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TECHNICAL MEMORANDUM NO. 2

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TO: John Gray
URS Corp., Santa Barbara, CA

DATE: May 10, 2004

FROM: Curtis Lawler

JOB NO.: 1944

RE: **WATER QUALITY IMPACT ANALYSES FOR CITY OF SOLVANG'S CEQA ENVIRONMENTAL DOCUMENT FOR A TIME EXTENSION FOR WATER RIGHTS PERMIT 15878**

1. INTRODUCTION

This second technical memorandum includes impact analyses on surface water salinity for the City of Solvang's CEQA environmental document in connection with the petition to the State Water Resources Control Board (SWRCB) for extension of time for permit 15878. Technical Memorandum No. 1 entitled Hydrologic Impact Analyses for City of Solvang's CEQA Environmental Document for a Time Extension for Water Rights Permit 15878 dated April 23, 2004 provides the results of hydrologic analyses on Cachuma Reservoir operations, Santa Ynez River flows, above Narrows groundwater storage, water right releases, and Cachuma Project deliveries. Table 1 lists the twelve alternatives analyzed in this study which include three levels of Solvang river well pumping (ranging from 600 to 3,600 acre-feet per year) and four scenarios for Cachuma Reservoir fish flow operations and surcharging as set forth in the SWRCB Draft EIR (see references).

The focus of this water quality analysis is on the total dissolved solids (TDS) concentration of the Santa Ynez River flow at the Lompoc Narrows. The Lompoc Narrows is located approximately 23 miles downstream of the proposed location of Solvang river wells as shown in Figure 1. The Santa Ynez River passes through the Lompoc Narrows, then flows across the Lompoc Plain, where the Lompoc Plain ground water basin is located (Figure 1). The TDS concentration of the groundwater in the central and western Lompoc Plain 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 increased Solvang river well pumping on TDS concentrations of surface flow at the Lompoc Narrows.

In addition to Technical Memorandum No. 1 and this technical memorandum (Technical Memorandum No. 2), hydrologic analyses for ground-water impacts (including water level changes and possible well interferences) in the Solvang area are provided in a separate technical memorandum.

TABLE 1

KEY ELEMENTS OF ALTERNATIVES REVIEWED FOR THE CITY OF SOLVANG EIR USING SYRHM

Alternative No.	Alternatives	City of Solvang		Cachuma Reservoir Surcharge Ft	Fish Flow Operations
		Gross Pumping afy	Net Pumping[1] Afy		
1	SWRCB EIR Alt 1	600	396	0	none
2	SWRCB EIR Alt 2 (current operations)	600	396	0.75	Interim BO/FMP
3	SWRCB EIR Alt 3A	600	396	0.75	Final BO/FMP
4	SWRCB EIR Alt 3C	600	396	3.00	Final BO/FMP
5	SWRCB EIR Alt 1 with Solvang Pumping 3600 afy	3,600	2,376	0	none
6	SWRCB EIR Alt 2 with Solvang Pumping 3600 afy	3,600	2,376	0.75	Interim BO/FMP
7	SWRCB EIR Alt 3A with Solvang Pumping 3600 afy	3,600	2,376	0.75	Final BO/FMP
8	SWRCB EIR Alt 3C with Solvang Pumping 3600 afy	3,600	2,376	3.00	Final BO/FMP
9	SWRCB EIR Alt 1 with Solvang Pumping 2400 afy	2,400	1,584	0	none
10	SWRCB EIR Alt 2 with Solvang Pumping 2400 afy	2,400	1,584	0.75	Interim BO/FMP
11	SWRCB EIR Alt 3A with Solvang Pumping 2400 afy	2,400	1,584	0.75	Final BO/FMP
12	SWRCB EIR Alt 3C with Solvang Pumping 2400 afy	2,400	1,584	3.00	Final BO/FMP

1) A return flow of 34% is assumed.

2. METHODOLOGY FOR MODELING SURFACE WATER 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 is based on the Santa Ynez River Hydrology Model (SYRHM). This analysis for the increased City of Solvang river well pumping uses the same programming model logic and assumptions as recent studies for the Santa Ynez River including the SWRCB Draft EIR (2003), the Settlement Agreement of 2002, and the Draft EIR/EIS (2003) on the Fish Management Plan and the Biological Opinion (see references). The SYRHM model was expanded to include the salinity modeling and the analyses were performed for the hydrologic period extending from 1942 through 1993 (52 years). The SYRHM was also expanded to include deliveries of State Water Project (SWP) water to Cachuma Reservoir. Below is an overview of the surface water salinity modeling methodology.

2.1 FLOW AND SALT BALANCE

Two basic principles were employed in determining the total dissolved solids (TDS) of the Santa Ynez River at Lompoc Narrows: water balance and salt balance. Figure 2 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. The atmospheric water fluxes, evaporation and lake precipitation, are assigned a very small, associated salt flux of 3mg/ℓ and 20 mg/ℓ, respectively. The remaining fluxes (local water accretions) account for the majority of salt entering the Santa Ynez River. In the winter months when there is runoff, the TDS concentrations are generally around 500 mg/ℓ. The TDS concentrations increase to about 1,000 mg/ℓ in the summer and fall when flows are minimal. Imports of SWP water, originating from snowmelt runoff, generally have much lower salinity than local water.

The mass of dissolved solids entering into the system from local water accretions are based on empirical relationships of flow and salinity data. For example, Figure 3 shows the flow-salt loading relationships based on gaged flow and measured TDS sampling on Salispuedes Creek. While the SYRHM was expanded to track these salts, the total volume of water on a monthly basis remains unchanged as provided in the SYRHM. Table 2 shows an example of flows and salt loads as generated on a daily basis with the monthly totals being the input for the SYRHM.

TABLE 2

EXAMPLE OF FLOW AND SALT LOADS

Date	Salsipuedes Flow USGS ID 1132500 (cfs)	Salsipuedes SYRHM Accretion Flow (acre-feet)	Salsipuedes Salt Mass (tons)
4/1/1941	481	954	497
4/2/1941	310	615	356
4/3/1941	200	397	255
4/4/1941	713	1,414	670
4/5/1941	300	595	347
4/6/1941	206	409	261
4/7/1941	181	359	236
4/8/1941	160	317	215
4/9/1941	150	298	205
4/10/1941	208	413	263
4/11/1941	456	904	477
4/12/1941	139	276	193
4/13/1941	120	238	173
4/14/1941	105	208	156
4/15/1941	96	190	146
4/16/1941	90	179	139
4/17/1941	84	167	132
4/18/1941	78	155	125
4/19/1941	72	143	117
4/20/1941	65	129	108
4/21/1941	61	121	103
4/22/1941	60	119	102
4/23/1941	57	113	98
4/24/1941	55	109	95
4/25/1941	53	105	93
4/26/1941	50	99	89
4/27/1941	46	91	83
4/28/1941	44	87	81
4/29/1941	44	87	81
4/30/1941	58	115	99
SUM		**9,406**	**5,992**

1944termed "Alisal to Narrows Salinity Increase" or ANSI) as the cause was examined. The nature of the ANSI is complex and is currently handled in the surface water salinity model using empirical relationships of ANSI to surface flow based on the available data. However, the dissolved-

solids data during water right releases are limited. Performing a water and salt balance calculation using the 13 samples taken by the USGS during water rights releases, 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 4. Figure 4 also shows the flow-ANSI relationships used to calculate the amount of salt input in the Buellton, East Santa Rita, and West Santa Rita subareas as used in the SYRHM due to the ANSI occurrence.

2.2 CACHUMA RESERVOIR STATE WATER PROJECT IMPORTS AND EXPORTS

The State Water Project Coastal Branch Extension Phase II extends from Devil's Den in Kern County to the Santa Ynez River basin and includes a water treatment plant in San Luis Obispo County known as the Polonio Pass Water Treatment Plant. Since 1997, the Central Coast Water Authority (CCWA) delivers SWP water to Cachuma Reservoir for the SWP contractors on the South Coast. When water rights releases are occurring, the SWP water is delivered directly into the Santa Ynez River at Bradbury Dam, limited to mixing of 50 percent of the total release to provide protection to steelhead.

The full SWP contracted water is assumed to be delivered each year, subject to the following assumptions and results of hydrologic modeling:

- A maximum delivery rate of 22 cfs is assumed which provides a monthly delivery capacity of 1,220 to 1,310 acre-feet per month.

- The total annual entitlement of SWP deliveries under contractual agreements to the South Coast is 13,750 acre-feet per year (excluding regular and additional drought buffers).

- Shortages in SWP deliveries to municipal and industrial contractors in the coastal aqueduct due to state-wide and Delta shortages are used from the output of the California Department of Water Resources hydrologic model DWRSIM v.9.06T. (DWRSIM studies that have been performed for the CALFED Bay-Delta Program are preliminary and have been recently updated by a new State Water Project/Central Valley Project simulation model called CALSIM. Currently they are being updated by CALSIM II. Due to small differences in Central Coast M&I delivery shortages resulting from the

above modeling works, the modeling performed for theses EIR analyses continue to use the output from the DWRSIM version for compatibility with previous analyses.)

- The Improvement District No. 1 (ID No.1) exchanges its allocation of Cachuma Project water for an equal amount of SWP water that would have been delivered to the South Coast members of Cachuma Project. The amount of this exchange is 10.313% of the Cachuma Project supply of 25,714 acre-feet per year. For the purpose of these EIR analyses, the ID No.1 exchange is based on 10% of Cachuma Project supply. The volume of exchange with ID No.1 is affected by Cachuma Project shortages.

- Deliveries of SWP water are not made in months when Cachuma Reservoir is spilling. Although SWP deliveries can be made up in other months, spill conditions usually indicate a wet period in which additional SWP deliveries probably would not be needed. Therefore, it was assumed that SWP deliveries would not be made during spills and would not be made up in subsequent months.

- The proportion of the SWP water as a part of downstream water rights releases is limited to 50 percent of the total release to provide protection to steelhead.

- The Biological Opinion states that SWP water "will not be mixed into the waters of the Santa Ynez River during the months of December through June unless flow is discontinuous in the mainstem." This limits the SWP deliveries when releases for steelhead passage are being made from Cachuma Reservoir.

Given the above restrictions and modeling assumptions, the imports of SWP water into Cachuma Reservoir vary for each alternative and would be less than the full 13,750 acre-feet per year. A summary of the assumed SWP deliveries for each EIR alternative is shown in Table 3. Except for the SWRCB Alt 1 which does not include any SWP deliveries, all of the alternatives include basically the same amount of SWP delivery for the South Coast of about 10,100 acre-feet or 74% of total entitlement. As presented in Technical Memorandum No. 1, the alternatives with increased river well pumping (Alternative Nos. 5-12) would have greater water rights releases (up to an 8% increase, 500 out of 6,000 acre-feet per year) due to an increase in dewatered storage in the Above Narrows groundwater basin. However, the amounts of SWP water released into the Santa

Ynez River directly through the outlet works at Bradbury Dam generally remain the same for all of the alternatives with SWP deliveries.

TABLE 3

SUMMARY OF STATE WATER PROJECT DELIVERIES AVERAGE FOR PERIOD 1942-1993 (ACRE-FEET)

ID	EIR Alternative	ID No. 1 Exchange [1]	SWP in Cachuma [2]	SWP in Outlet Works [3]	Total Imports under South Coast Contracts	Total Imports as a Percentage of 13,750 AF
1	1/ 600	0	0	0	0	
2	2/ 600	2,497	5,849	1,789	10,135	74%
3	3A/ 600	2,472	5,878	1,802	10,152	74%
4	3C/ 600	2,497	5,836	1,866	10,199	74%
5	1/ 3600	0	0	0	0	
6	2/ 3600	2,497	5,869	1,784	10,150	74%
7	3A/ 3600	2,462	5,856	1,815	10,133	74%
8	3C/ 3600	2,489	5,859	1,836	10,183	74%
9	1/ 2400	0	0	0	0	
10	2/ 2400	2,496	5,857	1,758	10,111	74%
11	3A/ 2400	2,468	5,890	1,804	10,162	74%
12	3C/ 2400	2,492	5,862	1,818	10,172	74%

In the model operation, SWP water imported into Cachuma Reservoir is assumed to be exported out through Tecolote Tunnel in the same month. Although the imported SWP water could be stored in Cachuma Reservoir for an additional cost, same month imports and exports were assumed for the State Board Draft EIR modeling analyses. Thus, SWP water is assumed not to change the net storage in Cachuma Reservoir.

The TDS concentrations of the SWP deliveries being imported are shown in Figure 5. 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 using monthly average values of historical measured data and average annual TDS values based on regression analysis with shortages in the Delta. More details on the development of the surface water salinity modeling methodology can be found in the Santa Ynez River Hydrology Model Manual, April 2004.

2.3 MODEL LIMITATIONS OF THE SYRHM

The intended use of the SYRHM is for comparative purposes between the EIR alternatives. The simulated flow data generated from the SYRHM is not meant to be predictive, but to be 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.

The model expansion for surface water salinity and the SWP imports was done in consultation with the Santa Ynez River Water Quality Technical Committee (WQTAC). There are technical issues regarding the surface water salinity modeling that have not reached closure for the WQTAC. However, the WQTAC did review and approve the SYRHM surface water salinity modeling for the SWRCB Draft EIR (see References, Appendix D) for the purposes of comparison of alternatives.

3. RESULTS OF SURFACE WATER SALINITY MODELING

The results of surface water salinity modeling for the twelve alternatives are shown in Figures 6a-b. The TDS concentrations of the surface water at the Lompoc Narrows are similar for all of the alternatives, except those with no SWP deliveries (Alt 1 series) which show salinities of about 50 to 100 mg/ℓ higher in the summertime and early fall. Figure 6a shows that there are slight differences of TDS concentrations between Alt 3C/ 2400 (Alternative No. 12, shown in light blue) and Alt 3C/ 600 (Alternative No. 3, shown in orange); however the difference is relatively small and it is not considered to be significant.

Figures 7a-d show the average monthly flow for the alternatives. Figures 7a-d show that the primary effect of the increased Solvang river pumping on the flow at the Lompoc Narrows is a decrease in the early fall flows. However, this is the period in which the TDS concentrations are high (Figures 6a-b), so the impact on TDS concentrations in the Lompoc ground water basin is minimal or none due to minor changes in loading (increased TDS concentrations associated with reduced flows). The average differences in TDS concentrations in the Lompoc groundwater basin would be very small relative to the total TDS levels in the Lompoc wells (800 to 2,500 mg/ℓ). Figures 8a-d show the frequency of TDS concentrations at the Lompoc Narrows for flows larger than 0.5 cfs which also show none to very small differences in salinity between alternatives including increased Solvang river well pumping.

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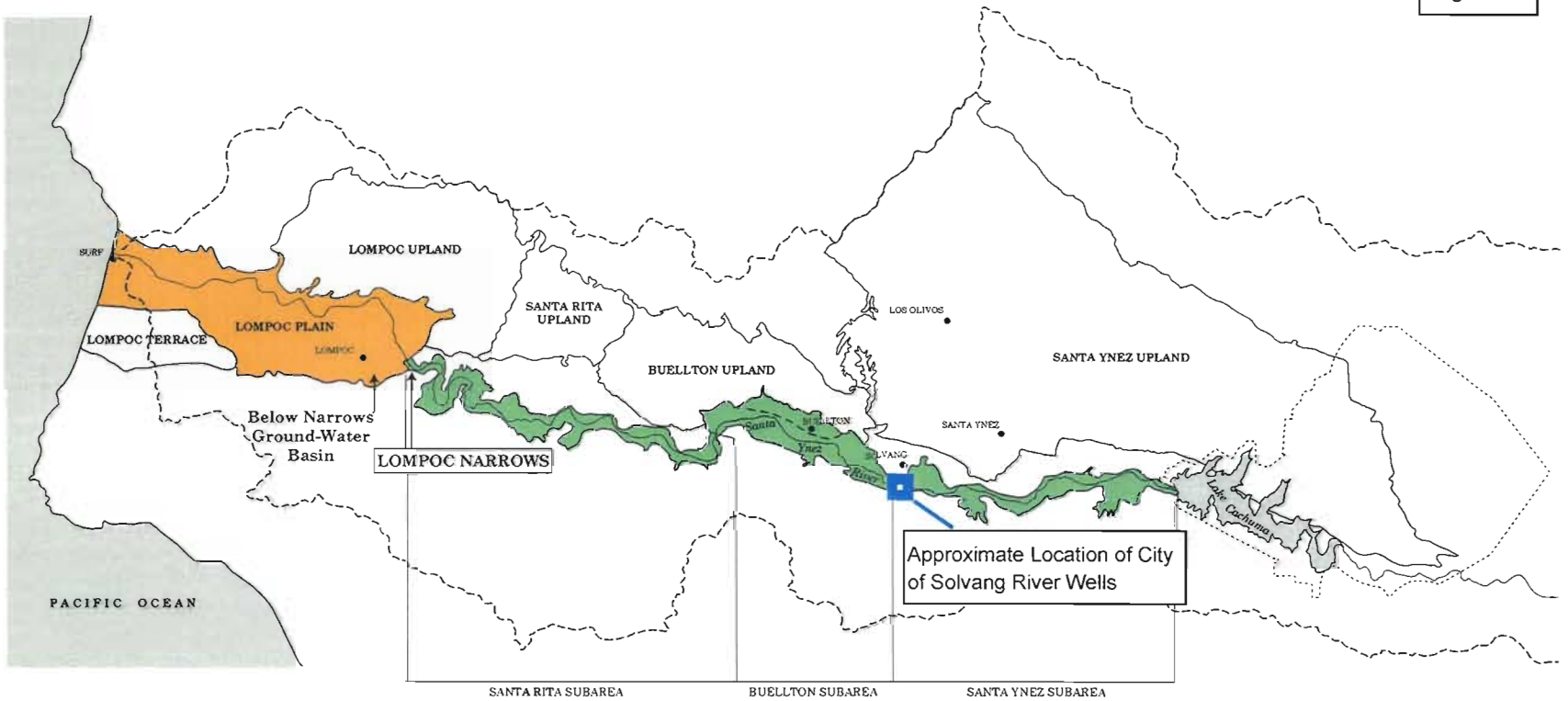
Figures

Figure 1



LEGEND

- Santa Ynez River Basin Boundary
- Ground-Water Basins
- Above Narrows Alluvial Ground-Water Basin
- Below Narrows Ground-Water (Lompoc Plain)

N
W E
S

0 5 10
MILES

MAJOR GROUND-WATER UNITS OF THE SANTA YNEZ RIVER BASIN

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FIGURE 2

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

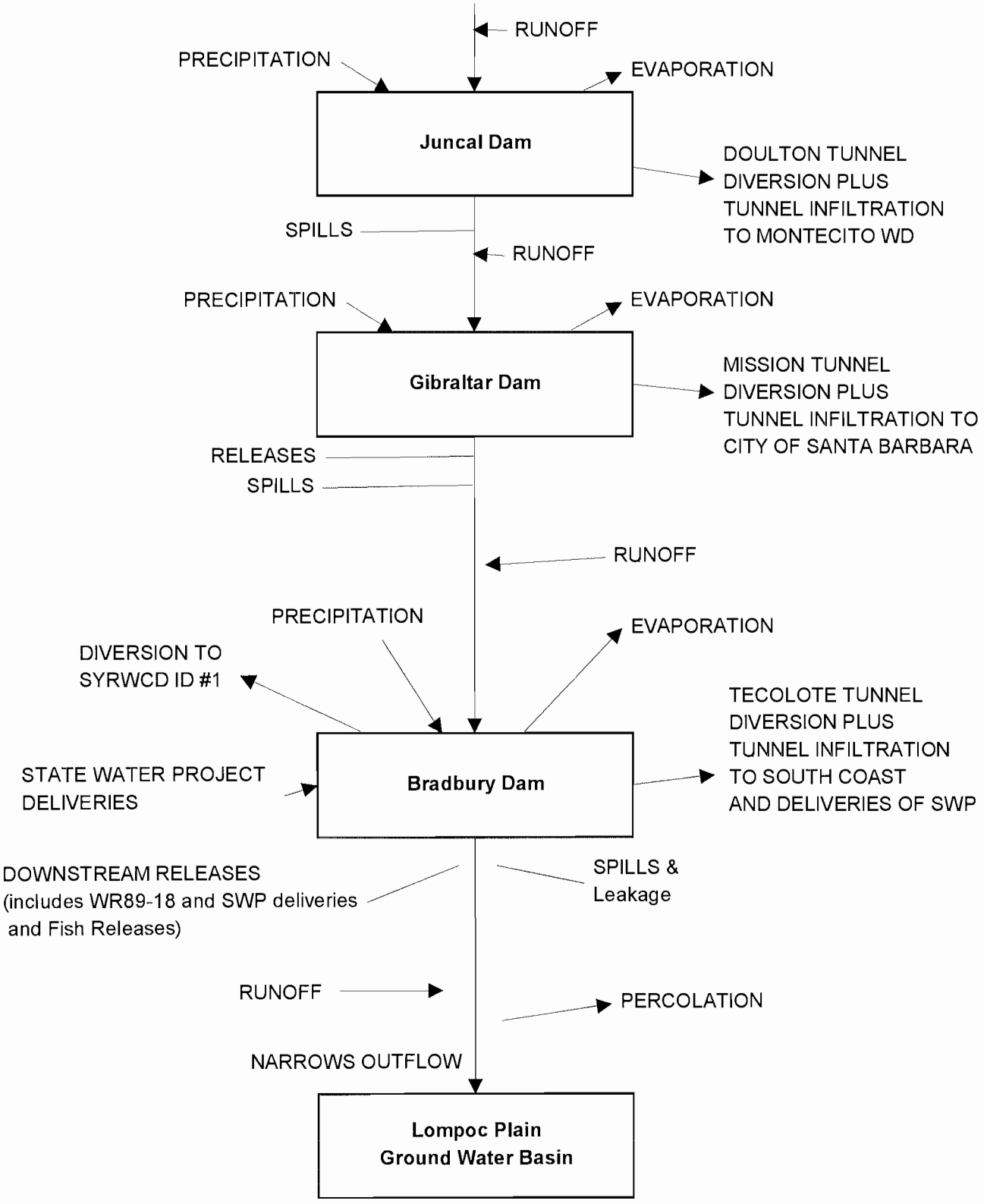
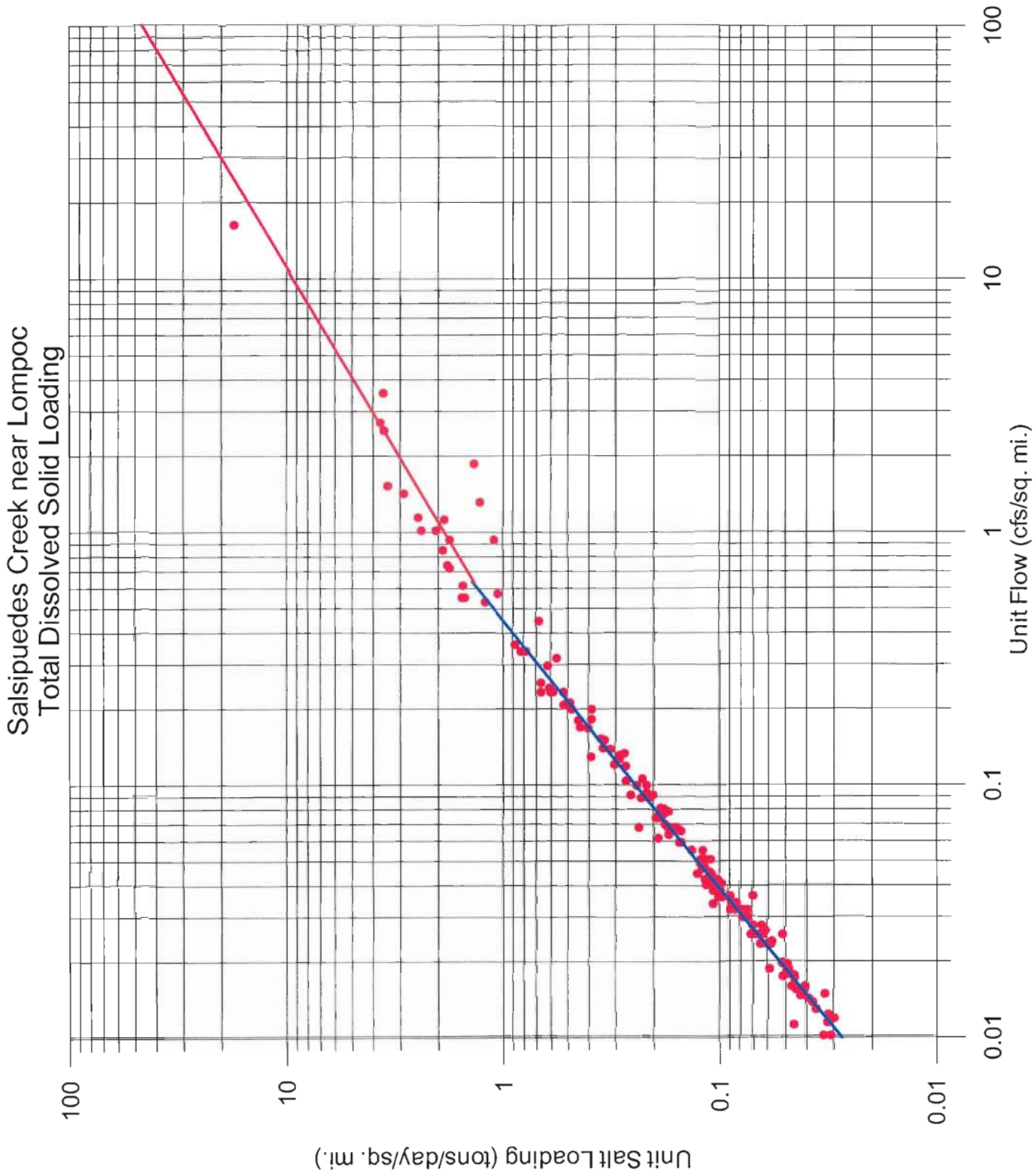


Figure 3



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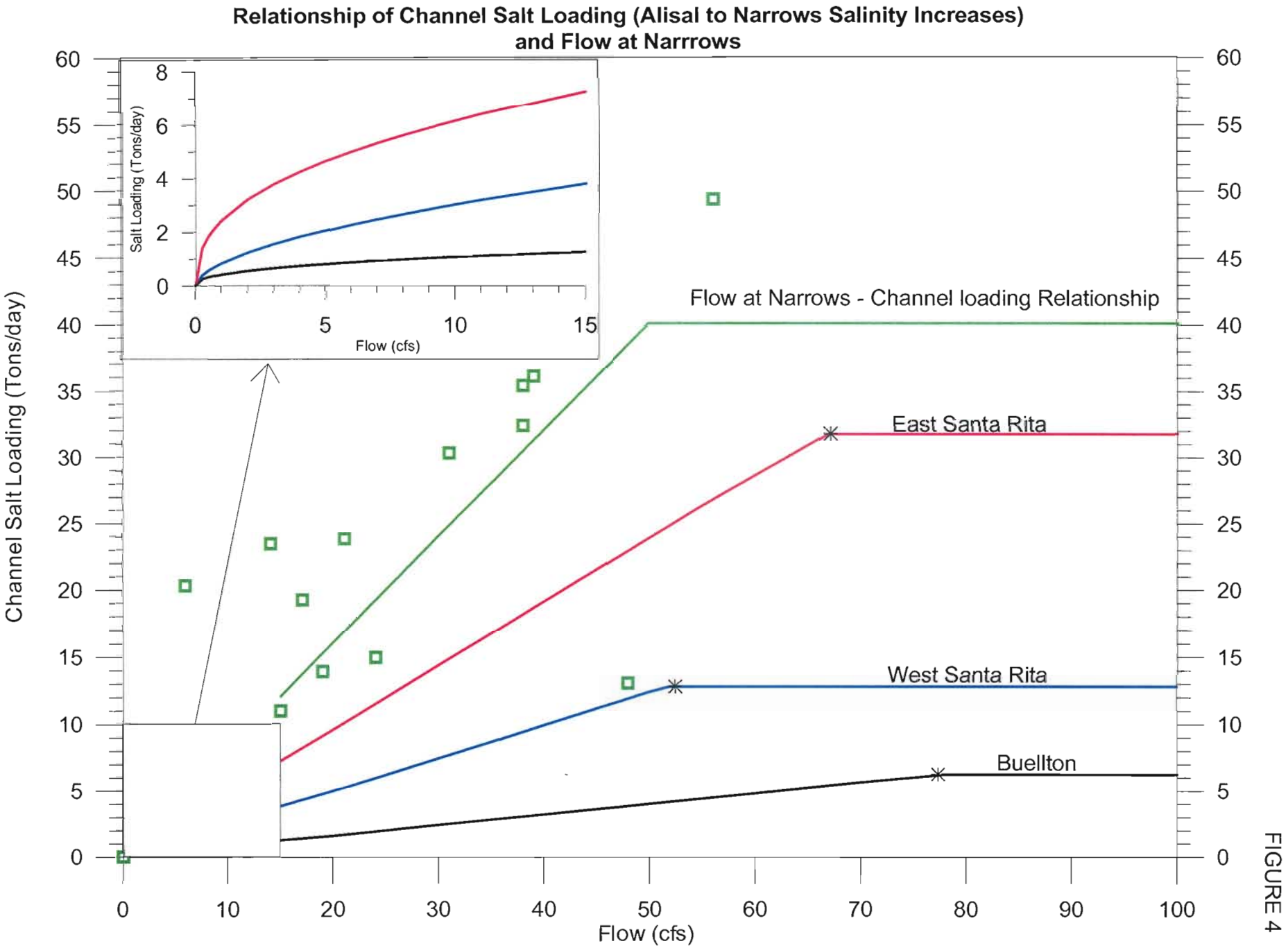

Relationship of Channel Salt Loading (Alisal to Narrows Salinity Increases) and Flow at Narrrows
Channel Salt Loading (Tons/day)
Flow (cfs)
Salt Loading (Tons/day)
Flow (cfs)
Flow at Narrows - Channel loading Relationship
East Santa Rita
West Santa Rita
Buellton

FIGURE 4

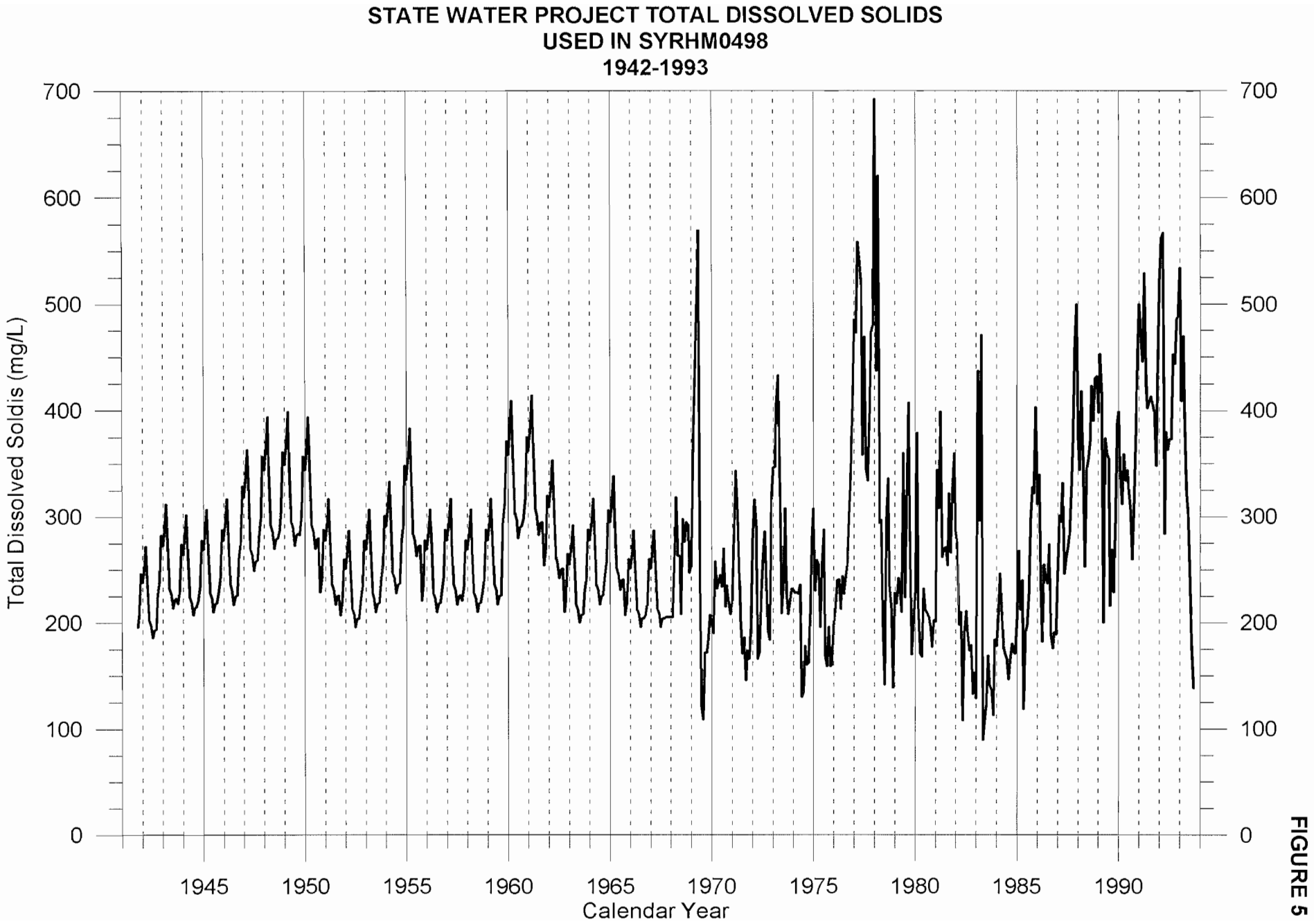

STATE WATER PROJECT TOTAL DISSOLVED SOLIDS
USED IN SYRHM0498
1942-1993
Total Dissolved Soldis (mg/L)
0
100
200
300
400
500
600
700
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
Calendar Year

FIGURE 5

Figure 6a

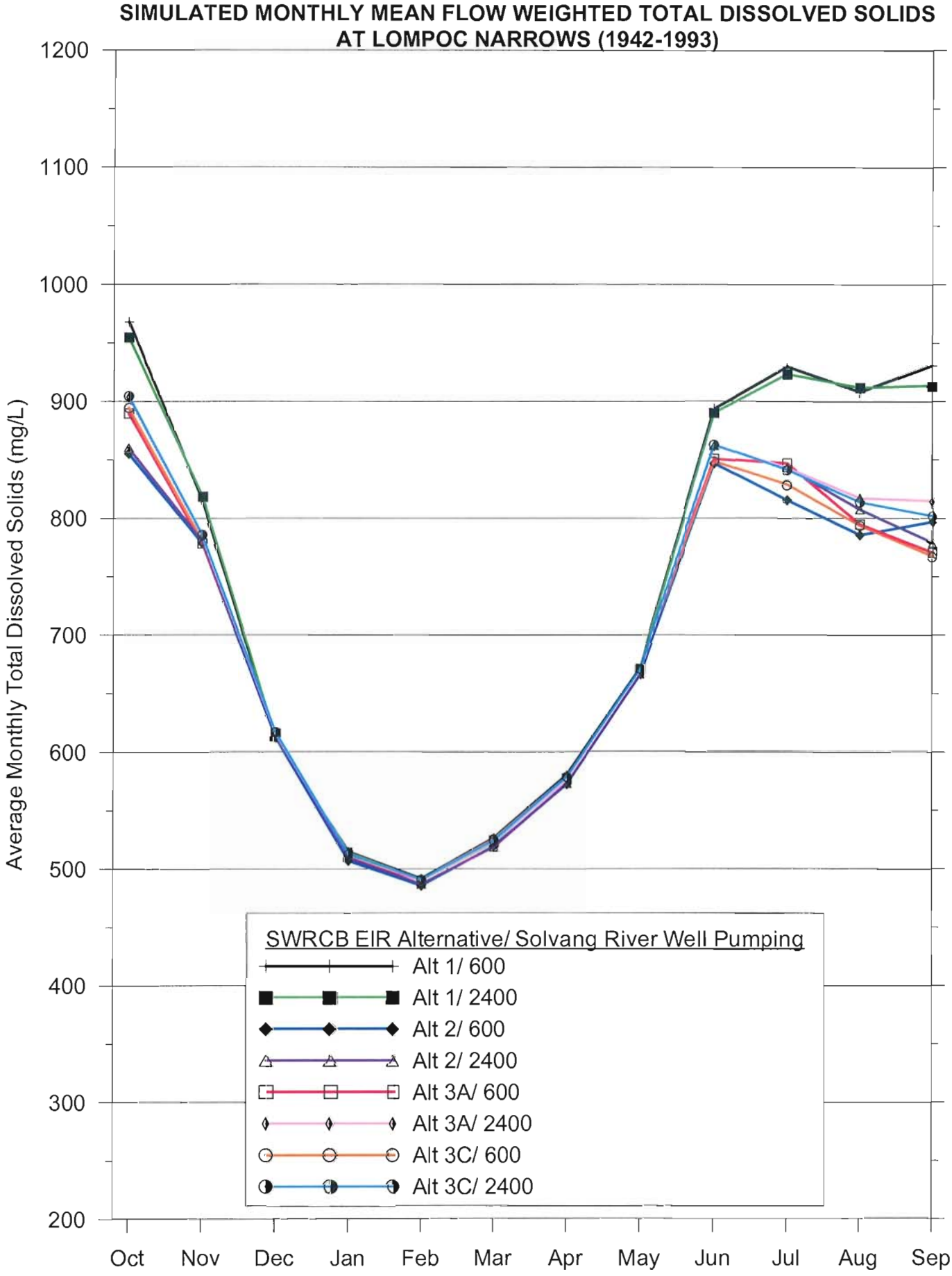

SIMULATED MONTHLY MEAN FLOW WEIGHTED TOTAL DISSOLVED SOLIDS
AT LOMPOC NARROWS (1942-1993)
Average Monthly Total Dissolved Solids (mg/L)
1200
1100
1000
900
800
700
600
500
400
300
200
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
SWRCB EIR Alternative/ Solvang River Well Pumping
Alt 1/ 600
Alt 1/ 2400
Alt 2/ 600
Alt 2/ 2400
Alt 3A/ 600
Alt 3A/ 2400
Alt 3C/ 600
Alt 3C/ 2400

Figure 6b

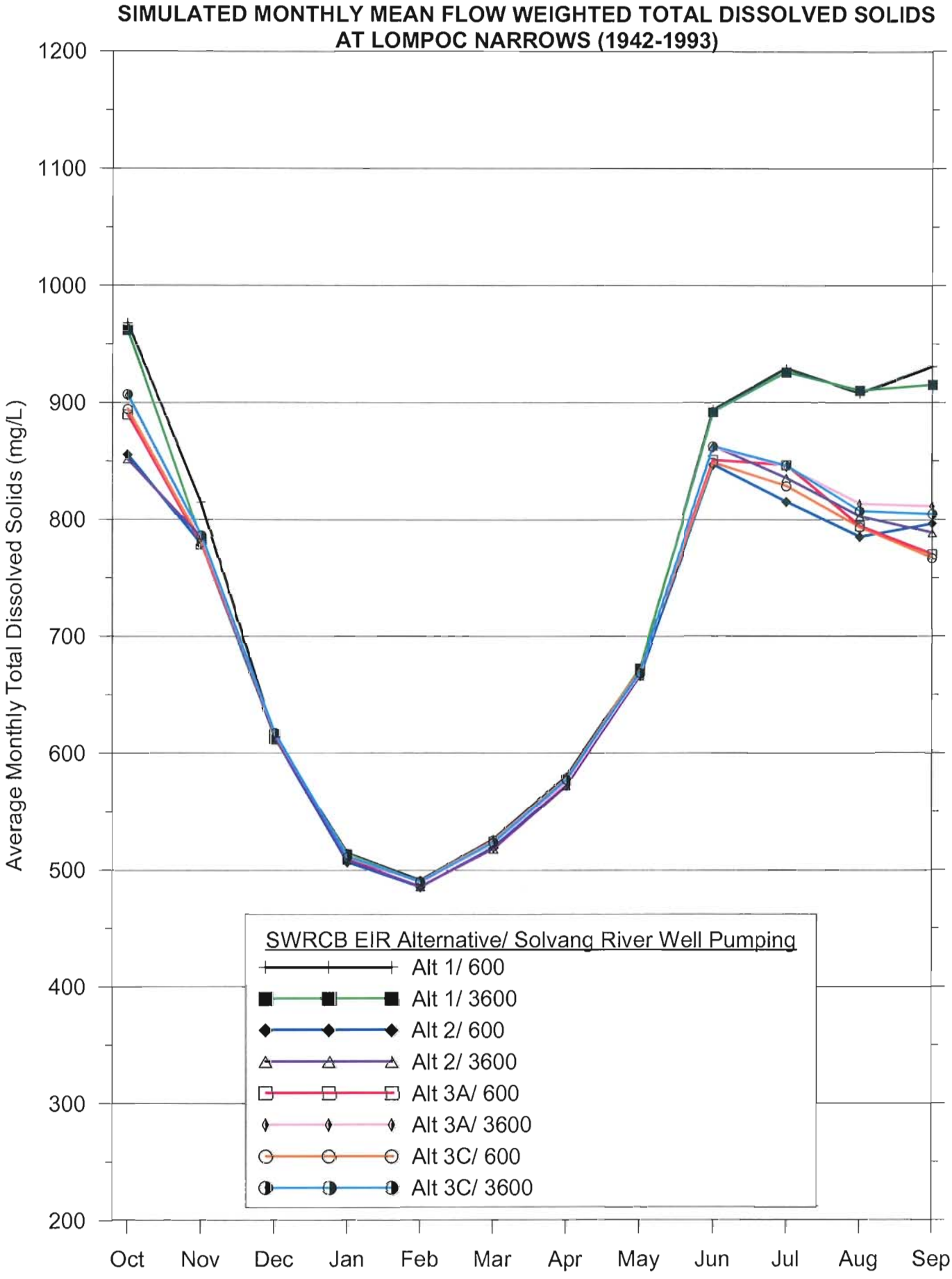

SIMULATED MONTHLY MEAN FLOW WEIGHTED TOTAL DISSOLVED SOLIDS
AT LOMPOC NARROWS (1942-1993)
Average Monthly Total Dissolved Solids (mg/L)
1200
1100
1000
900
800
700
600
500
400
300
200
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
SWRCB EIR Alternative/ Solvang River Well Pumping
Alt 1/ 600
Alt 1/ 3600
Alt 2/ 600
Alt 2/ 3600
Alt 3A/ 600
Alt 3A/ 3600
Alt 3C/ 600
Alt 3C/ 3600

Figure 7a

SIMULATED MEAN STREAMFLOW (1942-1993) AT LOMPOC NARROWS

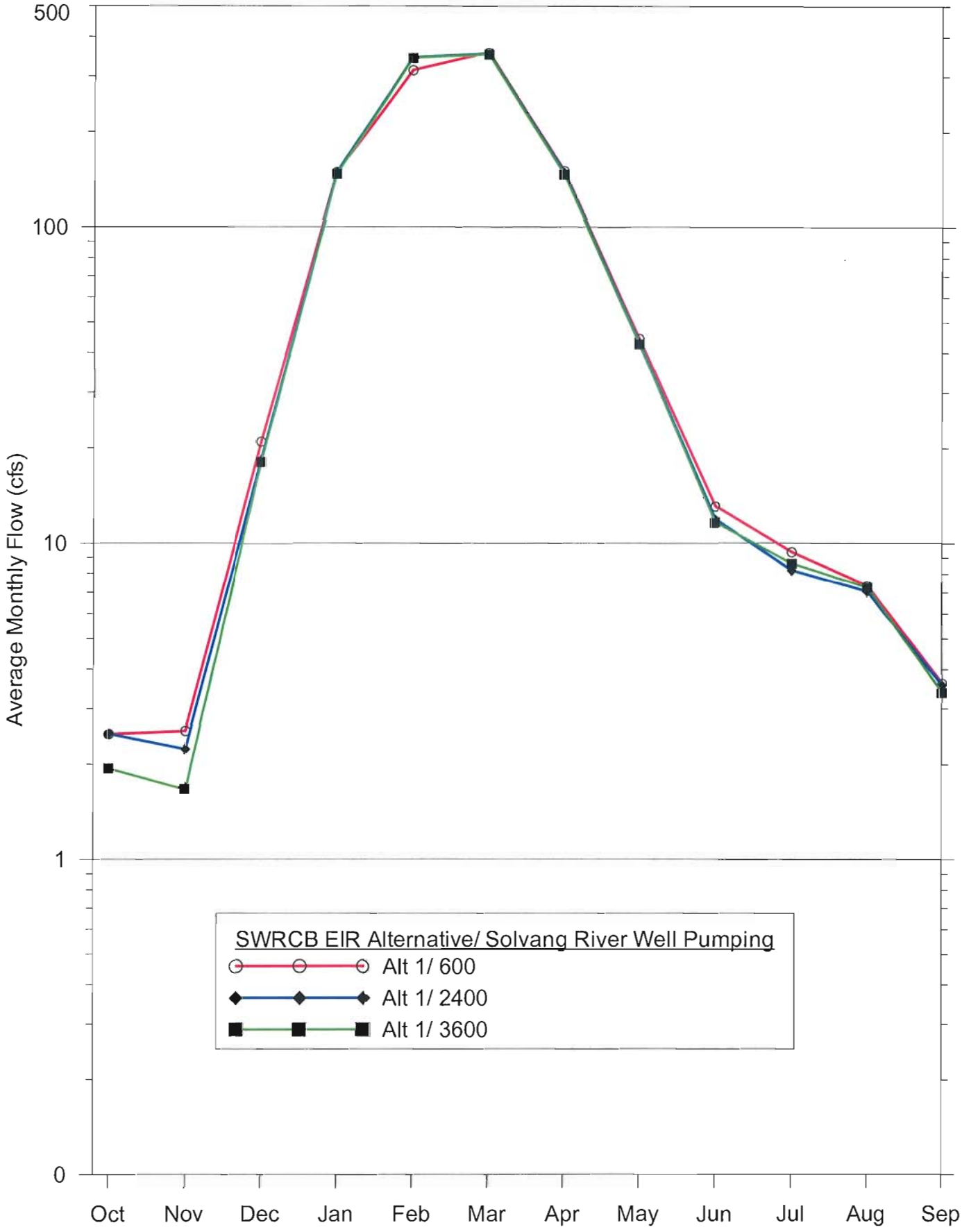


Figure 7b

SIMULATED MEAN STREAMFLOW (1942-1993) AT LOMPOC NARROWS

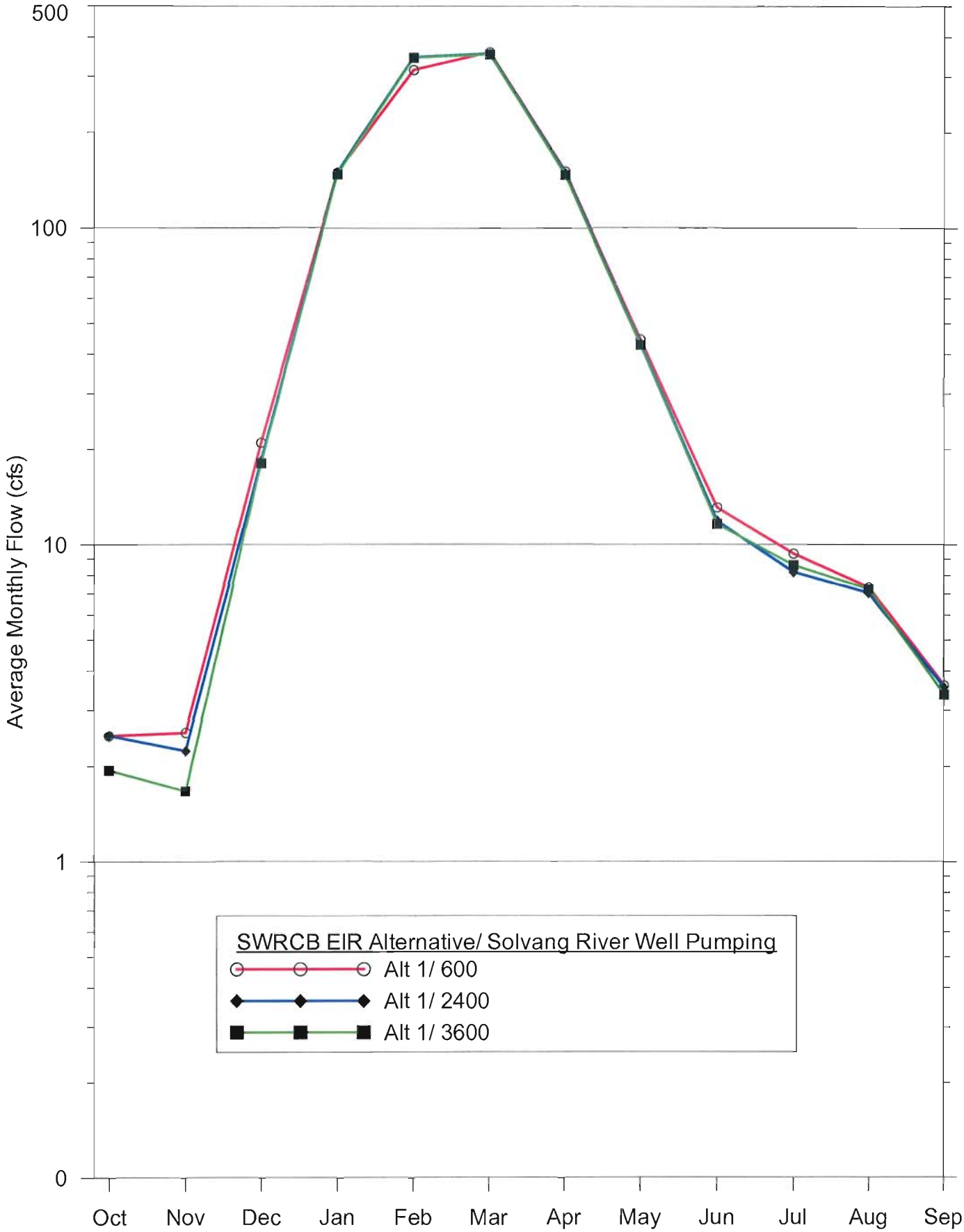


Figure 7c

SIMULATED MEAN STREAMFLOW (1942-1993) AT LOMPOC NARROWS

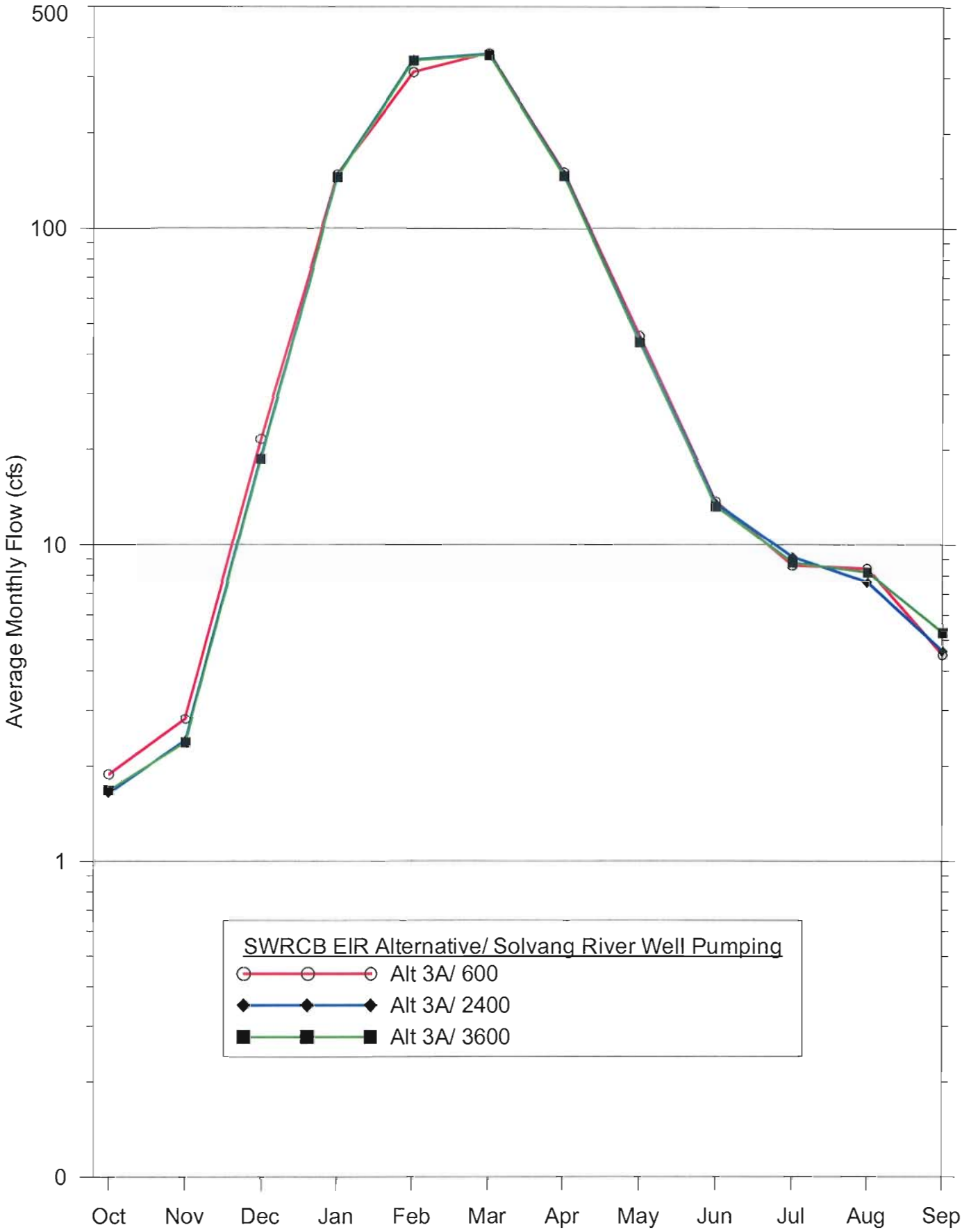


Figure 7d

SIMULATED MEAN STREAMFLOW (1942-1993) AT LOMPOC NARROWS

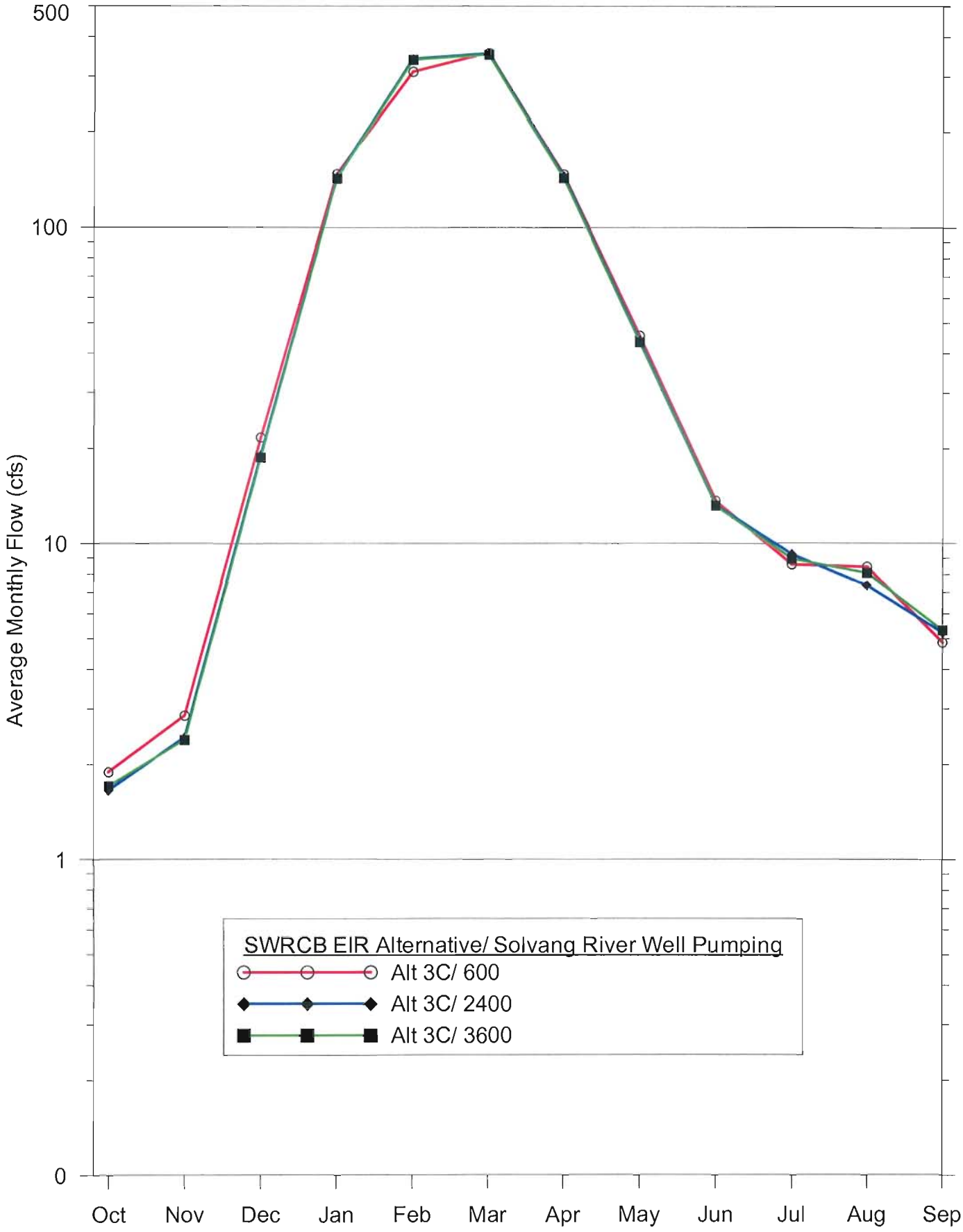
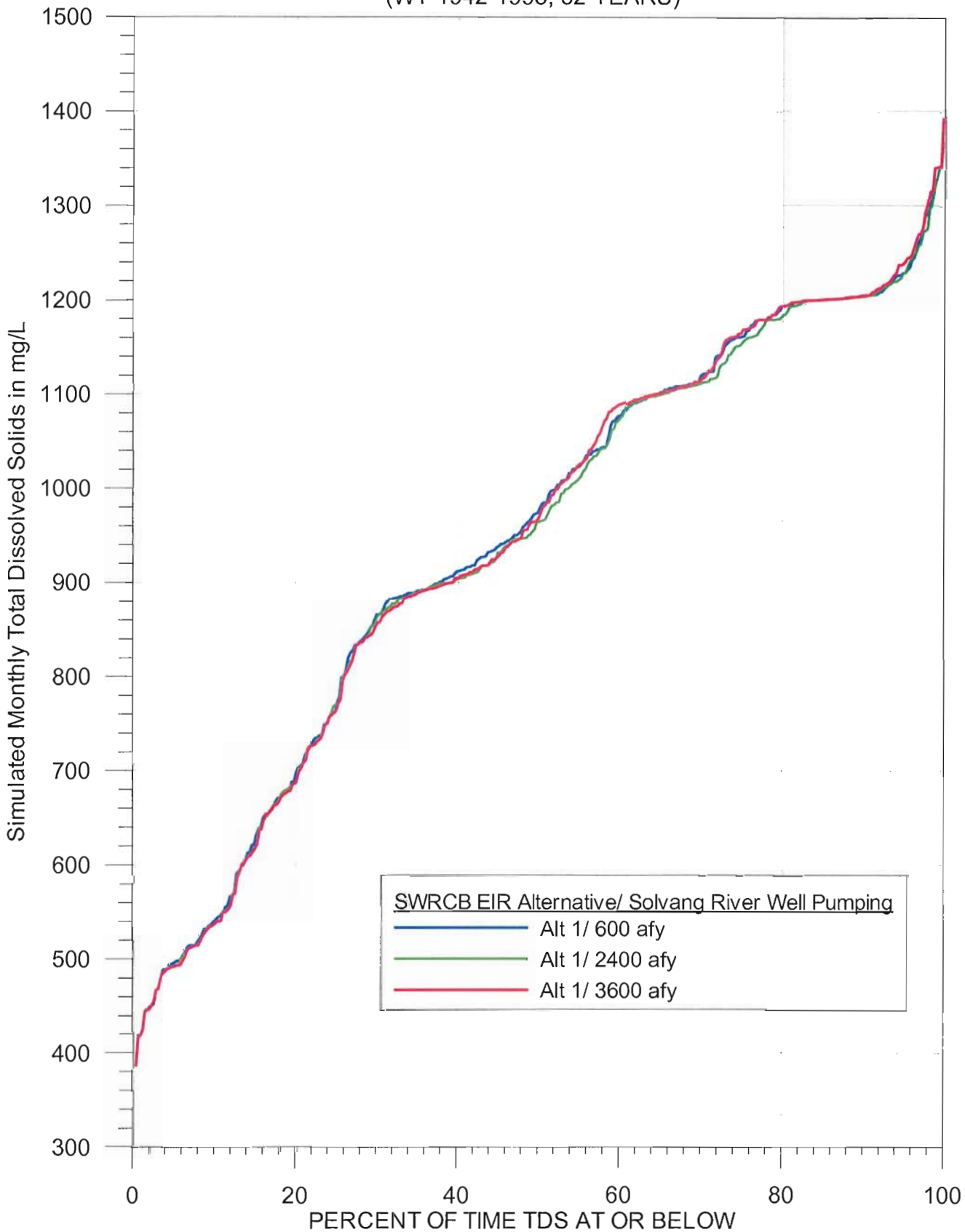


FIGURE 8a

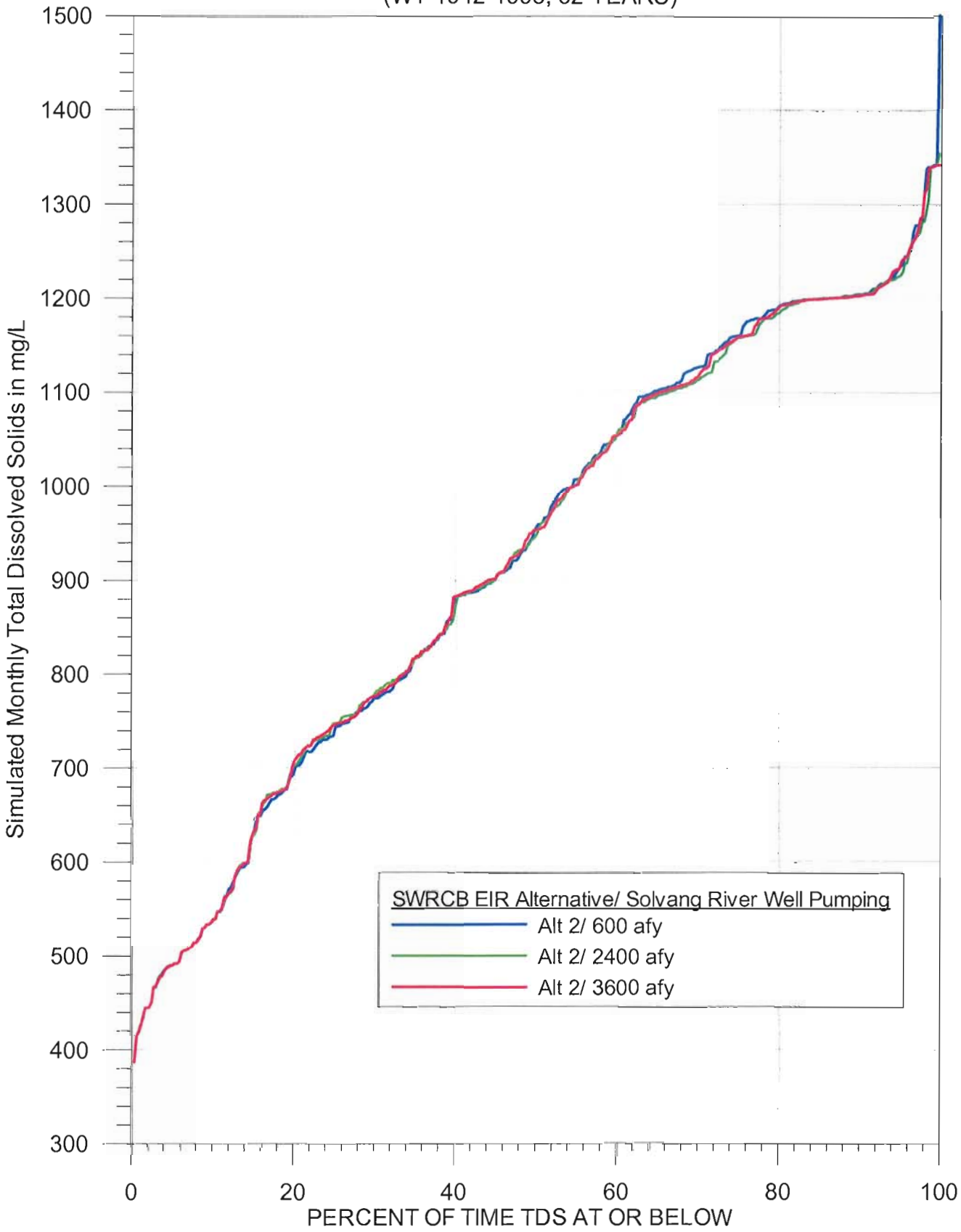
FREQUENCY OF DISSOLVED SOLIDS CONCENTRATIONS [1]
IN FLOWS AT LOMPOC NARROWS
(WY 1942-1993, 52 YEARS)



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

FIGURE 8b

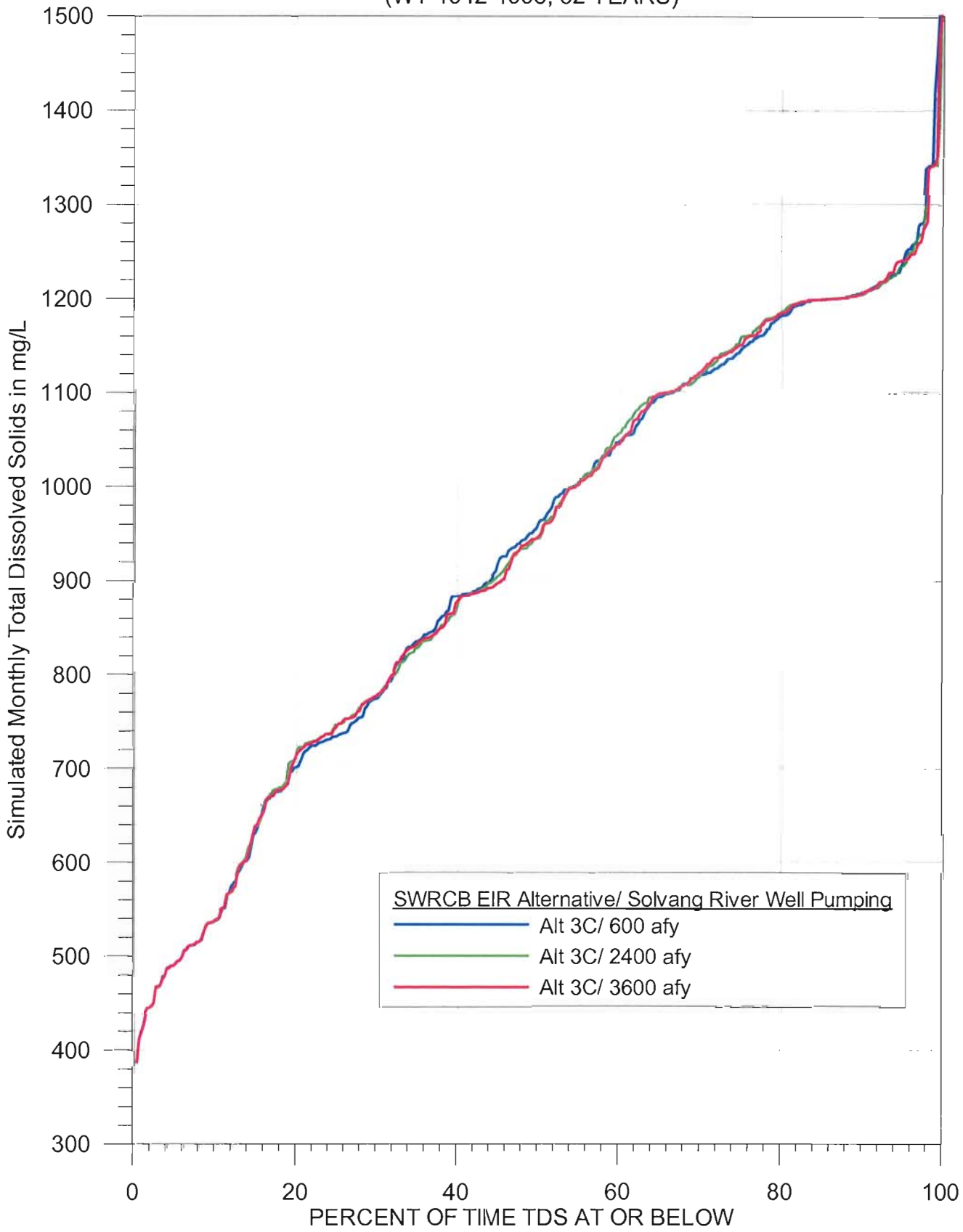
FREQUENCY OF DISSOLVED SOLIDS CONCENTRATIONS [1]
IN FLOWS AT LOMPOC NARROWS
(WY 1942-1993, 52 YEARS)



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

FIGURE 8d

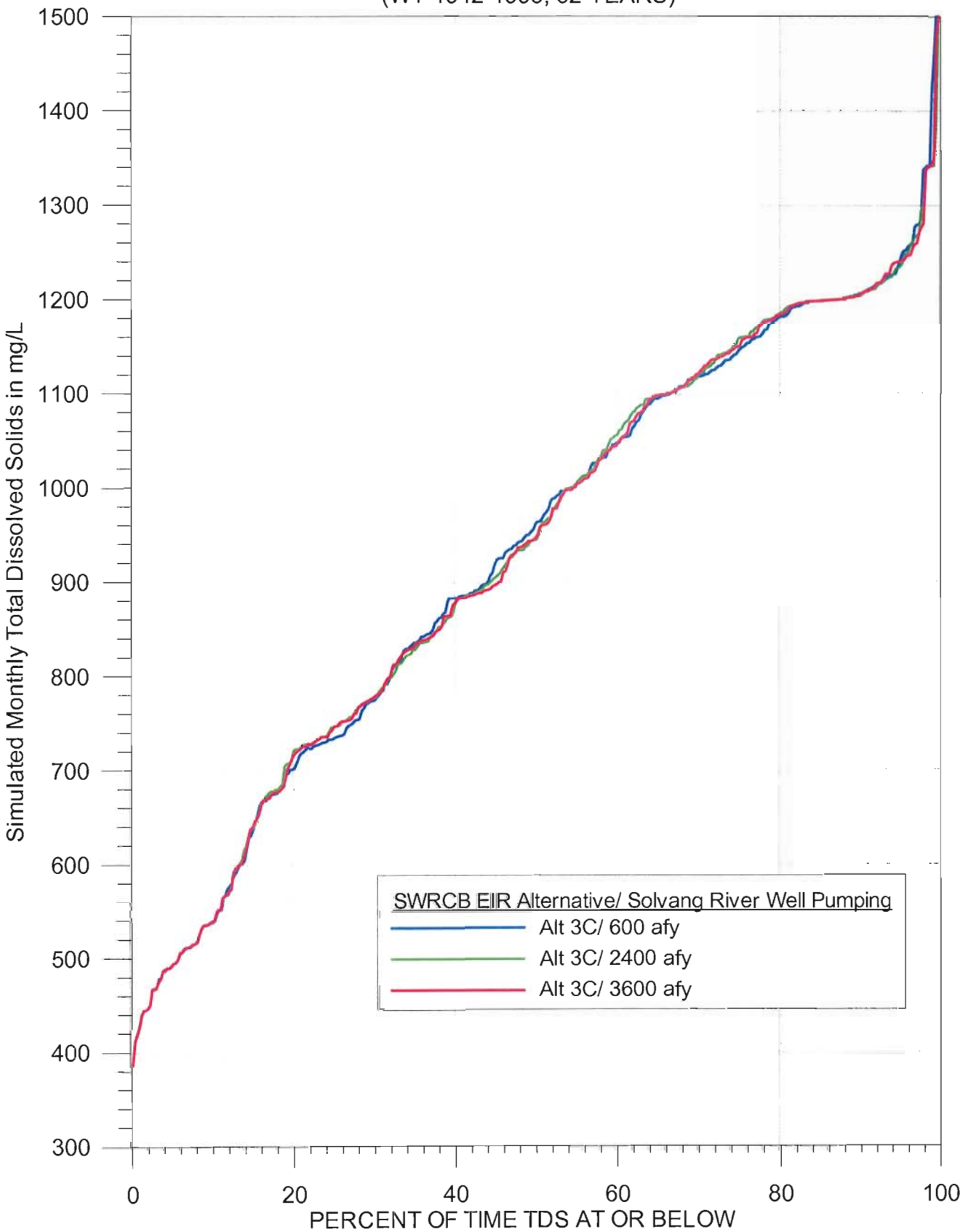
FREQUENCY OF DISSOLVED SOLIDS CONCENTRATIONS [1]
IN FLOWS AT LOMPOC NARROWS
(WY 1942-1993, 52 YEARS)



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

FIGURE 8d

FREQUENCY OF DISSOLVED SOLIDS CONCENTRATIONS [1]
IN FLOWS AT LOMPOC 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