GRASSLAND BYPASS PROJECT

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Flow, Salt and Selenium Mass Balances in the San Luis Drain

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Summary

Although lined with concrete along the 28 mile reach utilized by the Grassland Bypass Project (GBP), about 1,230 acre-feet of water entered the San Luis Drain (SLD) between Stations A and B during the 2001 Water Year. There was a net reduction in salt load of about 5,400 tons (4 percent) and a net decrease of about 116 pounds of selenium (about 3 percent) between the monitoring sites during WY 2001.

The reason for differences in flow may be due to water seeping into the SLD when adjacent wetlands are flooded. The difference in loads may be due to analytical errors. Tables 1, 2, and 3 summarize monthly flows, salt loads, and selenium loads that passed Stations A and B during the five years of the Project. Table 4 summarizes the effects of rainfall and evapotranspiration on the volume of water in the SLD.

Note that the historical concentration and load values have been updated and differ from those in the 1999 Annual Report and errata sheets.

Background

Seepage into the SLD most likely occurs through cracks and one-way weep valves that equalize hydraulic pressure to prevent the concrete lining from buckling. Along the SLD, the water surface elevation of adjacent wetlands, when flooded in the fall and winter, is often higher than the elevation of water in the SLD.

Leakage from the SLD can occur where the concrete lining is fractured or between adjacent concrete panels. Other losses from the SLD include direct evaporation of water and evapotranspiration by algae and aquatic plants.

Flow Differences between Stations A and B

Table 1 summarizes the amount of water that flowed past Stations A and B during the five years of the Project. Figure 1 compares the monthly flows of water that passed Stations A and B for all five years of the GBP.

About 1,230 acre-feet more water flowed past Station B than Station A during WY 2001. This occurred during October through January while adjacent wetlands were flooded. Similar increases have occurred in the autumn and winter of previous years.

Summers Engineering analyzed this situation. Table 4 calculates the net discharge in acre-feet per month by taking into account precipitation and evaporation from the surface area of the Drain. Once precipitation and evaporation are accounted for, the difference in flow between Stations A and B ranges from −3 percent to +4 percent for February through August 2001

Figure 1. Comparison of Flows in the San Luis Drain WY 1997 - 2001

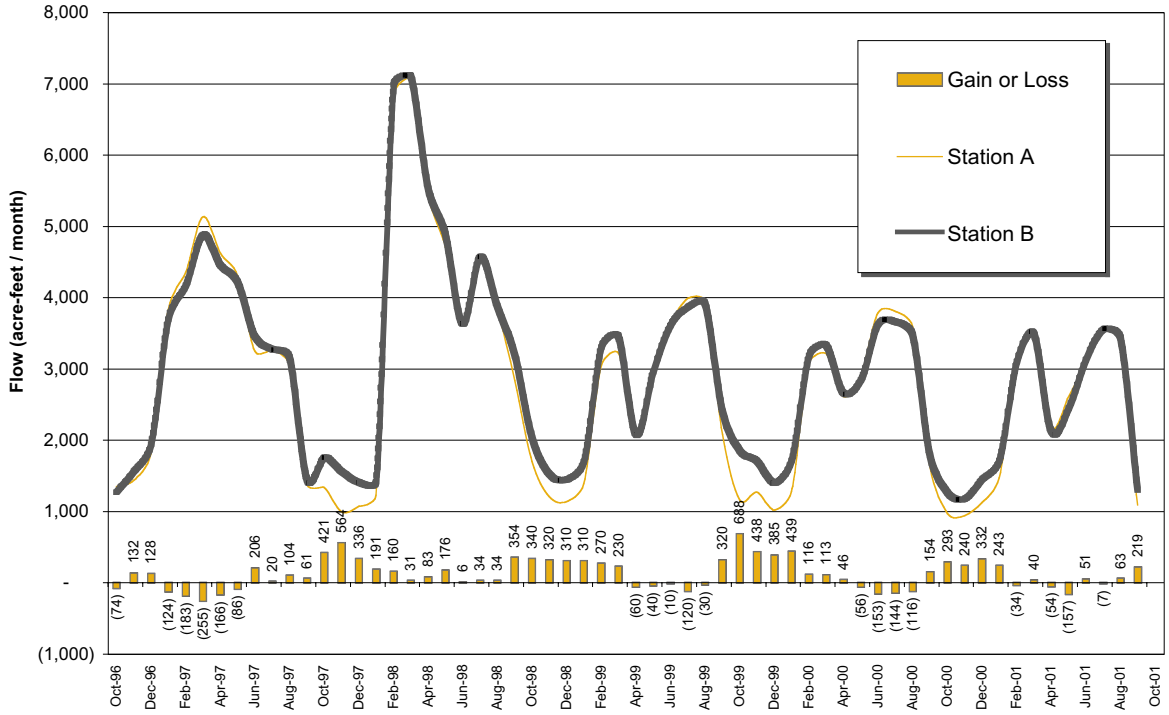

Table 1. Comparison of Flow Measurements

	Monthly Average Flow							
	Station A cfs		Station B cfs		Station A af/month	Station B af/month	Difference	Percent of Station B
Oct-1996	22.0	Lr	20.8	Lr	1,350	1,276	(74)	-6%
Nov-1996	24.2	Lr	26.4	Lr	1,437	1,569	132	8%
Dec-1996	29.6	Lr	31.7	Lr	1,818	1,946	128	7%
Jan-1997	62.2	Lr	60.2	Lr	3,827	3,703	(124)	-3%
Feb-1997	78.4	Lr	75.1	Lr	4,356	4,173	(183)	-4%
Mar-1997	83.5	Lr	79.3	Lr	5,131	4,876	(255)	-5%
Apr-1997	77.6	Lr	74.8	Lr	4,619	4,453	(166)	-4%
May-1997	69.9	Lr	68.6	Lr	4,301	4,215	(86)	-2%
Jun-1997	54.6	Lr	58.1	Lr	3,251	3,457	206	6%
Jul-1997	53.0	Lr	53.3	Lr	3,257	3,277	20	1%
Aug-1997	49.7	Lr	51.4	Lr	3,055	3,159	104	3%
Sep-1997	23.3	Lr	24.3	Lr	1,384	1,445	61	4%
Oct-1997	21.7	Lr	28.6	Lr	1,335	1,756	421	24%
Nov-1997	16.7	Lr	26.2	Lr	994	1,558	564	36%
Dec-1997	17.4	Lr	22.9	Lr	1,070	1,406	336	24%
Jan-1998	20.0	Lr	23.1	Lr	1,230	1,421	191	13%
Feb-1998	123.0	Lr	125.9	Lr	6,833	6,993	160	2%
Mar-1998	115.1	Lr	115.6	Lr	7,075	7,106	31	0%
Apr-1998	91.5	Lr	92.9	Lr	5,444	5,527	83	2%
May-1998	76.7	Lr	79.5	Lr	4,714	4,890	176	4%
Jun-1998	61.0	Lr	61.1	Lr	3,629	3,635	6	0%
Jul-1998	73.8	Lr	74.3	Lr	4,538	4,572	34	1%
Aug-1998	62.6	Lr	63.1	Lr	3,849	3,883	34	1%
Sep-1998	47.7	Lr	53.7	Lr	2,839	3,193	354	11%
Oct-1998	27.6	G	33.2	G	1,700	2,040	340	17%
Nov-1998	20.4	G	25.7	G	1,210	1,530	320	21%
Dec-1998	18.6	G	23.6	G	1,140	1,450	310	21%
Jan-1999	22.7	G	27.6	G	1,390	1,700	310	18%
Feb-1999	54.8	G	59.6	G	3,040	3,310	270	8%
Mar-1999	52.3	G	56.0	G	3,220	3,450	230	7%
Apr-1999	35.9	G	34.9	G	2,140	2,080	(60)	-3%
May-1999	48.7	G	48.2	G	3,000	2,960	(40)	-1%
Jun-1999	60.9	G	60.7	G	3,620	3,610	(10)	0%
Jul-1999	64.8	G	63.0	G	3,990	3,870	(120)	-3%
Aug-1999	64.1	G	63.6	G	3,940	3,910	(30)	-1%
Sep-1999	34.9	G	40.3	G	2,080	2,400	320	13%
Oct-1999	18.9	S	30.0	G	1,162	1,850	688	37%
Nov-1999	21.4	S	28.8	G	1,273	1,710	438	26%
Dec-1999	16.5	S	22.8	G	1,015	1,400	385	28%
Jan-2000	20.8	S	27.9	G	1,281	1,720	439	26%
Feb-2000	53.4	S	55.5	G	3,074	3,190	116	4%
Mar-2000	52.3	S	54.2	G	3,217	3,330	113	3%
Apr-2000	43.9	S	44.8	G	2,614	2,660	46	2%
May-2000	47.3	S	46.4	G	2,906	2,850	(56)	-2%
Jun-2000	63.6	S	61.0	G	3,783	3,630	(153)	-4%
Jul-2000	61.9	S	59.5	G	3,804	3,660	(144)	-4%
Aug-2000	58.3	S	56.5	G	3,586	3,470	(116)	-3%
Sep-2000	27.5	S	30.1	G	1,637	1,790	154	9%
Oct-2000	15.8	S	20.6	G	972	1,265	293	23%
Nov-2000	15.8	S	19.8	G	940	1,180	240	20%
Dec-2000	18.3	S	23.7	G	1,126	1,458	332	23%
Jan-2001	24.0	S	27.9	G	1,475	1,718	243	14%
Feb-2001	56.6	S	56.0	G	3,142	3,108	(34)	-1%
Mar-2001	56.1	S	56.8	G	3,451	3,491	40	1%
Apr-2001	36.7	S	35.8	G	2,184	2,130	(54)	-3%
May-2001	42.5	S	39.9	G	2,611	2,454	(157)	-6%
Jun-2001	51.7	S	52.6	G	3,077	3,128	51	2%
Jul-2001	58.0	S	57.9	G	3,567	3,560	(7)	0%
Aug-2001	54.8	S	55.9	G	3,372	3,435	63	2%
Sep-2001	18.3	S	22.0	G	1,088	1,307	219	17%

	Average cfs	Average cfs	Total acre-feet	Total acre-feet		
WY 1997	52.3	52.0	37,786	37,550	(237)	-1%
WY 1998	60.6	63.9	43,550	45,939	2,389	5%
WY 1999	42.1	44.7	30,470	32,310	1,840	6%
WY 2000	40.5	43.1	29,350	31,260	1,910	6%
WY 2001	37.4	39.1	27,005	28,234	1,229	4%

(Column 15). These differences are within the margin of error for flow measurements specified in the Quality Assurance Project Plan. The remaining months (October 2000 – January 2001, September 2001) show significant gains of water (14 – 23 percent). This is most likely seepage into the drain from adjacent wetland ponds.

Salt Mass Balance between Stations A and B

Figure 2 shows the monthly loads of salt in water that passed Stations A and B during WY 2001. Figure 2b shows the monthly loads of salt in water that passed Stations A and B during the five years of the Project.

Table 2 compares monthly loads of salts in water that passed Stations A and B during the five years of the Project. There was a net difference of about 5,400 tons of salt betwen Stations A and B during this water year. Figure 2 shows the monthly loads of salts that passed these stations during the five years of the Project.

Since salinity is a conservative chemical constituent, the monthly salt load measured at Station A should be identical to that at Station B. An increase in salt load must infer inflow of saline water into the SLD from adjacent wetlands if other factors such as precipitation and evaporation are taken into account. A decrease in salt load would infer the loss of saline water from the drain.

The WY 2001 monthly differences in salt loads, ±15 percent, are probably the result of cumulative errors from different analytical methods and equipment. Flow at Station A is measured as flow over a sharp-crested weir with a precision of ±5 percent. The USGS has developed a stage-discharge rating curve for Station B; the accuracy of flow measurements with this method is between – 4 % and +6 percent. The net difference in flow between the stations was about 4 percent (27,000 vs. 28,200 acre-feet).

Drift in the EC sensor response can also affect the computation of salt load. However, EC is measured with identical sensors and methods at both sites. USGS staff consider the EC sensor at Station B to be accurate within 3 percent. In previous years, algae bio-fouling of the probe at Station B has caused errors of more than 30 percent during summer months, but diligent maintenance prevented this from occurring and kept the rate of error less than 10 percent. The difference in flow-weighted average EC between the stations was about 11 percent (4,490 vs. 4,380 µS/cm).

Figure 2. Comparison of Salt Loads in the San Luis Drain WY 1997 - 2001

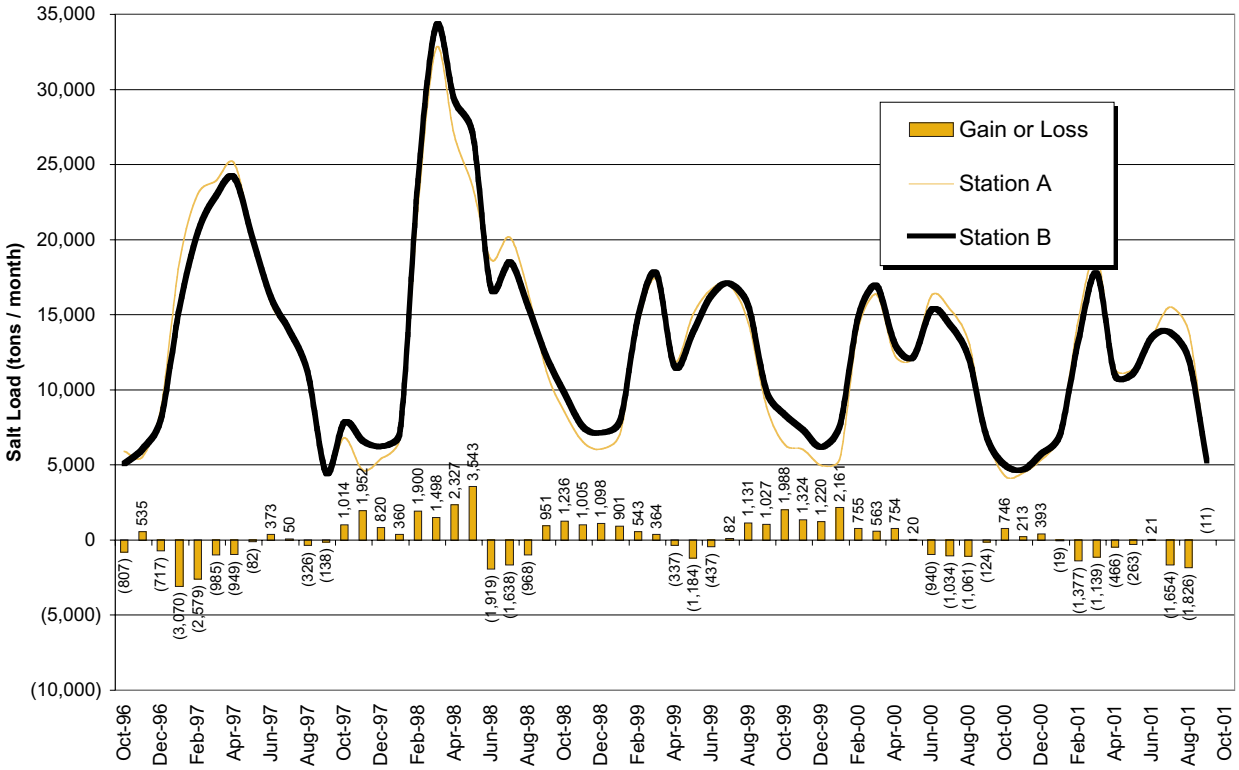

Table 2. Comparison of Salinity and Salt Loads

	Flow-weighted Electrical Conductivity				Loads			
	Station A µS/cm		Station B µS/cm		Station A tons/month	Station B tons/month	difference	Percent of Station B
Oct-1996	4,326	Rr	3,948	L	5,877	5,070	(807)	-16%
Nov-1996	3,812	Rr	3,830	L	5,513	6,048	535	9%
Dec-1996	4,775	Rr	4,095	L	8,737	8,020	(717)	-9%
Jan-1997	4,804	Rr	4,142	L	18,503	15,433	(3,070)	-20%
Feb-1997	5,256	Rr	4,872	L	23,042	20,463	(2,579)	-13%
Mar-1997	4,628	Rr	4,669	L	23,898	22,913	(985)	-4%
Apr-1997	5,391	Rr	5,380	L	25,060	24,111	(949)	-4%
May-1997	4,654	Rr	4,730	L	20,145	20,063	(82)	0%
Jun-1997	4,823	Rr	4,642	L	15,780	16,153	373	2%
Jul-1997	4,217	Rr	4,206	L	13,823	13,873	50	0%
Aug-1997	3,722	Rr	3,497	L	11,443	11,117	(326)	-3%
Sep-1997	3,311	Rr	3,077	L	4,612	4,474	(138)	-3%
Oct-1997	5,065	Rr	4,425	L	6,805	7,819	1,014	13%
Nov-1997	4,640	Rr	4,206	L	4,642	6,594	1,952	30%
Dec-1997	5,016	Rr	4,398	L	5,401	6,221	820	13%
Jan-1998	5,393	Rr	4,919	L	6,676	7,036	360	5%
Feb-1998	3,200	Rr	3,397	L	22,006	23,906	1,900	8%
Mar-1998	4,599	Rr	4,788	L	32,746	34,244	1,498	4%
Apr-1998	4,914	Rr	5,258	L	26,923	29,250	2,327	8%
May-1998	4,952	Rr	5,494	L	23,493	27,036	3,543	13%
Jun-1998	5,109	Rr	4,576	L	18,659	16,740	(1,919)	-11%
Jul-1998	4,408	Rr	4,020	L	20,132	18,494	(1,638)	-9%
Aug-1998	4,267	Rr	3,983	L	16,529	15,561	(968)	-6%
Sep-1998	3,938	Rr	3,798	L	11,252	12,203	951	8%
Oct-1998	4,972	Gr	4,738	Gr	8,506	9,742	1,236	13%
Nov-1998	5,371	Gr	4,909	Gr	6,541	7,546	1,005	13%
Dec-1998	5,268	Gr	4,881	Gr	6,044	7,142	1,098	15%
Jan-1999	5,010	Gr	4,628	Gr	7,008	7,909	901	11%
Feb-1999	4,687	Gr	4,467	Gr	14,340	14,883	543	4%
Mar-1999	5,363	Gr	5,117	Gr	17,379	17,743	364	2%
Apr-1999	5,511	Gr	5,512	Gr	11,869	11,532	(337)	-3%
May-1999	4,973	Gr	4,637	Gr	15,014	13,830	(1,184)	-9%
Jun-1999	4,581	Gr	4,471	Gr	16,689	16,252	(437)	-3%
Jul-1999	4,230	Gr	4,380	Gr	16,986	17,068	82	0%
Aug-1999	3,648	Gr	3,960	Gr	14,465	15,596	1,131	7%
Sep-1999	4,234	Gr	4,094	Gr	8,863	9,890	1,027	10%
Oct-1999	5,423	Rr	4,482	Gr	6,341	8,329	1,988	24%
Nov-1999	4,693	Rr	4,253	Gr	6,010	7,334	1,324	18%
Dec-1999	4,853	Rr	4,383	Gr	4,957	6,177	1,220	20%
Jan-2000	4,158	Rr	4,355	Gr	5,359	7,520	2,161	29%
Feb-2000	4,554	S	4,622	Gr	14,089	14,844	755	5%
Mar-2000	5,051	S	5,047	Gr	16,353	16,916	563	3%
Apr-2000	4,669	S	4,863	Gr	12,283	13,037	754	6%
May-2000	4,150	S	4,238	Gr	12,137	12,157	20	0%
Jun-2000	4,269	S	4,190	Gr	16,253	15,313	(940)	-6%
Jul-2000	4,017	S	3,899	Gr	15,378	14,344	(1,034)	-7%
Aug-2000	3,669	S	3,485	Gr	13,241	12,180	(1,061)	-9%
Sep-2000	4,230	S	3,792	Gr	6,967	6,843	(124)	-2%
Oct-2000	4,340	S	3,919	Gr	4,245	4,991	746	15%
Nov-2000	4,733	S	3,949	Gr	4,477	4,690	213	5%
Dec-2000	4,713	S	3,908	Gr	5,341	5,734	393	7%
Jan-2001	4,692	S	4,018	Gr	6,965	6,946	(19)	0%
Feb-2001	4,635	S	4,245	Gr	14,656	13,279	(1,377)	-10%
Mar-2001	5,438	S	5,052	Gr	18,887	17,748	(1,139)	-6%
Apr-2001	5,183	S	5,096	Gr	11,392	10,926	(466)	-4%
May-2001	4,318	S	4,488	Gr	11,346	11,083	(263)	-2%
Jun-2001	4,340	S	4,276	Gr	13,440	13,461	21	0%
Jul-2001	4,314	S	3,860	Gr	15,487	13,833	(1,654)	-12%
Aug-2001	4,096	S	3,492	Gr	13,900	12,074	(1,826)	-15%
Sep-2001	4,801	S	3,988	Gr	5,257	5,246	(11)	0%

	Average µS/cm	Average µS/cm	Total tons	Total tons	difference	
WY 1997	4,477	4,257	176,433	167,739	(8,695)	-5%
WY 1998	4,625	4,439	195,263	205,104	9,841	5%
WY 1999	4,821	4,650	143,705	149,133	5,428	4%
WY 2000	4,478	4,301	129,368	134,994	5,626	4%
WY 2001	4,634	4,191	125,394	120,011	(5,383)	-4%

Selenium Mass Balance between Stations A and B

A simple mass balance of selenium was calculated to better understand the dynamics of selenium mass transport and mass transfer within the San Luis Drain. Selenium is a non-conservative chemical constituent. These data are presented in Table 3. Despite the seepage inflow, there is little difference (three percent) in the loads of selenium that passed each station. About 116 pounds of selenium that entered the drain at Station A did not flow past Station B, a reduction of about 3 percent.

Flow data, when combined with continuous and discrete selenium data, are used to compute this mass balance. However, selenium sampling does not occur at the same frequency at both Stations A and B.

During WY 2001, selenium samples were collected by auto-samplers at both sites. At Station B, seven samples were collected each day; the composite of each day's samples were analyzed in the laboratory. At Station A, seven daily samples were mixed to produce a single weekly composite for analysis. In addition, CVRWQCB collected weekly grab samples at both sites.

Figure 3 shows the monthly loads of selenium at both sites during the five years of the GBP. Table 3 lists the monthly loads of selenium in water passing both stations.

During WY 2001, there was a slight reduction in the load of selenium that flowed between Stations A and B. The load decreased during eight months.

The reduction of selenium between the sites may be due to measurement error, microbial uptake, adsorption to sediments, volatilization, or seepage from the SLD between the sites. The increase of selenium may be due to measurement error or seepage of seleniferous water into the drain between Stations A and B.

Conclusions

In the five years of the GBP, there have been slight increases in the volume of water in the San Luis Drain during autumn and winter months when adjacent wetlands are flooded. The annual loads of salts have varied ± 5 percent. A annual loads of selenium have varied from a net loss of 7 percent to a gain of 6 percent. These differences are within the realm of measurement error. The differences in selenium loads due to natural processes cannot be determined.

Figure 3. Comparison of Selenium Loads in the San Luis Drain WY 1997 - 2001

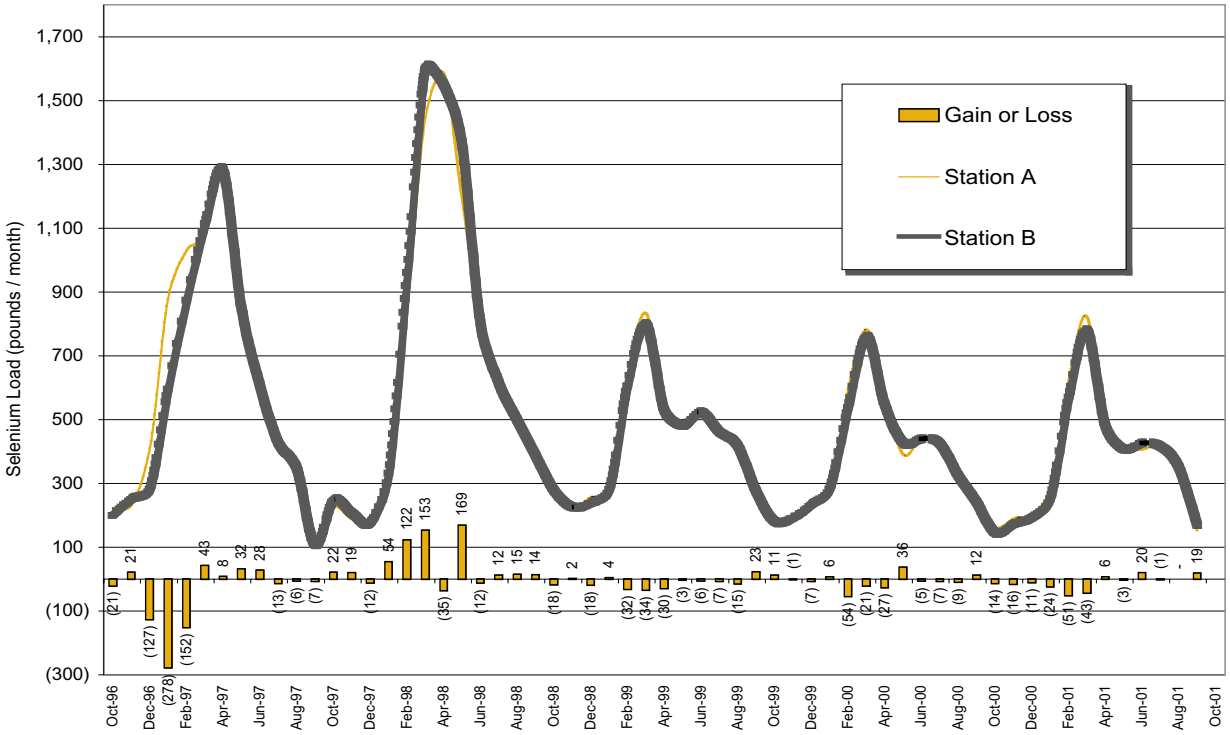

Table 3. Comparison of Selenium Measurements

	Flow-weighted Concentration				Loads					
	Station A µg/L	Rr	Station B µg/L	R	Station A lbs/month	Rr	Station B lbs/month	R	Difference	Percent of Station B
Oct-1996	60.6	Rr	58.3	R	223	Rr	202	R	(21)	-10%
Nov-1996	59.2	Rr	59.0	R	232	Rr	252	R	21	8%
Dec-1996	83.2	Rr	53.9	R	412	Rr	285	R	(127)	-44%
Jan-1997	84.3	Rr	59.5	R	877	Rr	599	R	(278)	-46%
Feb-1997	86.9	Rr	77.3	R	1,030	Rr	878	R	(152)	-17%
Mar-1997	77.1	Rr	84.4	R	1,076	Rr	1,119	R	43	4%
Apr-1997	101.2	Rr	105.7	R	1,272	Rr	1,280	R	8	1%
May-1997	69.8	Rr	74.1	R	817	Rr	849	R	32	4%
Jun-1997	65.9	Rr	65.0	R	583	Rr	611	R	28	5%
Jul-1997	49.8	Rr	48.0	R	441	Rr	428	R	(13)	-3%
Aug-1997	42.6	Rr	40.5	R	354	Rr	348	R	(6)	-2%
Sep-1997	30.7	Rr	27.7	R	116	Rr	109	R	(7)	-6%
Oct-1997	62.3	Rr	51.9	R	226	Rr	248	R	22	9%
Nov-1997	69.4	Rr	48.9	R	188	Rr	207	R	19	9%
Dec-1997	65.4	Rr	46.6	R	190	Rr	178	R	(12)	-7%
Jan-1998	84.2	Rr	86.7	R	282	Rr	335	R	54	16%
Feb-1998	45.3	Rr	50.8	R	843	Rr	965	R	122	13%
Mar-1998	75.2	Rr	82.8	R	1,447	Rr	1,600	R	153	10%
Apr-1998	107.1	Rr	103.1	R	1,585	Rr	1,550	R	(35)	-2%
May-1998	93.7	Rr	103.0	R	1,201	Rr	1,370	R	169	12%
Jun-1998	83.0	Rr	81.6	R	819	Rr	807	R	(12)	-2%
Jul-1998	48.8	Rr	49.5	R	603	Rr	615	R	12	2%
Aug-1998	46.3	Rr	47.4	R	485	Rr	500	R	15	3%
Sep-1998	48.5	Rr	44.7	R	374	Rr	388	R	14	4%
Oct-1998	63.7	Rr	49.5	Rr	295	Rr	277	R	(18)	-6%
Nov-1998	67.9	Rr	53.2	Rr	224	Rr	226	R	2	1%
Dec-1998	82.6	Rr	61.0	Rr	257	Rr	239	R	(18)	-7%
Jan-1999	73.9	Rr	62.1	Rr	280	Rr	284	R	4	1%
Feb-1999	77.5	Rr	67.0	Rr	641	Rr	609	R	(32)	-5%
Mar-1999	95.3	Rr	85.9	Rr	833	Rr	799	R	(34)	-4%
Apr-1999	96.1	Rr	90.2	Rr	559	Rr	529	R	(30)	-6%
May-1999	59.5	Rr	60.3	Rr	485	Rr	482	R	(3)	-1%
Jun-1999	53.7	Rr	53.3	Rr	530	Rr	524	R	(6)	-1%
Jul-1999	43.2	Rr	43.8	Rr	469	Rr	462	R	(7)	-1%
Aug-1999	40.4	Rr	39.1	Rr	433	Rr	418	R	(15)	-4%
Sep-1999	44.6	Rr	41.8	Rr	252	Rr	275	R	23	8%
Oct-1999	53.7	Rr	35.1	R	170	Rr	181	R	11	6%
Nov-1999	56.1	Rr	41.4	R	194	Rr	193	R	(1)	-1%
Dec-1999	88.1	Rr	61.9	R	243	Rr	236	R	(7)	-3%
Jan-2000	80.0	Rr	61.0	R	279	Rr	285	R	6	2%
Feb-2000	101.0	Rr	62.3	R	595	Rr	541	R	(54)	-10%
Mar-2000	96.8	Rr	84.0	R	782	Rr	761	R	(21)	-3%
Apr-2000	92.9	Rr	75.8	R	576	Rr	549	R	(27)	-5%
May-2000	49.4	Rr	55.1	R	391	Rr	427	R	36	9%
Jun-2000	43.2	Rr	44.4	R	444	Rr	439	R	(5)	-1%
Jul-2000	41.8	Rr	42.7	R	432	Rr	425	R	(7)	-2%
Aug-2000	34.1	Rr	34.3	R	333	Rr	324	R	(9)	-3%
Sep-2000	51.6	Rr	49.7	R	230	Rr	242	R	12	5%
Oct-2000	61.2	Rr	42.8	R	160	Rr	146	R	(14)	-9%
Nov-2000	74.9	Rr	54.4	R	190	Rr	174	R	(16)	-9%
Dec-2000	66.8	Rr	48.9	R	205	Rr	194	R	(11)	-5%
Jan-2001	69.5	Rr	53.8	R	279	Rr	255	R	(24)	-9%
Feb-2001	72.6	Rr	67.2	R	625	Rr	574	R	(51)	-9%
Mar-2001	87.0	Rr	82.0	R	822	Rr	779	R	(43)	-6%
Apr-2001	79.9	Rr	82.9	R	475	Rr	481	R	6	1%
May-2001	58.8	Rr	62.5	R	411	Rr	408	R	(3)	-1%
Jun-2001	48.5	Rr	49.9	R	406	Rr	426	R	20	5%
Jul-2001	43.0	Rr	42.9	R	417	Rr	416	R	(1)	0%
Aug-2001	38.7	Rr	37.9	R	353	Rr	353	R	0	0%
Sep-2001	50.0	Rr	47.2	R	152	Rr	171	R	19	11%

	average µg/L	average µg/L	total pounds	total pounds	difference	
WY 1997	67.6	62.8	7,431	6,960	(471)	-6%
WY 1998	69.1	66.4	8,244	8,763	519	6%
WY 1999	66.5	58.9	5,257	5,124	(133)	-3%
WY 2000	65.7	54.0	4,669	4,603	(65)	-1%
WY 2001	62.6	56.0	4,493	4,377	(116)	-3%

Table 4. Grassland Bypass Project San Luis Drain Discharge Balance

	CIMIS ETo				Evaporation (Kc=1.1)		Water Loss to Evap.	Water Gain from Precip	Gain or Loss from Water Surface	Site A	Site B	B-A	Net Water Gain/Loss	Equivalent Flowrate	Percent of Discharge
	Panoche	Telles	Los Banos	Average	inches	feet	acre feet	acre feet	acre feet	acre feet	acre feet	acre feet	acre feet	cfs	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Oct-1999	4.26	4.28	3.76	4.10	4.51	0.38	38.3	0.0	-38.3	1,162	1,850	688	726.3	11.8	39%
Nov-1999	2.02	1.97	1.63	1.87	2.06	0.17	17.5	2.1	-15.4	1,273	1,710	437	452.4	7.4	26%
Dec-1999	1.78	1.81	1.42	1.67	1.84	0.15	15.6	0.5	-15.1	1,015	1,400	385	400.1	6.5	29%
Jan-2000	1.12	1.12	0.86	1.03	1.14	0.09	9.6	13.0	3.4	1,281	1,720	439	435.6	7.1	25%
Feb-2000	1.48	1.54	1.36	1.46	1.61	0.13	13.6	17.3	3.7	3,074	3,190	116	112.3	1.8	4%
Mar-2000	4.04	4.15	3.90	4.03	4.43	0.37	37.6	3.5	-34.1	3,217	3,330	113	147.1	2.4	4%
Apr-2000	5.46	5.66	5.25	5.46	6.00	0.50	50.9	9.6	-41.3	2,614	2,660	46	87.3	1.4	3%
May-2000	7.74	7.60	6.87	7.40	8.14	0.68	69.1	0.8	-68.3	2,906	2,850	-56	12.3	0.2	0%
Jun-2000	8.57	8.50	8.34	8.47	9.32	0.78	79.0	0.8	-78.2	3,783	3,630	-153	-74.8	-1.2	-2%
Jul-2000	8.04	8.28	8.34	8.22	9.04	0.75	76.7	0.0	-76.7	3,804	3,660	-144	-67.3	-1.1	-2%
Aug-2000	7.20	7.37	7.40	7.32	8.06	0.67	68.3	0.2	-68.1	3,586	3,470	-116	-47.9	-0.8	-1%
Sep-2000	5.22	5.41	5.25	5.29	5.82	0.49	49.4	0.3	-49.1	1,637	1,790	153	202.1	3.3	11%
Oct-2000	3.56	3.49	3.42	3.49	3.84	0.32	32.6	12.9	-19.7	972	1,270	298	317.7	5.2	25%
Nov-2000	1.88	1.79	1.70	1.79	1.97	0.16	16.7	0.9	-15.8	940	1,180	240	255.8	4.3	22%
Dec-2000	1.28	1.23	1.25	1.25	1.38	0.11	11.7	0.7	-11.0	1,126	1,460	334	345.0	5.6	24%
Jan-2001	1.56	1.54	1.48	1.53	1.68	0.14	14.2	15.7	1.5	1,475	1,720	245	243.5	4.0	14%
Feb-2001	2.08	2.05	1.99	2.04	2.24	0.19	19.0	12.0	-7.0	3,142	3,110	-32	-25.0	-0.4	-1%
Mar-2001	4.22	4.15	3.95	4.11	4.52	0.38	38.3	10.7	-27.6	3,451	3,490	39	66.6	1.1	2%
Apr-2001	5.76	5.25	5.15	5.39	5.93	0.49	50.3	7.7	-42.6	2,184	2,130	-54	-11.4	-0.2	-1%
May-2001	9.80	9.22	8.44	9.15	10.07	0.84	85.4	1.1	-84.3	2,611	2,454	-157	-72.7	-1.2	-3%
Jun-2001	9.58	9.24	8.84	9.22	10.14	0.85	86.0	0.2	-85.8	3,077	3,130	53	138.8	2.3	4%
Jul-2001	8.11	8.04	8.00	8.05	8.86	0.74	75.1	0.0	-75.1	3,567	3,560	-7	68.1	1.1	2%
Aug-2001	7.68	7.89	7.77	7.78	8.56	0.71	72.6	0.0	-72.6	3,372	3,440	68	140.6	2.3	4%
Sep-2001	5.80	5.92	5.78	5.83	6.42	0.53	54.4	0.5	-53.9	1,088	1,310	222	275.9	4.6	21%

Prepared by Summers Engineering, Inc. Revised April 2002.

Notes:

(1) - (3)	CIMIS base evapotranspiration in inches
(4)	Average of (1) through (3)
(5) & (6)	Evaporation calculated from ETo. Kc value based on UC Extension leaflet 21427
(7)	(6) x SLD surface area. SLD surface area = 28 mi x 30' top width = 101.8 ac
(8)	Monthly CIMIS precipitation (Tellis, Panoche, and Los Banos) applied to SLD surface area
(9)	(8) - (7)
(10)	Site A discharge in acre feet
(11)	Site B discharge in acre feet
(12)	(11) - (10)
(13)	Net water volume gained from or lost to local high ground water = (12) - (9)
(14)	Average daily flowrate (cfs) of the Net Water Gain
(15)	(14) / (11) x 100%