TECHNICAL M E M O R A N D U M No. 3

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TO: John Gray
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DATE: February 23, 2001
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FROM: Curtis Lawler

JOB NO.: 1815

RE: **Hydrologic Analyses of Surface Water Salinity**

1. INTRODUCTION

This third technical memorandum includes DEIR hydrologic impact analyses concerning surface water salinity for the seven alternatives identified for the Cachuma Water Rights EIR. The previous draft technical memoranda (RE: Impacts of EIR Alternatives Using the Santa Ynez River Hydrology Model, 12/22/2000, rev. 12/22/2001 and RE: Daily Flows for Use in Assessing Impacts on Rainbow Trout/ Steelhead, 1/16/2001, rev. 12/22/2001) provide a detailed discussion on: (a) how these alternatives were incorporated into the model; (b) the results concerning Cachuma Reservoir operations, storage and elevations; (c) Santa Ynez River flows and above Narrows groundwater storage; (d) water right releases and Cachuma Project deliveries; and (e) impacts on spawning, rearing, and passage for rainbow trout/steelhead. Included in this memorandum are the DEIR hydrologic impact analyses for:

- Effects on salinity in Cachuma Reservoir
- Effects on salinity in the surface flow at the Narrows

The focus of this salinity analysis is on the total dissolved solids (TDS) concentration of the Santa Ynez River flow (surface flow) at the Lompoc Narrows. The Santa Ynez River passes through the Lompoc Narrows, then flows across the Lompoc Plain, where the Lompoc Plain ground water basin is located. The dissolved-solids concentration of the groundwater in the central and western Lompoc plains has increased from less than 1,000 milligrams per liter in the 1940s to greater than 2,000 milligrams per liter in the 1960s (USGS, 1997). The surface water flow of Santa Ynez River

reaching the Lompoc Narrows is a significant source of recharge for the Lompoc Plain aquifer. This study has been undertaken, primarily, for the purpose of determining the impacts, if any, of the Cachuma Project operations (including SWP water deliveries) on the dissolved-solids concentrations of surface flow at the Lompoc Narrows.

Separate technical memoranda are provided to you on impacts of Santa Ynez River water salinity in the Lompoc ground water basin for the EIR alternatives using the Lompoc groundwater models (USGS and HCI).

2. METHODOLOGY FOR MODELING SALINITY IN SANTA YNEZ RIVER FROM CACHUMA RESERVOIR TO LOMPOC NARROWS

The methodology used to determine the impacts of the EIR alternatives on surface water salinity includes the use of Santa Ynez River Hydrology Model (SYRHM). Lompoc Basin ground-water models, which are used in conjunction with the results from this surface water model, are run for the periods 1942-1994 (HCI) and 1941-1988 (USGS). The SYRHM salinity model was developed and includes analyses for the overlapping time period of 1942-1993.

2.1 FLOW AND SALT BALANCE

Two basic principles were employed in determining the TDS of the Santa Ynez River at Lompoc Narrows: water balance and salt balance. Figure 1 shows the surface flow components in the water balance as used in the SYRHM. For each of these surface flow components, a surface water salt flux was assigned as part of the salt balance.

Figure 2 shows the key gaged salinity locations and corresponding sub-areas. The key gaged salinity locations are described below (Table 1) and were used in the model calibration and verification process.

TABLE 1
KEY TO SALINITY LOCATIONS FOR
TDS DATA IN SANTA YNEZ RIVER WATERSHED USED TO
DEVELOP SALT LOADING RELATIONSHIPS

LOCATION	NUMBER OF MEASUREMENTS TDS	NUMBER OF MEASUREMENTS EC W/O TDS	PERIOD OF RECORD AVAILABLE	SOURCES
1. SantaYnez River below Los Laureles Canyon	64	21	1951-54, 73, 80, 89, 91-98	USGS
2. Santa Cruz Creek	65	1	1980, 92-98	USGS
3. Cachuma Reservoir at Tecolote Tunnel Intake	618	3	1982-1999	City of Santa Barbara
4. Cachuma Reservoir Near Dam	388	66	1958-1999	USBR, DWR, Lompoc
5. Santa Ynez River near Solvang	223	121	1951-89, 91-98	USGS, DWR, Lompoc
6. Salsipuedes Creek near Lompoc	241	2	1971, 77-98	USGS
7. Santa Ynez River at Narrows near Lompoc	235	8	1962-64, 66-70, 72-88, 91-98	USGS, Lompoc

For each of the five sub-areas shown in Figure 2, input files were created which include loading of dissolved solids into the system based on flow and salt relationships at one of the above gaged locations. Thus, all salinity-flow relationships used are based upon empirical data that exist specifically in the Santa Ynez watershed for tributaries both above and below Cachuma Reservoir. Figures 3a-d show the flow-salt loading relationships per drainage area using actual gaged flow and measured TDS sampling at four key stations.

- Santa Ynez River at Los Laureles
- Santa Cruz Creek near Santa Ynez
- Santa Ynez River at Solvang when Cachuma is not releasing or spilling
- Salsipuedes Creek near Lompoc

Each of the gaging stations corresponds to a sub-area from which the calculated dissolved solids mass is used as an input just like flow accretions are currently utilized in the SYRHM. Due to lack of water quality data for tributaries from Alisal Bridge to Narrows, the flow-salt loading relationship of Santa Ynez River at Solvang when Cachuma is not releasing or spilling was used in combination with the flow-salt loading relationship for the Salsipuedes Creek for this sub-area due to similarities in geologic and hydrologic characteristics.

Because the SYRHM uses a monthly time-step, it was necessary to develop an algorithm that uses the monthly flow input (termed "accretion" files in the Santa Ynez River Hydrology Model manual) and proportions the amount of monthly flow on a daily basis. Daily flows for the period from 1942 through 1993 were calculated separately in an Excel spreadsheet by distributing the monthly accretions from the input files to the pattern of historical daily gaged flows in Salsipuedes Creek for inputs below Cachuma Reservoir and to the pattern of historical daily gaged flows in Santa Cruz Creek for inputs above Cachuma Reservoir. The total volume of water on a monthly basis remained unchanged as provided in the SYRHM. Table 2 shows an example of how flows and salt loads are generated on a daily basis with the monthly sums inputted in the SYRHM.

The results from the SYRHM show that when using the flow and salt loading relationships based on available data, the TDS would be consistently overestimated in Cachuma Reservoir by up to 150 mg/L. In this process, it was discovered that the key factor in modeling TDS in Cachuma Reservoir is the salinity of storm events. However, there are only a few TDS data available for high flow events. Therefore, the salinity of high flows was adjusted to match the observed TDS in the reservoir. This was achieved by reducing all dissolved solid inflows by 15% when the average monthly combined inflow into Lake Cachuma was greater than 75 cfs. After this high flow adjustment, the simulated TDS matches the observed TDS quite well with a standard deviation of 50 mg/L or 9% (see Figure 4). Conceptually, the rationale for adjusting high flows is based on lack of TDS data at high flows and lack of instantaneous flow data.

2.2 ALISAL TO NARROWS SALINITY INCREASE

Another source of salt loading was discovered when WR89-18 releases were made. Increases in TDS concentrations have been observed, but tributary runoff does not exist or is insignificant when

TABLE 2
EXAMPLE OF HOW DAILY FLOWS USED TO CREATE
SALT MASS INPUT FILES
FOR SYRHM

DATE	Salsipuedes Flow USGS ID 1132500 cfs	Salsipuedes SRYHM Accretion Flow Acre-feet	Salsipuedes Salt Mass tons
4/1/41	481	954	497
4/2/41	310	615	356
4/3/41	200	397	255
4/4/41	713	1,414	670
4/5/41	300	595	347
4/6/41	206	409	261
4/7/41	181	359	236
4/8/41	160	317	215
4/9/41	150	298	205
4/10/41	208	413	263
4/11/41	456	904	477
4/12/41	139	276	193
4/13/41	120	238	173
4/14/41	105	208	156
4/15/41	96	190	146
4/16/41	90	179	139
4/17/41	84	167	132
4/18/41	78	155	125
4/19/41	72	143	117
4/20/41	65	129	108
4/21/41	61	121	103
4/22/41	60	119	102
4/23/41	57	113	98
4/24/41	55	109	95
4/25/41	53	105	93
4/26/41	50	99	89
4/27/41	46	91	83
4/28/41	44	87	81
4/29/41	44	87	81
4/30/41	58	115	99
SUM		**9,406**	**5,992**

These monthly totals are then inputed directly into SYRHM

water right releases are made, so the concept of channel loading (currently termed "Alisal to Narrows Salinity Increase" or ANSI) as the cause and nature of the increase of TDS was examined. The nature of the ANSI is complex and is currently handled in the surface water salinity model using the empirical relationship of the ANSI and surface flow based on the available data. However, the dissolved-solids data during water right releases are limited. Using the limited observations (13 samples) made by the USGS during water rights releases and performing a water and salt balance calculation, the average flux of the ANSI is estimated to be about 25 tons/day. In addition, the amount of flux of the ANSI is proportional to the flow as shown in Figure 5. Figure 5 also shows the flow-ANSI relationships used to calculate the amount of salt input in the Buellton, East Santa Rita, and West Santa Rita sub-areas as used in the SYRHM due to the ANSI occurrence.

2.3 SURFACE WATER SALINITY MODEL VERIFICATION

In order to verify SYRHM accuracy regarding simulating TDS at the Narrows, a historical period was run from 1942-1993 (52 years) using historical Cachuma Reservoir operations and downstream water use. This verification run of the SYRHM allows for the opportunity to evaluate the major assumption used in this modeling effort of surface water salinity. The major factor affecting salt flux is the relationship of surface flow with tons of salt as shown in Figures 3a-d.

Because continuous recording of TDS at the Narrows does not exist for the period 1942-1993, the historic monthly salt outflows at the Narrows was independently estimated by using the measured daily flow at the Narrows and the flow-salt loading relationships (based on actual measurements) at the Narrows with and without Cachuma releases (see Figure 6a). This method of calculating salt flux is referred to as the "estimated" historic salt flux at the Narrows. Figure 6b shows that the match between the estimated salt flux and the measured salt flux for the Narrows is very good.

The method of calculating salt flux by the SYRHM is referred to as the model "simulated" salt flux at the Narrows. This method performs the water and salt balance as explained above. Figure 7a shows that the match between the simulated and estimated monthly salt flux at the Lompoc Narrows is very good. The correlation between the plotted points and the 45-degree line is determined as $R^2 = 0.9618$. Figure 7b shows that the TDS-flow relationships as simulated by the SYRHM are quite reasonable when compared with the estimated average monthly and measured instantaneous TDS at the Lompoc

Narrows. Furthermore, Figure 7c shows that the frequency of TDS in flows at the Narrows as simulated by the SYRHM compares favorably with estimated average monthly and measured instantaneous TDS values.

2.4 WATER QUALITY TECHNICAL ADVISORY COMMITTEE

Starting in October 22, 1999, Stetson Engineers has conducted several water quality technical advisory committee meetings for the purpose of pooling raw data and methodologies for modeling salinity in the Santa Ynez River watershed. Stetson would like to thank the following 13 participants of the water quality technical advisory committee for sharing data and contributing in developing concepts for the salinity modeling: Jon Ahlroth, County Water Agency; Chuck Evans, Cachuma Conservation Release Board; Chuck Howard, U.S. Bureau of Reclamation; Steve Mack, City of Santa Barbara; Bruce Wales, Santa Ynez River Water Conservation District; Jeff Lefkoff, consultant for City of Lompoc; Barry Hecht, Jonathan Owens, and Bonnie Mallory, Balance Hydrologics Consulting; Ali Shahroody, Peter Pyle, Martin Liu, Curtis Lawler, and Suleiman Mirzad, Stetson Engineers.

2.5 LIMITATIONS OF THE SURFACE WATER SALINITY MODELING

Of important note is that technical issues regarding the surface water salinity modeling have not reached closure for the above TAC participants (TAC minutes 2000-2001). Currently there are some unresolved technical issues regarding the SYRHM and surface water salinities as indicated by TAC members (Balance Hydrologics, 6/2001). The salinity modeling is also a part of the Lompoc-South Coast negotiations as well as the Cachuma water rights EIR. Several committee members feel technical issues need further review and evaluation before these latest modeling works are used for resolving the question of how the historical operations of the Cachuma Project affected, if at all, the ground water quality of the Lompoc Plain and/or the City of Lompoc. Therefore, the TAC currently supports the application of the surface water salinity modeling for the EIR alternatives and recommends additional work for the Lompoc-South Coast negotiations. Additional work by TAC may or may not affect the results of the current surface water salinity modeling. The current methodology employed in determining surface water salinity in the Santa Ynez River as described above is the best available information to determine the surface water salinity impacts for the EIR alternatives.

The intended use of the SYRHM is for comparative purposes between the EIR alternatives. The simulated salinity data generated from the SYRHM is not meant to be predictive, but it is used as an analytical tool for statistical and comparative purposes. Since the model is used for comparative analyses, some of the inherent inaccuracies in the model are expected to cancel out when comparing the results of one scenario with another.

3. STATE WATER PROJECT IMPORTS

The assumptions regarding the quantity of State Water Project (SWP) imports are discussed in the first technical memorandum (12/22/2000, rev. 12/22/2001) in sections 2.B.3 State Water Project Imports, 2.B.4 Below Narrows Exchange Project (BNE), and 3.G State Water Project Deliveries. A summary of the assumed SWP deliveries for each EIR alternative is shown in Table 3. Annual delivery amounts under Alternatives 2, 3A, 3B, 3C, 4A, and 4B are shown in Tables 4a through e. Alternatives 2, 3A, 3B, 3C, 4A, and 4B would import 10,135 to 10,369 acre-feet per year of SWP water under South Coast contracts or around 74 to 75% of their full entitlement.

3.1 OPTIONS A AND B OF ALTERNATIVE 4, THE BELOW NARROWS EXCHANGE (BNE)

Currently, the BNE is incorporated into the SYRHM by using average Below Narrows deliveries of 1,771 acre-feet per year as an amount for a possible exchange of SWP water with the South Coast member units. Due to Delta shortages in 1992 and the exchange with ID No. 1, SWP water is not available to meet the entire exchange amount of 1,771 acre-feet. The shortage of SWP to meet the BNE in this year (34 acre-feet) is small but could become larger if there are changes in exchange assumptions.

Under Option A of Alternative 4, exchanged BNA water would be provided by direct delivery of SWP water to the City of Lompoc and will be incorporated into the Lompoc groundwater models. Under Option B of Alternative 4, exchanged BNA water would be provided by discharging SWP water to the river near Lompoc for recharge. Under Option B, it was assumed that SWP water would be released for recharge at Lompoc Narrows for practical use in modeling. Also, SWP BNE imports were assumed not to be recharged under Option B at the Narrows in the months of December through June due to imprint of Delta water during the endangered steelhead

TABLE 3						
SUMMMARY OF STATE WATER PROJECT DELIVERIES						
AVERAGE FOR PERIOD 1942-1993						
(ACRE-FEET/YEAR)						
					Total Imports	Total Imports
EIR	ID No. 1	BNA	SWP in	SWP in	under South	as a Percentage
Alternative	Exchange [1)]	Exchange [2)]	Cachuma [3)]	Outlet Works [4)]	Coast Contracts	of 13,750 AF
1	0	0	0	0	0	
2	2,497	0	5,849	1,789	10,135	74%
3A	2,472	0	5,878	1,802	10,152	74%
3B	2,482	0	5,844	1,841	10,167	74%
3C	2,497	0	5,836	1,866	10,199	74%
4 A&B	2,501	1,770	4,853	1,245	10,369	75%
1) Based on shortages in Cachuma Project estimated by the SYRHM 0498						
2) Based on exchange of 1,771 AF each year; actual Below Narrows Exchange might vary in timing and amount.						
3) Based on shortages in SWP from DWRSIM and no deliveries when Cachuma is spilling from SYRHM						
4) SWP reductions in delivery due to restrictions of 50% SWP during water right releases and 0% SWP during passage releases.						

TABLE 4A
SUMMMARY OF STATE WATER PROJECT DELIVERIES
FOR EIR ALTERNATIVE 2
(ACRE-FEET/YEAR)

	DEMAND		SUPPLY			DELIVERY			
			M&I Projected	ID No. 1	Reduced				Total Imports
WATER	TOTAL	ID No. 1	Delivery as Percentage	Exchange	Delivery due	ID No. 1	SWP in	SWP in	under South
YEAR	SWP Demand [1]	Exchange	of Full Entitlement [2]	Shortage [3]	to Spill [4]	Exchange	Cachuma [5]	Outlet Works [6]	Coast Contracts
1942	13,750	2,571	100%	100%	2,370	2,571	8,937	641	12,149
1943	13,750	2,571	89%	100%	3,653	2,571	6,002	0	8,573
1944	13,750	2,571	92%	100%	3,487	2,571	7,623	255	10,449
1945	13,750	2,571	90%	100%	2,448	2,571	7,811	1,285	11,667
1946	13,750	2,571	88%	100%	2,012	2,571	5,313	2,801	10,685
1947	13,750	2,571	75%	100%	0	2,571	3,485	4,260	10,316
1948	13,750	2,571	67%	100%	1,351	2,571	4,856	1,744	9,171
1949	13,750	2,571	65%	92%	914	2,372	5,847	753	8,972
1950	13,750	2,571	67%	77%	1,118	1,989	6,419	757	9,165
1951	13,750	2,571	88%	62%	2,788	1,590	9,919	520	12,029
1952	13,750	2,571	96%	90%	2,551	2,320	6,314	1,990	10,624
1953	13,750	2,571	90%	100%	0	2,571	7,432	2,706	12,709
1954	13,750	2,571	83%	100%	598	2,571	5,218	3,776	11,565
1955	13,750	2,571	69%	100%	1,898	2,571	4,829	2,251	9,651
1956	13,750	2,571	90%	98%	2,528	2,509	8,401	1,460	12,370
1957	13,750	2,571	88%	87%	2,934	2,244	7,355	3,018	12,617
1958	13,750	2,571	90%	94%	4,732	2,414	7,039	285	9,737
1959	13,750	2,571	88%	100%	0	2,571	6,959	2,601	12,131
1960	13,750	2,571	63%	100%	222	2,571	3,826	2,097	8,494
1961	13,750	2,571	61%	100%	750	2,568	5,140	695	8,403
1962	13,750	2,571	78%	100%	1,712	2,569	6,746	1,379	10,694
1963	13,750	2,571	94%	100%	1,316	2,571	8,810	1,252	12,633
1964	13,750	2,571	88%	100%	1,388	2,571	8,772	1,040	12,383
1965	13,750	2,571	82%	98%	2,180	2,524	6,134	2,114	10,772
1966	13,750	2,571	96%	99%	0	2,557	9,164	1,946	13,667
1967	13,750	2,571	96%	100%	4,224	2,571	3,712	2,916	9,199
1968	13,750	2,571	89%	100%	1,717	2,571	5,816	4,087	12,474
1969	13,750	2,571	93%	100%	5,477	2,571	4,630	1,070	8,271
1970	13,750	2,571	89%	100%	1,080	2,571	6,308	3,061	11,940
1971	13,750	2,571	94%	100%	1,526	2,571	5,042	5,367	12,980
1972	13,750	2,571	88%	100%	1,214	2,571	4,464	4,595	11,630
1973	13,750	2,571	82%	100%	1,794	2,571	6,373	1,320	10,264
1974	13,750	2,571	94%	100%	1,890	2,571	7,104	2,293	11,968
1975	13,750	2,571	96%	100%	2,882	2,571	8,420	291	11,282
1976	13,750	2,571	88%	100%	22	2,571	6,391	3,457	12,419
1977	13,750	2,571	33%	100%	56	2,571	1,495	524	4,590
1978	13,750	2,571	68%	100%	2,080	2,571	4,704	0	7,275
1979	13,750	2,571	85%	100%	2,755	2,571	6,695	431	9,697
1980	13,750	2,571	82%	100%	3,438	2,571	5,531	411	8,513
1981	13,750	2,571	83%	100%	1,238	2,571	7,151	1,926	11,648
1982	13,750	2,571	94%	100%	808	2,571	6,899	3,416	12,886
1983	13,750	2,571	100%	100%	5,254	2,571	4,901	1,025	8,497
1984	13,750	2,571	100%	100%	3,523	2,571	6,553	2,695	11,819
1985	13,750	2,571	96%	100%	1,862	2,571	7,176	2,957	12,704
1986	13,750	2,571	81%	100%	2,198	2,571	6,219	1,071	9,861
1987	13,750	2,571	69%	100%	300	2,571	5,850	1,130	9,551
1988	13,750	2,571	43%	100%	0	2,571	2,121	1,228	5,920
1989	13,750	2,571	58%	95%	1,293	2,448	3,163	2,309	7,920
1990	13,750	2,571	46%	81%	1,212	2,077	2,776	1,092	5,944
1991	13,750	2,571	29%	81%	26	2,082	1,336	1,049	4,467
1992	13,750	2,571	31%	96%	108	2,478	1,143	578	4,200
1993	13,750	2,571	76%	100%	3,729	2,571	3,841	1,089	7,501
AVG	13,750	2,571	80%	97%	1,820	2,497	5,849	1,789	10,135

NOTES

1) Based on total South Coast contractual agreements with CCWA

2) Based on DWR's SWP model DWRSIM v. 9.06T
Uses results from DWR's No Action scenario 786 which uses Delta historic hydrology
with regulations (including 1995 WQCP Bay-Delta Accord, 1997 AFRP CVPIA(b) and the New Melones Interim Operation plan)
and no new storage facilities.
The percentages in this table do not include the option of purchasing the 10% drought buffer.

3) Based on shortages in Cachuma Project estimated by the SYRHM 0498

4) Assumes no CCWA deliveries when Cachuma is spilling and also that South Coast would not want to make-up that delivery water
because of the wetness of the basin and already assuming full deliveries of 13750 pending spills

5) SWP reductions in delivery (due to restrictions of 50% SWP during water right releases and 0% SWP during passage releases)
are redistributed to the following months up to one year.

6) Limited to being 50% of outlet releases

TABLE 4B

SUMMMARY OF STATE WATER PROJECT DELIVERIES

FOR EIR ALTERNATIVE 3A

(ACRE-FEET/YEAR)

	DEMAND		SUPPLY			DELIVERY			
WATER YEAR	TOTAL SWP Demand [1]	ID No. 1 Exchange	M&I Projected Delivery as Percentage of Full Entitlement [2]	ID No. 1 Exchange Shortage [3]	Reduced Delivery due to Spill [4]	ID No. 1 Exchange	SWP in Cachuma [5]	SWP in Outlet Works [6]	Total Imports under South Coast Contracts
1942	13,750	2,571	100%	100%	1,602	2,571	9,059	519	12,149
1943	13,750	2,571	89%	100%	3,653	2,571	6,002	0	8,573
1944	13,750	2,571	92%	100%	2,157	2,571	7,878	0	10,449
1945	13,750	2,571	90%	100%	1,410	2,571	7,308	1,121	11,000
1946	13,750	2,571	88%	100%	678	2,571	5,399	3,382	11,352
1947	13,750	2,571	75%	100%	0	2,571	3,485	4,260	10,316
1948	13,750	2,571	67%	100%	0	2,571	4,908	1,692	9,171
1949	13,750	2,571	65%	90%	0	2,305	5,613	1,054	8,972
1950	13,750	2,571	67%	71%	0	1,831	6,015	1,319	9,164
1951	13,750	2,571	88%	54%	0	1,390	10,120	520	12,029
1952	13,750	2,571	96%	88%	2,561	2,274	6,824	1,513	10,610
1953	13,750	2,571	90%	100%	0	2,571	6,423	3,416	12,410
1954	13,750	2,571	83%	100%	0	2,571	4,815	4,075	11,461
1955	13,750	2,571	69%	100%	0	2,571	3,780	3,809	10,160
1956	13,750	2,571	90%	96%	0	2,466	7,736	1,604	11,806
1957	13,750	2,571	88%	83%	0	2,143	6,536	3,351	12,030
1958	13,750	2,571	90%	92%	1,639	2,374	8,111	285	10,770
1959	13,750	2,571	88%	100%	0	2,571	6,180	3,279	12,030
1960	13,750	2,571	63%	100%	0	2,571	4,467	1,557	8,595
1961	13,750	2,571	61%	97%	0	2,499	5,201	701	8,401
1962	13,750	2,571	78%	99%	0	2,539	6,437	1,719	10,695
1963	13,750	2,571	94%	100%	0	2,571	9,225	1,190	12,986
1964	13,750	2,571	88%	100%	0	2,571	8,415	1,044	12,030
1965	13,750	2,571	82%	95%	0	2,446	5,641	3,182	11,268
1966	13,750	2,571	96%	99%	0	2,534	8,695	1,952	13,181
1967	13,750	2,571	96%	100%	4,224	2,571	2,492	3,888	8,951
1968	13,750	2,571	89%	100%	0	2,571	6,867	2,788	12,226
1969	13,750	2,571	93%	100%	3,869	2,571	5,278	1,077	8,926
1970	13,750	2,571	89%	100%	0	2,571	6,669	2,986	12,226
1971	13,750	2,571	94%	100%	0	2,571	5,439	4,976	12,986
1972	13,750	2,571	88%	100%	0	2,571	4,523	4,936	12,030
1973	13,750	2,571	82%	100%	1,246	2,571	6,651	797	10,019
1974	13,750	2,571	94%	100%	746	2,571	7,276	2,393	12,240
1975	13,750	2,571	96%	100%	1,520	2,571	8,410	674	11,655
1976	13,750	2,571	88%	100%	0	2,571	7,505	1,954	12,030
1977	13,750	2,571	33%	100%	0	2,571	1,640	368	4,579
1978	13,750	2,571	68%	100%	2,080	2,571	4,704	0	7,275
1979	13,750	2,571	85%	100%	1,953	2,571	6,740	386	9,697
1980	13,750	2,571	82%	100%	2,666	2,571	6,028	0	8,599
1981	13,750	2,571	83%	100%	0	2,571	6,719	2,171	11,461
1982	13,750	2,571	94%	100%	0	2,571	5,824	4,590	12,985
1983	13,750	2,571	100%	100%	5,254	2,571	5,926	0	8,497
1984	13,750	2,571	100%	100%	2,403	2,571	7,753	1,024	11,348
1985	13,750	2,571	96%	100%	1	2,571	7,687	2,917	13,175
1986	13,750	2,571	81%	100%	1,220	2,571	6,230	1,060	9,861
1987	13,750	2,571	69%	100%	0	2,571	6,071	909	9,551
1988	13,750	2,571	43%	100%	0	2,571	1,881	1,468	5,920
1989	13,750	2,571	58%	92%	1	2,369	3,619	2,032	8,020
1990	13,750	2,571	46%	74%	0	1,899	3,449	959	6,306
1991	13,750	2,571	29%	75%	0	1,927	963	1,119	4,009
1992	13,750	2,571	31%	95%	0	2,447	1,170	587	4,204
1993	13,750	2,571	76%	100%	2,999	2,571	3,847	1,083	7,501
AVG	13,750	2,571	80%	96%	844	2,472	5,878	1,802	10,152

NOTES

1) Based on total South Coast contractual agreements with CCWA

2) Based on DWR's SWP model DWRSIM v. 9.06T
Uses results from DWR's No Action scenario 786 which uses Delta historic hydrology
with regulations (including 1995 WQCP Bay-Delta Accord, 1997 AFRP CVPIA(b) and the New Melones Interim Operation plan)
and no new storage facilities.
The percentages in this table do not include the option of purchasing the 10% drought buffer.

3) Based on shortages in Cachuma Project estimated by the SYRHM 0498

4) Assumes no CCWA deliveries when Cachuma is spilling and also that South Coast would not want to make-up that delivery water
because of the wetness of the basin and already assuming full deliveries of 13750 pending spills

5) SWP reductions in delivery (due to restrictions of 50% SWP during water right releases and 0% SWP during passage releases)
are redistributed to the following months up to one year.

6) Limited to being 50% of outlet releases

TABLE 4C
SUMMMARY OF STATE WATER PROJECT DELIVERIES
FOR EIR ALTERNATIVE 3B
(ACRE-FEET/YEAR)

	DEMAND		SUPPLY			DELIVERY			
			M&I Projected	ID No. 1	Reduced				Total Imports
WATER	TOTAL	ID No. 1	Delivery as Percentage	Exchange	Delivery due	ID No. 1	SWP in	SWP in	under South
YEAR	SWP Demand [1]	Exchange	of Full Entitlement [2]	Shortage [3]	to Spill [4]	Exchange	Cachuma [5]	Outlet Works [6]	Coast Contracts
1942	13,750	2,571	100%	100%	1,602	2,571	9,058	520	12,149
1943	13,750	2,571	89%	100%	3,653	2,571	6,002	0	8,573
1944	13,750	2,571	92%	100%	2,157	2,571	7,878	0	10,449
1945	13,750	2,571	90%	100%	1,410	2,571	7,308	1,121	11,000
1946	13,750	2,571	88%	100%	678	2,571	4,446	4,335	11,352
1947	13,750	2,571	75%	100%	0	2,571	3,485	4,260	10,316
1948	13,750	2,571	67%	100%	0	2,571	4,991	1,609	9,171
1949	13,750	2,571	65%	91%	0	2,333	5,886	757	8,976
1950	13,750	2,571	67%	73%	0	1,883	5,997	1,289	9,168
1951	13,750	2,571	88%	56%	0	1,445	10,065	520	12,030
1952	13,750	2,571	96%	89%	1,779	2,286	7,147	1,965	11,398
1953	13,750	2,571	90%	100%	0	2,571	6,497	3,342	12,410
1954	13,750	2,571	83%	100%	0	2,571	3,932	4,958	11,461
1955	13,750	2,571	69%	100%	0	2,571	3,780	3,199	9,550
1956	13,750	2,571	90%	97%	0	2,498	8,357	1,561	12,416
1957	13,750	2,571	88%	86%	0	2,200	6,481	3,351	12,031
1958	13,750	2,571	90%	93%	1,637	2,393	8,101	285	10,779
1959	13,750	2,571	88%	100%	0	2,571	6,180	3,279	12,030
1960	13,750	2,571	63%	100%	0	2,571	3,936	2,088	8,595
1961	13,750	2,571	61%	98%	0	2,531	5,173	698	8,402
1962	13,750	2,571	78%	99%	0	2,553	6,418	1,718	10,689
1963	13,750	2,571	94%	100%	0	2,571	9,225	1,190	12,986
1964	13,750	2,571	88%	100%	0	2,571	8,415	1,044	12,030
1965	13,750	2,571	82%	96%	0	2,469	5,599	3,198	11,266
1966	13,750	2,571	96%	99%	0	2,541	8,685	1,950	13,176
1967	13,750	2,571	96%	100%	4,224	2,571	2,492	3,888	8,951
1968	13,750	2,571	89%	100%	0	2,571	7,045	2,610	12,226
1969	13,750	2,571	93%	100%	3,869	2,571	5,278	1,077	8,926
1970	13,750	2,571	89%	100%	0	2,571	6,669	2,986	12,226
1971	13,750	2,571	94%	100%	0	2,571	4,685	5,730	12,986
1972	13,750	2,571	88%	100%	1	2,571	4,257	5,202	12,030
1973	13,750	2,571	82%	100%	1,246	2,571	6,651	797	10,019
1974	13,750	2,571	94%	100%	746	2,571	7,270	2,398	12,239
1975	13,750	2,571	96%	100%	1,520	2,571	8,400	684	11,655
1976	13,750	2,571	88%	100%	0	2,571	7,858	1,601	12,030
1977	13,750	2,571	33%	100%	0	2,571	1,640	368	4,579
1978	13,750	2,571	68%	100%	2,080	2,571	4,704	0	7,275
1979	13,750	2,571	85%	100%	1,953	2,571	6,726	400	9,697
1980	13,750	2,571	82%	100%	2,666	2,571	6,028	0	8,599
1981	13,750	2,571	83%	100%	0	2,571	7,019	1,871	11,461
1982	13,750	2,571	94%	100%	0	2,571	5,824	4,590	12,985
1983	13,750	2,571	100%	100%	5,254	2,571	5,926	0	8,497
1984	13,750	2,571	100%	100%	2,403	2,571	7,752	1,025	11,348
1985	13,750	2,571	96%	100%	1	2,571	7,687	2,917	13,175
1986	13,750	2,571	81%	100%	1,220	2,571	6,228	1,062	9,861
1987	13,750	2,571	69%	100%	0	2,571	6,067	913	9,551
1988	13,750	2,571	43%	100%	0	2,571	1,881	1,468	5,920
1989	13,750	2,571	58%	93%	0	2,404	3,513	2,107	8,024
1990	13,750	2,571	46%	76%	0	1,961	3,388	953	6,302
1991	13,750	2,571	29%	77%	0	1,975	917	1,122	4,014
1992	13,750	2,571	31%	96%	0	2,457	1,105	640	4,202
1993	13,750	2,571	76%	100%	2,999	2,571	3,849	1,081	7,501
AVG	13,750	2,571	80%	97%	829	2,482	5,844	1,841	10,167

NOTES

1) Based on total South Coast contractual agreements with CCWA

2) Based on DWR's SWP model DWRSIM v. 9.06T
Uses results from DWR's No Action scenario 786 which uses Delta historic hydrology
with regulations (including 1995 WQCP Bay-Delta Accord, 1997 AFRP CVPIA(b) and the New Melones Interim Operation plan)
and no new storage facilities.
The percentages in this table do not include the option of purchasing the 10% drought buffer.

3) Based on shortages in Cachuma Project estimated by the SYRHM 0498

4) Assumes no CCWA deliveries when Cachuma is spilling and also that South Coast would not want to make-up that delivery water
because of the wetness of the basin and already assuming full deliveries of 13750 pending spills

5) SWP reductions in delivery (due to restrictions of 50% SWP during water right releases and 0% SWP during passage releases)
are redistributed to the following months up to one year.

6) Limited to being 50% of outlet releases

TABLE 4D
SUMMMARY OF STATE WATER PROJECT DELIVERIES
FOR EIR ALTERNATIVE 3C
(ACRE-FEET/YEAR)

DEMAND			SUPPLY			DELIVERY			
			M&I Projected	ID No. 1	Reduced				Total Imports
WATER	TOTAL	ID No. 1	Delivery as Percentage	Exchange	Delivery due	ID No. 1	SWP in	SWP in	under South
YEAR	SWP Demand [1]	Exchange	of Full Entitlement [2]	Shortage [3]	to Spill [4]	Exchange	Cachuma [5]	Outlet Works [6]	Coast Contracts
1942	13,750	2,571	100%	100%	1,602	2,571	9,057	521	12,149
1943	13,750	2,571	89%	100%	2,768	2,571	6,887	0	9,458
1944	13,750	2,571	92%	100%	2,157	2,571	7,878	0	10,449
1945	13,750	2,571	90%	100%	1,410	2,571	7,308	1,121	11,000
1946	13,750	2,571	88%	100%	678	2,571	4,446	4,335	11,352
1947	13,750	2,571	75%	100%	0	2,571	3,485	4,260	10,316
1948	13,750	2,571	67%	100%	0	2,571	5,049	1,551	9,171
1949	13,750	2,571	65%	93%	0	2,393	5,630	951	8,974
1950	13,750	2,571	67%	78%	0	2,000	5,850	1,319	9,169
1951	13,750	2,571	88%	62%	0	1,582	9,931	520	12,032
1952	13,750	2,571	96%	90%	1,773	2,317	7,092	1,990	11,399
1953	13,750	2,571	90%	100%	0	2,571	6,497	3,342	12,410
1954	13,750	2,571	83%	100%	0	2,571	4,302	4,588	11,461
1955	13,750	2,571	69%	100%	1	2,571	3,868	3,112	9,551
1956	13,750	2,571	90%	98%	0	2,529	8,324	1,558	12,411
1957	13,750	2,571	88%	88%	0	2,270	6,739	3,026	12,035
1958	13,750	2,571	90%	94%	1,632	2,420	8,075	285	10,780
1959	13,750	2,571	88%	100%	0	2,571	6,180	3,279	12,030
1960	13,750	2,571	63%	100%	0	2,571	3,936	2,088	8,595
1961	13,750	2,571	61%	100%	0	2,563	5,145	695	8,403
1962	13,750	2,571	78%	100%	0	2,567	6,399	1,726	10,692
1963	13,750	2,571	94%	100%	0	2,571	9,221	1,194	12,986
1964	13,750	2,571	88%	100%	0	2,571	8,415	1,044	12,030
1965	13,750	2,571	82%	97%	0	2,497	5,557	3,216	11,270
1966	13,750	2,571	96%	99%	0	2,549	8,680	1,948	13,177
1967	13,750	2,571	96%	100%	3,464	2,571	3,252	3,888	9,711
1968	13,750	2,571	89%	100%	0	2,571	6,871	2,784	12,226
1969	13,750	2,571	93%	100%	3,870	2,571	5,279	1,076	8,926
1970	13,750	2,571	89%	100%	0	2,571	6,669	2,986	12,226
1971	13,750	2,571	94%	100%	0	2,571	4,685	5,730	12,986
1972	13,750	2,571	88%	100%	0	2,571	4,257	5,202	12,030
1973	13,750	2,571	82%	100%	1,246	2,571	6,651	797	10,019
1974	13,750	2,571	94%	100%	746	2,571	7,166	2,502	12,239
1975	13,750	2,571	96%	100%	1,520	2,571	8,308	776	11,655
1976	13,750	2,571	88%	100%	0	2,571	7,857	1,602	12,030
1977	13,750	2,571	33%	100%	0	2,571	1,640	368	4,579
1978	13,750	2,571	68%	100%	2,080	2,571	4,704	0	7,275
1979	13,750	2,571	85%	100%	1,953	2,571	6,687	439	9,697
1980	13,750	2,571	82%	100%	2,666	2,571	6,028	0	8,599
1981	13,750	2,571	83%	100%	1	2,571	6,720	2,170	11,461
1982	13,750	2,571	94%	100%	0	2,571	5,804	4,611	12,986
1983	13,750	2,571	100%	100%	5,254	2,571	5,926	0	8,497
1984	13,750	2,571	100%	100%	2,403	2,571	7,752	1,025	11,348
1985	13,750	2,571	96%	100%	1	2,571	7,687	2,917	13,175
1986	13,750	2,571	81%	100%	1,220	2,571	6,226	1,064	9,861
1987	13,750	2,571	69%	100%	0	2,571	5,863	1,117	9,551
1988	13,750	2,571	43%	100%	0	2,571	1,334	2,015	5,920
1989	13,750	2,571	58%	95%	0	2,450	3,017	2,555	8,022
1990	13,750	2,571	46%	80%	0	2,062	3,299	944	6,304
1991	13,750	2,571	29%	80%	0	2,057	894	1,059	4,010
1992	13,750	2,571	31%	96%	0	2,472	1,097	636	4,205
1993	13,750	2,571	76%	100%	2,999	2,571	3,846	1,084	7,501
AVG	13,750	2,571	80%	97%	797	2,497	5,836	1,866	10,199

NOTES

1) Based on total South Coast contractual agreements with CCWA

2) Based on DWR's SWP model DWRSIM v. 9.06T
Uses results from DWR's No Action scenario 786 which uses Delta historic hydrology
with regulations (including 1995 WQCP Bay-Delta Accord, 1997 AFRP CVPIA(b) and the New Melones Interim Operation plan)
and no new storage facilities.
The percentages in this table do not include the option of purchasing the 10% drought buffer.

3) Based on shortages in Cachuma Project estimated by the SYRHM 0498

4) Assumes no CCWA deliveries when Cachuma is spilling and also that South Coast would not want to make-up that delivery water
because of the wetness of the basin and already assuming full deliveries of 13750 pending spills

5) SWP reductions in delivery (due to restrictions of 50% SWP during water right releases and 0% SWP during passage releases)
are redistributed to the following months up to one year.

6) Limited to being 50% of outlet releases

TABLE 4E

SUMMMARY OF STATE WATER PROJECT DELIVERIES

FOR EIR ALTERNATIVE 4A&B

(ACRE-FEET/YEAR)

	DEMAND			SUPPLY				DELIVERY				
WATER YEAR	TOTAL SWP Demand [1]	ID No. 1 Exchange	BNA Exchange	M&I Projected Delivery as Percentage of Full Entitlement [2]	ID No. 1 Exchange Shortage [3]	BNA Exchange Shortage	Reduced Delivery due to Spill [4]	ID No. 1 Exchange	BNA Exchange	SWP in Cachuma [5]	SWP in Outlet Works [6]	Total Imports under South Coast Contracts
1942	13,750	2,571	1,771	100%	100%	none	674	2,571	1,771	8,197	533	13,072
1943	13,750	2,571	1,771	89%	100%	none	2,260	2,571	1,771	5,619	0	9,961
1944	13,750	2,571	1,771	92%	100%	none	1,776	2,571	1,771	6,483	0	10,825
1945	13,750	2,571	1,771	90%	100%	none	1,156	2,571	1,771	5,554	1,360	11,256
1946	13,750	2,571	1,771	88%	100%	none	551	2,571	1,771	4,996	2,143	11,481
1947	13,750	2,571	1,771	75%	100%	none	0	2,571	1,771	4,328	1,641	10,311
1948	13,750	2,571	1,771	67%	100%	none	1	2,571	1,771	3,191	1,632	9,165
1949	13,750	2,571	1,771	65%	96%	none	0	2,473	1,771	4,136	597	8,977
1950	13,750	2,571	1,771	67%	82%	none	0	2,106	1,771	4,706	584	9,167
1951	13,750	2,571	1,771	88%	64%	none	0	1,636	1,771	8,107	520	12,034
1952	13,750	2,571	1,771	96%	90%	none	1,484	2,322	1,771	5,936	1,666	11,695
1953	13,750	2,571	1,771	90%	100%	none	0	2,571	1,771	5,881	2,189	12,412
1954	13,750	2,571	1,771	83%	100%	none	0	2,571	1,771	4,643	2,471	11,456
1955	13,750	2,571	1,771	69%	100%	none	0	2,571	1,771	2,819	2,385	9,546
1956	13,750	2,571	1,771	90%	99%	none	0	2,549	1,771	6,517	1,577	12,413
1957	13,750	2,571	1,771	88%	89%	none	0	2,285	1,771	4,937	3,040	12,033
1958	13,750	2,571	1,771	90%	94%	none	1,343	2,420	1,771	6,595	285	11,070
1959	13,750	2,571	1,771	88%	100%	none	0	2,571	1,771	6,280	1,410	12,032
1960	13,750	2,571	1,771	63%	100%	none	0	2,571	1,771	3,085	1,170	8,597
1961	13,750	2,571	1,771	61%	99%	none	0	2,550	1,771	3,549	534	8,404
1962	13,750	2,571	1,771	78%	100%	none	0	2,562	1,771	5,039	1,322	10,694
1963	13,750	2,571	1,771	94%	100%	none	0	2,571	1,771	7,437	1,202	12,981
1964	13,750	2,571	1,771	88%	100%	none	0	2,571	1,771	6,808	882	12,032
1965	13,750	2,571	1,771	82%	95%	none	1	2,432	1,771	4,474	2,592	11,269
1966	13,750	2,571	1,771	96%	98%	none	0	2,530	1,771	7,250	1,628	13,179
1967	13,750	2,571	1,771	96%	100%	none	2,886	2,571	1,771	4,690	1,259	10,291
1968	13,750	2,571	1,771	89%	100%	none	0	2,571	1,771	5,983	1,896	12,221
1969	13,750	2,571	1,771	93%	100%	none	3,199	2,571	1,771	4,180	1,076	9,598
1970	13,750	2,571	1,771	89%	100%	none	0	2,571	1,771	6,682	1,197	12,221
1971	13,750	2,571	1,771	94%	100%	none	0	2,571	1,771	5,923	2,716	12,981
1972	13,750	2,571	1,771	88%	100%	none	0	2,571	1,771	5,179	2,511	12,032
1973	13,750	2,571	1,771	82%	100%	none	992	2,571	1,771	5,298	635	10,275
1974	13,750	2,571	1,771	94%	100%	none	0	2,571	1,771	6,393	2,246	12,981
1975	13,750	2,571	1,771	96%	100%	none	1,266	2,571	1,771	6,343	1,225	11,910
1976	13,750	2,571	1,771	88%	100%	none	0	2,571	1,771	5,939	1,751	12,032
1977	13,750	2,571	1,771	33%	100%	none	0	2,571	1,771	195	44	4,581
1978	13,750	2,571	1,771	68%	100%	none	1,537	2,571	1,771	3,478	0	7,820
1979	13,750	2,571	1,771	85%	100%	none	1,572	2,571	1,771	5,225	513	10,080
1980	13,750	2,571	1,771	82%	100%	none	2,123	2,571	1,771	4,235	567	9,144
1981	13,750	2,571	1,771	83%	100%	none	0	2,571	1,771	5,404	1,710	11,456
1982	13,750	2,571	1,771	94%	100%	none	0	2,571	1,771	6,267	2,371	12,980
1983	13,750	2,571	1,771	100%	100%	none	4,420	2,571	1,771	4,276	708	9,326
1984	13,750	2,571	1,771	100%	100%	none	2,022	2,571	1,771	6,520	862	11,724
1985	13,750	2,571	1,771	96%	100%	none	0	2,571	1,771	6,242	2,593	13,177
1986	13,750	2,571	1,771	81%	100%	none	966	2,571	1,771	4,827	941	10,110
1987	13,750	2,571	1,771	69%	100%	none	0	2,571	1,771	4,390	814	9,546
1988	13,750	2,571	1,771	43%	100%	none	0	2,571	1,771	1,145	435	5,922
1989	13,750	2,571	1,771	58%	96%	none	0	2,460	1,771	2,297	1,492	8,019
1990	13,750	2,571	1,771	46%	81%	none	0	2,073	1,771	1,693	762	6,298
1991	13,750	2,571	1,771	29%	80%	none	0	2,044	1,771	88	108	4,011
1992	13,750	2,571	1,771	31%	96%	34	0	2,465	1,737	0	0	4,202
1993	13,750	2,571	1,771	76%	100%	none	2,333	2,571	1,771	2,902	930	8,174
AVG	13,750	2,571	1,771	80%	97%	1	626	2,501	1,770	4,853	1,245	10,369

NOTES

1) Based on total South Coast contractual agreements with CCWA

2) Based on DWR's SWP model DWRSIM v. 9.06T
Uses results from DWR's No Action scenario 786 which uses Delta historic hydrology
with regulations (including 1995 WQCP Bay-Delta Accord, 1997 AFRP CVPIA(b) and the New Melones Interim Operation plan)
and no new storage facilities.
The percentages in this table do not include the option of purchasing the 10% drought buffer.

3) Based on shortages in Cachuma Project estimated by the SYRHM 0498

4) Assumes no CCWA deliveries when Cachuma is spilling and also that South Coast would not want to make-up that delivery water
because of the wetness of the basin and already assuming full deliveries of 13750 pending spills

5) SWP reductions in delivery (due to restrictions of 50% SWP during water right releases and 0% SWP during passage releases)
are redistributed to the following months up to one year.

6) Limited to being 50% of outlet releases

passage and spawning period. Also, SWP BNE imports were assumed not to occur when flow at the Narrows was greater than 0.5 cfs. Table 5 shows the SWP imports discharged in the Santa Ynez River at the Lompoc Narrows for recharge under Option B. Alternative 4 might still be affected by changes in exchange assumptions and additional analyses might be performed based on further refinements, if necessary.

3.2 Salinity of SWP Imports

The TDS concentration of the SWP deliveries being imported are shown in Figure 8. From 1968 to 1993, the historical measured TDS in the California Aqueduct near Kettleman City was used directly. The TDS concentration from 1942 to 1967 was estimated by using monthly average values of historic measured data (Figure 9) and average annual TDS values based on regression analysis with shortages in the Delta (Figure 10).

4. RESULTS OF SURFACE WATER SALINITY MODELING OF EIR ALTERNATIVES

4.1 Cachuma Reservoir

Figure 11 shows the Cachuma TDS for each alternative. (Note: Because Alternatives 3A and 3B are very similar to 3C, only 3C is shown on this graph and the rest of the graphs that deal with TDS). Alternative 1 has the highest TDS due to no imports of SWP. All of the TDS concentrations are very similar, except during droughts when the amount of storage in Cachuma decreases so that SWP imports become a larger percentage of the storage.

4.2 Water Rights Releases (WR 89-18)

Figure 12a shows the frequency of TDS concentrations in water rights releases directly below the dam. SWP mixing in the outlet works is limited to 50% of the WR89-18 release, and SWP imports are typically about 300 mg/L lower in TDS concentration than the TDS in Cachuma Reservoir. For these reasons, the TDS of WR89-18 releases under Alternative 2, 3A, 3B, 3C, 4A, and 4B are typically about 150 mg/L lower than Alternative 1 as shown in Figure 12a. In Alternative 4, even though no Below Narrows Account releases take place under the Below Narrows Exchange (BNE), it was still assumed to mix SWP imports in the outlet works for Above Narrows Account releases.

TABLE 5

Alternative 4 - Below Narrows Exchange, Option B

SWP Imports Discharged into the River near Lompoc Narrows for Recharge (acre-feet/month)

Water Year	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	SUM
1942	0	0	***0***	***0***	***0***	***0***	***0***	***0***	***0***	0	0	0	0
1943	0	0	***0***	***0***	***0***	***0***	***0***	***0***	***0***	0	0	0	0
1944	0	0	***0***	***0***	***0***	***0***	***0***	***0***	***0***	0	0	0	0
1945	446	0	***0***	***0***	***0***	***0***	***0***	***0***	***0***	446	446	432	1,771
1946	359	347	***0***	***0***	***0***	***0***	***0***	***0***	***0***	359	359	347	1,771
1947	446	0	***0***	***0***	***0***	***0***	***0***	***0***	***0***	446	446	432	1,771
1948	359	347	***0***	***0***	***0***	***0***	***0***	***0***	***0***	359	359	347	1,771
1949	359	347	***0***	***0***	***0***	***0***	***0***	***0***	***0***	359	359	347	1,771
1950	359	347	***0***	***0***	***0***	***0***	***0***	***0***	***0***	359	359	347	1,771
1951	359	347	***0***	***0***	***0***	***0***	***0***	***0***	***0***	359	359	347	1,771
1952	450	435	***0***	***0***	***0***	***0***	***0***	***0***	***0***	450	0	435	1,771
1953	446	0	***0***	***0***	***0***	***0***	***0***	***0***	***0***	446	446	432	1,771
1954	446	432	***0***	***0***	***0***	***0***	***0***	***0***	***0***	446	446	0	1,771
1955	450	435	***0***	***0***	***0***	***0***	***0***	***0***	***0***	450	0	435	1,771
1956	450	435	***0***	***0***	***0***	***0***	***0***	***0***	***0***	0	450	435	1,771
1957	450	435	***0***	***0***	***0***	***0***	***0***	***0***	***0***	450	0	435	1,771
1958	900	871	***0***	***0***	***0***	***0***	***0***	***0***	***0***	0	0	0	1,771
1959	0	0	***0***	***0***	***0***	***0***	***0***	***0***	***0***	597	597	578	1,771
1960	450	435	***0***	***0***	***0***	***0***	***0***	***0***	***0***	450	0	435	1,771
1961	446	0	***0***	***0***	***0***	***0***	***0***	***0***	***0***	446	446	432	1,771
1962	450	435	***0***	***0***	***0***	***0***	***0***	***0***	***0***	0	450	435	1,771
1963	450	435	***0***	***0***	***0***	***0***	***0***	***0***	***0***	0	450	435	1,771
1964	359	347	***0***	***0***	***0***	***0***	***0***	***0***	***0***	359	359	347	1,771
1965	450	435	***0***	***0***	***0***	***0***	***0***	***0***	***0***	0	450	435	1,771
1966	446	0	***0***	***0***	***0***	***0***	***0***	***0***	***0***	446	446	432	1,771
1967	603	584	***0***	***0***	***0***	***0***	***0***	***0***	***0***	0	0	584	1,771
1968	359	347	***0***	***0***	***0***	***0***	***0***	***0***	***0***	359	359	347	1,771
1969	900	871	***0***	***0***	***0***	***0***	***0***	***0***	***0***	0	0	0	1,771
1970	0	0	***0***	***0***	***0***	***0***	***0***	***0***	***0***	597	597	578	1,771
1971	446	0	***0***	***0***	***0***	***0***	***0***	***0***	***0***	446	446	432	1,771
1972	359	347	***0***	***0***	***0***	***0***	***0***	***0***	***0***	359	359	347	1,771
1973	597	0	***0***	***0***	***0***	***0***	***0***	***0***	***0***	0	597	578	1,771
1974	359	347	***0***	***0***	***0***	***0***	***0***	***0***	***0***	359	359	347	1,771
1975	603	584	***0***	***0***	***0***	***0***	***0***	***0***	***0***	0	0	584	1,771
1976	0	0	***0***	***0***	***0***	***0***	***0***	***0***	***0***	597	597	578	1,771
1977	359	347	***0***	***0***	***0***	***0***	***0***	***0***	***0***	359	359	347	1,771
1978	900	871	***0***	***0***	***0***	***0***	***0***	***0***	***0***	0	0	0	1,771
1979	0	0	***0***	***0***	***0***	***0***	***0***	***0***	***0***	0	900	871	1,771
1980	450	435	***0***	***0***	***0***	***0***	***0***	***0***	***0***	0	450	435	1,771
1981	450	435	***0***	***0***	***0***	***0***	***0***	***0***	***0***	0	450	435	1,771
1982	359	347	***0***	***0***	***0***	***0***	***0***	***0***	***0***	359	359	347	1,771
1983	0	0	***0***	***0***	***0***	***0***	***0***	***0***	***0***	0	0	0	0
1984	0	0	***0***	***0***	***0***	***0***	***0***	***0***	***0***	597	597	578	1,771
1985	359	347	***0***	***0***	***0***	***0***	***0***	***0***	***0***	359	359	347	1,771
1986	359	347	***0***	***0***	***0***	***0***	***0***	***0***	***0***	359	359	347	1,771
1987	359	347	***0***	***0***	***0***	***0***	***0***	***0***	***0***	359	359	347	1,771
1988	450	435	***0***	***0***	***0***	***0***	***0***	***0***	***0***	450	0	435	1,771
1989	359	347	***0***	***0***	***0***	***0***	***0***	***0***	***0***	359	359	347	1,771
1990	359	347	***0***	***0***	***0***	***0***	***0***	***0***	***0***	359	359	347	1,771
1991	359	347	***0***	***0***	***0***	***0***	***0***	***0***	***0***	359	359	347	1,771
1992	416	435	***0***	***0***	***0***	***0***	***0***	***0***	***0***	0	450	435	1,737
1993	603	584	***0***	***0***	***0***	***0***	***0***	***0***	***0***	0	0	584	1,771
AVG	379	306								267	313	370	1,634

Notes

BNE SWP imports are not recharged at the Narrows December through June due to imprint of Delta water during endangered steelhead passage and spawning period.

BNE SWP imports are canceled in years when flow is greater than 0.5 cfs at the Narrows during the summer and fall.

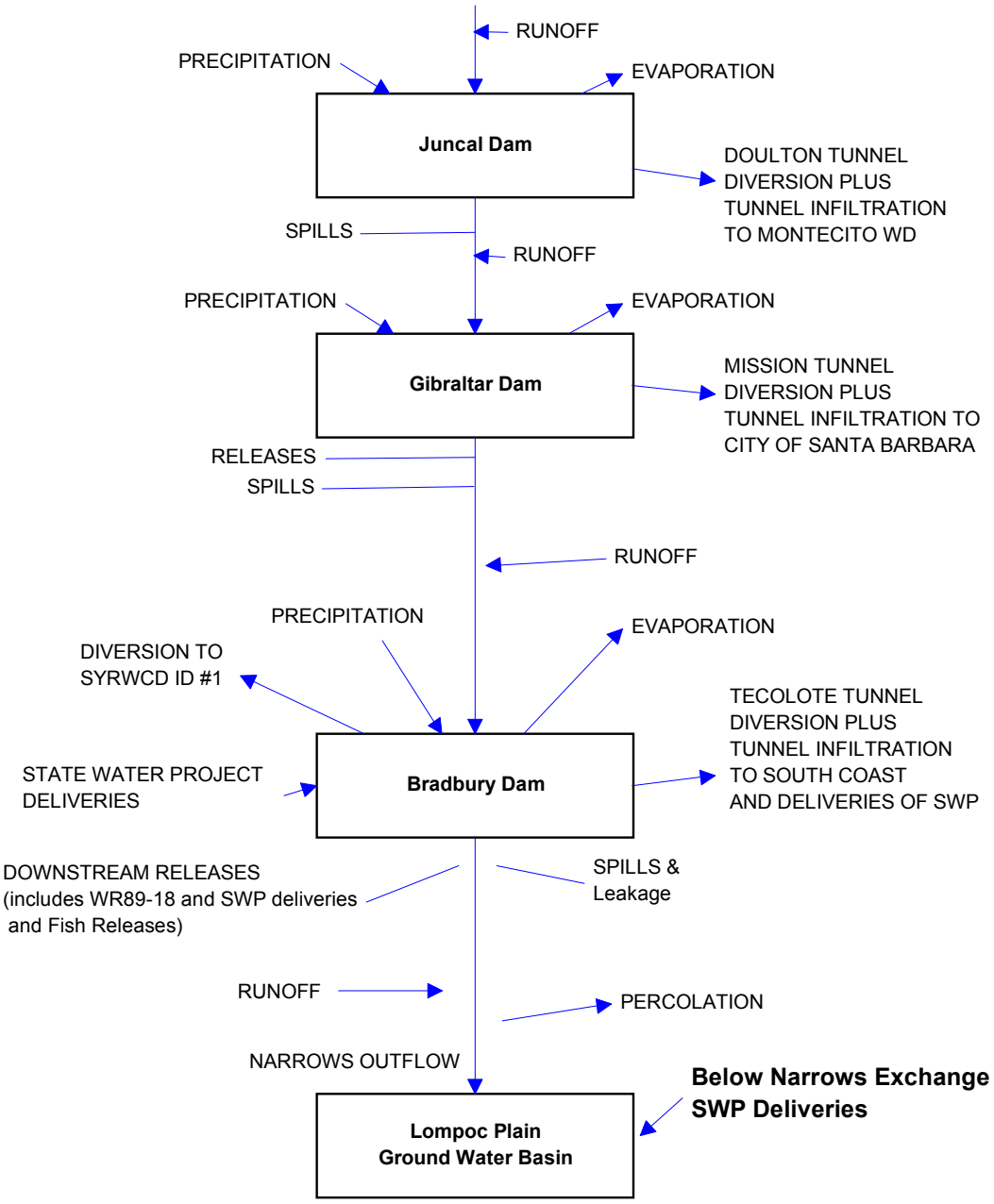
Figure 12b shows the frequency of TDS of water rights releases (WR 89-18) at the Narrows. The frequency does not include months of no flows or flows less than 0.5 cfs at the Narrows. Imports of SWP water improve the TDS at the Narrows during WR89-18 releases. The median difference in TDS between Alternative 3 and Alternative 1 is about 130 mg/L.

4.3 SALINITY OF THE SURFACE FLOW AT THE NARROWS

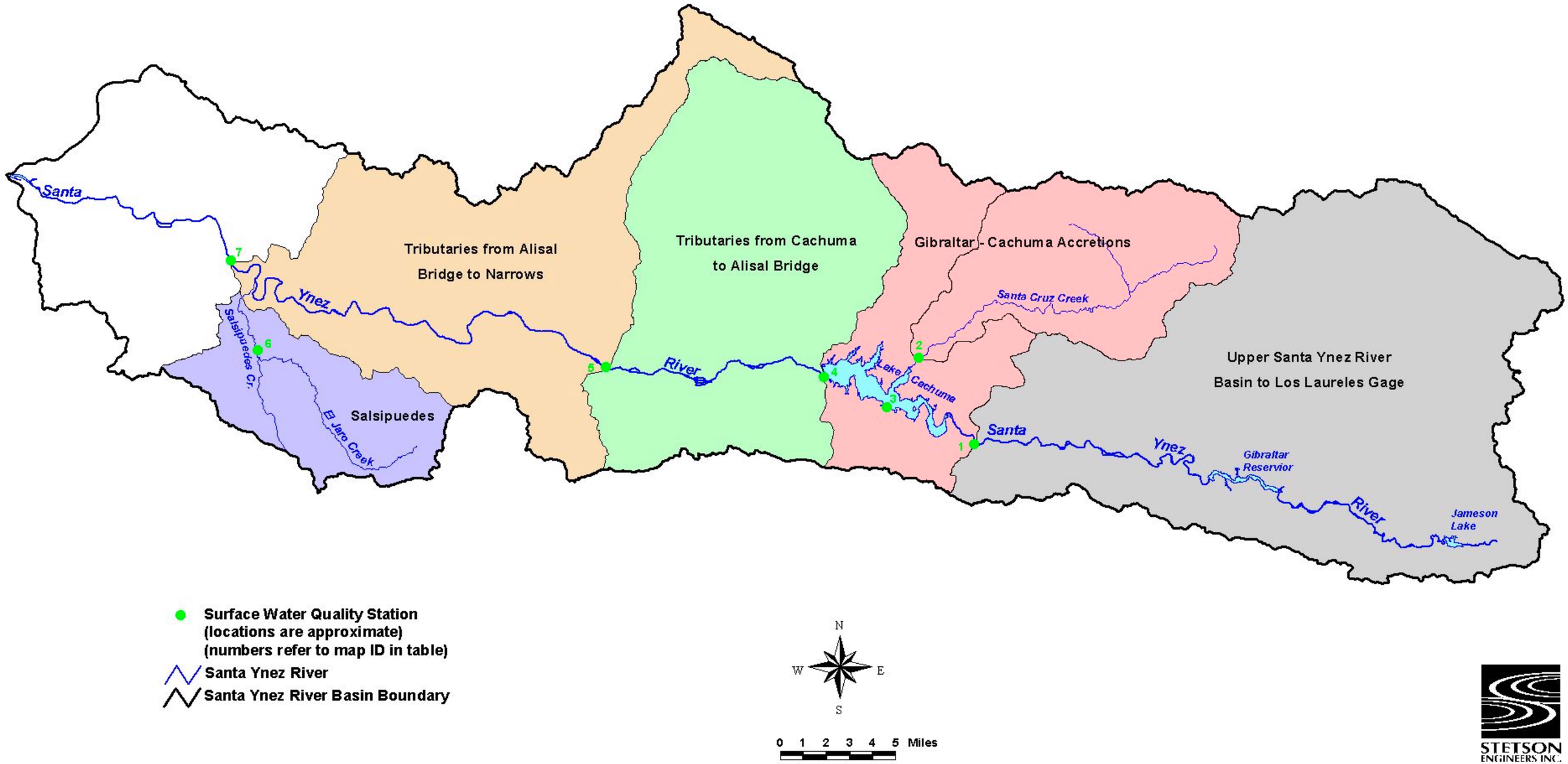
Figures 13a and b show the frequency of TDS at the Narrows for comparisons between Alternative 1 and Alternatives 2 and 3, respectively. A similar comparison is not provided for Alternative 4 because of the reduced frequency of summer flows at the Narrows by eliminating the Cachuma BNA releases under Alternative 4. The ground water models (HCI, USGS) are used to determine the impact of these changes in TDS at the Narrows on Lompoc plain ground water quality (see Technical Memorandum No. 4).

FIGURE 1

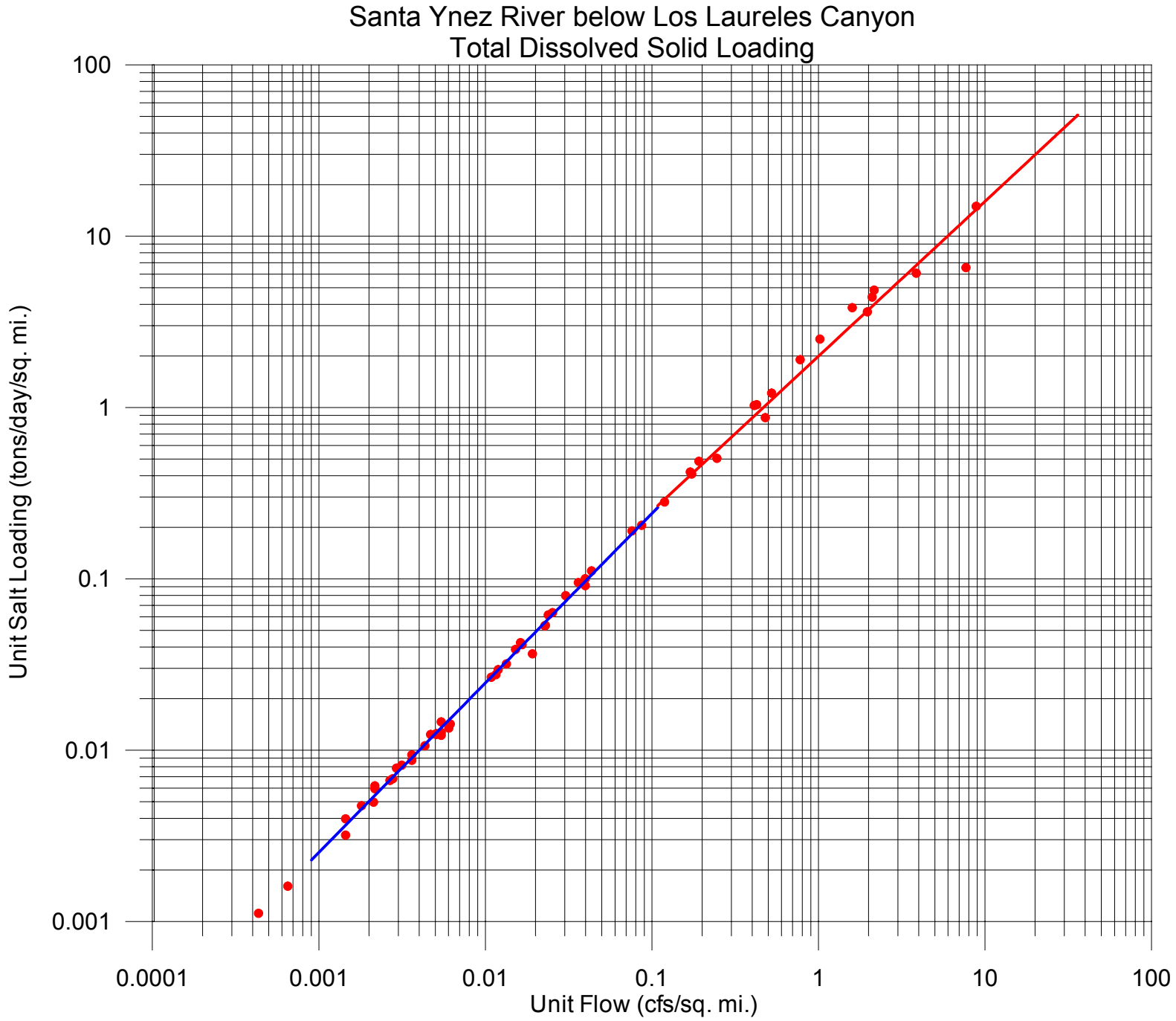
SCHEMATIC PRESENTATION OF THE SURFACE FLOWS ASSIGNED A SALT FLUX IN THE SANTA YNEZ RIVER HYDROLOGY MODEL



KEY SALINITY CALIBRATION LOCATIONS AND CORRESPONDING SUB-AREAS
SANTA YNEZ RIVER WATERSHED

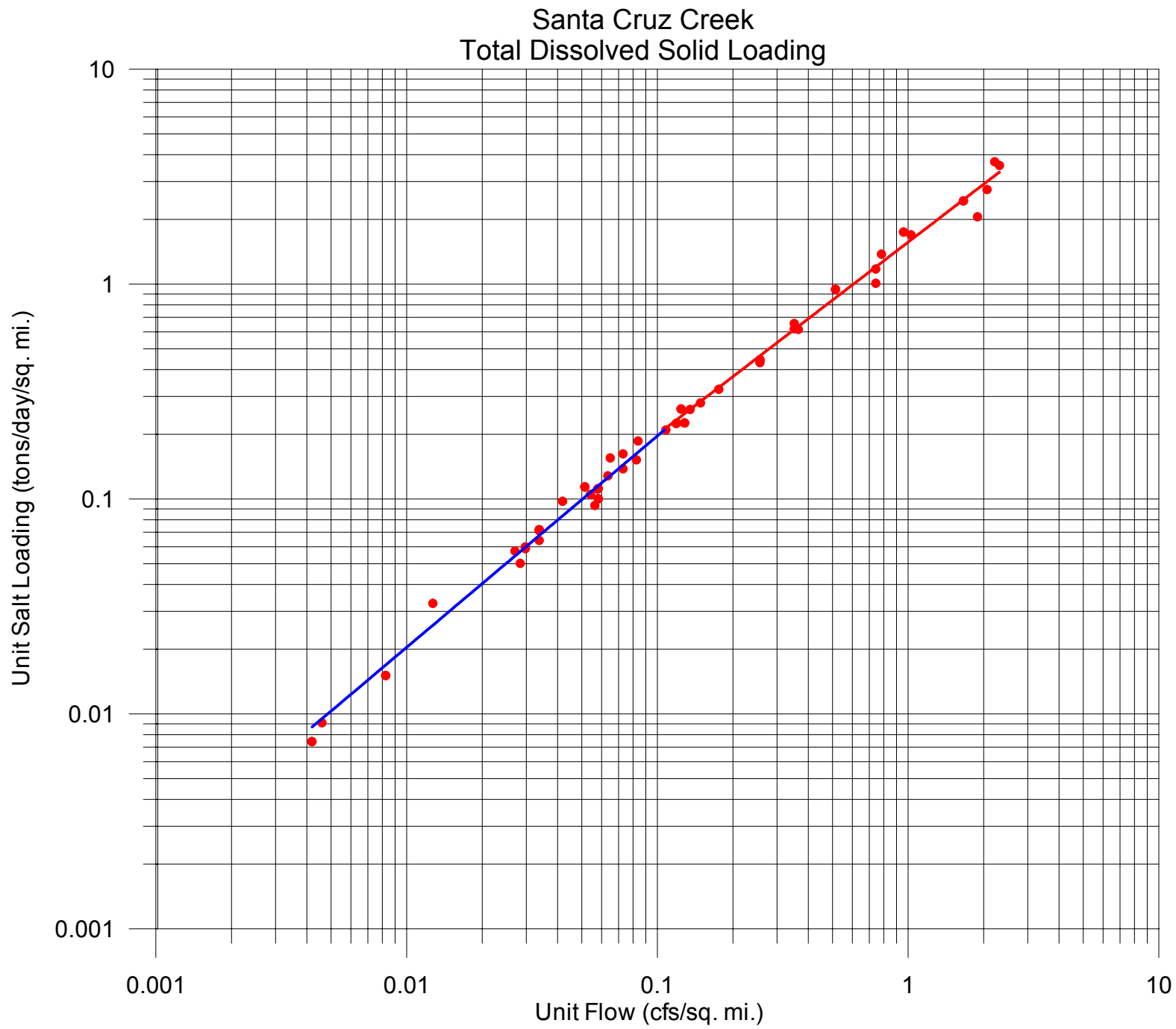


calareas.apr 2/20/01



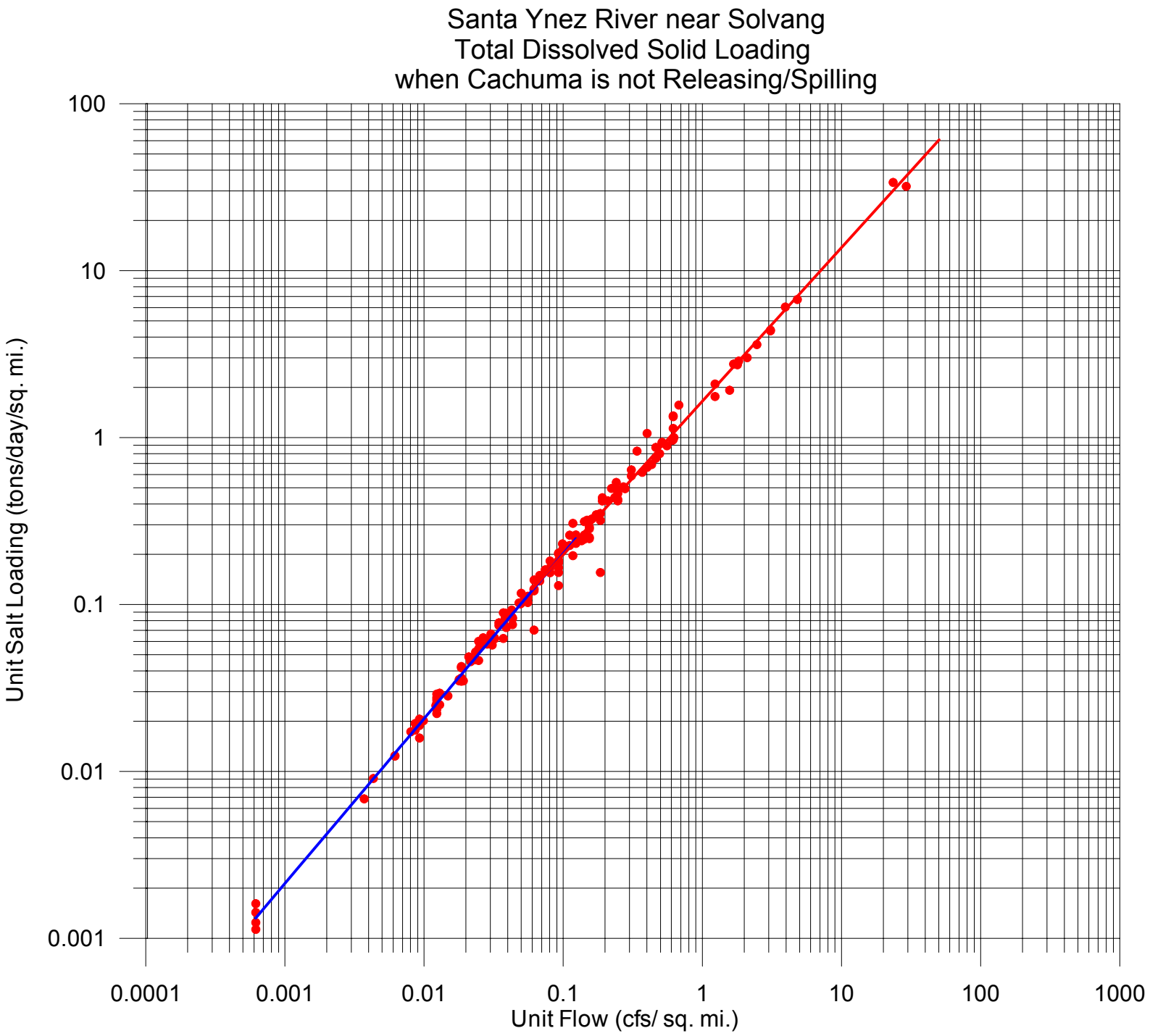
STETSON ENGINEERS INC.

Figure 3a



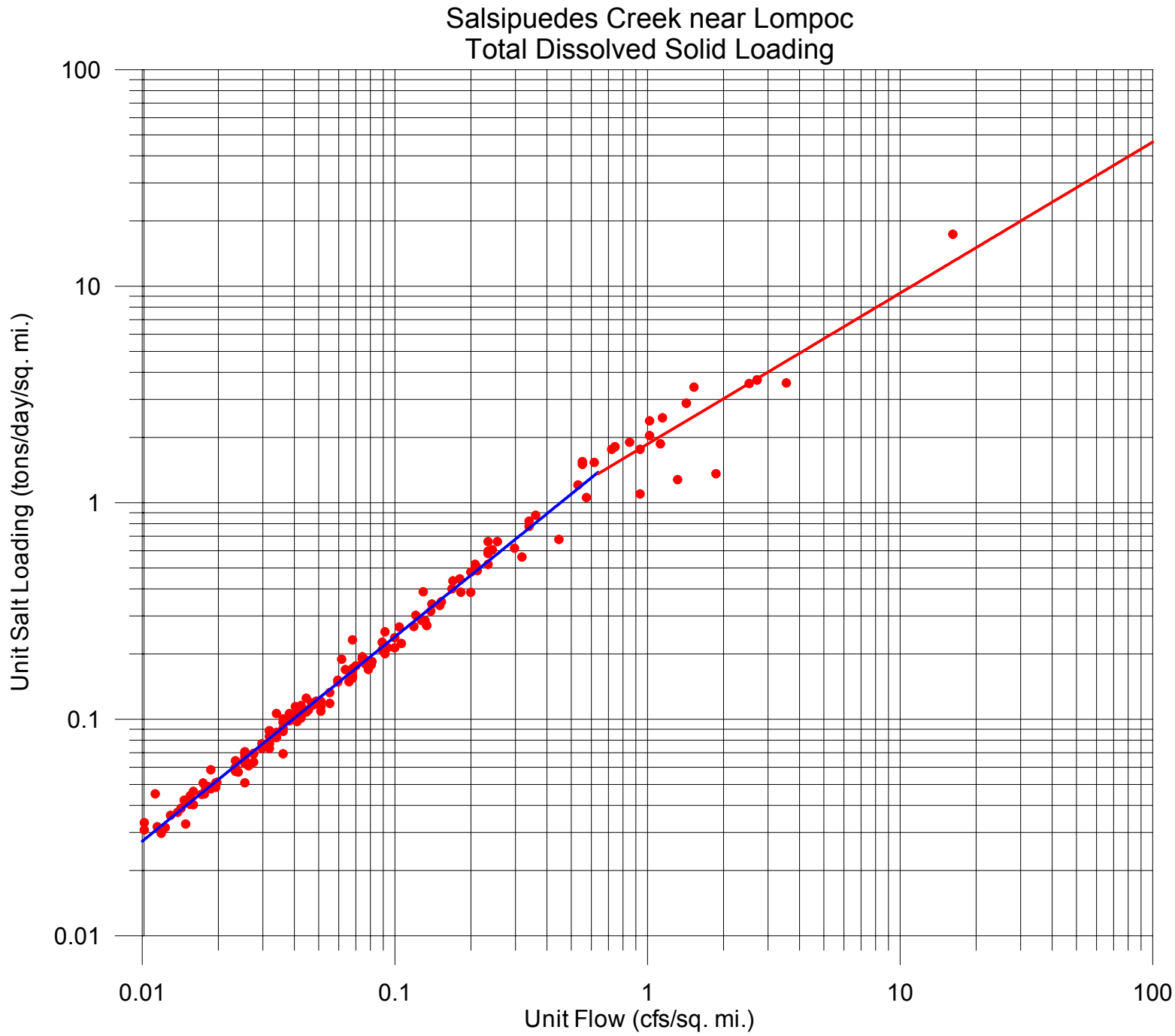
STETSON ENGINEERS INC.

Figure 3b



STETSON ENGINEERS INC.

Figure 3c

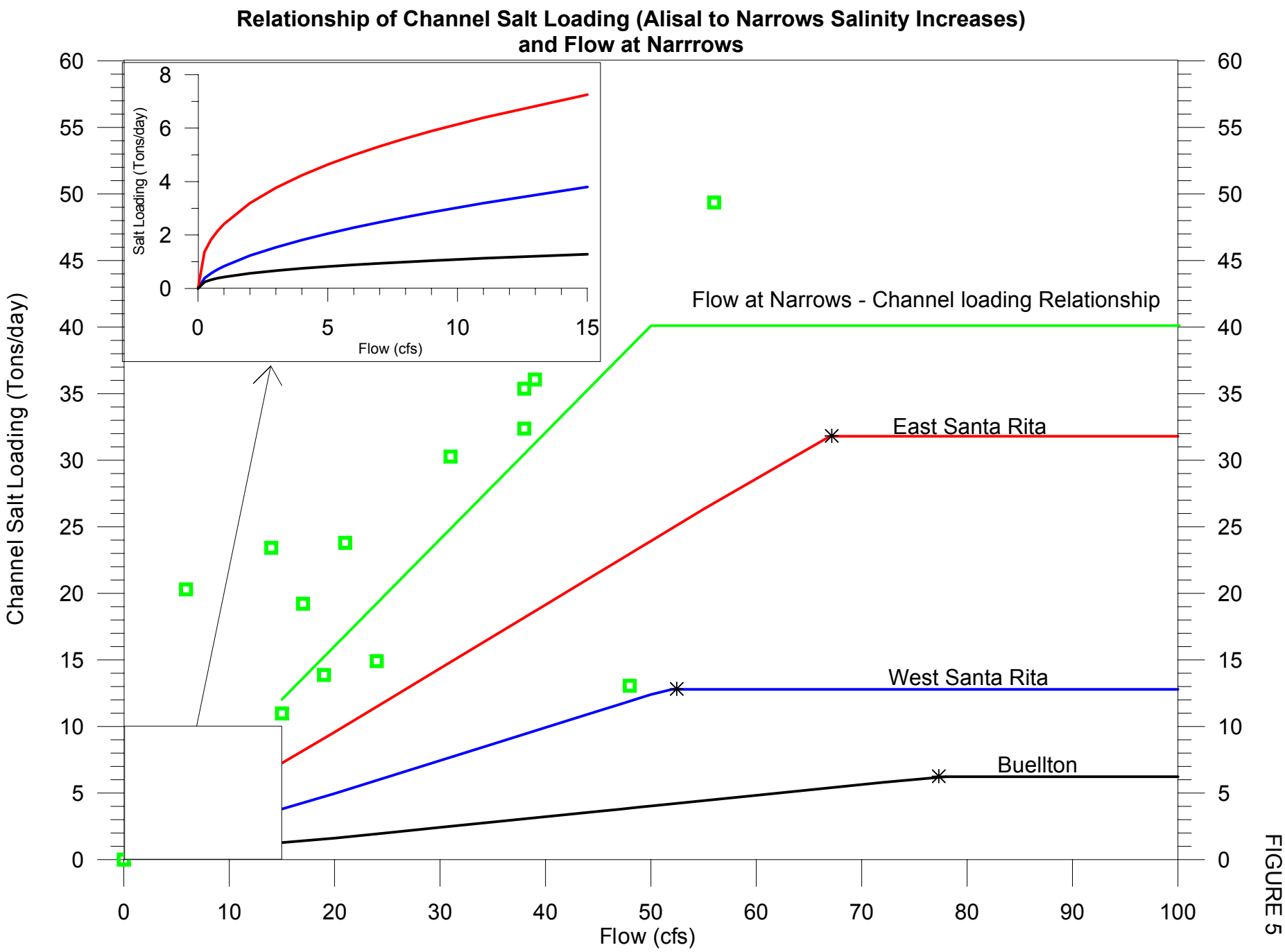


STETSON ENGINEERS INC.

Figure 3d

FIGURE 4

Lake Cachuma Total Dissolved Solids (TDS)
Monthly Average from Various Sources versus SYRHM
1958 through 1999


Relationship of Channel Salt Loading (Alisal to Narrows Salinity Increases)
and Flow at Narrrows
Channel Salt Loading (Tons/day)
Flow (cfs)
Salt Loading (Tons/day)
Flow (cfs)
Flow at Narrows - Channel loading Relationship
East Santa Rita
West Santa Rita
Buellton
FIGURE 5

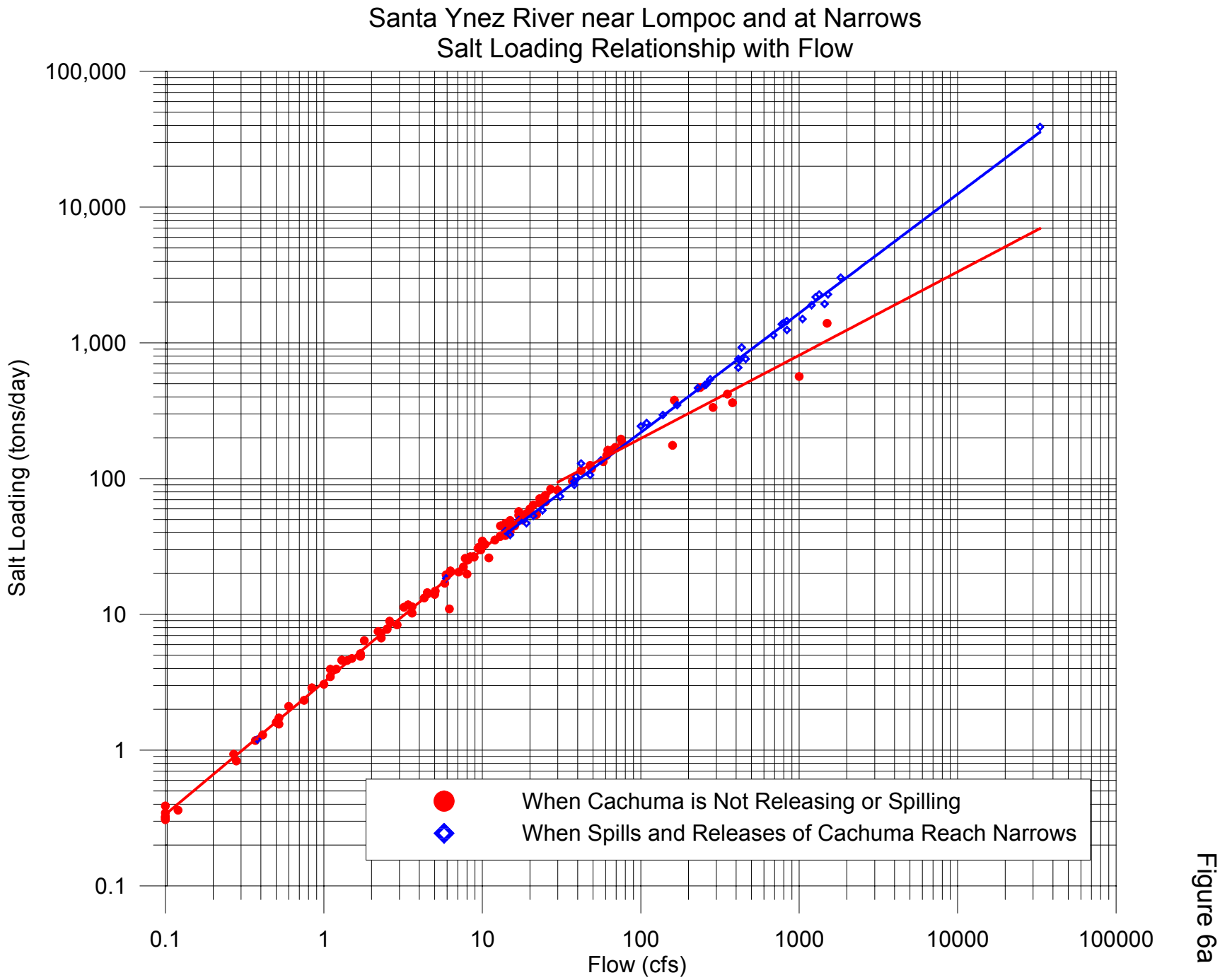

Santa Ynez River near Lompoc and at Narrows
Salt Loading Relationship with Flow
Salt Loading (tons/day)
100,000
10,000
1,000
100
10
1
0.1
0.1
1
10
100
1000
10000
100000
Flow (cfs)
When Cachuma is Not Releasing or Spilling
When Spills and Releases of Cachuma Reach Narrows

Figure 6a

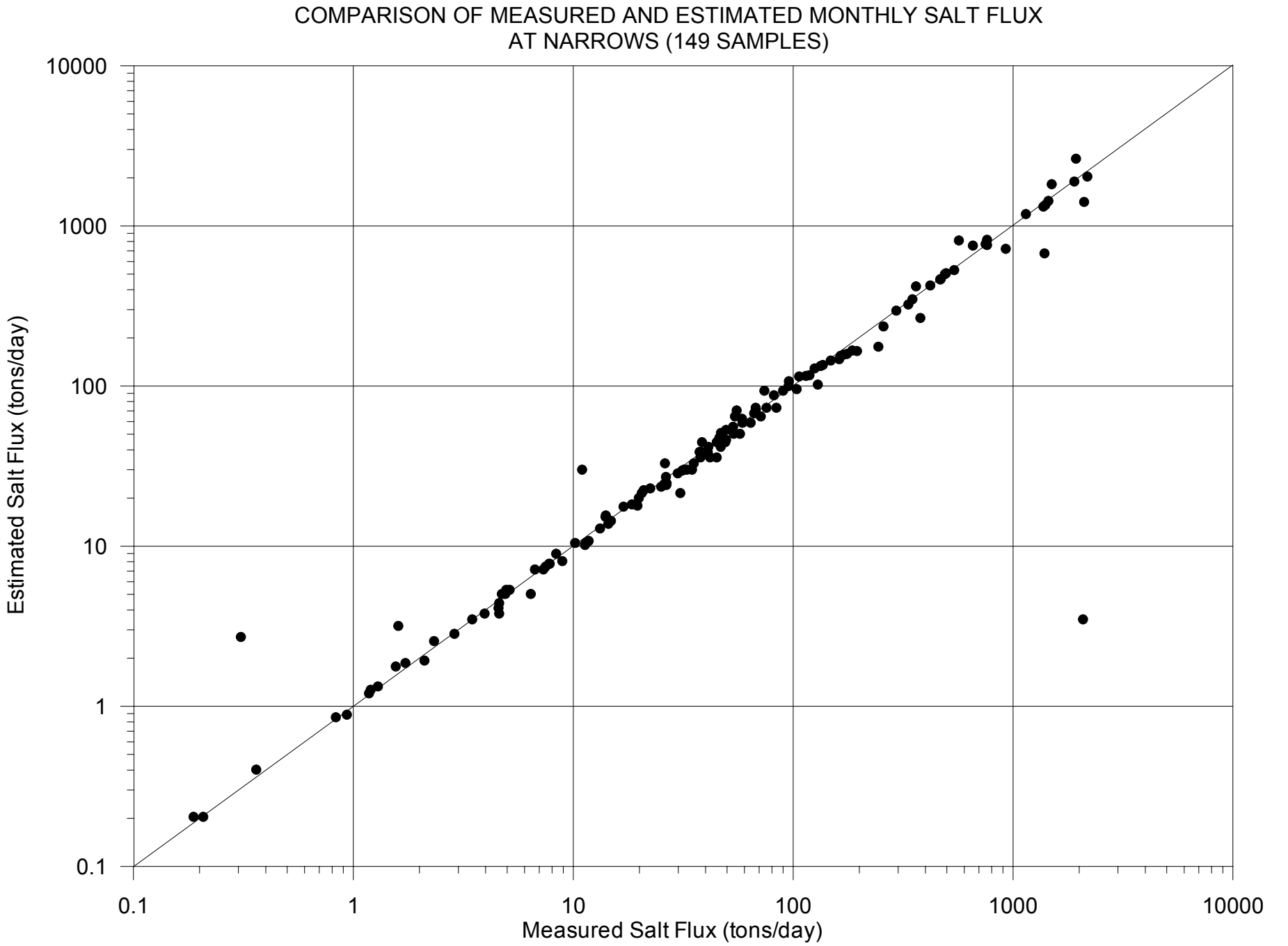

COMPARISON OF MEASURED AND ESTIMATED MONTHLY SALT FLUX
AT NARROWS (149 SAMPLES)
Estimated Salt Flux (tons/day)
Measured Salt Flux (tons/day)
10000
1000
100
10
1
0.1
0.1
1
10
100
1000
10000

FIGURE 6b

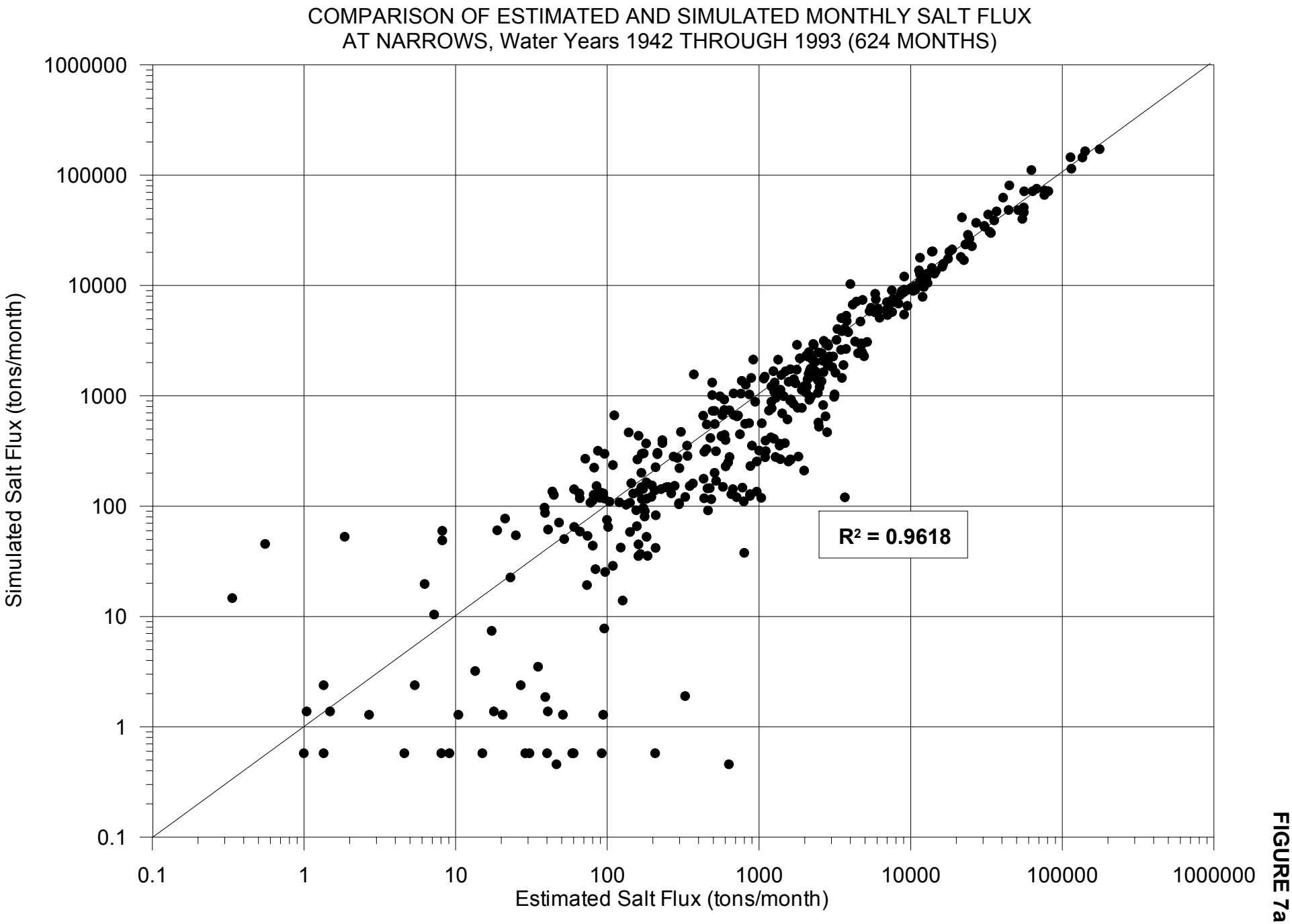

COMPARISON OF ESTIMATED AND SIMULATED MONTHLY SALT FLUX
AT NARROWS, Water Years 1942 THROUGH 1993 (624 MONTHS)
Simulated Salt Flux (tons/month)
Estimated Salt Flux (tons/month)
1000000
100000
10000
1000
100
10
1
0.1
0.1
1
10
100
1000
10000
100000
1000000
R² = 0.9618

FIGURE 7a

TDS-FLOW RELATIONSHIPS
SANTA YNEZ RIVER ATNARROWS
1942-1993 (52 years)

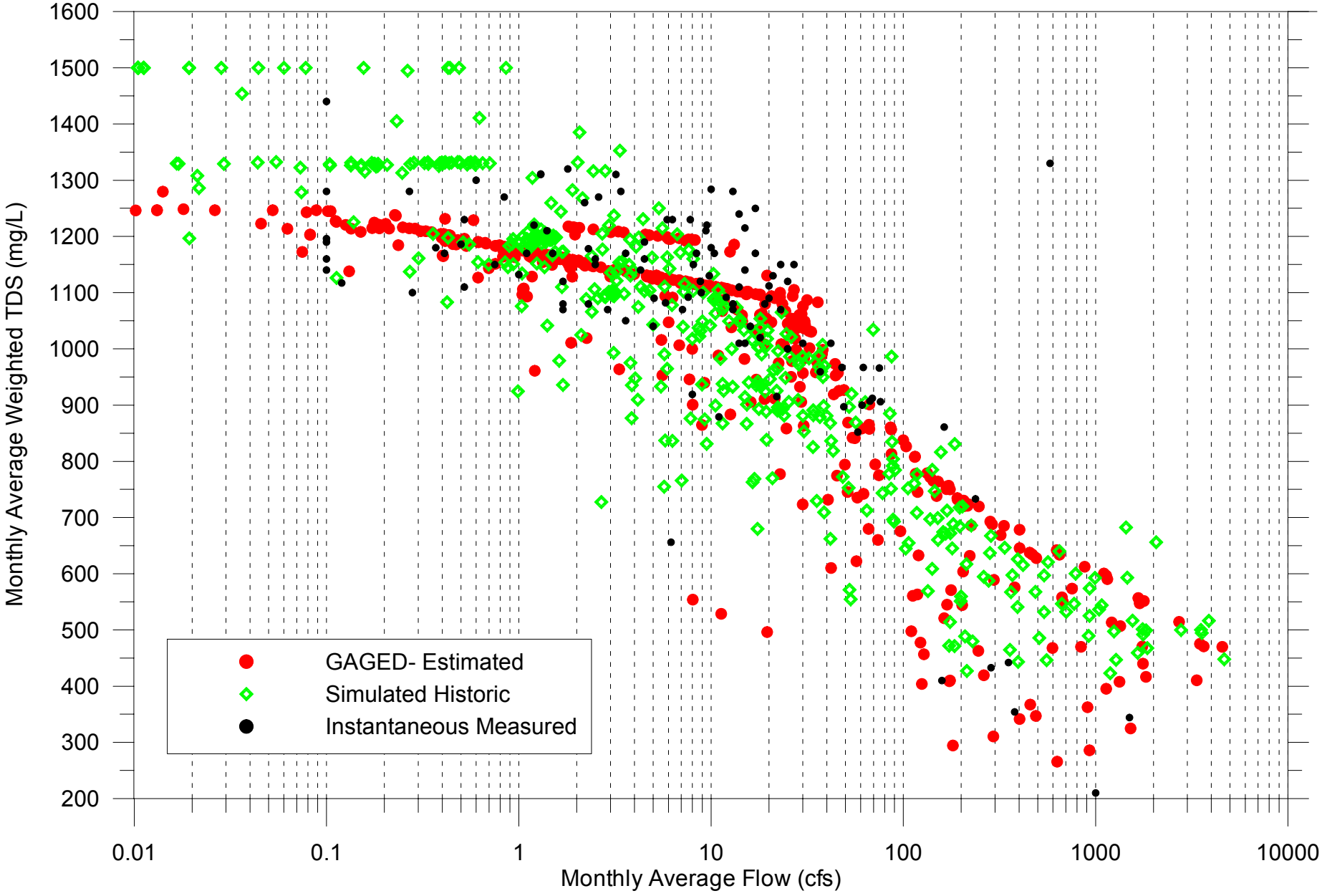
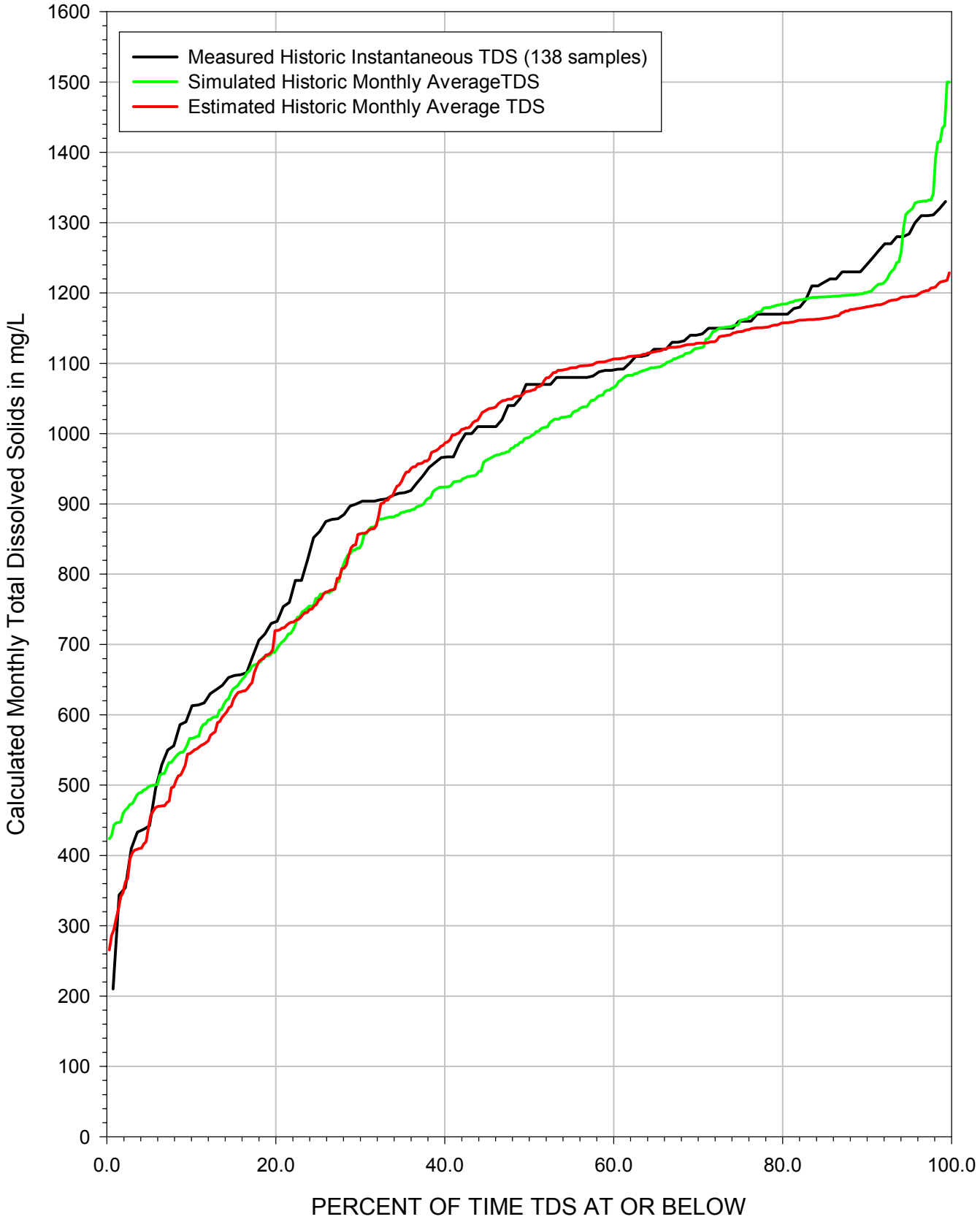


FIGURE 7b

FIGURE 7c

FREQUENCY OF DISSOLVED SOLIDS CONCENTRATIONS IN FLOWS AT NARROWS (WY 1942-1993)



[1] Frequency does not include months of no flow or flows less than 0.5 cfs at the Narrows

STATE WATER PROJECT TOTAL DISSOLVED SOLIDS
USED IN SYRHM0498
1942-1993

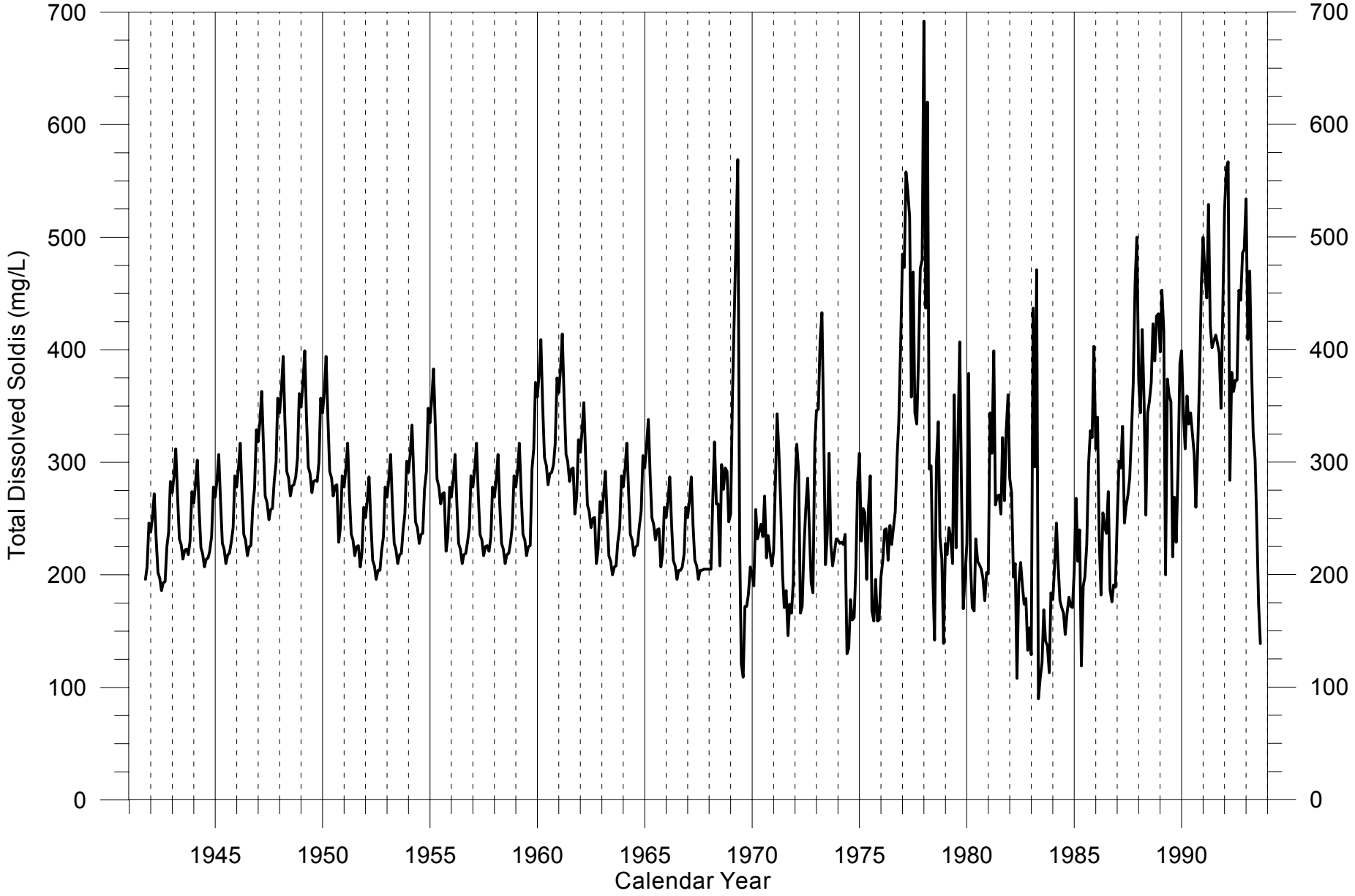


FIGURE 8

AVERAGE MONTHLY VARIATION OF STATE WATER PROJECT
CALIFORNIA AQUEDUCT NEAR KETTLEMAN CITY
1968-2000

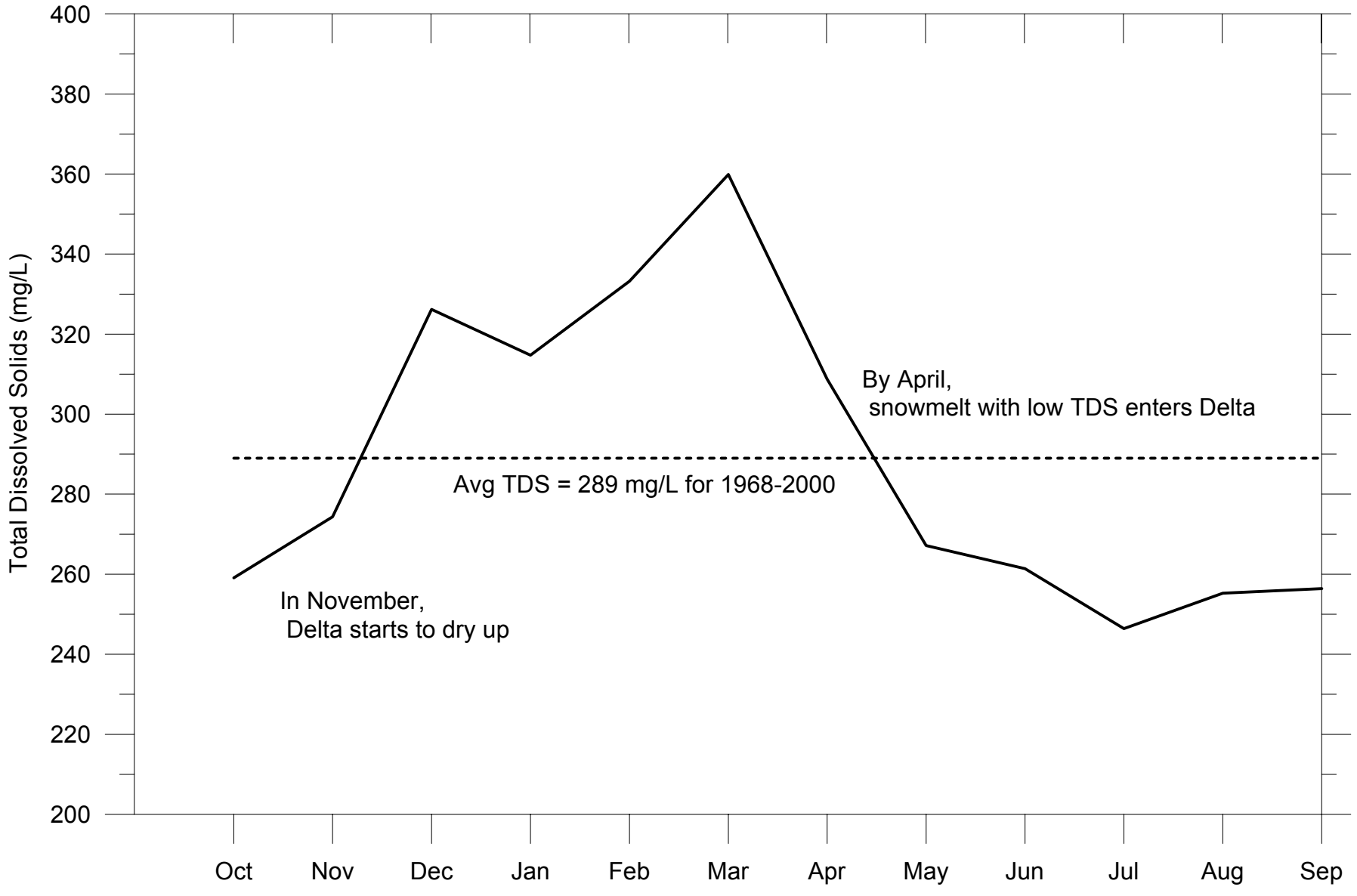


FIGURE 9

RELATIONSHIP OF SHORTAGES IN DELTA AND DELTA DISSOLVED SOLIDS

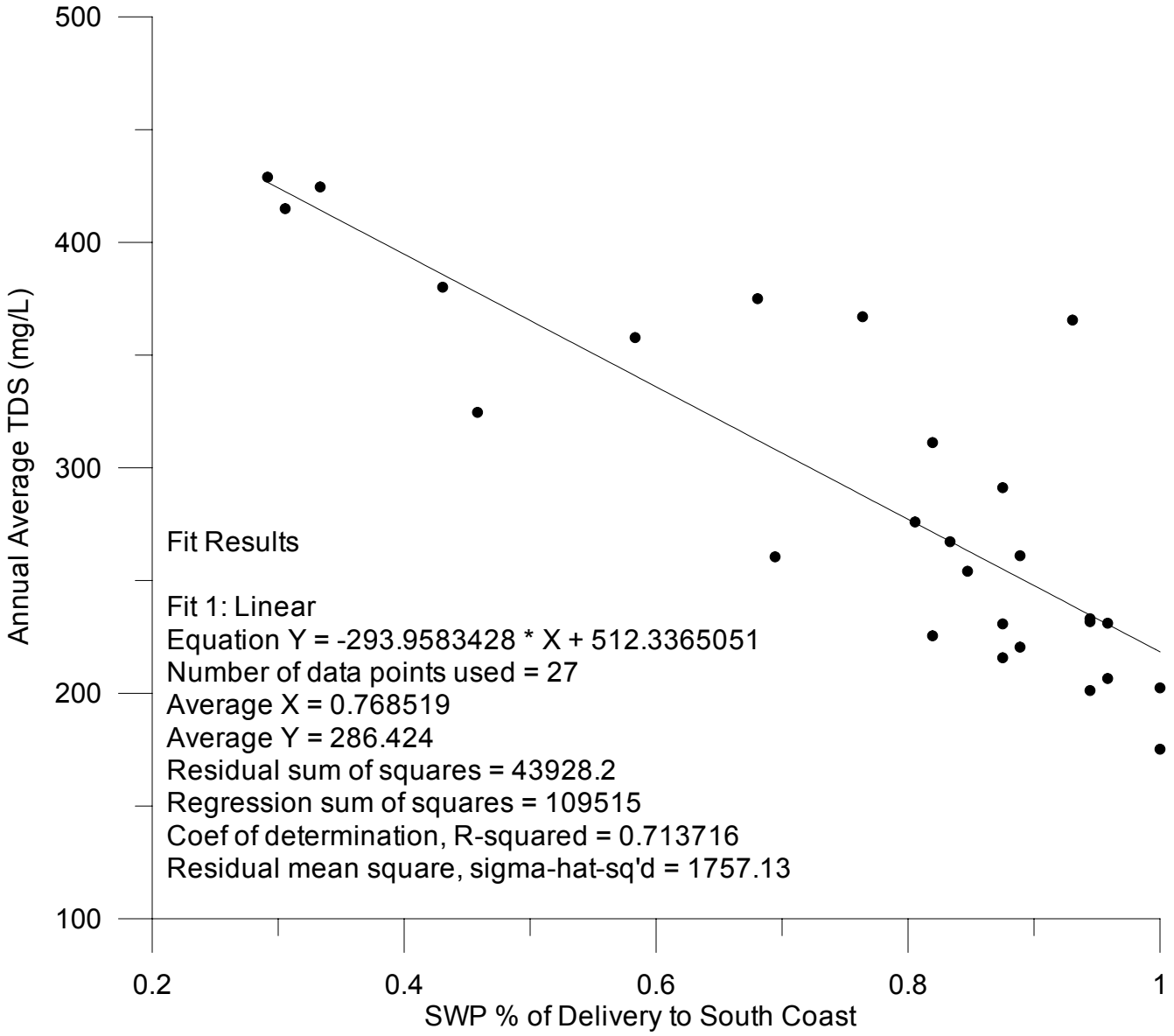
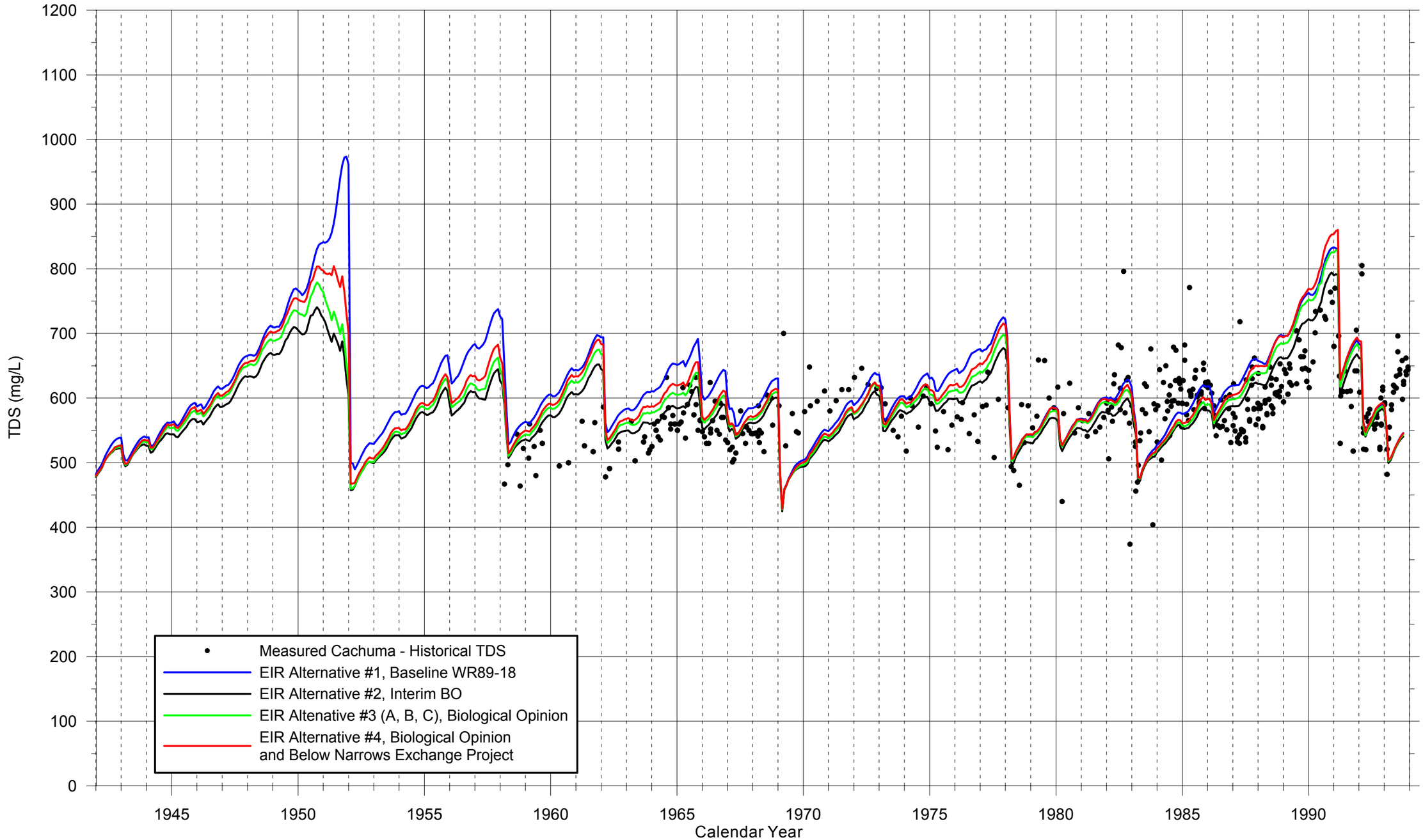


FIGURE 10

FIGURE 11

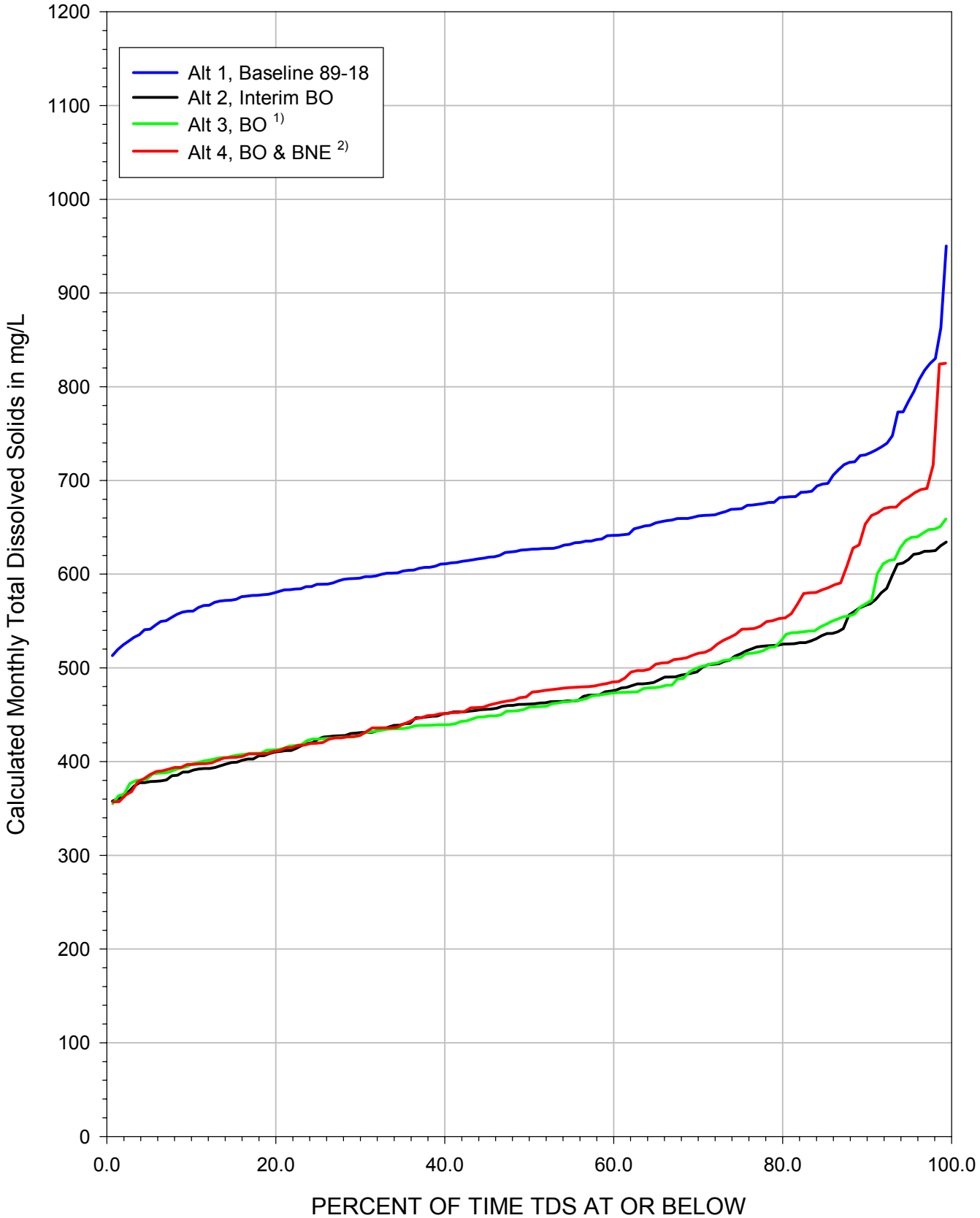
Lake Cachuma Total Dissolved Solids (TDS) for EIR Alternatives using SYRHM 0498 1942 through 1993



Note: Results from EIR Alternative#3C is plotted here; Alternatives 3A and 3B are very similar to 3C for Cachuma TDS

FIGURE 12a

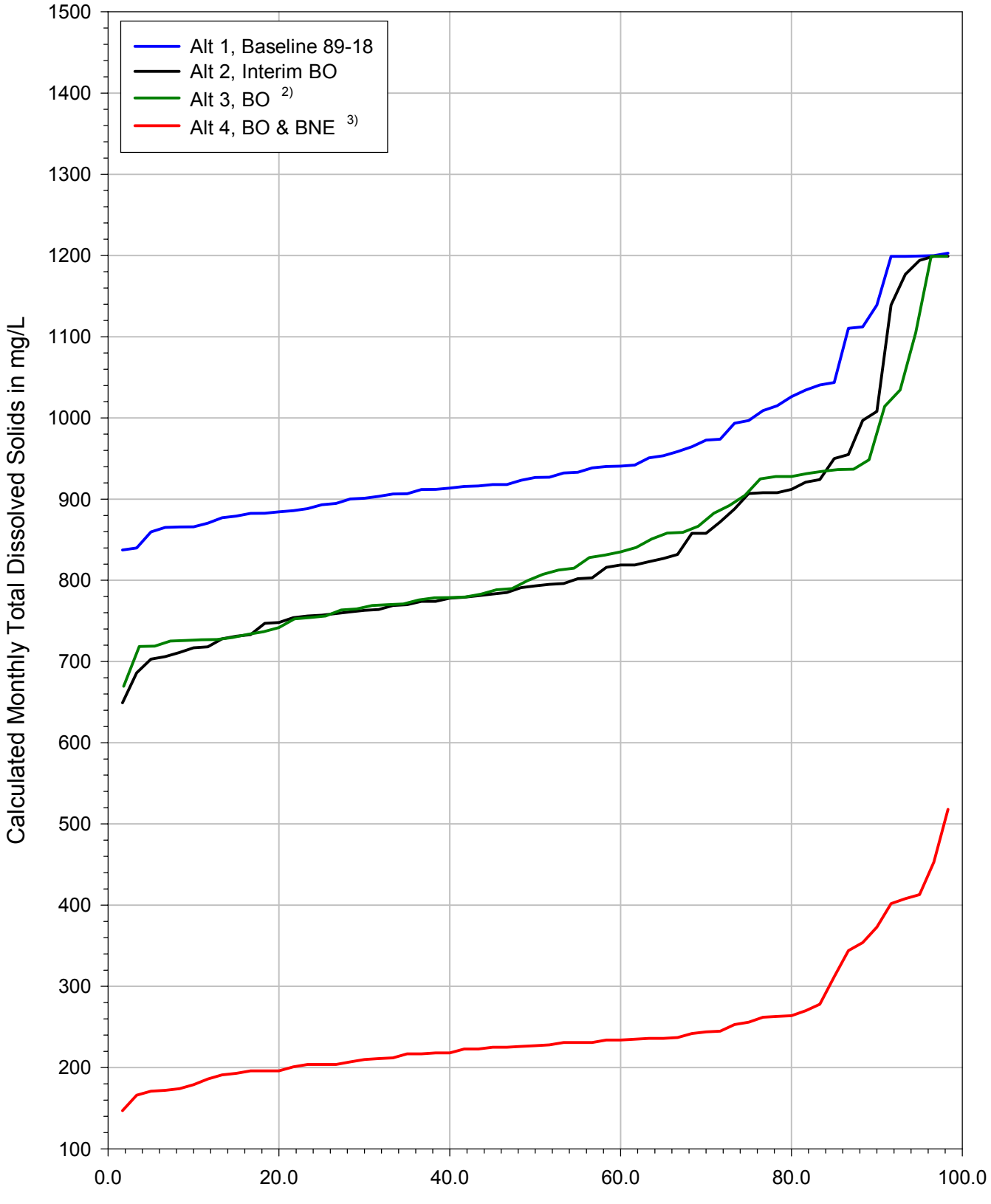
FREQUENCY CURVE
DISSOLVED SOLIDS CONCENTRATIONS
OF WATER RIGHT RELEASES BELOW THE DAM
(WY 1942-1993)



1) Results from EIR Alternative 3C are plotted here; Alts 3A and 3B are very similar to Alt 3C for Narrows TDS
2) Water right release TDS for ANA releases are shown here for 4A&B

FIGURE 12b

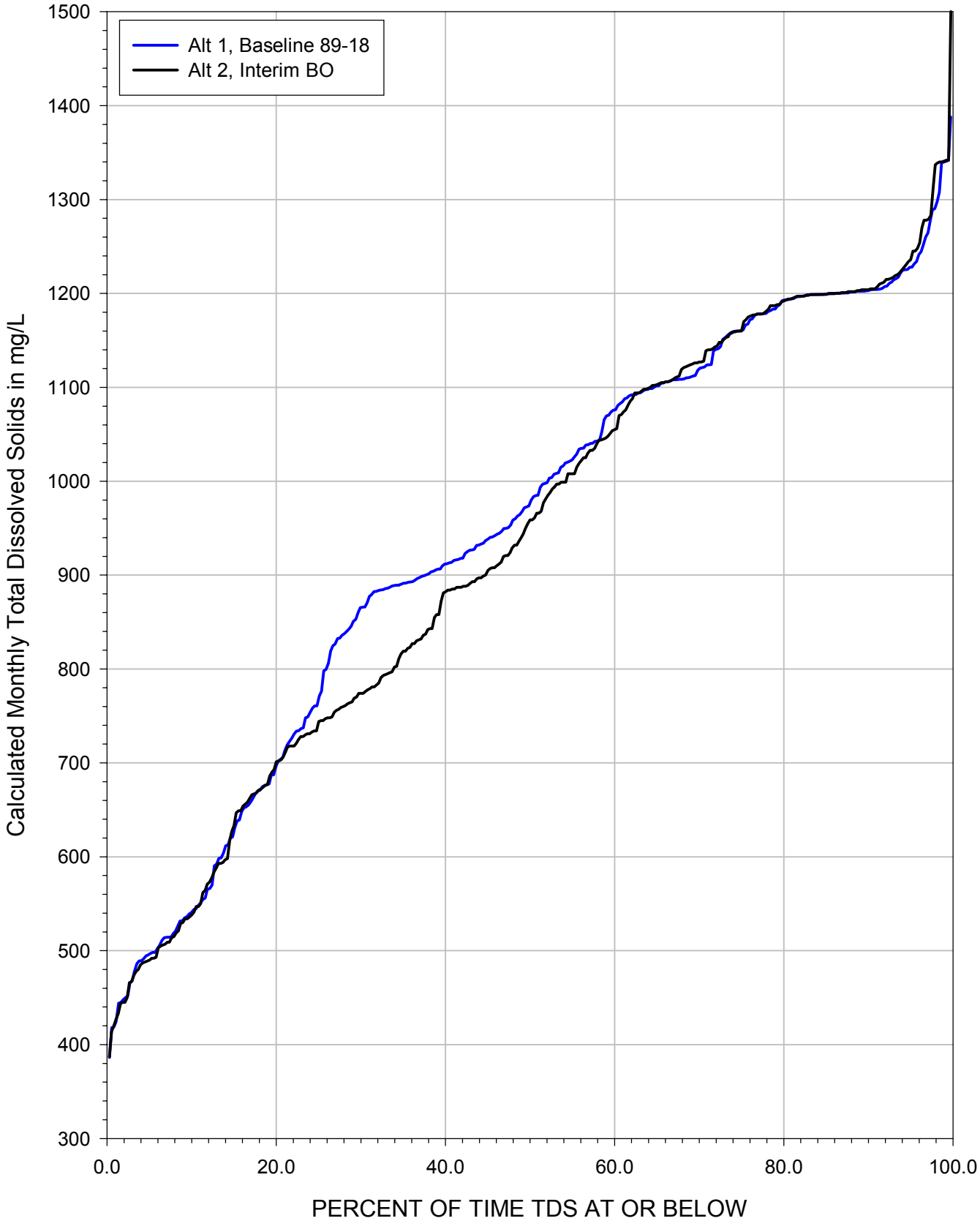
FREQUENCY OF DISSOLVED SOLIDS CONCENTRATIONS [1] IN WATER RIGHT RELEASES AT NARROWS (WY 1942-1993, 52 years)



1) Frequency does not include months of no flow or flows less than 0.5 cfs at the Narrows
2) Results from EIR Alternative 3C are plotted here; Alts 3A and 3B are very similar to Alt 3C for Narrows TDS
3) State Water Project TDS during Below Narrows Account water right releases

FIGURE 13a

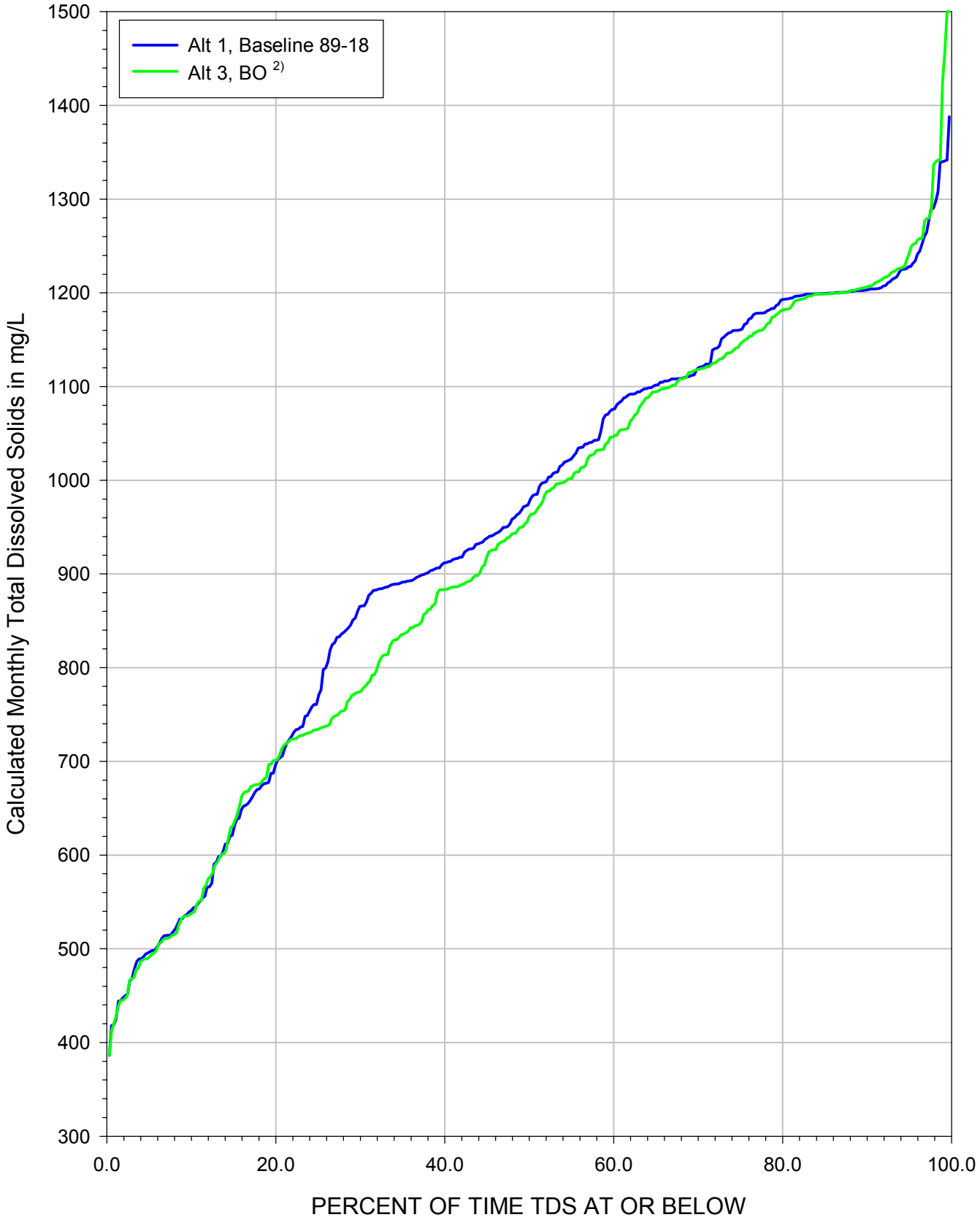
FREQUENCY OF DISSOLVED SOLIDS CONCENTRATIONS [1] IN FLOWS AT NARROWS (WY 1942-1993, 52 years)



[1)] Frequency does not include months of no flow or flows less than 0.5 cfs at the Narrows

FIGURE 13b

FREQUENCY OF DISSOLVED SOLIDS CONCENTRATIONS [1] IN FLOWS AT NARROWS (WY 1942-1993, 52 years)



1) Frequency does not include months of no flow or flows less than 0.5 cfs at the Narrows
2) Results from EIR Alternative 3C are plotted here; Alts 3A and 3B are very similar to Alt 3C for Narrows TDS