Current Conditions – No Caps IPO scenario these release constraints were removed and full compliance with the Vernalis flow and water quality objectives was achieved.[3] Thus, the results presented in this memorandum indicate the additional water necessary to meet the Bay Institute's proposed flow objectives over and above that hypothetically provided by New Melones for full compliance with the current water quality and flow objectives.

Table 1 below describes the flows suggested by the Bay Institute. The proposed flow objectives vary by year type as defined by the San Joaquin River Basin Index (SJRBI).

Table 1
Bay Institute Proposed Vernalis Flows - CFS

SJRBI	Feb	Mar	Apr	May	Jun
C	1,500	1,500	2,000	2,000	1,500
D	2,280	2,280	5,000	3,420	2,280
BN	2,280	3,420	5,000	5,000	3,420
AN	3,420	5,000	5,000	5,000	5,000
W	3,420	5,000	7,000	7,000	5,000

April flow is for April 1-14
May flow is for May 16-31

Table 2 provides a summary of the deficits in flow that occur between those flow objectives and the flows of the San Joaquin River at Vernalis as simulated for the Current Conditions – No Caps IPO scenario.

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[1] Daniel B. Steiner to Tim O'Laughlin, "Analysis of Bay Institute Proposed Vernalis Flows", April 25, 2005.
[2] Daniel B. Steiner to Tim O'Laughlin, "San Joaquin Basin Operations – "No Caps" Simulation", May 3, 2005.
[3] There were several periods when full compliance with the flow objective did not occur due to the assumed maximum release constraint (1,500 cfs) at Goodwin. These instances were minor in volume, and the analysis indicated that sufficient water existed in New Melones Reservoir to fully meet the objective.

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Table 2
Deficit between Vernalis Flow and Bay Institute Proposed Flows - Current Conditions
CFS - Ranked by SJRBI (TAF)

Averages of the Deficits - CFS

SJRBI	Feb	Mar	Apr	May	Jun
W	0	-933	-1,343	-2,923	-1,741
AN	-52	-1,538	-1,009	-1,561	-1,929
BN	-74	-1,015	-2,306	-2,336	-1,334
D	-61	-393	-2,878	-1,437	-787
C	0	-240	-615	-579	-439

Averages of the Deficits - 1,000 Acre-feet — All Years

SJRBI	Feb	Mar	Apr	May	Jun	Ave Annual	Max Annual	Min Annual	Ave Annual
W	0	-57	-37	-93	-104	-155	-345	0	-70
AN	-3	-95	-28	-50	-115	-181	-257	-112	-181
BN	-4	-62	-64	-74	-79	-223	-285	-166	-223
D	-3	-24	-80	-46	-47	-170	-207	-120	-170
C	0	-15	-17	-18	-26	-60	-95	-27	-60

"Averages of the Deficits" values determined for the periods only when a deficit occurs.
"All Years" values determined for the entire 73-year simulation period.

Table 3 illustrates the Current Condition – No Caps IPO flows at Vernalis. The data are presented in chronologic order for the CALSIM 1922-94 simulation sequence. Table 4 illustrates the application of the proposed flow objectives to the historically observed hydrologic condition of the San Joaquin River Basin, as described by the 60-20-20 index. The difference between the proposed flow objectives and the Current Condition – No Caps IPO flow is illustrated in Table 5. These data are presented rank-ordered, descending from wettest year to driest year. Positive values indicate a proposed flow objective being met incidentally to other basin operations. Negative values indicate deficits between a proposed flow objective and Current Condition – No Caps IPO flows. The implication of these deficits is that additional flow (e.g., releases) would be required to comply with the proposed flow objectives, over and above the compliance with the current objectives.

Table 2 summarizes the results into year-type averages. The results describing "Averages of the Deficits" reflect the average deficit that occurs within that year type for the years when a deficit occurs. For instance, in wet years (a total of 20 years) during March there are two years when a deficit occurs. The average deficit during those two years is 933 cfs. The results are provided in flow and volume (1,000 acre-feet). The 933 cfs value equates to a deficit volume of about 57,000 acre-feet. For wet years, when there is a deficit within any part of the year, an average annual deficit volume of 155,000 acre-feet occurs for the years when there is a deficit. The "All Years" data are provided to illustrate the range of deficits that occur within a year type. For wet years (all 20 years), the annual deficit ranges from 0 to 345,000 acre-feet, with an average deficit (including the no-deficit years) of 70,000 acre-feet. The monthly and annual volume deficit information is additionally illustrated in Table 6.

Table 6 can also be used to illustrate the cumulative additional release that would be necessary to meet the Bay Institute's proposed flow objectives. For instance, during the 1987 through 1992 drought period an additional 410,000 acre-feet of water is needed to comply with the proposed flow objectives, over and above full compliance with the current objectives. Sufficient water in New Melones Reservoir does not exist to satisfy this supplemental requirement. Sufficient water also does not exist in New Melones Reservoir to satisfy the cumulative supplemental requirement during the hydrology of the 1920s/1930s assuming the continuance of the other water supply objectives of the IPO.

Table 3

Vernalis Flow - Non-pulse Period

C639_NP_DV Case5_2_8_05 **Current Conditions**

CFS

WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	SJR 60-20-20	SJR Type
1922	2,178	2,240	2,481	3,574	5,868	9,829	6,983	4,928	10,678	7,956	2,428	2,348	4.54	W
1923	2,473	2,327	4,390	7,288	5,894	3,254	6,005	3,743	3,387	2,800	1,706	2,381	3.55	AN
1924	2,963	2,647	2,531	2,048	2,199	1,699	1,386	1,550	1,217	1,040	1,160	1,596	1.42	C
1925	1,723	1,928	1,973	1,686	2,223	2,285	2,667	3,536	2,501	2,146	1,408	1,905	2.93	BN
1926	2,276	2,431	2,340	2,098	2,208	2,280	2,119	2,280	2,438	1,415	1,421	2,005	2.30	D
1927	1,982	1,938	2,272	1,908	3,420	3,797	4,343	3,322	3,205	2,580	1,865	2,323	3.56	AN
1928	2,880	2,570	2,682	2,379	3,069	6,899	3,677	2,280	2,156	1,524	1,460	2,099	2.63	BN
1929	2,260	2,409	2,318	2,233	2,323	1,920	1,740	1,373	1,512	1,102	1,204	1,758	2.00	C
1930	1,820	2,070	1,908	1,582	2,085	1,863	1,396	1,548	1,155	1,154	1,220	1,791	2.02	C
1931	2,006	2,168	2,074	1,764	2,135	1,685	1,292	1,468	1,198	1,092	1,115	1,569	1.20	C
1932	1,637	1,851	1,993	1,997	3,376	3,420	2,895	2,921	3,142	2,974	1,606	2,043	3.41	AN
1933	2,316	2,272	2,052	1,930	2,165	1,959	2,079	1,641	1,449	1,279	1,282	1,708	2.44	D
1934	2,087	1,993	1,918	2,017	2,106	1,801	1,198	1,428	1,216	1,034	1,106	1,590	1.44	C
1935	1,669	1,821	1,814	1,789	3,352	3,420	3,248	3,420	3,334	2,550	1,619	2,172	3.56	AN
1936	2,573	2,283	2,430	2,304	6,340	8,714	6,190	3,912	2,861	2,506	1,957	2,446	3.74	AN
1937	2,849	2,336	2,499	3,255	11,247	10,083	9,759	7,406	3,377	3,175	2,135	2,419	3.90	W
1938	2,504	2,370	6,486	6,686	24,463	30,723	17,197	21,703	18,227	10,898	5,237	4,763	5.89	W
1939	3,734	2,891	2,958	2,772	3,181	3,479	2,079	2,146	1,503	1,257	1,368	2,040	2.20	D
1940	2,179	2,162	2,077	2,069	3,376	7,943	8,173	3,529	3,576	2,208	1,581	2,175	3.36	AN
1941	2,515	2,325	2,743	4,911	15,819	14,691	11,632	8,794	6,896	7,861	2,866	2,654	4.43	W
1942	3,149	2,792	4,382	8,610	11,616	7,082	7,930	7,042	7,588	7,477	4,159	4,317	4.44	W
1943	3,350	2,826	4,061	12,416	11,800	21,402	10,018	4,954	5,716	2,023	2,053	2,523	4.03	W
1944	2,934	2,728	2,924	2,660	3,076	3,482	3,021	2,511	2,484	1,731	1,534	2,224	2.76	BN
1945	2,450	2,537	2,397	2,624	7,828	6,974	4,868	5,677	2,947	3,185	3,080	2,979	3.59	AN
1946	3,543	2,821	7,763	6,380	6,553	5,145	3,881	4,371	3,023	1,772	1,759	2,209	3.30	AN
1947	2,653	2,605	2,939	2,912	2,894	2,280	2,170	1,600	1,449	1,173	1,317	1,821	2.18	D
1948	2,161	2,207	2,072	1,793	2,250	1,744	1,850	2,280	2,194	1,691	1,476	1,834	2.70	BN
1949	2,247	2,187	1,987	1,834	2,143	2,202	2,280	2,225	1,735	1,299	1,394	1,797	2.53	BN
1950	2,031	2,090	1,985	2,124	2,280	2,280	2,251	2,280	2,268	1,374	1,398	1,918	2.85	BN
1951	2,103	1,841	12,079	10,894	10,142	5,910	3,751	2,904	2,388	1,485	1,456	1,991	3.14	AN
1952	2,268	2,247	2,276	3,907	6,477	11,847	11,205	14,635	17,381	9,583	4,140	4,087	5.17	W
1953	2,994	2,745	2,570	6,437	5,027	2,412	3,237	3,395	2,414	1,833	1,546	2,080	3.03	BN
1954	2,572	2,394	2,193	2,121	2,534	2,280	2,573	2,862	1,786	1,362	1,411	1,830	2.72	BN
1955	2,084	2,066	2,276	2,747	2,280	1,921	1,820	1,724	1,649	1,189	1,286	1,797	2.30	D
1956	1,854	1,880	5,644	15,920	12,255	7,229	5,610	4,904	9,054	6,052	2,694	2,700	4.46	W
1957	2,859	2,584	2,196	2,394	2,441	3,726	2,868	3,029	2,276	1,506	1,537	2,002	3.01	BN
1958	2,432	2,151	2,194	2,501	3,955	10,561	18,177	12,554	14,535	7,863	4,143	4,213	4.77	W
1959	2,790	2,511	2,519	2,617	3,651	2,648	2,137	2,079	1,420	1,220	1,329	1,992	2.21	D
1960	2,057	1,906	1,794	1,773	2,379	1,747	1,424	1,468	1,121	932	1,070	1,540	1.85	C
1961	1,551	1,761	1,799	1,717	1,985	1,705	1,227	1,385	1,053	834	950	1,389	1.38	C
1962	1,439	1,707	1,784	1,464	3,530	3,007	2,223	2,280	1,665	1,473	1,490	1,908	3.07	BN
1963	2,040	1,829	1,946	1,763	3,420	3,420	3,248	3,223	3,377	1,843	1,682	2,163	3.57	AN
1964	2,316	2,072	2,099	2,171	2,250	1,781	1,535	1,646	1,449	1,165	1,230	1,731	2.19	D
1965	2,182	1,970	2,114	9,330	5,785	4,714	6,309	3,270	2,947	1,804	1,896	2,611	3.81	W
1966	2,510	2,471	5,600	5,376	4,359	3,030	2,221	2,225	1,449	1,220	1,237	1,660	2.51	BN
1967	1,846	1,753	2,089	2,289	3,420	5,712	12,243	10,643	13,751	15,263	3,058	3,427	5.25	W
1968	3,107	2,359	2,589	2,497	3,385	3,336	2,370	2,229	1,484	1,314	1,426	1,849	2.21	D
1969	2,052	2,180	2,170	9,769	27,600	22,818	20,250	22,665	26,438	10,200	3,891	4,379	6.09	W
1970	4,238	2,979	4,260	16,550	9,809	7,782	4,075	2,946	2,216	1,824	1,492	2,097	3.18	AN
1971	2,644	2,430	2,500	2,599	3,029	3,716	3,458	3,072	2,108	1,598	1,442	1,914	2.89	BN
1972	2,695	2,029	2,091	1,694	2,250	2,280	2,172	1,725	1,477	1,283	1,346	1,629	2.16	D
1973	2,204	2,591	2,366	2,593	4,487	7,396	4,670	2,801	3,282	1,532	1,568	2,172	3.50	AN
1974	2,699	2,079	3,163	7,551	5,151	6,028	6,498	3,801	3,334	2,573	2,492	2,673	3.90	W
1975	3,348	3,304	2,986	2,404	7,659	8,537	5,124	2,628	4,999	3,418	2,583	2,721	3.85	W
1976	3,813	3,128	2,313	2,154	2,548	1,834	1,684	1,508	1,225	1,168	1,420	1,755	1.57	C
1977	2,037	2,221	1,867	1,680	1,875	1,260	983	1,480	719	620	670	1,066	0.84	C
1978	1,222	1,435	1,441	2,516	8,098	7,626	10,420	10,920	9,458	4,178	2,582	3,754	4.58	W
1979	2,421	3,010	2,467	5,291	9,766	9,695	5,892	5,034	3,119	1,665	1,820	2,327	3.67	AN
1980	2,865	2,657	2,325	11,521	23,039	16,341	7,343	5,517	8,641	7,038	2,934	3,238	4.73	W
1981	3,114	2,989	2,433	2,347	2,741	4,384	2,507	2,424	1,509	1,417	1,345	1,798	2.44	D
1982	2,278	2,238	2,400	4,550	15,741	15,069	25,094	16,558	11,418	8,705	4,677	8,283	5.45	W
1983	8,442	10,325	20,934	27,393	37,764	49,558	23,884	23,952	27,548	25,925	9,885	9,207	7.22	W
1984	6,794	15,925	24,677	16,894	10,931	6,984	4,929	4,172	3,136	2,033	2,325	3,352	3.69	AN
1985	3,934	3,026	2,217	2,260	2,526	2,545	2,351	2,323	1,540	1,480	1,730	2,261	2.40	D
1986	2,375	2,475	2,416	1,820	16,735	27,752	12,167	10,077	9,504	3,097	2,825	3,771	4.31	W
1987	3,744	3,451	2,390	2,155	2,207	2,986	1,620	1,618	1,352	1,191	1,246	1,689	1.86	C
1988	1,834	2,249	1,912	1,822	1,958	1,707	1,660	1,344	1,081	782	1,000	1,507	1.48	C
1989	1,235	1,664	1,693	1,433	1,933	1,750	1,483	1,172	921	845	1,025	2,119	1.96	C
1990	1,841	1,991	1,811	1,524	2,057	1,563	1,025	1,560	864	838	1,117	1,448	1.51	C
1991	1,771	1,963	1,641	1,166	1,852	2,308	1,396	1,260	918	703	795	1,146	1.96	C
1992	1,331	1,557	1,484	1,231	2,457	1,885	1,338	1,067	710	552	761	1,112	1.56	C
1993	1,215	1,321	1,425	4,016	3,420	3,420	3,420	2,612	3,377	4,151	2,155	2,587	4.20	W
1994	2,452	2,159	1,951	1,587	2,432	1,941	1,305	1,511	1,159	849	916	1,175	2.05	C

Table 4

Bay Institute Proposed Flows

CFS

WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	SJR 60-20-20	SJR Type
1922					3,420	5,000	7,000	7,000	5,000				4.54	W
1923					3,420	5,000	5,000	5,000	5,000				3.55	AN
1924					1,500	1,500	2,000	2,000	1,500				1.42	C
1925					2,280	3,420	5,000	5,000	3,420				2.93	BN
1926					2,280	2,280	5,000	3,420	2,280				2.30	D
1927					3,420	5,000	5,000	5,000	5,000				3.56	AN
1928					2,280	3,420	5,000	5,000	3,420				2.63	BN
1929					1,500	1,500	2,000	2,000	1,500				2.00	C
1930					1,500	1,500	2,000	2,000	1,500				2.02	C
1931					1,500	1,500	2,000	2,000	1,500				1.20	C
1932					3,420	5,000	5,000	5,000	5,000				3.41	AN
1933					2,280	2,280	5,000	3,420	2,280				2.44	D
1934					1,500	1,500	2,000	2,000	1,500				1.44	C
1935					3,420	5,000	5,000	5,000	5,000				3.56	AN
1936					3,420	5,000	5,000	5,000	5,000				3.74	AN
1937					3,420	5,000	7,000	7,000	5,000				3.90	W
1938					3,420	5,000	7,000	7,000	5,000				5.89	W
1939					2,280	2,280	5,000	3,420	2,280				2.20	D
1940					3,420	5,000	5,000	5,000	5,000				3.36	AN
1941					3,420	5,000	7,000	7,000	5,000				4.43	W
1942					3,420	5,000	7,000	7,000	5,000				4.44	W
1943					3,420	5,000	7,000	7,000	5,000				4.03	W
1944					2,280	3,420	5,000	5,000	3,420				2.76	BN
1945					3,420	5,000	5,000	5,000	5,000				3.59	AN
1946					3,420	5,000	5,000	5,000	5,000				3.30	AN
1947					2,280	2,280	5,000	3,420	2,280				2.18	D
1948					2,280	3,420	5,000	5,000	3,420				2.70	BN
1949					2,280	3,420	5,000	5,000	3,420				2.53	BN
1950					2,280	3,420	5,000	5,000	3,420				2.85	BN
1951					3,420	5,000	5,000	5,000	5,000				3.14	AN
1952					3,420	5,000	7,000	7,000	5,000				5.17	W
1953					2,280	3,420	5,000	5,000	3,420				3.03	BN
1954					2,280	3,420	5,000	5,000	3,420				2.72	BN
1955					2,280	2,280	5,000	3,420	2,280				2.30	D
1956					3,420	5,000	7,000	7,000	5,000				4.46	W
1957					2,280	3,420	5,000	5,000	3,420				3.01	BN
1958					3,420	5,000	7,000	7,000	5,000				4.77	W
1959					2,280	2,280	5,000	3,420	2,280				2.21	D
1960					1,500	1,500	2,000	2,000	1,500				1.85	C
1961					1,500	1,500	2,000	2,000	1,500				1.38	C
1962					2,280	3,420	5,000	5,000	3,420				3.07	BN
1963					3,420	5,000	5,000	5,000	5,000				3.57	AN
1964					2,280	2,280	5,000	3,420	2,280				2.19	D
1965					3,420	5,000	7,000	7,000	5,000				3.81	W
1966					2,280	3,420	5,000	5,000	3,420				2.51	BN
1967					3,420	5,000	7,000	7,000	5,000				5.25	W
1968					2,280	2,280	5,000	3,420	2,280				2.21	D
1969					3,420	5,000	7,000	7,000	5,000				6.09	W
1970					3,420	5,000	5,000	5,000	5,000				3.18	AN
1971					2,280	3,420	5,000	5,000	3,420				2.89	BN
1972					2,280	2,280	5,000	3,420	2,280				2.16	D
1973					3,420	5,000	5,000	5,000	5,000				3.50	AN
1974					3,420	5,000	7,000	7,000	5,000				3.90	W
1975					3,420	5,000	7,000	7,000	5,000				3.85	W
1976					1,500	1,500	2,000	2,000	1,500				1.57	C
1977					1,500	1,500	2,000	2,000	1,500				0.84	C
1978					3,420	5,000	7,000	7,000	5,000				4.58	W
1979					3,420	5,000	5,000	5,000	5,000				3.67	AN
1980					3,420	5,000	7,000	7,000	5,000				4.73	W
1981					2,280	2,280	5,000	3,420	2,280				2.44	D
1982					3,420	5,000	7,000	7,000	5,000				5.45	W
1983					3,420	5,000	7,000	7,000	5,000				7.22	W
1984					3,420	5,000	5,000	5,000	5,000				3.69	AN
1985					2,280	2,280	5,000	3,420	2,280				2.40	D
1986					3,420	5,000	7,000	7,000	5,000				4.31	W
1987					1,500	1,500	2,000	2,000	1,500				1.86	C
1988					1,500	1,500	2,000	2,000	1,500				1.48	C
1989					1,500	1,500	2,000	2,000	1,500				1.96	C
1990					1,500	1,500	2,000	2,000	1,500				1.51	C
1991					1,500	1,500	2,000	2,000	1,500				1.96	C
1992					1,500	1,500	2,000	2,000	1,500				1.56	C
1993					3,420	5,000	7,000	7,000	5,000				4.20	W
1994					1,500	1,500	2,000	2,000	1,500				2.05	C

Table 5

Deficit between Vernalis Flow and Bay Institute Proposed Flows

CFS - Ranked by SJRBI (TAF) **Case5_2_8_05 minus Bay Institute Proposed Flows**

WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	SJR 60-20-20	SJR Type	SJRBI
1983	0	0	0	0	34,344	44,558	16,884	16,952	22,548	0	0	0	7.22	W	7.22
1969	0	0	0	0	24,180	17,818	13,250	15,665	21,438	0	0	0	6.09	W	6.09
1938	0	0	0	0	21,043	25,723	10,197	14,703	13,227	0	0	0	5.89	W	5.89
1982	0	0	0	0	12,321	10,069	18,094	9,558	6,418	0	0	0	5.45	W	5.45
1967	0	0	0	0	0	712	5,243	3,643	8,751	0	0	0	5.25	W	5.25
1952	0	0	0	0	3,057	6,847	4,205	7,635	12,381	0	0	0	5.17	W	5.17
1958	0	0	0	0	535	5,561	11,177	5,554	9,535	0	0	0	4.77	W	4.77
1980	0	0	0	0	19,619	11,341	343	-1,483	3,641	0	0	0	4.73	W	4.73
1978	0	0	0	0	4,678	2,626	3,420	3,920	4,458	0	0	0	4.58	W	4.58
1922	0	0	0	0	2,448	4,829	-17	-2,072	5,678	0	0	0	4.54	W	4.54
1956	0	0	0	0	8,835	2,229	-1,390	-2,096	4,054	0	0	0	4.46	W	4.46
1942	0	0	0	0	8,196	2,082	930	42	2,588	0	0	0	4.44	W	4.44
1941	0	0	0	0	12,399	9,691	4,632	1,794	1,896	0	0	0	4.43	W	4.43
1986	0	0	0	0	13,315	22,752	5,167	3,077	4,504	0	0	0	4.31	W	4.31
1993	0	0	0	0	0	-1,580	-3,580	-4,388	-1,623	0	0	0	4.20	W	4.20
1943	0	0	0	0	8,380	16,402	3,018	-2,046	716	0	0	0	4.03	W	4.03
1937	0	0	0	0	7,827	5,083	2,759	406	-1,623	0	0	0	3.90	W	3.90
1974	0	0	0	0	1,731	1,028	-502	-3,199	-1,666	0	0	0	3.90	W	3.90
1975	0	0	0	0	4,239	3,537	-1,876	-4,372	-1	0	0	0	3.85	W	3.85
1965	0	0	0	0	2,365	-286	-691	-3,730	-2,053	0	0	0	3.81	W	3.81
1936	0	0	0	0	2,920	3,714	1,190	-1,088	-2,139	0	0	0	3.74	AN	3.74
1984	0	0	0	0	7,511	1,984	-71	-828	-1,864	0	0	0	3.69	AN	3.69
1979	0	0	0	0	6,346	4,695	892	34	-1,881	0	0	0	3.67	AN	3.67
1945	0	0	0	0	4,408	1,974	-132	677	-2,053	0	0	0	3.59	AN	3.59
1963	0	0	0	0	0	-1,580	-1,752	-1,777	-1,623	0	0	0	3.57	AN	3.57
1927	0	0	0	0	0	-1,203	-657	-1,678	-1,795	0	0	0	3.56	AN	3.56
1935	0	0	0	0	-68	-1,580	-1,752	-1,580	-1,666	0	0	0	3.56	AN	3.56
1923	0	0	0	0	2,474	-1,746	1,005	-1,257	-1,613	0	0	0	3.55	AN	3.55
1973	0	0	0	0	1,067	2,396	-330	-2,199	-1,718	0	0	0	3.50	AN	3.50
1932	0	0	0	0	-44	-1,580	-2,105	-2,079	-1,858	0	0	0	3.41	AN	3.41
1940	0	0	0	0	-44	2,943	3,173	-1,471	-1,424	0	0	0	3.36	AN	3.36
1946	0	0	0	0	3,133	145	-1,119	-629	-1,977	0	0	0	3.30	AN	3.30
1970	0	0	0	0	6,389	2,782	-925	-2,054	-2,784	0	0	0	3.18	AN	3.18
1951	0	0	0	0	6,722	910	-1,249	-2,096	-2,612	0	0	0	3.14	AN	3.14
1962	0	0	0	0	1,250	-413	-2,777	-2,720	-1,755	0	0	0	3.07	BN	3.07
1953	0	0	0	0	2,747	-1,008	-1,763	-1,605	-1,006	0	0	0	3.03	BN	3.03
1957	0	0	0	0	161	306	-2,132	-1,971	-1,144	0	0	0	3.01	BN	3.01
1925	0	0	0	0	-57	-1,135	-2,333	-1,464	-919	0	0	0	2.93	BN	2.93
1971	0	0	0	0	749	296	-1,542	-1,928	-1,312	0	0	0	2.89	BN	2.89
1950	0	0	0	0	0	-1,140	-2,749	-2,720	-1,152	0	0	0	2.85	BN	2.85
1944	0	0	0	0	796	62	-1,979	-2,489	-936	0	0	0	2.76	BN	2.76
1954	0	0	0	0	254	-1,140	-2,427	-2,138	-1,634	0	0	0	2.72	BN	2.72
1948	0	0	0	0	-30	-1,676	-3,150	-2,720	-1,226	0	0	0	2.70	BN	2.70
1928	0	0	0	0	789	3,479	-1,323	-2,720	-1,264	0	0	0	2.63	BN	2.63
1949	0	0	0	0	-137	-1,218	-2,720	-2,775	-1,685	0	0	0	2.53	BN	2.53
1966	0	0	0	0	2,079	-390	-2,779	-2,775	-1,971	0	0	0	2.51	BN	2.51
1933	0	0	0	0	-115	-321	-2,921	-1,779	-831	0	0	0	2.44	D	2.44
1981	0	0	0	0	461	2,104	-2,493	-996	-771	0	0	0	2.44	D	2.44
1985	0	0	0	0	246	265	-2,649	-1,097	-740	0	0	0	2.40	D	2.40
1926	0	0	0	0	-72	0	-2,881	-1,140	158	0	0	0	2.30	D	2.30
1955	0	0	0	0	0	-359	-3,180	-1,696	-631	0	0	0	2.30	D	2.30
1959	0	0	0	0	1,371	368	-2,863	-1,341	-860	0	0	0	2.21	D	2.21
1968	0	0	0	0	1,105	1,056	-2,630	-1,191	-796	0	0	0	2.21	D	2.21
1939	0	0	0	0	901	1,199	-2,921	-1,274	-777	0	0	0	2.20	D	2.20
1964	0	0	0	0	-30	-499	-3,465	-1,774	-831	0	0	0	2.19	D	2.19
1947	0	0	0	0	614	0	-2,830	-1,820	-831	0	0	0	2.18	D	2.18
1972	0	0	0	0	-30	0	-2,828	-1,695	-803	0	0	0	2.16	D	2.16
1994	0	0	0	0	932	441	-695	-489	-341	0	0	0	2.05	C	2.05
1930	0	0	0	0	585	363	-604	-452	-345	0	0	0	2.02	C	2.02
1929	0	0	0	0	823	420	-260	-627	12	0	0	0	2.00	C	2.00
1989	0	0	0	0	433	250	-517	-828	-579	0	0	0	1.96	C	1.96
1991	0	0	0	0	352	808	-604	-740	-582	0	0	0	1.96	C	1.96
1987	0	0	0	0	707	1,486	-380	-382	-148	0	0	0	1.86	C	1.86
1960	0	0	0	0	879	247	-576	-532	-379	0	0	0	1.85	C	1.85
1976	0	0	0	0	1,048	334	-316	-492	-275	0	0	0	1.57	C	1.57
1992	0	0	0	0	957	385	-662	-933	-790	0	0	0	1.56	C	1.56
1990	0	0	0	0	557	63	-975	-440	-636	0	0	0	1.51	C	1.51
1988	0	0	0	0	458	207	-340	-656	-419	0	0	0	1.48	C	1.48
1934	0	0	0	0	606	301	-802	-572	-284	0	0	0	1.44	C	1.44
1924	0	0	0	0	699	199	-614	-450	-283	0	0	0	1.42	C	1.42
1961	0	0	0	0	485	205	-773	-615	-447	0	0	0	1.38	C	1.38
1931	0	0	0	0	635	185	-708	-532	-302	0	0	0	1.20	C	1.20
1977	0	0	0	0	375	-240	-1,017	-520	-781	0	0	0	0.84	C	0.84

Table 6

Vernalis Flow
Deficit between Vernalis Flow and Bay Institute Proposed Flows
1,000 Acre-feet - Ranked by SJRBI (TAF)

WY	Feb	Mar	Apr	May	Jun	Annual Deficit	SJR 60-20-20	SJR Type
1983	-	-	-	-	-	0	7.22	W
1969	-	-	-	-	-	0	6.09	W
1938	-	-	-	-	-	0	5.89	W
1982	-	-	-	-	-	0	5.45	W
1967	-	-	-	-	-	0	5.25	W
1952	-	-	-	-	-	0	5.17	W
1958	-	-	-	-	-	0	4.77	W
1980	-	-	-	-47	-	-47	4.73	W
1978	-	-	-	-	-	0	4.58	W
1922	-	-	0	-66	-	-66	4.54	W
1956	-	-	-39	-67	-	-105	4.46	W
1942	-	-	-	-	-	0	4.44	W
1941	-	-	-	-	-	0	4.43	W
1986	-	-	-	-	-	0	4.31	W
1993	-	-10	-99	-139	-97	-345	4.20	W
1943	-	-	-	-65	-	-65	4.03	W
1937	-	-	-	-	-97	-97	3.90	W
1974	-	-	-14	-102	-99	-215	3.90	W
1975	-	-	-52	-139	-	-191	3.85	W
1965	-	-2	-19	-118	-122	-261	3.81	W
1936	-	-	-	-35	-127	-162	3.74	AN
1984	-	-	-2	-26	-111	-139	3.69	AN
1979	-	-	-	-	-112	-112	3.67	AN
1945	-	-	-4	-	-122	-126	3.59	AN
1963	-	-10	-49	-56	-97	-211	3.57	AN
1927	-	-7	-18	-53	-107	-186	3.56	AN
1935	-4	-10	-49	-50	-99	-211	3.56	AN
1923	-	-11	-	-40	-96	-147	3.55	AN
1973	-	-	-9	-70	-102	-181	3.50	AN
1932	-2	-10	-58	-66	-111	-247	3.41	AN
1940	-2	-	-	-47	-85	-134	3.36	AN
1946	-	-	-31	-20	-118	-169	3.30	AN
1970	-	-	-26	-65	-166	-257	3.18	AN
1951	-	-	-35	-67	-155	-257	3.14	AN
1962	-	-3	-77	-86	-104	-270	3.07	BN
1953	-	-6	-49	-51	-60	-166	3.03	BN
1957	-	-	-59	-63	-68	-190	3.01	BN
1925	-3	-7	-65	-46	-55	-176	2.93	BN
1971	-	-	-43	-61	-78	-182	2.89	BN
1950	-	-7	-76	-86	-69	-238	2.85	BN
1944	-	-	-55	-79	-56	-190	2.76	BN
1954	-	-7	-67	-68	-97	-239	2.72	BN
1948	-2	-10	-87	-86	-73	-259	2.70	BN
1928	-	-	-37	-86	-75	-198	2.63	BN
1949	-8	-7	-76	-88	-100	-279	2.53	BN
1966	-	-2	-77	-88	-117	-285	2.51	BN
1933	-6	-2	-81	-56	-49	-195	2.44	D
1981	-	-	-69	-32	-46	-147	2.44	D
1985	-	-	-74	-35	-44	-152	2.40	D
1926	-4	-	-80	-36	-	-120	2.30	D
1955	-	-2	-88	-54	-38	-182	2.30	D
1959	-	-	-80	-43	-51	-173	2.21	D
1968	-	-	-73	-38	-47	-158	2.21	D
1939	-	-	-81	-40	-46	-168	2.20	D
1964	-2	-3	-96	-56	-49	-207	2.19	D
1947	-	-	-79	-58	-49	-186	2.18	D
1972	-2	-	-79	-54	-48	-182	2.16	D
1994	-	-	-19	-16	-20	-55	2.05	C
1930	-	-	-17	-14	-20	-52	2.02	C
1929	-	-	-7	-20	-	-27	2.00	C
1989	-	-	-14	-26	-34	-75	1.96	C
1991	-	-	-17	-23	-35	-75	1.96	C
1987	-	-	-11	-12	-9	-31	1.86	C
1960	-	-	-16	-17	-23	-55	1.85	C
1976	-	-	-9	-16	-16	-41	1.57	C
1992	-	-	-18	-30	-47	-95	1.56	C
1990	-	-	-27	-14	-38	-79	1.51	C
1988	-	-	-9	-21	-25	-55	1.48	C
1934	-	-	-22	-18	-17	-57	1.44	C
1924	-	-	-17	-14	-17	-48	1.42	C
1961	-	-	-21	-20	-27	-68	1.38	C
1931	-	-	-20	-17	-18	-54	1.20	C
1977	-	-1	-28	-17	-46	-93	0.84	C

Vernalis Flow
Deficit between Vernalis Flow and Bay Institute Proposed Flows
1,000 Acre-feet - Chronological

WY	Feb	Mar	Apr	May	Jun	Annual Deficit
1922	-	-	0	-66	-	-66
1923	-	-11	-	-40	-96	-147
1924	-	-	-17	-14	-17	-48
1925	-3	-7	-65	-46	-55	-176
1926	-4	-	-80	-36	-	-120
1927	-	-7	-18	-53	-107	-186
1928	-	-	-37	-86	-75	-198
1929	-	-	-7	-20	-	-27
1930	-	-	-17	-14	-20	-52
1931	-	-	-20	-17	-18	-54
1932	-2	-10	-58	-66	-111	-247
1933	-6	-2	-81	-56	-49	-195
1934	-	-	-22	-18	-17	-57
1935	-4	-10	-49	-50	-99	-211
1936	-	-	-	-35	-127	-162
1937	-	-	-	-	-97	-97
1938	-	-	-	-	-	0
1939	-	-	-81	-40	-46	-168
1940	-2	-	-	-47	-85	-134
1941	-	-	-	-	-	0
1942	-	-	-	-	-	0
1943	-	-	-	-65	-	-65
1944	-	-	-55	-79	-56	-190
1945	-	-	-4	-	-122	-126
1946	-	-	-31	-20	-118	-169
1947	-	-	-79	-58	-49	-186
1948	-2	-10	-87	-86	-73	-259
1949	-8	-7	-76	-88	-100	-279
1950	-	-7	-76	-86	-69	-238
1951	-	-	-35	-67	-155	-257
1952	-	-	-	-	-	0
1953	-	-6	-49	-51	-60	-166
1954	-	-7	-67	-68	-97	-239
1955	-	-2	-88	-54	-38	-182
1956	-	-	-39	-67	-	-105
1957	-	-	-59	-63	-68	-190
1958	-	-	-	-	-	0
1959	-	-	-80	-43	-51	-173
1960	-	-	-16	-17	-23	-55
1961	-	-	-21	-20	-27	-68
1962	-	-3	-77	-86	-104	-270
1963	-	-10	-49	-56	-97	-211
1964	-2	-3	-96	-56	-49	-207
1965	-	-2	-19	-118	-122	-261
1966	-	-2	-77	-88	-117	-285
1967	-	-	-	-	-	0
1968	-	-	-73	-38	-47	-158
1969	-	-	-	-	-	0
1970	-	-	-26	-65	-166	-257
1971	-	-	-43	-61	-78	-182
1972	-2	-	-79	-54	-48	-182
1973	-	-	-9	-70	-102	-181
1974	-	-	-14	-102	-99	-215
1975	-	-	-52	-139	-	-191
1976	-	-	-9	-16	-16	-41
1977	-	-1	-28	-17	-46	-93
1978	-	-	-	-	-	0
1979	-	-	-	-	-112	-112
1980	-	-	-	-47	-	-47
1981	-	-	-69	-32	-46	-147
1982	-	-	-	-	-	0
1983	-	-	-	-	-	0
1984	-	-	-2	-26	-111	-139
1985	-	-	-74	-35	-44	-152
1986	-	-	-	-	-	0
1987	-	-	-11	-12	-9	-31
1988	-	-	-9	-21	-25	-55
1989	-	-	-14	-26	-34	-75
1990	-	-	-27	-14	-38	-79
1991	-	-	-17	-23	-35	-75
1992	-	-	-18	-30	-47	-95
1993	-	-10	-99	-139	-97	-345
1994	-	-	-19	-16	-20	-55