



Staff Report of the
CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

**WATER QUALITY OF THE LOWER
SAN JOAQUIN RIVER:
LANDER AVENUE TO VERNALIS
OCTOBER 1998 - SEPTEMBER 2000
(WATER YEARS 1999 AND 2000)**



APRIL 2002

State of California

California Environmental Protection Agency

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Many thanks to the staff and students of the San Joaquin Watershed Section without whose efforts during field sampling, quality control, and data processing, this report would not have been possible.

Table of Contents

	<u>Page</u>
Executive Summary	1
Introduction.....	5
Study Area	7
Sampling Program	9
Sample Collection Methods.....	10
Grab Samples.....	10
Composite Automated Samples.....	10
Quality Control and Quality Assurance.....	10
Rainfall and Discharge Patterns.....	12
Results.....	13
Electrical Conductivity, Boron and Selenium	13
Grab Samples.....	15
Daily Composite Samples.....	16
Other Elements of Concern.....	19
Eastside Tributaries.....	19
Discussion.....	22
Comparison to Pre-Project Conditions and Water Year 1998.....	22
Comparison to Applicable Water Quality Objectives	23
Boron.....	24
Selenium	25
Molybdenum.....	25
Loads of Salt, Boron and Selenium	29
Data Availability, Water Years 1999 and 2000.....	29
Monthly Loads: Water Years 1999 and 2000.....	29
Annual Loads: Water Years 1986 to 2000.....	30
References.....	44

Appendices

Appendix A. Grab Sample Water Quality Data.....	48
Appendix B. Automated Daily Composite Water Quality Data.....	62

List of Tables

	<u>Page</u>
1. Tributaries and Drains to the San Joaquin River between Monitoring Stations from the Lander Avenue Bridge to Vernalis	8
2. Monitoring Sites, Sampling Frequencies, and Parameters Measured in the San Joaquin River and Major Tributaries: Water Years 1999 and 2000.....	9
3. Quality Assurance Tolerance Guidelines Used in the Regional Water Quality Control Board Agricultural Drainage Monitoring Program.....	11
4. Annual Minimum, Mean and Maximum Electrical Conductivity, Boron and Selenium at Monitoring Sites on the San Joaquin River: Water Years: 1986-1996, 97, 98, 99 and 2000.....	14
5. Summary of Copper, Chromium, Lead, Nickel, Zinc, and Molybdenum Results at Selected Sites in the Lower San Joaquin River: Water Years 1999 and 2000	21
6. Summary of Total Suspended Solids Concentrations at Selected Sites in the Lower San Joaquin River: Water Year 1999	21
7. Boron, Selenium, and Molybdenum Water Quality Objectives for the Lower San Joaquin River	23
8. Summary of Selenium Water Quality Objectives and Compliance Time Schedule.....	24
9. Monthly Mean Boron Concentrations and Water Quality Objective (WQO) Exceedances in the San Joaquin River: Water Years 1999 and 2000.....	27
10. Monthly Mean Selenium Concentrations and Potential Water Quality Objective (WQO) Exceedances in the San Joaquin River: Water Year 1999 and 2000.....	27
11. Monthly and Annual Discharge and Salt, Boron and Selenium Loads and Flow Weighted Concentrations for SJR at Crows Landing for Water Year 1999	33
12. Monthly and Annual Discharge and Salt, Boron and Selenium Loads and Flow Weighted Concentrations for SJR at Crows Landing for Water Year 2000	33
13. Monthly and Annual Discharge and Salt, Boron and Selenium Loads and Flow Weighted Concentrations for SJR near Vernalis for Water Year 1999.....	34
14. Monthly and Annual Discharge and Salt, Boron and Selenium Loads and Flow Weighted Concentrations for SJR near Vernalis for Water Year 2000	34
15. Water Year 1999 Load Summary and Comparison Between the Drainage Project Area, Grassland Watershed and San Joaquin River at Crows Landing and near Vernalis	35
16. Water Year 2000 Load Summary and Comparison Between the Drainage Project Area, Grassland Watershed and San Joaquin River at Crows Landing and near Vernalis	36

List of Figures

1. Monitoring Locations Along the Lower San Joaquin River	6
2. Comparison of Rainfall and San Joaquin River Flows Below Friant Dam: Water Years 1999 and 2000	12
3. Comparison of Rainfall (Kesterson National Wildlife Refuge) and Flows in the San Joaquin River at Lander Avenue, Patterson and Vernalis: Water Years 1999-2000 ..	13
4. Comparison of Weekly Measurements of Electrical Conductivity, Boron and Selenium Concentrations in the San Joaquin River at Patterson, Maze Boulevard, and Vernalis: Water Years 1999 and 2000.....	17

List of Figures continued:

Page

5. Comparison of Electrical Conductivity, Boron and Selenium from Weekly Grabs and Autosampler Collections in the San Joaquin River at Crows Landing: Water Years 1999 and 2000	18
6. San Joaquin River Flows Compared to Electrical Conductivity and Boron at Crows Landing: Water Years 1999 and 2000	20
7. Relationship Between Flows in the San Joaquin River and Selenium Concentrations at Crows Landing: Water Years 1999 and 2000	20
8. 4-day Running Average Selenium Concentrations in the San Joaquin River at Crows Landing: Water Years 1997, 1998, 1999 and 2000	28
9. San Joaquin River Flows at Crows Landing: Water Years 1997, 1998, 1999 and 2000	28
10. Monthly Discharge for the San Joaquin River at Crows Landing and near Vernalis: Water Year 1999	37
11. Monthly Discharge for the San Joaquin River at Crows Landing and near Vernalis: Water Year 2000	37
12. Monthly Salt Loads for the San Joaquin River at Crows Landing and near Vernalis: Water Year 1999	38
13. Monthly Salt Loads for the San Joaquin River at Crows Landing and near Vernalis: Water Year 2000	38
14. Monthly Boron Loads for the San Joaquin River at Crows Landing and near Vernalis: Water Year 1999	39
15. Monthly Boron Loads for the San Joaquin River at Crows Landing and near Vernalis: Water Year 2000	39
16. Monthly Selenium Loads for the San Joaquin River at Crows Landing and near Vernalis: Water Year 1999	40
17. Monthly Selenium Loads for the San Joaquin River at Crows Landing and near Vernalis: Water Year 2000	40
18. Measured Selenium Load in the San Joaquin River at Lander Avenue, Crows Landing, Patterson, and Vernalis, as Compared to Estimated River Reach Load Based on Summed Tributary Contributions	41
19. Annual Discharge from the Drainage Project Area, Grassland Watershed and the San Joaquin River at Crows Landing and Vernalis: Water Years 1986 through 2000	42
20. Annual Salt Loads from the Drainage Project Area, Grassland Watershed and the San Joaquin River at Crows Landing and Vernalis: Water Years 1986 through 2000	42
21. Annual Boron Loads from the Drainage Project Area, Grassland Watershed and the San Joaquin River at Crows Landing and Vernalis: Water Years 1986 through 2000	43
22. Annual Selenium Loads from the Drainage Project Area, Grassland Watershed and the San Joaquin River at Crows Landing and Vernalis: Water Years 1986 through 2000	43

EXECUTIVE SUMMARY

Since May 1985, the Central Valley Regional Water Quality Control Board (Regional Board) has conducted a water quality monitoring program on the lower San Joaquin River to evaluate the effects of subsurface agricultural drainage inflows. The study area consists of the 60-mile section of the San Joaquin River extending from Lander Avenue near Stevinson to Airport Way near Vernalis. Five major tributaries flow into the river within this study area: Salt Slough, Mud Slough (north), and the Merced, Tuolumne, and Stanislaus Rivers. Salt Slough and Mud Slough (north) drain the Grassland Watershed of western Merced County and are the major source of agricultural subsurface drainage water discharges to the river system. The Merced, Tuolumne, and Stanislaus Rivers are east side streams which drain the Sierra Nevada and provide high quality fresh water flows.

The period covered by this report, 1 October 1998 through 30 September 2000 (Water Years 1999 and 2000¹), represents the third and fourth years of the operation of the Grassland Bypass Project. The project began operation on 23 September 1996 and consolidated the majority of subsurface agricultural drainage within the Grassland Watershed into a single channel, allowing the drainage to bypass approximately 90 miles of wetland water supply channels and Salt Slough. The drainage was redirected into the lower nine miles of Mud Slough and eventually into the San Joaquin River.

During Water Years 1999 and 2000 (WYs 99-00), water quality information was collected at seven sites along the San Joaquin River, representing both background water quality and influences of major inflows. The primary constituents evaluated included electrical conductivity, boron and selenium, with more limited analyses of molybdenum, copper, chromium, lead, nickel, zinc, chloride and sulfate. Grab samples were collected weekly, monthly, or quarterly depending on the location. Automated, daily composite samples were also collected at the Crows Landing site (downstream of the Merced River inflow).

The San Joaquin River Index is used to classify water year type in the river basin based on total runoff (SWRCB, 1997). Water Years 1999 and 2000 were classified as above normal water years based on the total year's runoff and the percentage carryover that occurred from the previous water year.

During Water Years 1999 and 2000, constituent concentrations followed trends observed during the previous two years of study. The highest concentrations occurred downstream of the discharges from the Grassland Bypass Channel (downstream of Mud Slough north), while the lowest concentrations were recorded at the background (Lander Avenue) site and at the Vernalis site (Airport Road) downstream of the eastside tributary dilution flows. Mean concentrations of selenium continued to be lower at all sites, as compared to pre-project water years. EC and boron concentrations were lower than concentrations noted during pre-project critical water years, but in some cases higher than pre-Project wet water years. Maximum selenium concentrations were higher than those recorded during post-Project, wet Water Year 1998 at sites located downstream of the Mud Slough tributary.

¹ A Water Year covers the time period from 1 October through 30 September of the following year.

In October 1988, the Regional Board adopted water quality objectives for boron, molybdenum and selenium for the lower San Joaquin River between Sack Dam and Vernalis. Two sets of objectives were developed. One set of objectives was established for the river reach with minimal freshwater flow (between Sack Dam and the mouth of the Merced River) and the second set was for the reach of river with highly managed freshwater flows (from the mouth of the Merced River to Vernalis). The boron objective is also based on season, with more stringent objectives applying during the irrigation season (March 15 through September 15) when downstream crops would be susceptible to boron toxicity from irrigation water.

In May 1996, the Regional Board adopted a revised selenium water quality objective for the lower San Joaquin River along with a compliance time schedule. The revised objective (5 ug/L 4-day average) and compliance time schedule were approved by the State Water Resources Control Board on 10 January 1997. The selenium compliance time schedule does not require full compliance with the selenium objective until 1 October 2005 or 1 October 2010, depending on which reach of the river is being evaluated and the classification of the water year.

During Water Years 1999 and 2000, weekly grab samples indicated that boron concentrations were above the applicable monthly mean boron objective (0.8 mg/L) in the lower San Joaquin River at the Crows Landing site in June, July and August. Review of the daily composited data from the Crows Landing site confirmed the concentrations. Boron concentrations remained below the instantaneous maximum boron water quality objectives (2.0 mg/L to 5.8 mg/L, depending on the river location and time of year) during Water Years 1999 and 2000.

During Water Year 1999, 4-day average selenium concentrations were above 5 ug/L at the Crows Landing site continuously from 20 June through 26 June, from 9 July through 12 July, and from 31 August to 1 September. During Water Year 2000, the 4-day average selenium concentration at this site was only above 5 ug/L on 15 June. The continuous selenium objectives are currently subject to a compliance time schedule. The maximum selenium water quality objectives, 12 ug/L to 20 ug/L, depending on location, were not exceeded in the San Joaquin River at any time during the study period.

The molybdenum water quality objectives, 10 ug/L to 19 ug/L, depending on location, were met at all sites monitored. The highest molybdenum concentration detected in the San Joaquin River during the study period, was 18 ug/L at the Lander Avenue site on 28 September 2000. The reported maximum concentration does not exceed the continuous or maximum molybdenum water quality objective and is upstream of major inflows to the system.

Salt, boron, and selenium loads for the San Joaquin River (SJR) at Crows Landing, the SJR near Vernalis, the Drainage Project Area (DPA), and the Grassland Watershed were estimated based upon the flow weighted monthly average of available water quality data for Water Years 1999 and 2000. Discharge for these sites was based upon US Geological Survey (USGS) reported daily discharges.

The seasonal pattern of monthly salt and boron loads for a particular site is generally similar to the pattern of discharge for that site. The seasonal pattern of monthly selenium loads for all sites is generally similar to the discharge of the Grassland Watershed. Discharge for Crows Landing

and Vernalis peaked in the months of February and March for both water years. Salt, boron, and selenium loads for Crows Landing and Vernalis, as well as for the DPA and Grassland Watershed, peaked in March for both water years.

The widespread flooding and the resultant commingling of waters that occurred in the San Joaquin River Basin during Water Years 1997 and 1998 did not occur during Water Year 1999 or 2000. Estimates of constituent loads were made based on available flow and concentration data. Discharge at Vernalis decreased 20% from Water Year 1999 to 2000, due primarily to a reduction in freshwater inflows from the Tuolumne and Stanislaus Rivers. Loads of salt and boron remained nearly identical from Water Year 1999 to 2000. In contrast, from Water Year 1999 to 2000, selenium loads decreased 8% at Crows Landing, but increased 11% at Vernalis. Although some of the apparently increased selenium load calculated at Vernalis may be attributed to calculation errors described in this report, the monitoring program has been expanded to include other possible sources of selenium discharging to the San Joaquin River between Crow's Landing and Vernalis. In general, loads of all constituents were lower in Water Years 1999 and 2000 relative to Water Year 1996; a pre-project year with discharge similar to Water Years 1999 and 2000.

Water quality monitoring is continuing in the Grassland Watershed and along the San Joaquin River and selected tributaries. Draft water quality information from the continuing studies is available on the following Central Valley Regional Water Quality Control Board Web Site:

<http://www.swrcb.ca.gov/rwqcb5/programs/index.html>

A detailed discussion of monthly and annual discharge and loads for the DPA and the Grassland Watershed can be found in *Agricultural Drainage Contribution to Water Quality in the Grassland Watershed of Western Merced County, California: October 1998 – September 2000; Water Years 1999 & 2000* (Crader et al., 2002).

INTRODUCTION

The Agricultural Unit of the Central Valley Regional Water Quality Control Board (Regional Board) initiated a water quality monitoring program on the lower San Joaquin River in May 1985 to evaluate the effects of subsurface agricultural drainage inflows. Water quality samples have been collected at several San Joaquin River monitoring sites along a 60-mile section of the lower river, extending from near Stevinson in Merced County to Airport Way near Vernalis in San Joaquin County, since the beginning of the program. This monitoring program has provided an on-going database for selected inorganic constituents found in San Joaquin River. The database is used to assess the immediate effects of agricultural drainage water on the quality of the San Joaquin River, as well as the long-term effects of regional agricultural drainage reduction programs on overall river water quality.

This report contains laboratory results and a summary of water quality analyses for all constituents measured as part of the program during Water Years 1999 and 2000 (October 1998 through September 2000).² Water Years 1999 and 2000 represent conditions during the third and fourth years of operation of the Grassland Bypass Project. The Grassland Bypass began operation on 23 September 1996 and consolidated the majority of subsurface agricultural drainage, within the Grassland Watershed, into a single channel that discharges into the final nine miles of Mud Slough (north), allowing the drainage to bypass approximately 90 miles of wetland water supply channels. Water quality information collected as part of this multi-agency project is available on the Internet at the Regional Board website at:

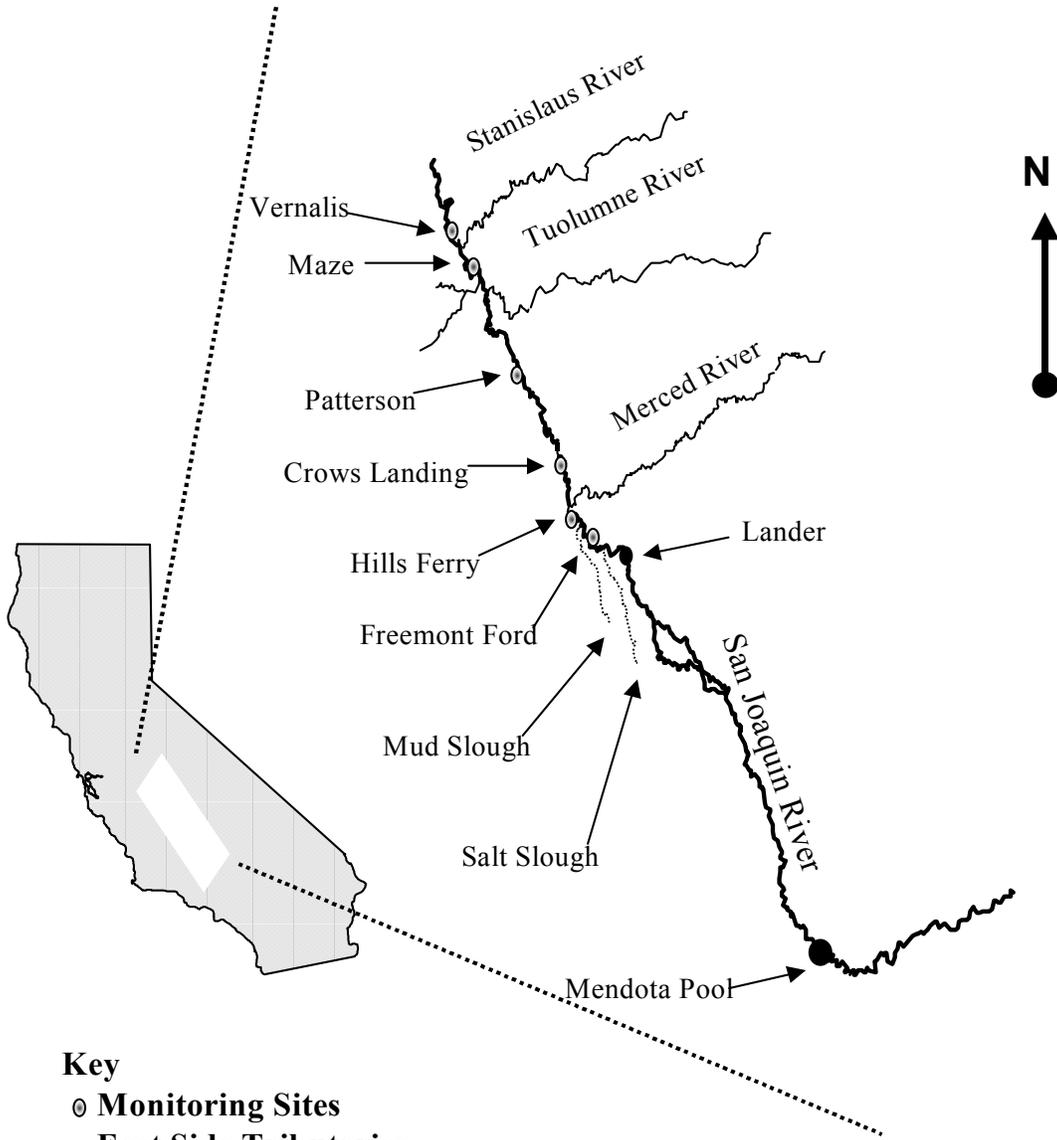
<http://www.swrcb.ca.gov/rwqcb5/agunit/bypass/disclaim.htm>

This report presents the data and compares salinity (measured as electrical conductivity), boron and selenium water quality at selected sites on the San Joaquin River, including sites upstream and downstream of the Mud Slough (north) inflow, with respect to hydrology, change in water management, and applicable water quality objectives.

Water quality data collected during the previous years of study can be found in both a summary report presenting salinity, boron, and selenium information from May 1985 through September 1996 (Steensen *et al.*, 1998) and in a series of annual reports presenting all water quality information collected through September 1998 (James, *et al.*, 1988; Westcot, *et al.*, 1989a, 1990, 1991, and 1992, Karkoski and Tucker, 1993; Chilcott, *et al.*, 1995; Steensen *et al.*, 1996; Chilcott, *et al.*, 1998a and Chilcott, *et al.*, 2000). This monitoring program was designed to complement monitoring programs conducted by other state, federal, and local agencies.

² A water year lasts from October 1st of one year through September 30th of the following year.

Figure 1. Monitoring Locations Along the Lower San Joaquin River.



- Key**
- ⊙ Monitoring Sites
 - East Side Tributaries
 - San Joaquin River
 - Sloughs

STUDY AREA

The study area consists of the 60-mile section of the San Joaquin River extending from Lander Avenue (Highway 165) near Stevinson to Airport Way near Vernalis. Monitoring sites are located near seven of the eight river over crossings on this section of the river (**Figure 1**).

Five major tributaries flow into the San Joaquin River within this study area: Salt Slough, Mud Slough (north), and the Merced, Tuolumne, and Stanislaus Rivers. Salt Slough and Mud Slough (north) drain the Grassland Watershed of western Merced County and discharge to the San Joaquin River in the southern portion of the study area. These two sloughs carry a varying mixture of surface and subsurface agricultural drainage, operational spillage from irrigation canals, and drainage from duck ponds flooded for waterfowl habitat. The Merced, Tuolumne, and Stanislaus Rivers are east side inflows which drain the Sierra Nevada. All three streams receive some agricultural return flows in their lower reaches upstream of the San Joaquin River, however, overall water quality remains relatively high.

In addition to the five major tributaries, there are also a number of smaller tributaries, as well as surface and subsurface agricultural drains, that discharge to the San Joaquin River within the study area. All significant inflows and their locations, including the monitoring sites, are referenced by river mile and listed in **Table 1**. A full description of the inflow points that occur in this 60-mile section of the river is in James, *et al.* (1989).

The Hills Ferry Road site was initiated in order to measure water quality in the San Joaquin River downstream of inflows from the Grassland Watershed and upstream of inflows from eastside tributaries. Aerial surveillance and ground truthing conducted toward the end of Water Year 1998 indicated that a portion of the Merced River seasonally discharges upstream of the sampling site. Reevaluation of the sampling location was conducted and possible alternate sites explored during Water Year 1999 and into Water Year 2000. After Water Year 1999, regular monitoring at the Hills Ferry site was discontinued by the Regional Board, due to lack of a site where a grab sample would adequately represent the quality of the river upstream of eastside tributary flows.

Prior to October 1996, subsurface agricultural drainage water (tile drainage) and surface runoff (irrigation tail water) from the Grassland Watershed was discharged to the San Joaquin River through Salt Slough and/or Mud Slough (north). These two sloughs are tributary to the San Joaquin River and serve as the drainage outlets for the Grassland Watershed. Salt Slough carried the bulk of the subsurface agricultural drainage from Water Year 1989 through Water Year 1996 (Steensen, *et al.*, 1998 and Chilcott, *et al.*, 1998b). After October 1996, all subsurface agricultural drainage from a 97,000 acre area within the Grassland Watershed known as the Drainage Project Area (DPA), was rerouted into the Grassland Bypass which discharges into the final 28 miles of the San Luis Drain. The consolidated subsurface drainage is then released into Mud Slough (north), nine miles upstream of its confluence with the San Joaquin River. Consolidating the subsurface drainage removed the primary source of selenium in approximately 90 miles of canals within the Grassland Watershed which can supply water to wetland habitat, and also removed this drainage from Salt Slough. Reducing selenium in these water bodies is a

primary goal of the project, since elevated concentrations of selenium have been documented to impact waterfowl (Skorupa, 1998).

Table 1. Tributaries and Drains to the San Joaquin River Between Monitoring Stations from the Lander Avenue Bridge to Vernalis (James et al., 1989)

River Mile	Description	Water Make-up	Sampling Period of Record
132.9	Lander Avenue	R	85-00
129.7	Salt Slough	T,S	85-00
125.1	Freemont Ford	R	85-00
121.2	Mud Slough	T,S	85-00
119.6	Newman Wasteway	O,S	
119.5	Newman Drainage District Collector Line A	T	
119.1	Hills Ferry Road Drain	S	
118.8	Hills Ferry Road	R	85-99
118.2	Merced River	N	99-00
117.5	Newman Drainage District Lateral Line 1	T	
117.2	Azevedo Road Drain	S	
113.4	Frietas Road Drain and South of Frietas Road Drain	S	
112	Turlock Irrigation District Lateral 6	S,O	
109	Orestimba Creek	N,S	94
107.2	Crows Landing Road	R	85-00
105	Spanish Grant, Marshall Road, Moran Road Drain	S,T	
103.5	Turlock Irrigation District Lateral 5	S	
100	Ramona Lake Main Drain	S,T	
98.6	Patterson Water District Main Drain	S,T	
98.4	Patterson: Las Palmas Launching Facility	R	85-00
97.6	Olive Avenue Drain	S	
97.3	Lemon Avenue Drain	S	
97	Eucalyptus Avenue Drain	S	
95.2	Turlock Irrigation District Lateral 3	S	
92.9	Del Puerto Creek	N,S	
91.4	Houk Ranch Drain	S,T	
90.3	Turlock Irrigation Lateral 4	S	
89.1	Grayson Road *	R	85-92
87	Old San Joaquin River Channel	S	
83.7	Tuolumne River	N	99-00
81.1	Merced Irrigation District Lateral 4	S	
79.9	Hospital/Ingram Creeks	S,T	
78.9	Center Road Drain	S	
77.6	Blewett Drain	S,T	
77.4	Blewett Drain	S	
77.3	Maze Boulevard	R	85-00
74.9	Stanislaus River	N	99-00
73.6	Vernalis (Airport Way)	R	85-00

LEGEND

- R San Joaquin River Water
- S Surface Agriculture Drain
- T Subsurface Agriculture Drain
- N Natural Stream
- O Operation Spillage

* Deleted from monitoring program after WY93

Stations shown in BOLD type are part of the monitoring program

Table 2. Monitoring Sites, Sampling Frequencies, and Parameters Measured in the San Joaquin River and Major Tributaries: Water Years 1999 and 2000.

Site ID	Site Description	Constituents																		Dissolved		Auto-Samplers			
		Temp		pH		EC		Se		Mo		TE's		Boron		Full Min		Part Min		Se		TSS			
	Water Year	99	00	99	00	99	00	99	00	99	00	99	00	99	00	99	00	99	00	99	00	99	00	99	00
	SJR at:																								
MER522	Lander Avenue	W	W	W	W	W	W	M	W	Q	Q	Q	Q*	M					Q	Q			W		
MER538	Fremont Ford	W	W	W	W	W	W	W	W					W	W				Q	Q					
STC512	Hills Ferry	W		W		W		W		M		Q		W		Q						W			
STC504	Crows Landing	W	W	W	W	W	W	W	W	M	M	Q	Q*	W	W	Q	Q			W		W		a	a
STC507	Patterson	W	W	W	W	W	W	W	W					W	W				Q	Q		W			
STC510	Maze	W	W	W	W	W	W	W	W					W	W				Q	Q					
SJC501	Vernalis	W	W	W	W	W	W	W	W	Q	Q	Q	Q*	W	W	Q	Q					W			
	Tributaries:																								
MER546	Merced River	Q	Q	Q	Q	Q	Q	Q	Q		Q		Q	Q	Q				Q	Q					
STC513	Tuolumne River	Q	Q	Q	Q	Q	Q	Q	Q		Q		Q	Q	Q				Q	Q					
STC514	Stanislaus River	Q	Q	Q	Q	Q	Q	Q	Q		Q		Q	Q	Q				Q	Q					

* weekly 3/30-6/29/00

W = weekly

M = monthly

Q = quarterly (Oct, Jan, Apr, and Jul)

a = daily composite sample for EC, Se and B

Temp: temperature

EC: electrical conductivity

Se: selenium

Mo: molybdenum

Full Min: B, Cl, SO4, CO3, HCO3, Alkalinity, Ca, Mg, Na, TDS, K, Hardness

TE's: Trace Elements (Chromium, copper, lead, nickel, zinc)

TSS: total suspended solids

Part Min: Boron, Chloride, Sulfate, Hardness

SAMPLING PROGRAM

The Regional Board monitoring program for the San Joaquin River began in May of 1985 and has continued through Water Year 2000. Grab samples were collected at seven of the eight original sites during Water Year 1999 and at six of the original sites in Water Year 2000. In addition, the three major eastside tributaries downstream of Fremont Ford (the Merced, Tuolumne and Stanislaus Rivers) were sampled quarterly. Monthly sampling was conducted in these tributaries after April 2000. Water temperature, pH, electrical conductivity (EC), and sample time were recorded in the field at each site. Laboratory analyses for total recoverable selenium, boron, and EC were performed on all samples weekly, except at the San Joaquin River at Lander Avenue site where samples were analyzed for selenium and boron monthly. (After 28 December, 1999 the Lander Avenue site was sampled on a weekly basis.) Dissolved selenium was analyzed at the Crows Landing site weekly during Water Year 1999. Also in Water Year 1999, total suspended solids were analyzed weekly at Lander, Hills Ferry, Crows Landing, and Vernalis (Airport) in order to establish background data for this section of the San Joaquin River. Samples from all sites were analyzed for chloride, sulfate and hardness on a quarterly basis. Samples from selected sites were also analyzed for total recoverable copper, chromium, lead, nickel and zinc on a quarterly basis and molybdenum on a quarterly or monthly basis depending on the site. Samples from the Crows Landing and Vernalis sites were analyzed quarterly for an additional suite of minerals. The primary focus of the program, however, remains electrical conductivity, boron and selenium.

A continuous automated sampler was employed at the Crows Landing site during Water Years 1999 and 2000. The autosampler collected daily composite samples near mid-channel for electrical conductivity, boron and selenium analyses. Data was rejected due to autosampler malfunction or corrupted quality control samples during the following time periods (43 of 730 days): between 4 and 15 October 1998, between 7 and 11 November 1999, between 3 and 5 April 2000, between 14 and 27 July 2000 and between 22 and 30 September 2000. A summary of the sites and frequency of constituent monitoring is listed in **Table 2**.

SAMPLE COLLECTION METHODS

Two distinct types of water samples were collected for this program: grab samples and automated composite samples. The types of samples, methods for collection and quality control and assurance are discussed below.

Grab Samples

Grab samples were collected weekly, monthly or quarterly depending on the site and the constituent to be analyzed (**Table 2**). Field measurements for water temperature, electrical conductivity (EC), and pH were conducted at all sites. Follow up EC measurements were made on all samples at the Regional Board office laboratory within 24-hours of sample collection by Regional Board staff.

Grab samples were collected in polyethylene bottles, usually within six feet of the bank. All sample bottles were rinsed with deionized water before use. All bottles were also rinsed three times with the water to be sampled prior to sample collection. All samples were kept on ice after collection and until processing. Selenium, boron, and trace element samples were preserved by lowering the pH to less than 2 within 24 hours of collection by using 1 mL reagent grade nitric acid per 500 mL of sample. Mineral and total suspended sediment samples were kept cool (less than 4 degrees Centigrade) until submittal to the laboratory for analysis. During Water Year 1999, samples for dissolved selenium were field filtered using a 0.45 micron filter in a cartridge system. The filtrate was acidified to $\text{pH} < 2$ with reagent grade nitric acid within 24 hours of collection.

Composite Automated Samples

In addition to grab samples, daily composite sampling was conducted on the San Joaquin River at Crows Landing, through the use of an automated Sigma sampling device. Each daily composite is made up of two 250 ml collections pulled at 12-hour intervals for a total sample volume of 500 ml. During Water Years 1999 and 2000, the autosampler was serviced every two weeks. All samples collected by Sigmas were analyzed for EC, boron and selenium.

QUALITY CONTROL AND QUALITY ASSURANCE

Potential contamination from the reagent grade nitric acid used to control pH was evaluated by submitting a deionized water matrix preserved with 1 ml of acid per 500 ml of sample, to the contract laboratories at monthly intervals to be analyzed for the trace elements of concern. All reported recoveries for these acid check samples were below the analytical detection limit.

Field and handling contamination was evaluated by submitting a travel blank on a monthly basis. The travel blank consisted of a sample of deionized water that was collected at the Regional Board laboratory, traveled through the sampling run, and then processed with the sample set. All results for travel blanks fell below the analytical detection limits for the elements of concern.

Additional quality control and quality assurance was conducted using blind split and spiked samples. Blind split samples were collected at a ten percent frequency for each sampling event by collecting the sample in a container double the normal sample volume and splitting that sample into two equal amounts for submittal to the analyzing laboratory. On a monthly basis, half of the blind split samples were spiked with known concentrations of constituents to be analyzed. Comparing the spiked split to the background split provided information on analytical accuracy. Comparing data from nonspiked splits provided information on analytical precision.

To evaluate the potential for contamination and evapo-concentration in samples collected using autosamplers, a series of special checks were developed. First, whenever the sampler was serviced, a deionized water sample, without a cap, was left in the collection base to be collected on the next servicing and analyzed for potential contamination. Second, during each servicing, replicate “grab” samples were collected through the autosampler mechanism, one was left in the sampler to be collected at the next servicing and the other was processed for immediate analyses. Final results of the two grabs were evaluated to determine concentration or dilution potentials. Every six weeks the entire Sigma unit was rotated out of the field for service and tubing replacement. Prior to the rotation, a sample of deionized water was passed through the used tubing and pump unit and analyzed for EC, boron and selenium.

During Water Year 1999, samples for dissolved selenium were collected from the San Joaquin River at the Crows Landing site. These samples required field filtration through a 0.45 micron cartridge system. To prevent potential contamination, the equipment was soaked in a two percent nitric acid solution for a minimum of two hours, and rinsed three times in DI water. The new filters were conditioned at the time of sampling by discarding the first 10 ml of water passed through the filter before the remaining sample was collected. Approximately quarterly, filter blanks were collected by processing Regional Board laboratory DI water through the standard equipment used in the field and submitting the filtrate for analyses.

Only data from sample sets whose blind QA/QC met specifications outlined in **Table 3** have been included in this report.

Table 3. Quality Assurance Tolerance Guidelines Used in the Regional Water Quality Control Board Agricultural Drainage Monitoring Program.

Constituent	Recovery Range at Low Levels (µg/L)*	Acceptable Split/Spike Recovery Range
Copper	1-20 ± 5	>20 70-130%
Chromium	1-20 ± 5	>20 70-130%
Lead	5-25 ± 8	>25 60-140%
Molybdenum	1-10 ± 2	>10 85-115%
Nickel	5-25 ± 6	>25 65-135%
Selenium	0.4-10 ± 1.0	>10 90-110%
Zinc	1-20 ± 6	>20 70-130%
Boron	50	85-115%
Chloride	5000	85-115%

* For certain constituents, recovery is expressed as an absolute value rather than a percentage at low levels. For example, if the result of copper analysis for a particular sample is 10 µg/L, a split analysis must fall between 5 µg/L and 15 µg/L. If the sample is greater than 20 µg/L, recovery is expressed as a percent and must be between 70 and 130%. If a recovery range is not shown at low levels, the detection limit is given.

RAINFALL AND DISCHARGE PATTERNS

The San Joaquin River Index, as described in the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (SWRCB, 1995) is used to classify the water year type in the river basin based on runoff. The 60-20-20 Index includes one “wet” classification, two “normal” classifications (above and below normal), and two “dry” classifications (dry and critical), for a total of five water year types. Water year 1999 was classified as “above normal” based on runoff of approximately 3.6 million acre feet and Water Year 2000 as “above normal” based on runoff of approximately 3.4 million acre feet. The widespread flooding and the resultant commingling of waters that occurred in the San Joaquin River Basin during Water Years 1997 and 1998 did not occur during either Water Year 1999 or 2000

Friant Dam essentially serves as the headwaters of the lower San Joaquin River. The majority of water from Friant Dam is diverted into the Friant-Kern Canal for use in agricultural irrigation outside of the San Joaquin River Basin. Historically, the only releases which reach the Lower San Joaquin River (Mendota Pool and downstream) are during flood events and high flows from winter snow melt. A comparison of rainfall at and discharge from Friant Dam into the San Joaquin River for Water Years 1999 and 2000 is depicted in **Figure 2**. During latter part of the water year, rainfall events have little if any effect on the releases from Friant Dam, indicating the highly managed nature of the San Joaquin River hydrology.

Flows in the San Joaquin River at Lander Avenue, Patterson, and Vernalis (a series of sites moving downstream to the Sacramento/San Joaquin Delta) and rainfall at the CIMIS (California Irrigation Management Information System) Station at Kesterson National Wildlife Refuge have been depicted in **Figure 3** for Water Years 1999 and 2000. Flows peaked in late February and early March in response to winter storms as well as pre-irrigation return flows and wetland releases in both Water Years 1999 and 2000.

Figure 2. Comparison of Rainfall and San Joaquin River Flows Below Friant Dam: Water Years 1999 and 2000

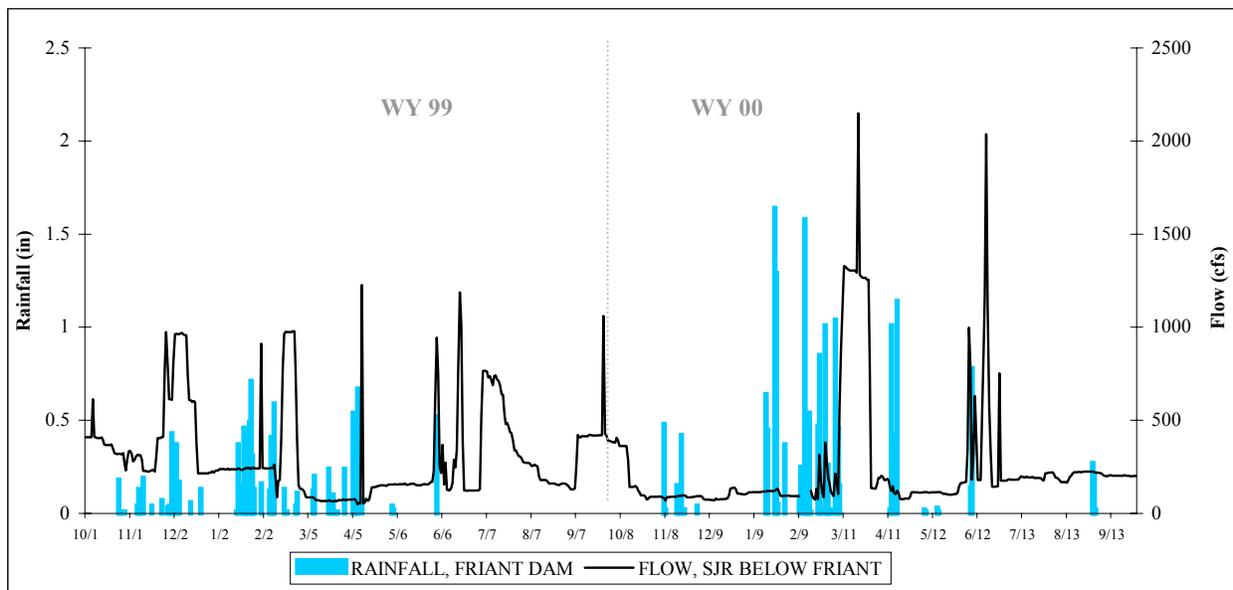
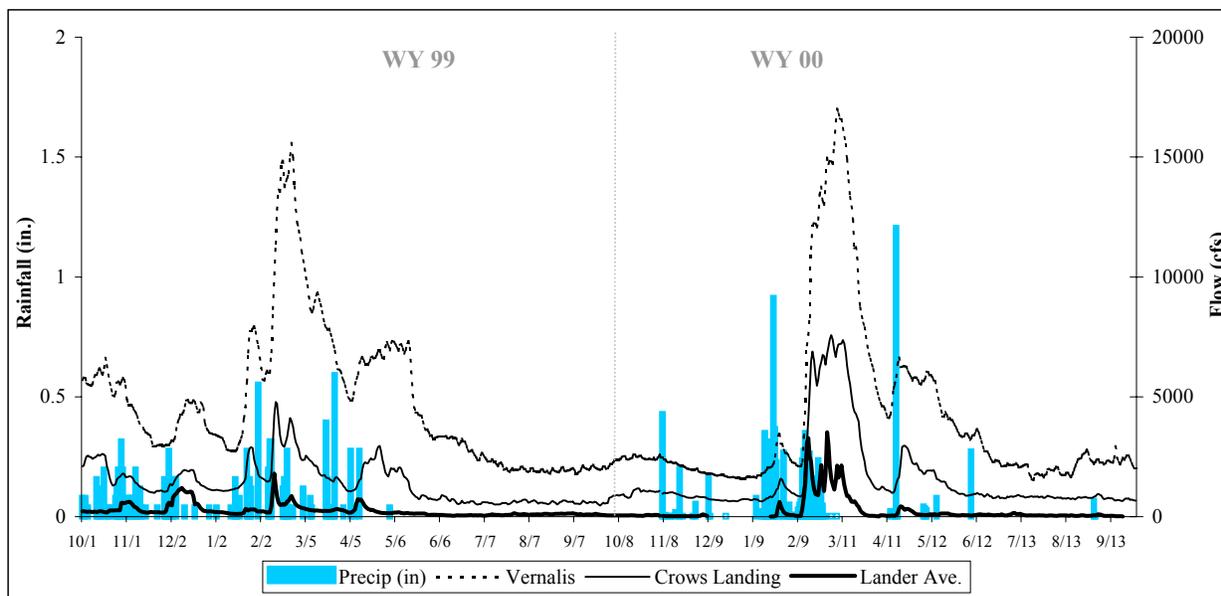


Figure 3. Comparison of Rainfall (Kesterson National Wildlife Refuge) and Flows in the San Joaquin River at Lander Avenue, Patterson and Vernalis: Water Years 1999 and 2000



RESULTS

Water quality analytical results for minerals and trace elements, as well as EC, pH, and temperature at time of sampling, are listed by site in Appendices A and B. Appendix A includes all grab sample data collected during Water Years 1999 and 2000, while Appendix B contains all information collected using automated samplers. The number of sampling events and the ranges, mean, geometric mean and median concentrations for each measured constituent at each site are shown in these appendices. The results have been grouped into three sections for discussion. The first section covers electrical conductivity, boron and selenium, the second section reviews results for other constituents of concern, and the final section reviews preliminary results for the eastside tributaries.

Electrical Conductivity, Boron and Selenium

Electrical conductivity, boron and selenium results have been grouped by grab samples or daily composite samples. Grab sample results are presented by site in the order of site location along the San Joaquin River. The first site, the San Joaquin River at Lander Avenue, is the furthest upstream and considered the background site for this program. The subsequent sites discussed progress downstream from the Lander Avenue site. **Table 4** summarizes annual minimum, mean and maximum EC, boron and selenium concentrations in the river during Water Years 1999 and 2000 and compares those values to the average range in concentration prior to and after the Grassland Bypass Project. The opening of the bypass channel significantly altered the water characteristics in the river downstream of Salt Slough. Pre-Project (Water Years 1986 to 1996) records contained seven critically dry years and four wet years as determined using the San Joaquin River Index (SWRCB, 1995). The summary information for the previous data record is presented in full and has also been separated into critically dry years and wet years. Post-Project Water Years 1997 and 1998 (both wet years) have also been presented, as have the results from the autosamplers which collected composite samples from the Crows Landing.

Table 4. Annual Minimum, Mean, and Maximum Electrical Conductivity, Boron, and Selenium at Monitoring Sites On the San Joaquin River: Water Years 1986-1996, 97, 98, 99 and 2000.

Site	Count	EC (umhos/cm)			Boron (mg/L)			Selenium (ug/L)		
		Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
SJR @ Lander Avenue										
WYs 86-96 (Pre-project; All)	400	46	1430	4060	<0.05	0.34	1.1	<0.4	0.5	5.0
WYs 86-96 (Pre-project; Dry years only)	304	100	1730	3990	<0.05	0.36	0.98	0.4	0.5	1.8
WYs 86-96 (Pre-project; Wet Years only)	96	46	865	4060	<0.05	0.27	1.1	<0.4	0.5	5.0
WY 97 (Wet)	6	88	767	1600	<0.05	0.06	0.16	<0.4	<0.4	<0.4
WY 98 (Wet)	11	46	394	1530	<0.05	<0.05	0.11	<0.4	0.4	1.1
WY 99 (Above Normal)	12	90	818	1580	<0.05	0.15	0.26	<0.4	<0.4	<0.4
WY 00 (Above Normal)	42	160	1030	1880	<0.05	0.17	0.35	<0.4	<0.4	0.8
SJR @ Fremont Ford										
WYs 86-96 (Pre-project; All)	474	64	2060	4290	<0.05	1.7	4.9	<0.4	11.6	35.2
WYs 86-96 (Pre-project; Dry years only)	313	600	2300	4290	0.28	1.9	4.9	0.8	13.2	35.2
WYs 86-96 (Pre-project; Wet Years only)	161	64	1600	4050	<0.05	1.3	3.5	<0.4	8.5	29.0
WY 97 (Wet)	47	85	1090	2110	0.08	0.47	0.96	<0.4	0.8	1.8
WY 98 (Wet)	52	48	708	2830	<0.05	0.33	1.2	<0.4	0.6	1.3
WY 99 (Above Normal)	53	300	1120	2060	0.14	0.51	0.95	<0.4	0.6	1.1
WY 00 (Above Normal)	52	295	1320	2560	0.13	0.62	1.2	<0.4	0.7	1.6
SJR @ Hills Ferry										
WYs 86-96 (Pre-project; All)	472	178	2100	4360	0.09	1.7	5.0	<0.4	9.6	28.4
WYs 86-96 (Pre-project; Dry years only)	308	750	2350	4360	0.34	1.9	5.0	1.0	10.9	28.4
WYs 86-96 (Pre-project; Wet Years only)	164	178	1630	3650	0.09	1.3	3.0	<0.4	7.1	23.0
WY 97 (Wet)	46	76	1540	2700	<0.05	1.3	2.5	<0.4	6.8	18.0
WY 98 (Wet)	52	208	1020	2710	0.18	0.84	1.9	0.9	3.1	7.8
WY 99 (Above Normal)	52	568	1530	2350	0.24	1.3	2.3	0.9	5.0	11.1
SJR @ Crows Landing										
WYs 86-96 (Pre-project; All)	482	135	1330	2490	<0.05	0.94	2.1	<0.4	5.2	17.0
WYs 86-96 (Pre-project; Dry years only)	315	209	1570	2490	0.11	1.1	2.1	0.5	6.2	17.0
WYs 86-96 (Pre-project; Wet Years only)	167	135	898	2060	<0.05	0.61	2.1	<0.4	3.3	12.0
WY 97 (Wet)	48	128	880	1460	0.06	0.62	1.2	<0.4	2.9	8.2
WY 98 (Wet)	52	133	648	1700	0.08	0.45	1.1	0.5	1.6	3.4
WY 99 (Above Normal)	53	313	968	1460	0.14	0.70	1.2	0.7	2.6	6.0
WY 00 (Above Normal)	52	320	1070	1690	0.22	0.75	1.4	0.8	2.5	4.9
SJR @ Patterson										
WYs 86-96 (Pre-project; All)	354	146	1270	2450	0.06	0.80	3.0	<0.4	4.0	14.0
WYs 86-96 (Pre-project; Dry years only)	191	249	1530	2450	0.11	1.0	3.0	0.5	4.9	14.0
WYs 86-96 (Pre-project; Wet Years only)	163	146	958	2120	0.06	0.60	1.8	<0.4	3.0	11.0
WY 97 (Wet)	47	218	893	1510	0.11	0.58	1.0	0.5	2.8	7.0
WY 98 (Wet)	52	137	683	1700	0.08	0.44	1.0	0.5	1.5	3.5
WY 99 (Above Normal)	52	356	996	1440	0.19	0.66	1.1	0.6	2.4	4.9
WY 00 (Above Normal)	52	330	1080	1690	0.22	0.71	1.3	0.9	2.3	4.3
SJR @ Maze Blvd.										
WYs 86-96 (Pre-project; All)	385	125	991	1750	<0.05	0.56	1.3	<0.4	2.7	9.8
WYs 86-96 (Pre-project; Dry years only)	234	211	1190	1750	0.08	0.68	1.3	<0.4	3.3	9.8
WYs 86-96 (Pre-project; Wet Years only)	151	125	680	1620	<0.05	0.38	0.92	<0.4	1.8	4.9
WY 97 (Wet)	47	172	625	1110	0.09	0.35	0.68	<0.4	1.5	4.7
WY 98 (Wet)	50	122	457	1200	0.07	0.27	0.67	0.4	0.9	2.1
WY 99 (Above Normal)	52	251	616	936	0.13	0.35	0.56	<0.4	1.1	2.5
WY 00 (Above Normal)	52	238	696	1270	0.13	0.40	1.1	<0.4	1.2	2.3
SJR @ Vernalis (Airport Rd.)										
WYs 86-96 (Pre-project; All)	476	123	810	1680	<0.05	0.44	1.2	<0.4	2.2	9.6
WYs 86-96 (Pre-project; Dry years only)	313	217	931	1680	<0.05	0.51	1.2	0.4	2.5	9.6
WYs 86-96 (Pre-project; Wet Years only)	162	123	575	1420	<0.05	0.31	0.83	<0.4	1.5	6.1
WY 97 (Wet)	45	156	491	816	0.07	0.25	0.43	<0.4	1.0	2.9
WY 98 (Wet)	53	141	414	983	0.07	0.22	0.57	<0.4	0.7	1.5
WY 99 (Above Normal)	51	206	451	669	<0.05	0.24	0.40	<0.4	0.7	1.7
WY 00 (Above Normal)	52	210	567	1070	0.11	0.31	0.73	<0.4	0.9	1.9
Autosampler Data - SJR @ Crows Landing										
WY 97 (Wet)	327	121	909	1740	0.05	0.68	1.6	<0.4	3.2	10.0
WY 98 (Wet)	342	126	649	1790	0.07	0.45	1.1	0.4	1.5	4.1
WY 99 (Above Normal)	352	305	993	1720	0.17	0.73	1.4	0.5	2.7	6.9
WY 00 (Above Normal)	335	324	1070	1690	0.21	0.76	1.4	0.6	2.5	5.6

Grab Samples

During Water Year 1999, the background site on the San Joaquin River at Lander Avenue was sampled weekly for EC and quarterly for boron and selenium. During Water Year 2000, the frequency of the boron and selenium analyses was increased to weekly by January 2000. Mean annual EC, boron and selenium values were 818 umhos/cm, 0.15 mg/L and <0.4 ug/L, respectively, in Water Year 1999 and 1030 umhos/cm, 0.17 mg/L and <0.4 ug/L, respectively, in Water Year 2000. Although the mean boron and EC concentrations in the San Joaquin River at Lander Avenue during Water Years 1999-2000 were lower than the preceding critical (dry) years, they were higher on the whole than those occurring in wet water years. Mean annual selenium concentrations remained low, near the detection limit of 0.4 ug/L.

Constituent concentrations at the Fremont Ford site reflect operation of the Grassland Bypass Project which resulted in the diversion of subsurface agricultural drainage water out of Salt Slough and into Mud Slough (north), after Water Year 1996. Salt Slough discharges into the San Joaquin River upstream of the Fremont Ford site and Mud Slough (north) discharges into the San Joaquin River downstream of the Fremont Ford site. After the Grassland Bypass Project went into operation, concentrations of all constituents of concern decreased at the Fremont Ford site. Mean EC, boron, and selenium concentrations dropped from a mean of 2060 umhos/cm, 1.7 mg/L, and 11.6 ug/L, respectively, for Water Years 1986-1996 (pre-Project), to 1120 umhos/cm, 0.51 mg/L, and 0.6 ug/L, respectively, in Water Year 1999; and 1320 umhos/cm, 0.62 mg/L, and 0.7 ug/L, respectively, in Water Year 2000. The overall decreases can be directly attributed to the redirection of the majority of subsurface agricultural drainage flows to Mud Slough (north) from Salt Slough.

The San Joaquin River site at Hills Ferry Road was considered to be downstream of the inflows from both Mud Slough (north) and Salt Slough and upstream of the eastside tributaries. Recent aerial surveillance and ground truthing indicate that the site also receives some portion of the Merced River inflow. After Water Year 1999, the Hills Ferry site was discontinued as a regular sampling location when no suitable alternative sample site upstream of the Merced River inflows and downstream of the Mud Slough (north) inflow could be located. EC concentrations at the Hills Ferry site varied during Water Year 1999, ranging from 568 umhos/cm (during periods of high flows) to 2350 umhos/cm with a mean of 1530 umhos/cm. Mean concentrations for boron and selenium at the Hills Ferry Road site were the highest of all the San Joaquin River sites sampled in Water Year 1999 at 1.3 mg/L and 5.0 ug/L, respectively. These mean concentrations of constituents were higher than in wet Water Year 1998 (0.84 mg/L for boron and 3.1 ug/L for selenium) but lower than the pre-Project Water Years 1986-1996 mean (1.7 mg/L for boron and 9.6 ug/L for selenium). Maximum boron and selenium concentrations reached 2.3 mg/L and 11.1 ug/L, respectively at the Hills Ferry site in Water Year 1999.

Farther downstream, freshwater inflow from the Merced River diluted constituent concentrations in the San Joaquin River at the Crows Landing sampling location. At this downstream site, grab samples for EC, boron and selenium recorded maximum Water Year 1999 concentrations of 1460 umhos/cm, 1.2 mg/L, and 6.0 ug/L, respectively, and mean values of 313 umhos/cm, 0.70 mg/L, and 2.6 ug/L, respectively. Water Year 2000 saw maximum concentrations of 1690

umhos/cm, 1.4 mg/L, and 4.9 ug/L and mean annual concentrations of 1065 umhos/cm, 0.75 mg/L, and 2.5 ug/L for conductivity, boron and selenium, respectively.

Concentrations continued to decrease downstream in the San Joaquin River with the inflow from two additional east side tributaries: the Tuolumne and Stanislaus Rivers. Salt, boron and selenium concentrations are very low in these tributaries and improve the water quality in the San Joaquin River accordingly. The Las Palmas site, near Patterson, is just upstream of these tributary inflows and concentrations at this site are similar to those measured at the Crows Landing Bridge site. At the farthest downstream sampling location, the San Joaquin River at Vernalis (sampled at Airport Road), EC ranged from 206 to 669 umhos/cm in Water Year 1999 and from 210 to 1070 umhos/cm in Water Year 2000, while mean boron and selenium concentrations were 0.24 mg/L and 0.7 ug/L, respectively, for Water Year 1999 and 0.31 mg/L and 0.9 ug/L, respectively, for Water Year 2000. **Figure 4** depicts the constituent concentrations in the San Joaquin River at Las Palmas, Maze Blvd. and Vernalis for Water Years 1999 and 2000.

Daily Composite Samples

During Water Years 1999 and 2000, daily composite water samples for EC, boron and selenium were collected year round from the San Joaquin River at the Crows Landing site using automated Sigma samplers. Several data gaps occurred within the Crows Landing sample set due to autosampler malfunction, or outside tampering resulting in corruption of the quality control samples. These data gaps occur: from 4 October 1998 to 15 October 1998, from 7 November 1999 to 11 November 1999, from 3 April 2000 to 5 April 2000, from 14 July 2000 to 27 July 2000 and from 22 September 2000 to 30 September 2000.

Figure 5 presents a comparison of electrical conductivity, boron and selenium water quality information from the daily composite samples with weekly grab samples. While the weekly grab samples appear to track overall trends, significant daily variability is evident.

Values recorded in the San Joaquin River at Crows Landing demonstrate the influence of dilution flows on the water quality at that site. Maximum selenium concentrations were recorded in June during both water years; at 6.9 ug/L in Water Year 1999 and 5.6 ug/L in Water Year 2000. Flows are typically lower in both the San Joaquin River and in the Merced River during this time period. Corresponding patterns of high and low concentrations were also evident for EC and boron. The highest concentrations of EC, boron and selenium are typically observed from June through September, when flows in the river are at their lowest. **Figure 6** compares the daily composite EC and boron values with the daily discharge at Crows Landing and **Figure 7** compares the daily composite selenium concentrations with the discharge values.

All available data for the daily composite samples has been presented in Appendix B. Appendix B also presents the 4-day running average selenium concentrations for the site based on the daily data obtained from the autosampler. These values are used with respect to compliance with water quality objectives and are discussed in more detail later in this report.

Figure 4. Comparison of Weekly Measurements of Electrical Conductivity, Boron and Selenium Concentrations in the San Joaquin River at Patterson, Maze Blvd. and Vernalis: Water Years 1999 and 2000

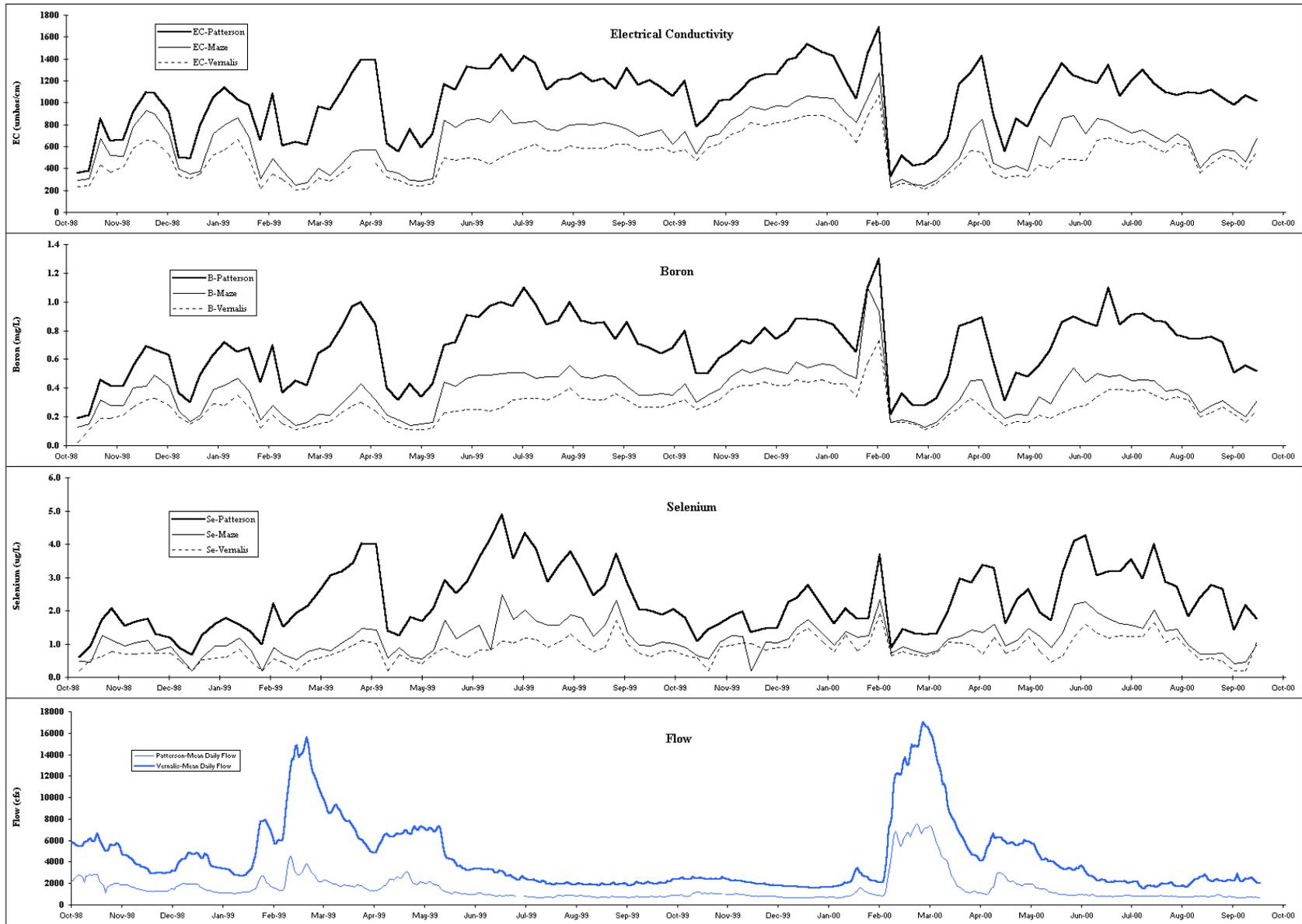
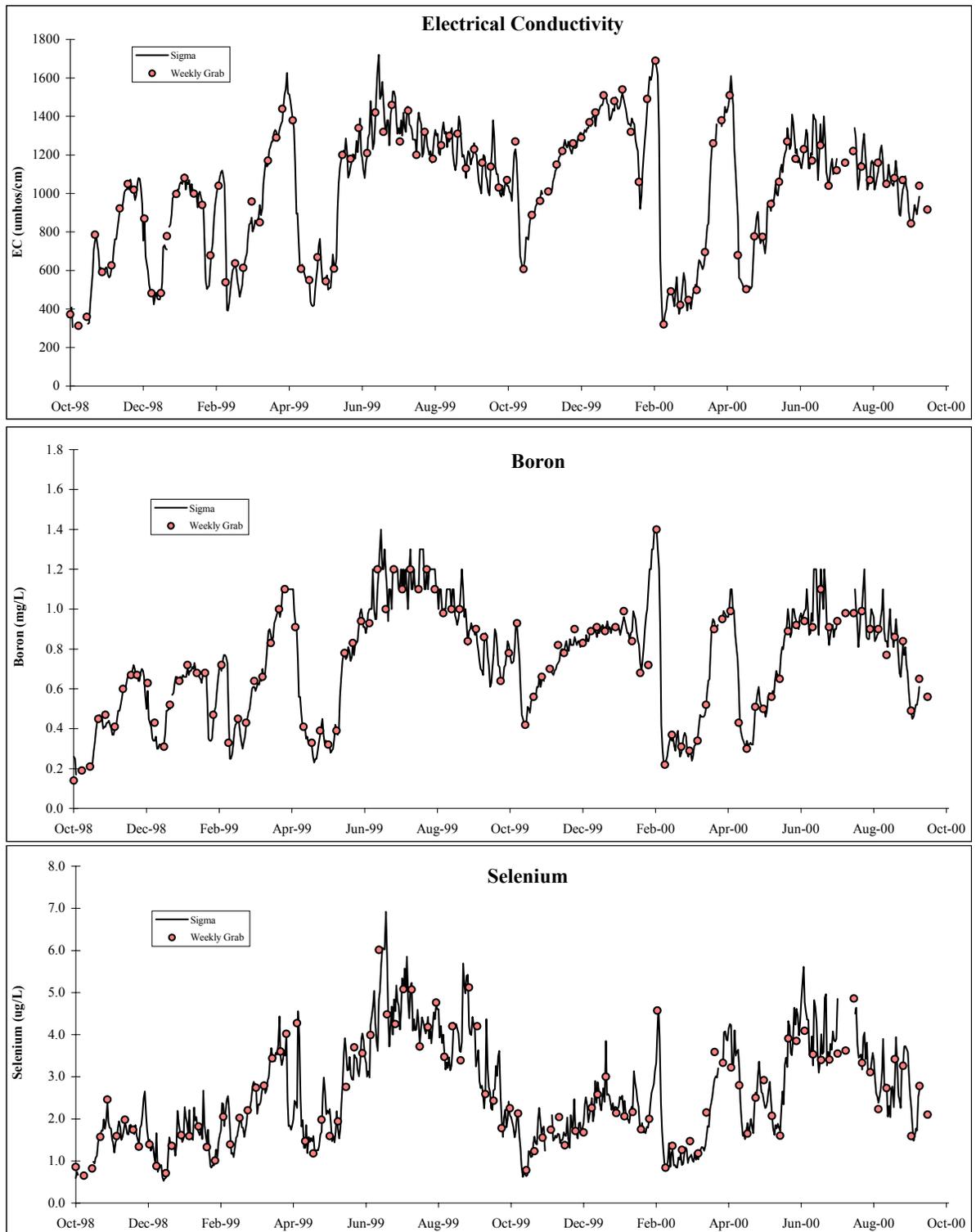


Figure 5. Comparison of Electrical Conductivity, Boron and Selenium from Weekly Grabs and Autosampler Collections in the San Joaquin River at Crows Landing: Water Years 1999 and 2000



Other Elements of Concern

Limited additional water quality analyses were conducted quarterly for copper, chromium, lead, nickel, zinc and molybdenum at four sites along the San Joaquin River in Water Year 1999: Lander Avenue, Hills Ferry, Crows Landing and Vernalis. During Water Year 2000, the Hills Ferry sampling site was discontinued, but additional sampling was conducted weekly at the remaining three sites in April, May and June. Results which satisfied the quality control criteria listed in **Table 3**, have been summarized in **Table 5**. None of the concentrations reach or exceed existing water quality objectives when adjusted for hardness levels (Marshack, 1998).

Weekly total suspended solids (TSS) analyses were also conducted at the aforementioned four sites plus the Las Palmas (Patterson) site during Water Year 1999 in order to establish a background dataset for this section of the San Joaquin River. The most upstream site at Lander Avenue, generally contained 40 mg/L TSS except for two values of 120 mg/L and 140 mg/L in February which correlate with two storm events. The TSS means, minimums and maximums at successive downstream sites have been listed in **Table 6**. TSS samples were not collected at any of the San Joaquin River sites in Water Year 2000. Complete results are listed in Appendix A.

Eastside Tributaries

Quarterly grab sampling was initiated on the eastside tributaries, the Merced, Tuolumne, and Stanislaus Rivers, during Water Year 1998. The quarterly samples continued to be collected during Water Year 1999; in October 1998, and in January, April and July 1999. The quarterly sampling continued into Water Year 2000 until April 2000, at which time the sampling frequency was increased to monthly. In general, water quality from all three eastside tributaries was very good, with EC values ranging from 51 to 380 umhos/cm and boron and selenium below their respective detection limits (0.05 mg/L boron, and 0.4 ug/L selenium). Trace elements (copper, chromium, lead, nickel and zinc) analyses were discontinued in the eastside tributaries after Water Year 1998 and then analyzed again on a monthly basis beginning in April 2000. Concentrations were low, with maximum concentrations in the month of June for molybdenum (2.4 ug/L), copper (2.4 ug/L) and zinc (5.2 ug/L). Chromium, nickel, and lead were not found above the detection limit in any samples. Complete results are listed in Appendix A.

Figure 6. San Joaquin River Flows Compared to Electrical Conductivity and Boron at Crows Landing: Water Years 1999 and 2000

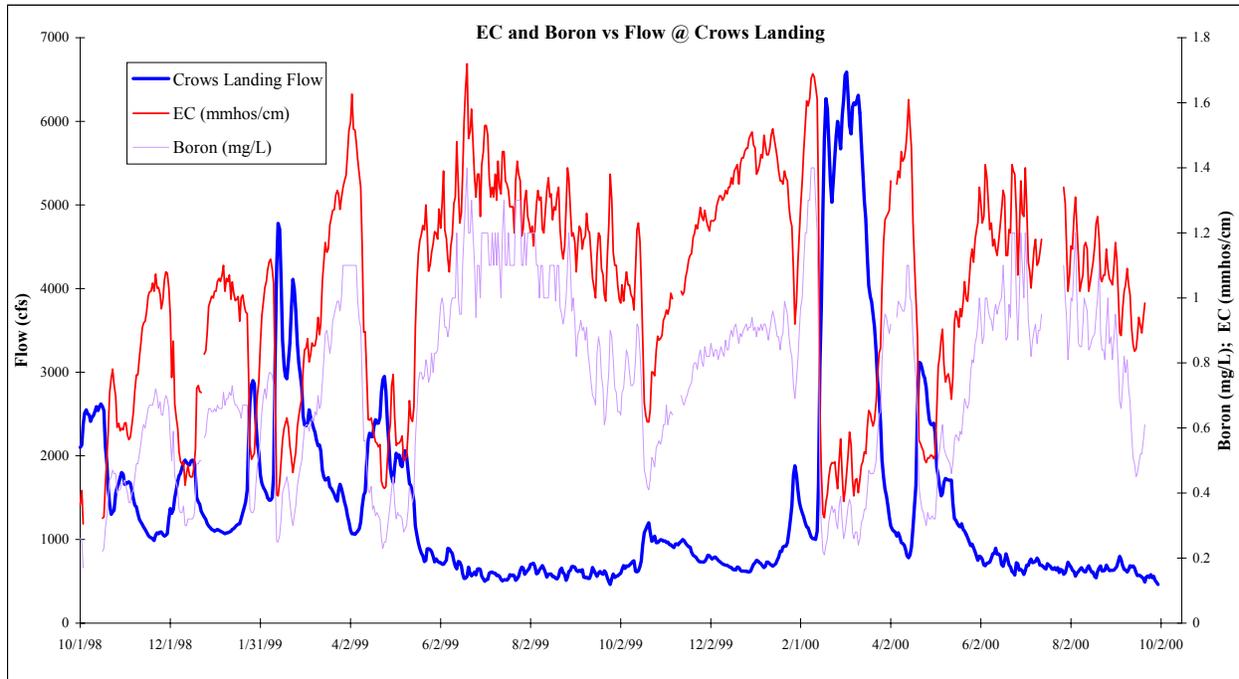


Figure 7. Relationship Between Flows in the San Joaquin River and Selenium Concentrations at Crows Landing: Water Years 1999 and 2000

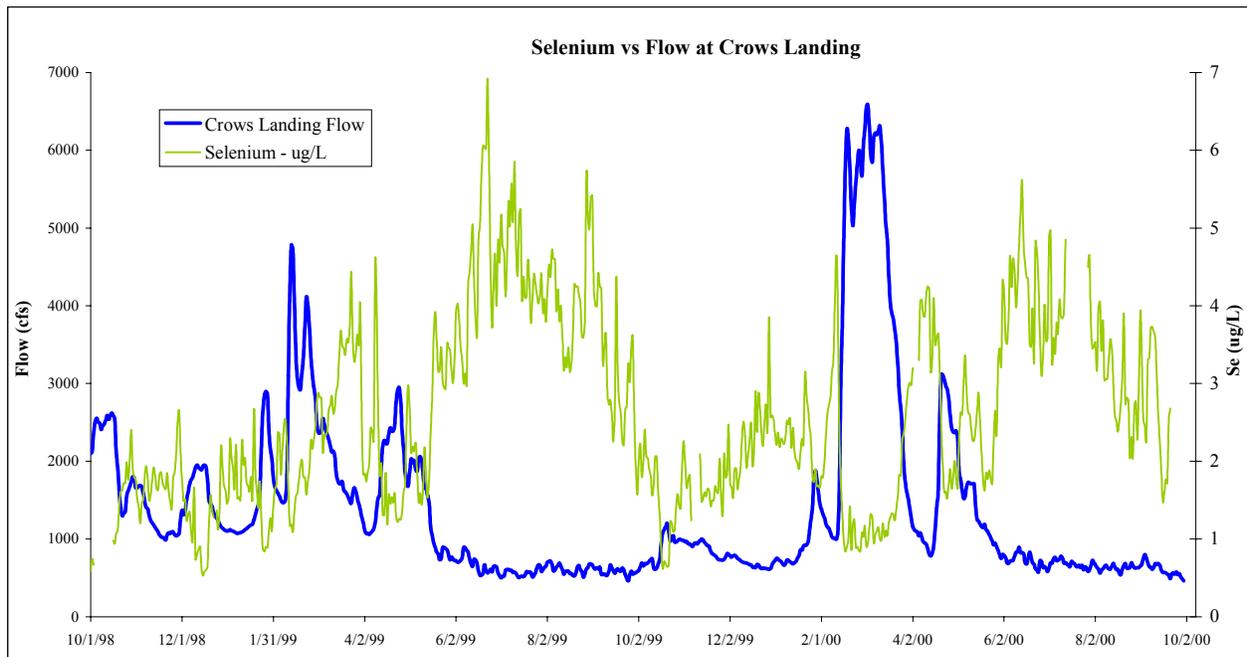


Table 5. Summary of Copper, Chromium, Lead, Nickel, Zinc and Molybdenum Results at Selected Sites in the lower San Joaquin River: Water Years 1999 and 2000.

Constituent	Water Year 1999 Total Concentrations (ug/L) in the San Joaquin River at:															
	Lander Avenue				Hills Ferry				Crows Landing				Vernalis (Airport)			
	count	min	mean	max	count	min	mean	max	count	min	mean	max	count	min	mean	max
Cu	4	2	4	6	4	3	5	7	4	3	4	6	4	3	4	6
Cr	4	1	2	3	4	3	4	6	4	2	3	5	4	2	3	4
Pb	4	<5	<5	<5	4	<5	<5	<5	4	<5	<5	<5	4	<5	<5	<5
Ni	4	<5	<5	<5	4	<5	6	9	4	<5	4	8	4	<5	4	6
Zn	3	6	7	8	3	8	11	15	3	7	10	12	3	6	9	12
Mo	4	<1	5	9	12	3	8	12	13	1	5	8	4	1	2	3
HDNS	4	42	141	220	4	180	295	400	4	130	176	290	4	55	86	140

Constituent	Water Year 2000 Total Concentrations (ug/L) in the San Joaquin River at:															
	Lander Avenue				Hills Ferry				Crows Landing				Vernalis (Airport)			
	count	min	mean	max	count	min	mean	max	count	min	mean	max	count	min	mean	max
Cu	19	2	4	9					19	3	4	6	17	2	3	4
Cr	19	<1	1	6					19	1	3	4	17	1	2	3
Pb	19	<5	<5	<5					19	<5	<5	<5	17	<5	<5	<5
Ni	19	<5	3	8					19	<5	3	7	17	<5	3	6
Zn	17	<2	5	16					18	<2	6	14	14	<2	5	7
Mo	8	3	9	18					12	3	5	9	8	1	2	4
HDNS	6	72	156	200					6	110	207	280	6	77	123	140

Table 6. Summary of Total Suspended Solids Concentrations at Selected Sites in the Lower San Joaquin River: Water Year 1999

San Joaquin River Location	Total Suspended Solids (mg/L)				
	Count	Minimum	Mean	Median	Maximum
Lander Avenue	49	14	40	34	140
Hills Ferry	47	30	98	90	170
Crows Landing	52	15	56	54	100
Patterson	45	15	56	54	110
Vernalis	45	11	55	48	190

DISCUSSION

Comparison to Pre-Project Conditions and Water Year 1998

When the Grassland Bypass became operational at the end of September 1997, it effectively consolidated agricultural subsurface drainage from the Drainage Project Area into a single channel for discharge into the final nine miles of Mud Slough (north). This consolidation removed the subsurface drainage from approximately 90 miles of internal wetland water supply channels and from Salt Slough.

Table 4 lists minimum, mean, and maximum electrical conductivity, boron and selenium concentrations for above normal water years 1999 and 2000 as well as wet water years 1997 and 1998 and a summary for all the wet water years, critical water years and combined water years that occurred between 1986 and 1996 (pre-Project).

In general, concentrations of all constituents measured during Water Years 1999 and 2000 were lower than concentrations measured during pre-Project 86-96 water years. The reduction in constituent concentrations can likely be attributed to impacts from the Grassland Bypass Project and agricultural drainage reduction programs in the Drainage Project Area.

The Lander Avenue site, which is upstream of most major discharges into the lower stem of the San Joaquin River, serves as the background site for this monitoring program. Flows upstream of the site are usually limited to groundwater accretions or storm related flows. Flows upstream of this site typically contain low concentrations of selenium. The mean EC, boron, and selenium concentrations at Lander Avenue during above normal Water Years 1999-2000 were 818 and 1030 umhos/cm, 0.15 and 0.17 mg/L, and <0.4 and <0.4 ug/L, respectively. These means are lower than the 1986-96 pre-Project means at the Lander Avenue site. The pre-Project mean EC was 1430 umhos/cm, boron was 0.34 mg/L and selenium was 0.5 ug/L. Maximum EC, boron and selenium concentrations at the Lander site were also lower during Water Years 1999-2000 than during pre-Project water years: 1880 vs. 4060 umhos/cm, 0.35 vs. 1.1 mg/L, and 0.8 vs. 5.0 ug/L, respectively. The ten-year period from 1986-96 consisted of 7 critically dry years. Concentrations during above normal Water Years 1999 and 2000 were slightly higher than those of post-Project wet Water Years 1997 and 1998. Post-project Water Years 1997 and 1998 were both wet water years that had relatively high flows sustained throughout the water year.

The opening of the Grassland Bypass impacted the hydrology of the lower San Joaquin River beginning in Water Year 1997. The immediate impact of the bypass was to divert subsurface agricultural drainage from Salt Slough into Mud Slough (north) thereby removing the subsurface drainage from the San Joaquin River at Fremont Ford. That impact is clear given the lower concentrations of all constituents at the Fremont Ford site during post-Project water years as compared to pre-Project water years, whether wet or critical (**Table 4**). For example, mean selenium concentrations at Fremont Ford were 0.6 ug/L for Water Year 1999 and 0.7 ug/L for Water Year 2000, as opposed 11.6 ug/L for pre-project years. Boron and salt followed similar trends.

The pattern seen at the Fremont Ford site continued downstream, with mean and maximum concentrations for Water Years 1999 and 2000 consistently lower than pre-bypass water years, and mean concentrations slightly higher than wet Water Year 1998. The overall reduction likely reflects implementation of management measures to reduce selenium loads exiting the DPA (see load section).

Comparison to Applicable Water Quality Objectives

In October 1988, the Regional Board adopted water quality objectives for boron, molybdenum and selenium for the lower San Joaquin River between Sack Dam and Vernalis. Two sets of objectives were developed. One set of objectives was established for the river reach with minimal freshwater flow, between Sack Dam and the inflow from the Merced River. The second set was established for the reach of river from the inflow of the Merced River to Vernalis, which has highly managed freshwater inflows. The objectives were also based on water year type, as classified by the San Joaquin River Index (SWRCB, 1995) and season. Slightly relaxed objectives adopted for critical water years reflecting the lack of good quality dilution flows from tailwater and/or flows from the eastside tributaries. In addition, more stringent boron objectives were adopted during the irrigation season, 15 March through 15 September, when downstream crops would be susceptible to boron toxicity from irrigation water. As specified in the amendment, compliance monitoring for selenium and boron water quality objectives is conducted on the San Joaquin River at the Crows Landing Road Bridge site. The Crows Landing Road Bridge site is downstream of the Merced River inflow and also receives water from agricultural return flows and groundwater seepage. In May 1996, the Regional Board adopted revised selenium water quality objectives for the lower San Joaquin River and also a compliance time schedule which includes performance goals.

Water quality objectives for boron, selenium and molybdenum, which applied to the two segments of the lower San Joaquin River during Water Years 1999-2000 (both above normal water years), have been listed in **Table 7**. The compliance time schedule and performance goals which apply to the selenium objective, are listed in **Table 8**.

Table 7. Boron, Selenium and Molybdenum Water Quality Objectives for the Lower San Joaquin River

Water Body	Boron (mg/L)		Selenium (ug/L)		Molybdenum (ug/L)	
	Continuous	Maximum	Continuous	Maximum	Continuous	Maximum
San Joaquin River between Sack Dam and the Merced River Inflow WY 1999	2.0 (monthly mean)†	5.8	5 (4-day average)*	20	19 (monthly mean)	50
San Joaquin River from the Merced River Inflow to Vernalis WY 1999	0.8 (monthly mean)† 1.0 (monthly mean)††	2.0† 2.6††	5 (4-day average)**	12	10 (monthly mean)	15

† = The water quality objective only applies from 15 March through 15 September

†† = The water quality objective only applies from 16 September through 14 March

* = Compliance time schedule adopted and in effect until October 2010

** = Compliance time schedule adopted and in effect until October 2005

**Table 8. Summary of Selenium Water Quality Objectives and Compliance Time Schedule
[Selenium Water Quality Objectives (in bold) and Performance Goals (in italics)]**

Water Body/ Water Year Type ¹	1 October 1996	1 October 2002	1 October 2005	1 October 2010
San Joaquin River below the Merced River; Above Normal and Wet Water Year types		<i>5 ug/L monthly mean</i>	5 ug/L 4-day average	
San Joaquin River below the Merced River; Critical, Dry, and Below Normal Water Year types		<i>8 ug/L monthly mean</i>	<i>5 ug/L monthly mean</i>	5 ug/L 4-day average
San Joaquin River from Sack Dam to the Merced River.				5 ug/L 4-day average

¹ The water year classification will be established using the best available estimate of the 60-20-20 San Joaquin Valley water year hydrologic classification (as defined in Footnote 17 for Table 3 in the State Water Resources Control Board's *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary*, May 1995) at the 75% exceedance level using data from the Department of Water Resources Bulletin 120 series. The previous water year's classification will apply until an estimate is made of the current water year.

Boron

Separate boron water quality objectives apply to the lower San Joaquin River upstream and downstream of the Merced River inflow. Downstream of the Merced River, the objectives are further divided seasonally: 0.8 mg/L during the irrigation season (15 March through 15 September) and 1.0 mg/L for the remainder of the year. **Table 9** lists the mean monthly boron concentrations at all sites monitored in the San Joaquin River for Water Years 1999-2000 and indicates whether concentrations were reported above the applicable monthly mean water quality objective.

During Water Year 1999, boron concentrations at both the Crows Landing and Las Palmas sites were reported above the applicable monthly mean boron objectives in March, June, July and August, based on weekly grab samples. Review of the daily composited data from the Crows Landing site confirmed the concentrations. Concentrations remained below the instantaneous maximum boron water quality objectives (2.0 mg/L to 5.8 mg/L, depending on river location and time of year) during Water Year 1999. The highest boron concentration recorded was 2.3 mg/L at Hills Ferry during mid-June, 1999.

Water Year 2000 exhibited similar trends. Boron concentrations were reported above the applicable monthly mean boron objectives at the Crows Landing site in June, July and August, and at the Las Palmas site in June and July, 2000. Again, boron concentrations remained below the instantaneous maximum boron objectives. The Hills Ferry site was not monitored in Water Year 2000.

Selenium

The continuous selenium water quality objective is 5 ug/L based on a 4-day average, and is subject to a compliance time schedule (**Table 8**). The instantaneous maximum objective varies according to location from 12 ug/L to 20 ug/L (**Table 7**).

Table 10 presents the monthly mean selenium concentrations at selected locations in the San Joaquin River, based on weekly grab samples, and indicates whether the monthly mean concentrations were above 5 ug/L. During Water Year 1999, the only monthly mean selenium concentrations above 5 ug/L were recorded from March through September at Hills Ferry. Monthly mean selenium concentrations at the remaining sites were all below 5 ug/L. None of the sites monitored in Water Year 2000 had monthly mean concentrations in excess of 5 ug/L.

The maximum selenium concentrations remained below instantaneous maximum water quality objectives (**Table 7**), during Water Years 1999 and 2000. The highest selenium concentration recorded in the river was 11.1 ug/L at Hills Ferry on 8 July 1999.

The selenium concentrations listed in **Table 10** are monthly mean concentrations calculated from weekly grab samples; however, the selenium water quality objective is a 4-day average. This objective is subject to a compliance time schedule and must be met no later than either 1 October, 2005 or 1 October, 2010, depending on water year type. Daily composite data collected from the Sigma automated samplers at the Crows Landing site was used to calculate actual 4-day average concentrations for Water Years 1999-2000 (Appendix B). The calculated 4-day averages were above 5 ug/L selenium on 13 days in Water Year 1999: from 20 June to 26 June 1999, from 9 July to 12 July 1999, from 31 August to 1 September 1999; and on one day in Water Year 2000: on 16 June 2000. The highest 4-day average value calculated (6.3 ug/L) was for the period of 20 through 23 June 1999.

The automated sampler was installed at Crows Landing late in Water Year 1996. The four years of selenium 4-day running averages, Water Years 1997-2000, are presented in **Figure 8**. Since the overall concentrations correlate to the amount of flow in an inverse relationship, the flow data for the same time period is presented in **Figure 9**. The calculated 4-day average selenium concentrations for Water Years 1999 and 2000, especially during the irrigation season, April through July, appear to be lower than in Water Year 1997, but are higher than those calculated for Water Year 1998. This difference likely reflects the higher dilution flows evident during the Water Year 1998 irrigation season. (Flow data for Water Years 1999 and 2000 obtained via Miyashita, USGS Hydrologic Clerk; subject to revision.)

Molybdenum

The molybdenum water quality objectives adopted for the lower San Joaquin River primarily reflect concern over the potential accumulation in livestock forage if the water is used for irrigation. Upstream of the Merced River, the monthly mean molybdenum objective is 19 ug/L with an instantaneous maximum of 50 ug/L. Downstream of the Merced River, the monthly mean molybdenum objective drops to 12 ug/L with an instantaneous maximum of 15 ug/L. The highest molybdenum concentration detected in the San Joaquin River during the study period,

was 12 ug/L at the Hills Ferry site on 27 May 1999 and again on 24 June 1999. The reported maximum concentration does not exceed any of the adopted continuous or maximum molybdenum water quality objectives.

Table 9. Monthly Mean Boron Concentrations and Water Quality Objective (WQO) Exceedances in the San Joaquin River: Water Years 1999 and 2000.

Water Year/Site	WQO mg/L	Monthly Mean Concentration (mg/L)											
		Water Year 1999											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Lander Avenue*	2†	<0.05	0.15	0.10	0.07	0.06	0.10	0.19	0.24	0.26	0.15	0.22	0.26
Freemont Ford	2†	0.36	0.50	0.29	0.68	0.42	0.79	0.67	0.56	0.55	0.49	0.44	0.41
Hills Ferry	2†	0.62	0.93	0.70	1.2	0.90	1.5	1.2	1.4	2.0	2.0	1.7	1.3
Crows Landing	0.8/1.0††	0.29	0.59	0.51	0.64	0.48	0.85	0.51	0.58	1.0	1.2	1.0	0.79
Las Palmas	0.8/1.0††	0.32	0.58	0.48	0.62	0.49	0.82	0.50	0.55	0.94	1.0	0.90	0.73
Maze Blvd.	0.8/1.0††	0.22	0.4	0.28	0.36	0.2	0.30	0.21	0.29	0.49	0.49	0.50	0.39
Vernalis	0.8/1.0††	0.13	0.28	0.22	0.26	0.15	0.23	0.16	0.18	0.25	0.33	0.34	0.28
Crows Ldg Sigma	0.8/1.0††	0.37	0.58	0.47	0.60	0.49	0.81	0.58	0.56	1.1	1.2	1.1	0.80

Water Year/Site	WQO mg/L	Monthly Mean Concentration (mg/L)											
		Water Year 2000											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Lander Avenue*	2†	0.19	0.23	0.32	0.25	0.1	0.06	0.15	0.14	0.18	0.17	0.21	0.23
Freemont Ford	2†	0.60	0.78	0.97	0.93	0.69	0.45	0.56	0.55	0.49	0.48	0.45	0.46
Hills Ferry	2†	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Crows Landing	0.8/1.0††	0.67	0.74	0.88	0.86	0.68	0.47	0.67	0.56	1.0	1.0	0.88	0.64
Las Palmas	0.8/1.0††	0.62	0.68	0.82	0.78	0.75	0.44	0.66	0.56	0.91	0.89	0.78	0.58
Maze Blvd.	0.8/1.0††	0.36	0.48	0.54	0.53	0.59	0.20	0.34	0.27	0.48	0.46	0.33	0.27
Vernalis	0.8/1.0††	0.29	0.39	0.44	0.42	0.41	0.17	0.24	0.18	0.30	0.38	0.28	0.23
Crows Ldg Sigma	0.8/1.0††	0.65	0.73	0.87	0.88	0.71	0.47	0.71	0.60	1.0	1.0	0.93	0.65

† = water quality objective only applies 15 March through 15 September

†† = 0.8 mg/L objective applies 15 March through 15 September; 1.0 mg/L objective applies 16 September through 14 March

** = analyzed monthly only until January 2000; analyzed weekly since January 2000

Bold Italic = water quality objective exceedance

Table 10. Monthly Mean Selenium Concentrations and Potential Water Quality Objective (WQO) Exceedances in the San Joaquin River: Water Years 1999 and 2000.

Water Year/Site	WQO* ug/L	Monthly Mean Concentration (ug/L)											
		Water Year 1999											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Lander Avenue**	5	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Freemont Ford	5	0.6	0.6	<0.4	0.7	0.5	0.8	0.6	0.6	0.7	0.7	0.7	0.7
Hills Ferry	5	2.6	2.5	1.8	2.8	3.5	5.9	6.4	6.3	8.9	8.4	6.5	5.4
Crows Landing	5	1.3	1.7	1.2	1.4	1.9	3.3	2.2	2.5	4.5	4.5	4.0	3.2
Las Palmas	5	1.3	1.6	1.1	1.4	1.9	3.3	2.1	2.3	3.9	3.6	3.0	2.5
Maze Blvd.	5	0.8	1.0	0.6	0.8	0.7	1.1	0.9	1.1	1.6	1.7	1.6	1.3
Vernalis	5	0.5	0.7	0.5	0.5	0.4	0.8	0.6	0.7	0.8	1.1	1.0	1.0
Crows Ldg Sigma	5	1.5	1.7	1.2	1.6	1.9	3.1	1.9	2.6	4.5	4.6	4.1	3.2

Water Year/Site	WQO* ug/L	Monthly Mean Concentration (ug/L)											
		Water Year 2000											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Lander Avenue**	5	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Freemont Ford	5	0.7	0.7	0.7	0.4	0.7	0.7	0.6	0.9	0.9	0.8	0.5	0.5
Hills Ferry	5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Crows Landing	5	1.6	1.7	2.2	2.0	2.2	1.9	2.8	2.3	3.8	3.9	3.0	2.4
Las Palmas	5	1.6	1.7	2.1	1.9	1.9	1.8	2.8	2.2	3.6	3.4	2.5	2.0
Maze Blvd.	5	0.8	0.9	1.3	1.2	1.3	0.9	1.3	1.2	1.9	1.7	1.0	0.7
Vernalis	5	0.7	1.0	1.1	1.0	1.1	0.8	0.9	0.8	1.2	1.3	0.8	0.8
Crows Ldg Sigma	5	1.5	1.7	2.3	2.2	1.9	1.5	3.0	2.4	4.2	4.0	3.0	2.7

* = Water quality objective applies as a 4-day average subject to a compliance time schedule

** = analyzed monthly only until January 2000; analyzed weekly since January 2000

Bold Italic = water quality objective exceedance

Figure 8. 4-day Running Average Selenium Concentrations in the San Joaquin River at Crows Landing: Water Years 1997, 1998, 1999 and 2000.

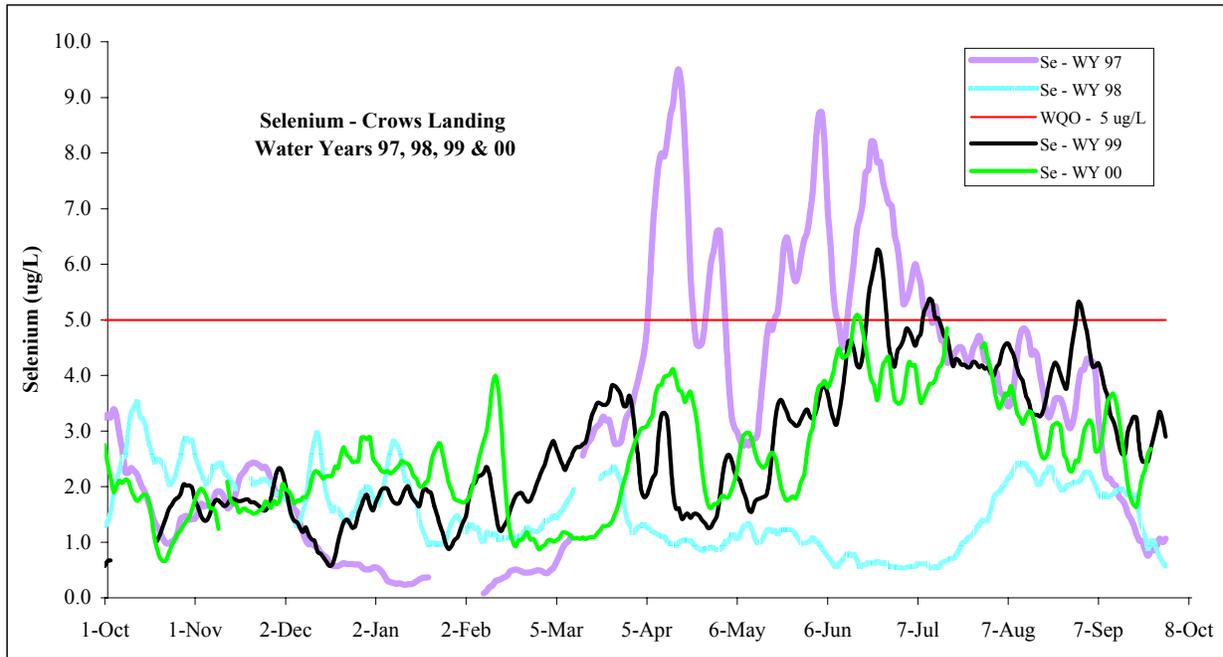
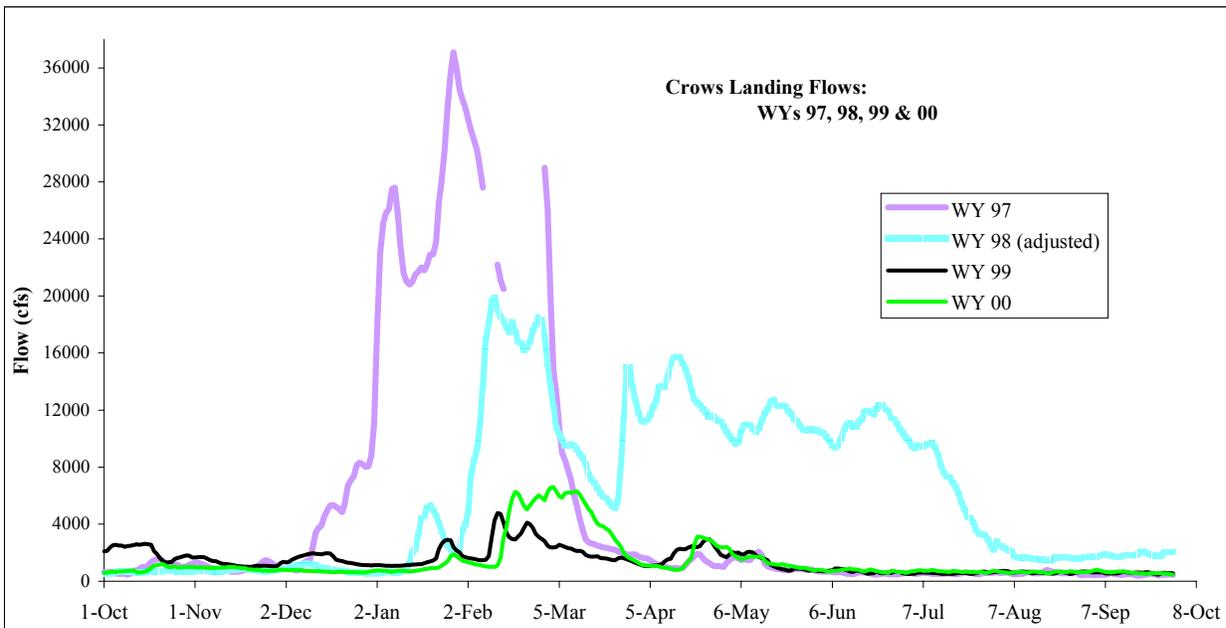


Figure 9. San Joaquin River Flows at Crows Landing: Water Years 1997, 1998, 1999 and 2000.



LOADS OF SALT, BORON AND SELENIUM

Data Availability: Water Years 1999 and 2000

Salt, boron, and selenium loads for the San Joaquin River (SJR) at Crows Landing, the SJR near Vernalis, the Drainage Project Area (DPA), and the Grassland Watershed were estimated based upon the flow weighted monthly average of available water quality data for Water Years 1999 and 2000. Daily discharge and daily electrical conductivity data for the sites was obtained from the USGS (Henry Miyashita, personal communication). Daily discharge data for the San Joaquin River at Lander Avenue was obtained from the California Department of Water Resources (California Data Exchange Center Website). Salt loads are based upon daily USGS electrical conductivity measurements. Boron and selenium loads for Crows Landing are based upon combined grab samples and composite samples collected by automated Sigma™ samplers. Boron and selenium loads for Vernalis are based upon grab samples. Boron and selenium loads for the DPA are based upon combined grab samples and composite samples collected by automated Sigma™ sampling devices, while loads for the Grassland Watershed sites are based upon grab samples. Detailed discussion of the DPA and Grassland Watershed loads can be found in Crader *et al.*, 2002. The methodology used to calculate loads can be found in Grober *et al.*, 1998. Raw data used to calculate loads have been tabulated and are available in hard copy from the Regional Board's Sacramento office. This information can also be found at the Regional Board web site. Follow the links to view or download files from:

<http://www.swrcb.ca.gov/rwqcb5/>

The tabulated flow and water quality data used to compute loads for Water Years 1986 through 1995 are presented at this website. Each year of data is comprised of four data tables: the first table contains mean daily flow data; the second, third and fourth contain electrical conductivity (EC), boron and selenium data, respectively. Additionally, EC, boron and selenium data are presented for five automated sampler sites for Water Year 1995. Matrices are sparsely filled for some water quality data.

Monthly Loads: Water Years 1999 and 2000

Monthly discharge and monthly flow weighted average concentrations and loads for Crows Landing and Vernalis were calculated for Water Years 1999 and 2000 (**Tables 11 - 14**). A detailed discussion of monthly discharge and loads for the DPA and the Grassland Watershed can be found in *Agricultural Drainage Contribution to Water Quality in the Grassland Watershed of Western Merced County, California: October 1998 – September 2000; Water Years 1999 & 2000* (Crader *et al.*, 2002).

Monthly discharge at Crows Landing and Vernalis for Water Years 1999 and 2000 is depicted in **Figures 10 and 11**. The discharge pattern for both sites is similar for both water years. Water Year 1999 discharge at Crows Landing ranged from a minimum of 35 thousand acre feet (taf) in July and September to a maximum of 162 taf in February. Water Year 2000 discharge at Crows Landing ranged from a minimum of 36 taf in September to a maximum of 275 taf in March. Water Year 1999 discharge at Vernalis ranged from a minimum of 121 taf in August and

September to a maximum of 649 taf in February. Water Year 2000 discharge at Vernalis ranged from a minimum of 117 taf in July, to a maximum of 744 taf in March. The seasonal pattern of monthly salt, boron, and selenium loads from these sites is generally similar to the pattern of discharge (**Figures 12 - 17**).

Annual Loads: Water Years 1986 to 2000

Water Years 1999 and 2000 annual discharge, load, and flow weighted concentrations for the SJR at Crows Landing, the SJR near Vernalis, the DPA, and the Grassland Watershed are listed in **Tables 15 and 16 part a**. Water Years 1999 and 2000 were both classified as above normal water years and had similar discharge patterns. The widespread flooding and the resultant commingling of subsurface and surface water that occurred in the San Joaquin River Basin during Water Years 1997 and 1998 did not occur in Water Years 1999 and 2000. Absent flooding, estimates of constituent loads were made based solely on available flow and concentration data.

Loads of all constituents are higher at Vernalis than at Crows Landing because of additional load contributed by the Tuolumne and Stanislaus Rivers on the east side, several smaller tributaries on the west side and numerous agricultural return flows from both the east and west side of the river. Unreported discharges, such as these, represent the “unaccounted for” loads and concentrations summarized in **Tables 15 and 16 parts b, c, and d** for the SJR near Vernalis. Unaccounted for sources at Crows Landing include the Merced River, the SJR upstream of the Grassland Watershed, and agricultural return flows other than the Grassland Watershed. Unaccounted sources within the Grassland Watershed include wetlands, agricultural drainage and other subsurface drainage from within the watershed exclusive of the Grassland Bypass Project. Other natural inflows, including groundwater accretions, contribute to unaccounted for discharges and loads at all sites.

During Water Year 1999, 100% of the calculated selenium load at Crows Landing was contributed by the Grassland Watershed. Seventy seven percent of the boron load and 59% of the salt load at Crows Landing was also contributed by the Grassland Watershed. In contrast, during Water Year 1999, the Grassland Watershed contributed only 25% of the discharge at Crows Landing.

During the same year, Water Year 1999, 99% of the selenium load at Vernalis could be accounted for at Crows Landing. Eighty two percent of the boron load and 65% of the salt load at Vernalis could also be accounted for at Crows Landing. Only 28% of the discharge at Vernalis could be accounted for at Crows Landing. In turn, during WY 1999, the Grassland Watershed contributed 99% of the selenium load, 63% of the boron load, and 39% of the salt load at Vernalis, and the DPA contributed 86% of the selenium load, 34% of the boron load, and 14% of the salt load at Vernalis.

During Water Year 2000, 86% of the calculated selenium load at Crows Landing was contributed by the Grassland Watershed. Sixty eight percent of the boron load and 54% of the salt load at Crows Landing was also contributed by the Grassland Watershed. In contrast, during

Water Year 2000, the Grassland Watershed contributed only 23% of the discharge at Crows Landing.

During the same year, Water Year 2000, 83% of the selenium load at Vernalis could be accounted for at Crows Landing. Eighty eight percent of the boron load and 68% of the salt load at Vernalis could also be accounted for at Crows Landing. Only 36% of the discharge at Vernalis could be accounted for at Crows Landing. In turn, during WY 2000, the Grassland Watershed contributed 71% of the selenium load, 59% of the boron load, and 37% of the salt load at Vernalis, and the DPA contributed 69% of the selenium load, 33% of the boron load, and 13% of the salt load at Vernalis.

Water Year 2000 selenium loads were calculated for the SJR at Lander Avenue, near Crow's Landing, near Patterson, and at Airport Way and then compared to estimated river reach loads which were calculated by combining available water quality and discharge information for major tributaries (Salt and Mud Sloughs, Orestimba Creeek, and the Merced, Tuolumne, and Stanislaus Rivers) in **Figure 18**. Estimated selenium loads using available tributary information and the most upstream San Joaquin River site (Lander Avenue) were lower than the selenium loads calculated at specific downstream San Joaquin River sites by: 255 pounds at Crows Landing (5%); 675 pounds at Patterson (11%); and 472 pounds at Vernalis (7%).

Annual discharges for the SJR at Crows Landing, the SJR near Vernalis, the DPA, and the Grassland Watershed for Water years 1986 though 2000 are shown in **Figure 19**. Annual discharge at Crows Landing increased 1% from Water Year 1999 to Water Year 2000. Annual discharge at Vernalis decreased 20% from Water Year 1999 to Water Year 2000, due primarily to a reduction in freshwater inflows from the Tuolumne and Stanislaus Rivers (Henry Miyashita, personal communication).

Annual salt loads for the SJR at Crows Landing, the SJR near Vernalis, the DPA, and the Grassland Watershed for Water years 1986 though 1999 are shown in **Figure 20**. Annual salt load at Crows Landing increased by 3% from Water Year 1999 to Water Year 2000. Annual salt load at Vernalis decreased by 2% from Water Year 1999 to Water Year 2000.

Annual boron loads for the SJR at Crows Landing, the SJR near Vernalis, the DPA, and the Grassland Watershed for Water years 1986 though 1999 are shown in **Figure 21**. Annual boron load at Crows Landing increased by 3% from Water Year 1999 to Water Year 2000. Annual boron load at Vernalis decreased by 3% from Water Year 1999 to Water Year 2000.

Annual selenium loads for the SJR at Crows Landing, the SJR near Vernalis, the DPA, and the Grassland Watershed for Water years 1986 though 1999 are shown in **Figure 22**. Annual selenium load at Crows Landing decreased by 8% from Water Year 1999 to Water Year 2000. Annual selenium load at Vernalis increased by 11% from Water Year 1999 to Water Year 2000. Although some of the apparently increased selenium load calculated at Vernalis may be attributed to calculation errors, including flow measurement, the monitoring program has been expanded to include other possible sources of selenium discharging to the San Joaquin River between Crow's Landing and Vernalis.

When compared to Water Year 1996, the last pre-project water year, Water Years 1999 and 2000 discharge for Crows Landing decreased 30% and 29%, respectively, salt load decreased 16% and 13%, respectively, boron load decreased 10% and 8%, respectively, and selenium load decreased 44% and 49%, respectively.

When compared to Water Year 1996, Water Years 1999 and 2000 discharge for Vernalis decreased 10% and 28%, respectively, salt load decreased 13% and 14%, respectively, boron load decreased 11% and 14%, respectively, and selenium load decreased 48% and 42%, respectively.

A detailed discussion of annual discharge and loads for the Grassland Watershed and the DPA can be found in *Agricultural Drainage Contribution to Water Quality in the Grassland Watershed of Western Merced County, California: October 1998 – September 2000* (Crader *et al*, 2002).

Table 11. Monthly and Annual Discharge and Salt, Boron and Selenium Loads and Flow Weighted Concentrations for SJR at Crows Landing for Water Year 1999

Month	Flow (taf)	Loads			Flow Weighted Concentrations		
		Se (lbs)	B (1000 lbs)	TDS (1000 tons)	Se (ppb)	B (ppm)	TDS (ppm)
Oct-98	129	457	110	44	1.3	0.3	254
Nov-98	73	343	110	52	1.7	0.6	526
Dec-98	95	301	110	52	1.2	0.4	403
Jan-99	95	376	140	64	1.5	0.5	497
Feb-99	162	787	190	84	1.8	0.4	380
Mar-99	116	956	250	104	3.0	0.8	659
Apr-99	113	538	150	72	1.8	0.5	470
May-99	82	531	110	54	2.4	0.5	481
Jun-99	40	476	110	45	4.3	1.0	812
Jul-99	35	431	110	38	4.5	1.2	802
Aug-99	38	424	110	39	4.1	1.1	765
Sep-99	35	308	75	32	3.3	0.8	673
WY Total	1,012	5,920	1,570	680	2.2	0.6	494

Table 12. Monthly and Annual Discharge and Salt, Boron and Selenium Loads and Flow Weighted Concentrations for SJR at Crows Landing for Water Year 2000

Month	Flow (taf)	Loads			Flow Weighted Concentrations		
		Se (lbs)	B (1000 lbs)	TDS (1000 tons)	Se (ppb)	B (ppm)	TDS (ppm)
Oct-99	52	199	87	38	1.4	0.6	542
Nov-99	52	240	100	48	1.7	0.7	676
Dec-99	42	260	100	47	2.3	0.9	823
Jan-00	59	346	140	59	2.2	0.9	729
Feb-00	202	714	240	90	1.3	0.4	328
Mar-00	275	953	290	137	1.3	0.4	366
Apr-00	100	696	160	70	2.6	0.6	517
May-00	84	543	130	60	2.4	0.6	525
Jun-00	43	494	120	44	4.2	1.0	752
Jul-00	42	453	110	40	4.0	1.0	712
Aug-00	39	317	98	35	3.0	0.9	670
Sep-00	36	269	64	29	2.7	0.7	584
WY Total	1,026	5,480	1,630	698	2.0	0.6	500

Table 13. Monthly and Annual Discharge and Salt, Boron and Selenium Loads and Flow Weighted Concentrations for SJR near Vernalis for Water Year 1999

Month	Flow (taf)	Loads			Flow Weighted Concentrations		
		Se (lbs)	B (1000 lbs)	TDS (1000 tons)	Se (ppb)	B (ppm)	TDS (ppm)
Oct-98	378	526	130	85	0.5	0.1	166
Nov-98	196	377	150	84	0.7	0.3	317
Dec-98	266	340	150	81	0.5	0.2	225
Jan-99	291	333	170	112	0.4	0.2	283
Feb-99	649	701	250	108	0.4	0.1	123
Mar-99	512	1,100	300	139	0.8	0.2	199
Apr-99	383	605	170	109	0.6	0.2	209
May-99	341	586	150	89	0.6	0.2	192
Jun-99	179	405	120	71	0.8	0.2	292
Jul-99	129	370	120	48	1.1	0.3	272
Aug-99	121	327	110	57	1.0	0.3	349
Sep-99	121	314	98	54	1.0	0.3	326
WY Total	3,567	5,980	1,910	1,038	0.6	0.2	214

Table 14. Monthly and Annual Discharge and Salt, Boron and Selenium Loads and Flow Weighted Concentrations for SJR near Vernalis for Water Year 2000

Month	Flow (taf)	Loads			Flow Weighted Concentrations		
		Se (lbs)	B (1000 lbs)	TDS (1000 tons)	Se (ppb)	B (ppm)	TDS (ppm)
Oct-99	156	237	120	66	0.6	0.3	314
Nov-99	128	341	130	70	1.0	0.4	400
Dec-99	104	298	120	68	1.1	0.4	482
Jan-00	131	337	140	81	0.9	0.4	453
Feb-00	435	992	290	123	0.8	0.2	209
Mar-00	744	1,560	310	169	0.8	0.2	167
Apr-00	298	750	180	97	0.9	0.2	240
May-00	296	691	140	90	0.9	0.2	224
Jun-00	165	529	130	79	1.2	0.3	351
Jul-00	117	427	120	59	1.3	0.4	373
Aug-00	133	290	99	61	0.8	0.3	336
Sep-00	139	177	84	58	0.5	0.2	306
WY Total	2,845	6,620	1,860	1,021	0.9	0.2	264

Table 15. Water Year 1999 Load Summary and Comparison Between the Drainage Project Area, Grassland Watershed and San Joaquin River at Crows Landing and near Vernalis

a. Summary of Annual Discharge and Loads				
Site	Discharge (taf)	Selenium (pounds)	Boron (1000 pounds)	Salt (1000 tons)
Drainage Project Area	32	5,120	643	149
Grassland Watershed (Mud Slough + Salt Slough)	253	5,910	1,210	402
Crows Landing	1,012	5,920	1,570	680
Vernalis	3,567	5,980	1,910	1,038

b. Difference in Discharges and Loads					
This site...	...minus this site	Discharge (taf)	Selenium (pounds)	Boron (1000 pounds)	Salt (1000 tons)
Grassland Watershed	Drainage Project Area	221	790	567	253
Crows Landing	Drainage Project Area	980	800	927	531
	Grassland Watershed	759	10	360	278
Vernalis	Drainage Project Area	3,535	860	1,267	889
	Grassland Watershed	3,314	70	700	636
	Crows Landing	2,555	60	340	359

c. Percent Difference in Discharges and Loads					
Percent Contribution to...	by...	Discharge	Selenium	Boron	Salt
Grassland Watershed	Drainage Project Area	13%	87%	53%	37%
	Grassland Watershed	100%	100%	100%	100%
	Unaccounted for	87%	13%	47%	63%
Crows Landing	Drainage Project Area	3%	86%	41%	22%
	Grassland Watershed	25%	100%	77%	59%
	Crows Landing	100%	100%	100%	100%
	Unaccounted for	75%	0%	23%	41%
Vernalis	Drainage Project Area	1%	86%	34%	14%
	Grassland Watershed	7%	99%	63%	39%
	Crows Landing	28%	99%	82%	65%
	Vernalis	100%	100%	100%	100%
	Unaccounted for	72%	1%	18%	35%

d. Unaccounted for Concentrations			
Site	Selenium (ppb)	Boron (ppm)	Salt (ppm)
Grassland Watershed	1.32	0.94	842
Crows Landing	0.00	0.17	269
Vernalis	0.01	0.05	103

Table 16. Water Year 2000 Load Summary and Comparison Between the Drainage Project Area, Grassland Watershed and San Joaquin River at Crows Landing and near Vernalis

a. Summary of Annual Discharge and Loads				
Site	Discharge (taf)	Selenium (pounds)	Boron (1000 pounds)	Salt (1000 tons)
Drainage Project Area	31	4,590	605	136
Grassland Watershed (Mud Slough + Salt Slough)	235	4,704	1,102	374
Crows Landing	1,026	5,480	1,630	698
Vernalis	2,845	6,620	1,860	1,021

b. Difference in Discharges and Loads					
This site...	...minus this site	Discharge (taf)	Selenium (pounds)	Boron (1000 pounds)	Salt (1000 tons)
Grassland Watershed	Drainage Project Area	204	114	497	238
Crows Landing	Drainage Project Area	995	890	1,025	562
	Grassland Watershed	790	776	528	324
Vernalis	Drainage Project Area	2,814	2,030	1,255	886
	Grassland Watershed	2,610	1,916	758	647
	Crows Landing	1,819	1,140	230	324

c. Percent Difference in Discharges and Loads					
Percent Contribution to...	by...	Discharge	Selenium	Boron	Salt
Grassland Watershed	Drainage Project Area	13%	98%	55%	36%
	Grassland Watershed	100%	100%	100%	100%
	Unaccounted for	87%	2%	45%	64%
Crows Landing	Drainage Project Area	3%	84%	37%	19%
	Grassland Watershed	23%	86%	68%	54%
	Crows Landing	100%	100%	100%	100%
	Unaccounted for	77%	14%	32%	46%
Vernalis	Drainage Project Area	1%	69%	33%	13%
	Grassland Watershed	8%	71%	59%	37%
	Crows Landing	36%	83%	88%	68%
	Vernalis	100%	100%	100%	100%
	Unaccounted for	64%	17%	12%	32%

d. Unaccounted for Concentrations			
Site	Selenium (ppb)	Boron (ppm)	Salt (ppm)
Grassland Watershed	0.21	0.89	858
Crows Landing	0.36	0.25	301
Vernalis	0.23	0.05	131

Figure 10. Monthly Discharge for the San Joaquin River at Crows Landing and near Vernalis: Water Year 1999

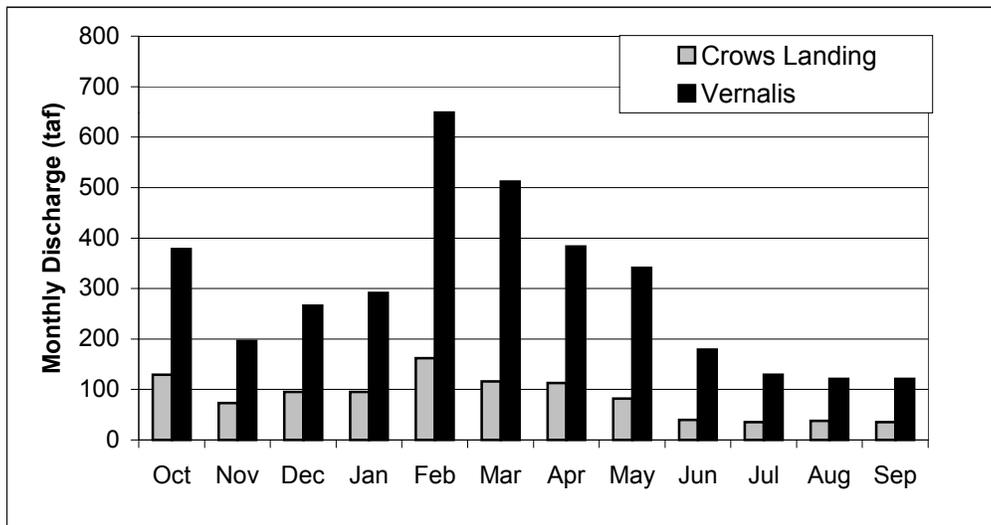


Figure 11. Monthly Discharge for the San Joaquin River at Crows Landing and near Vernalis: Water Year 2000

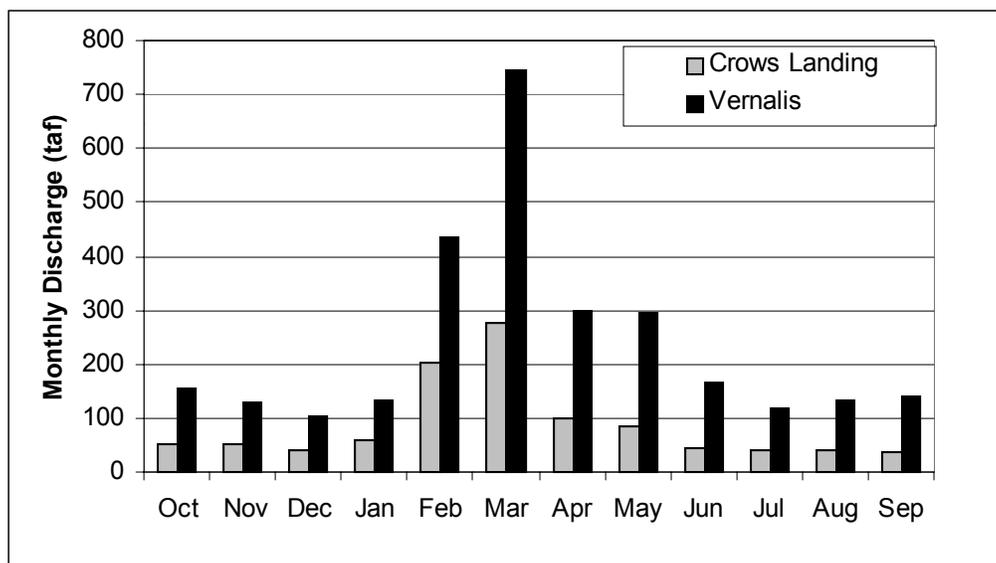


Figure 12. Monthly Salt Loads for the San Joaquin River at Crows Landing and near Vernalis: Water Year 1999

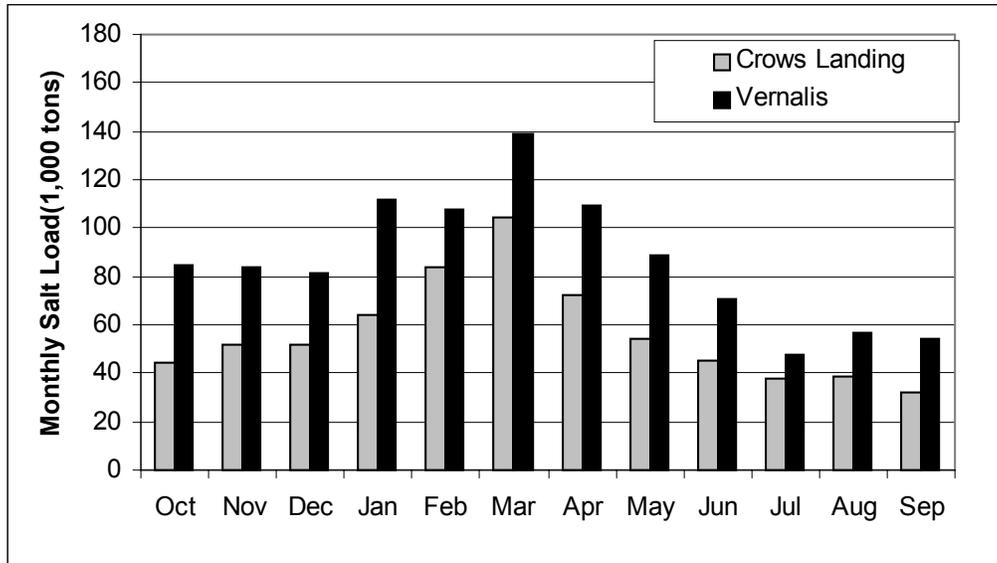


Figure 13. Monthly Salt Loads for the San Joaquin River at Crows Landing and near Vernalis: Water Year 2000

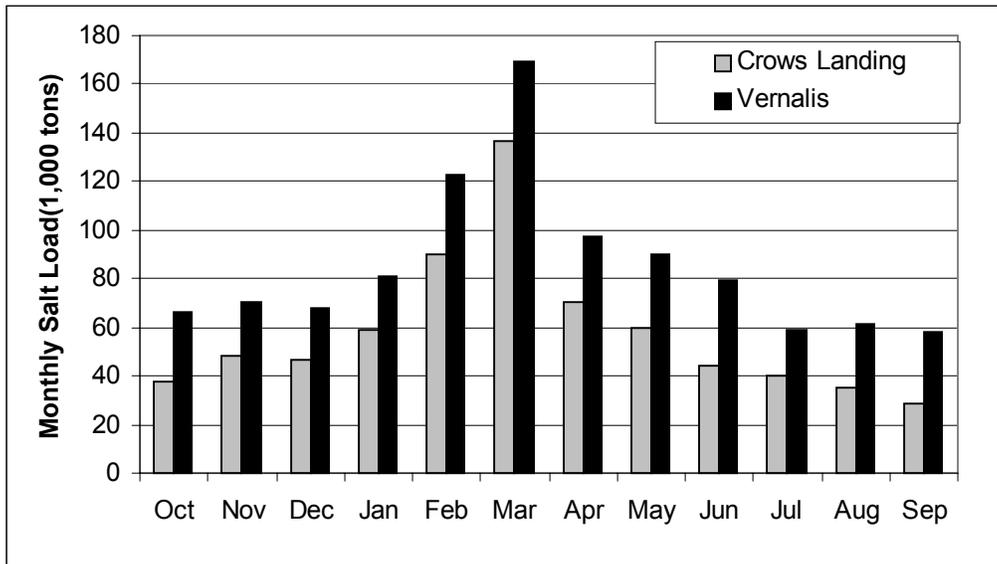


Figure 14. Monthly Boron Loads for the San Joaquin River at Crows Landing and near Vernalis: Water Year 1999

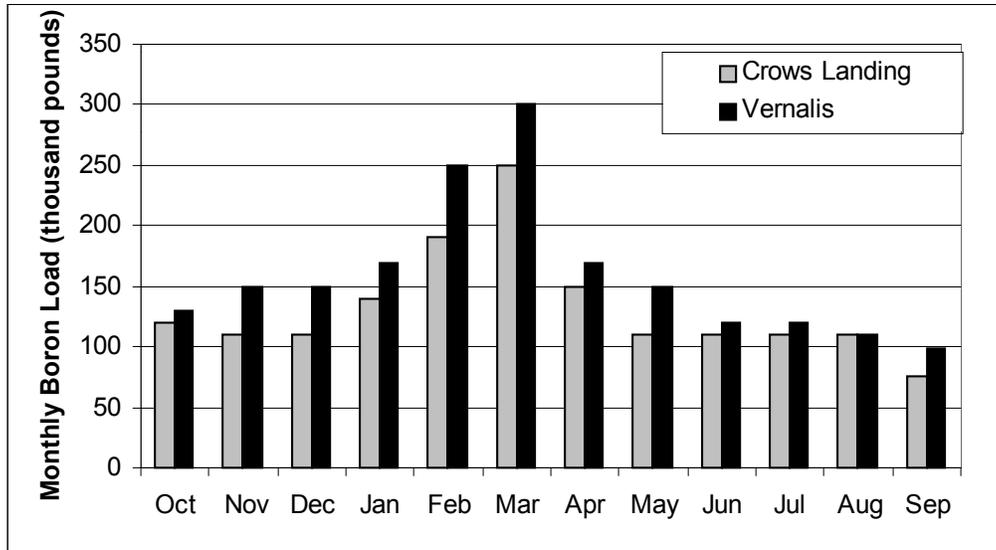


Figure 15. Monthly Boron Loads for the San Joaquin River at Crows Landing and near Vernalis: Water Year 2000

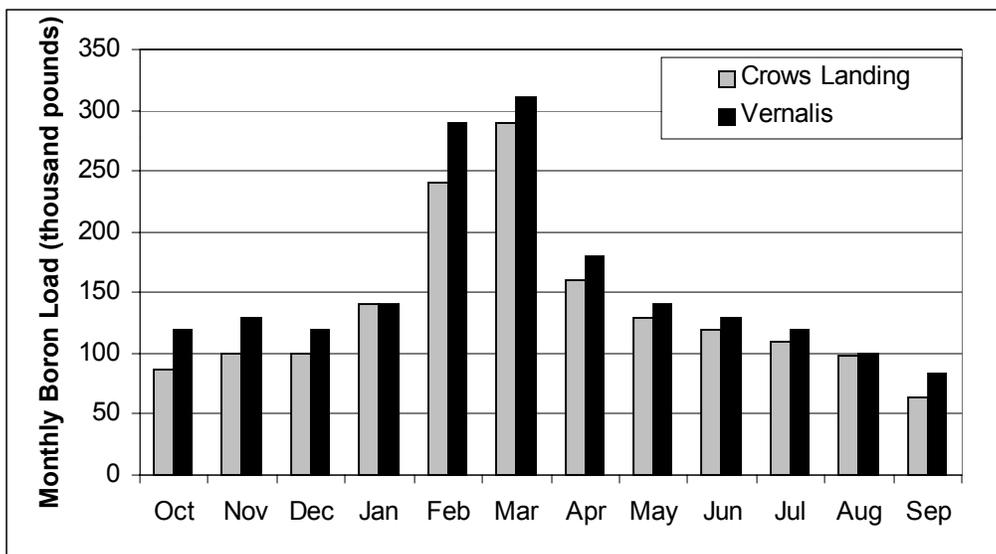


Figure 16. Monthly Selenium Loads for the San Joaquin River at Crows Landing and near Vernalis: Water Year 1999

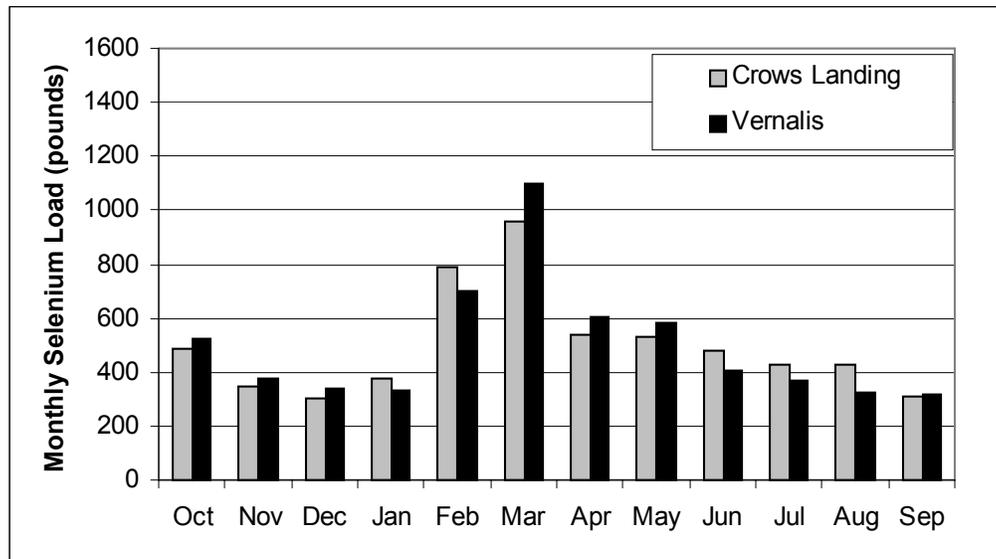


Figure 17. Monthly Selenium Loads for the San Joaquin River at Crows Landing and near Vernalis: Water Year 2000

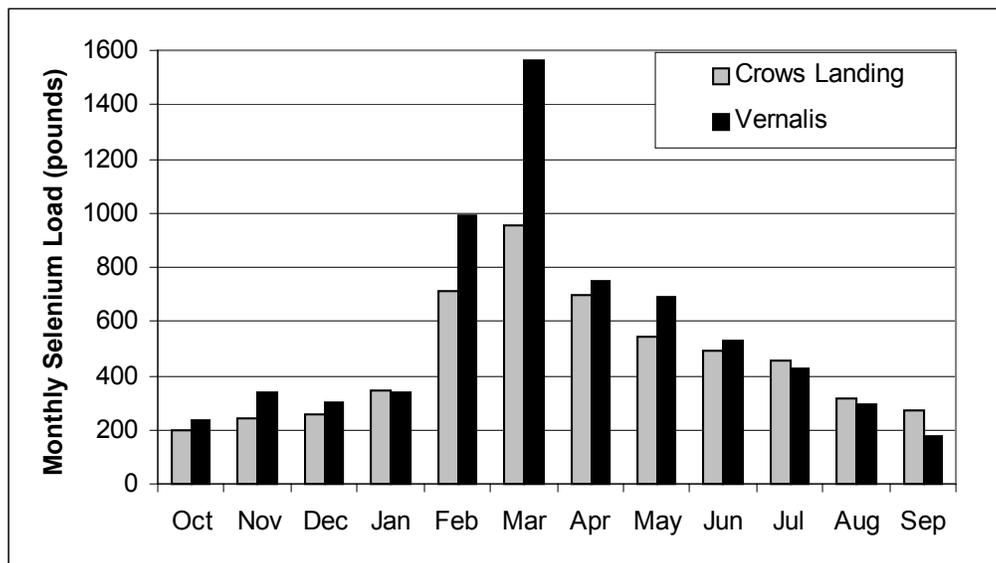


Figure 18. Measured Selenium Load in the San Joaquin River at Lander Avenue, Crows Landing, Patterson, and Vernalis, as Compared to Estimated River Reach Load Based on Summed Tributary Contributions

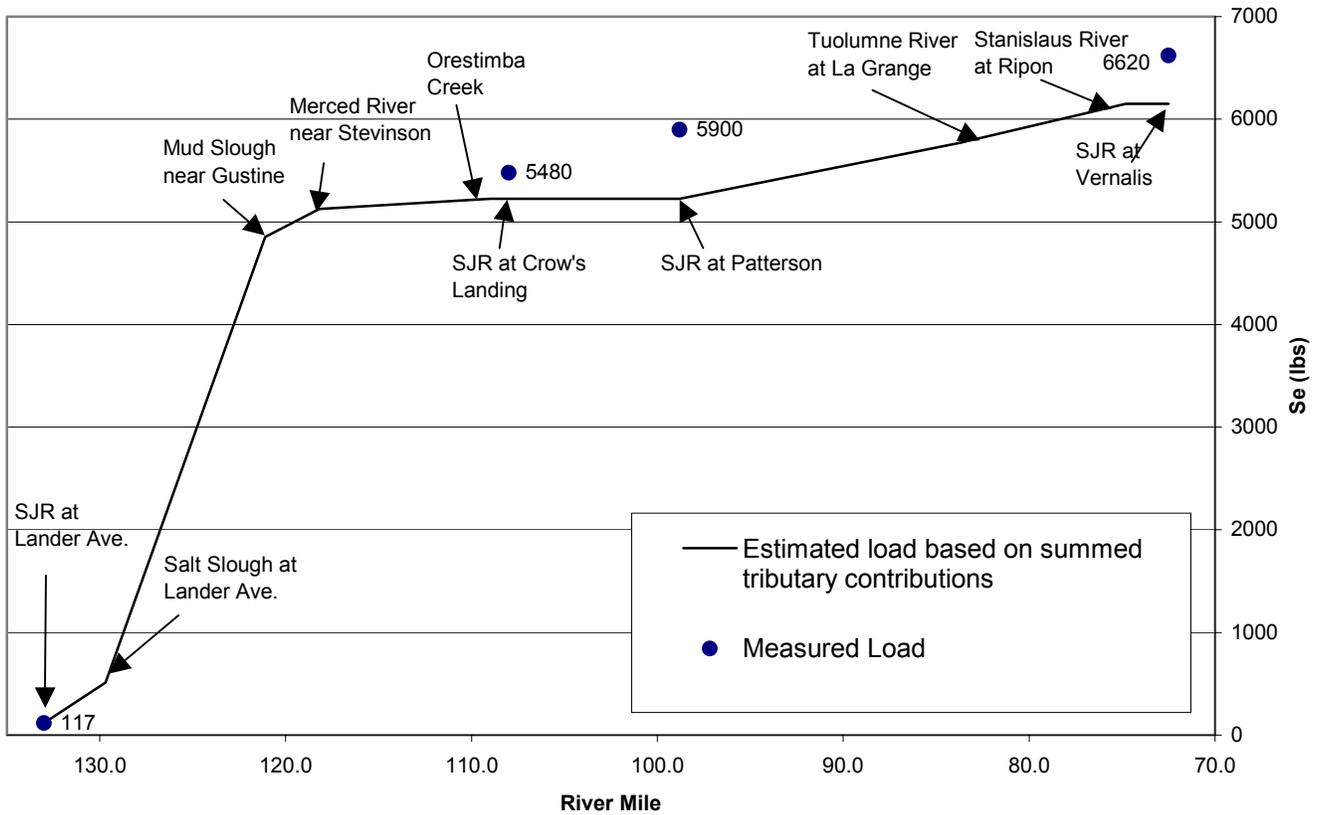


Figure 19. Annual Discharge from the Drainage Project Area, Grassland Watershed and the San Joaquin River at Crows Landing and Vernalis: Water Years 1986 through 2000

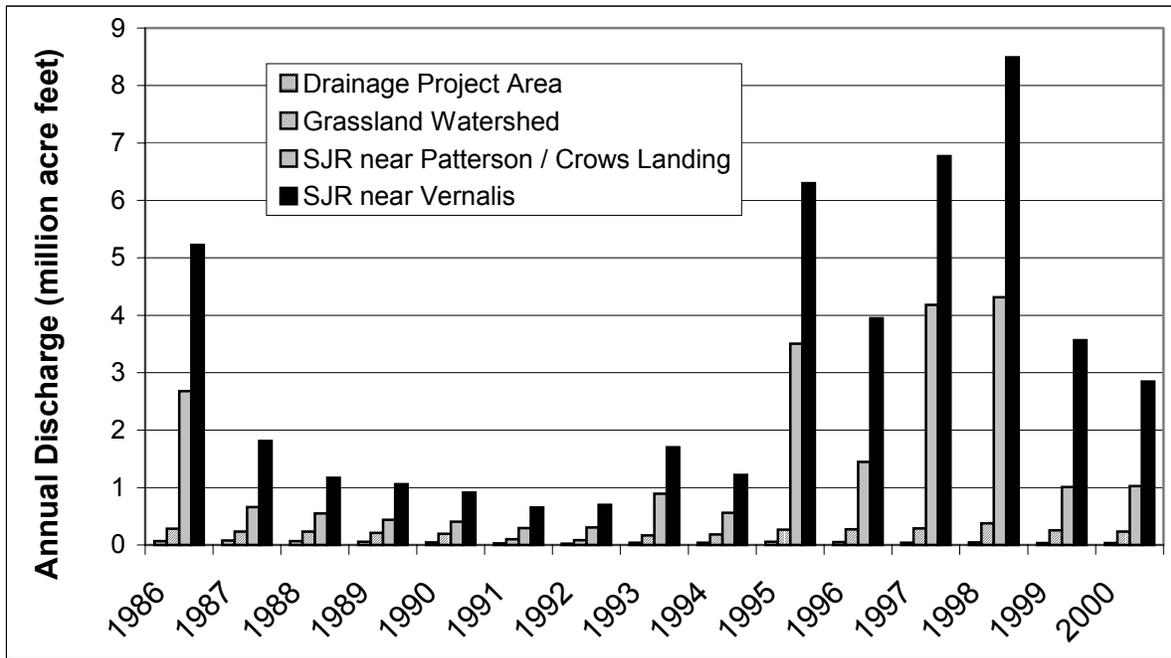


Figure 20. Annual Salt Loads from the Drainage Project Area, Grassland Watershed and the San Joaquin River at Crows Landing and Vernalis: Water Years 1986 through 2000

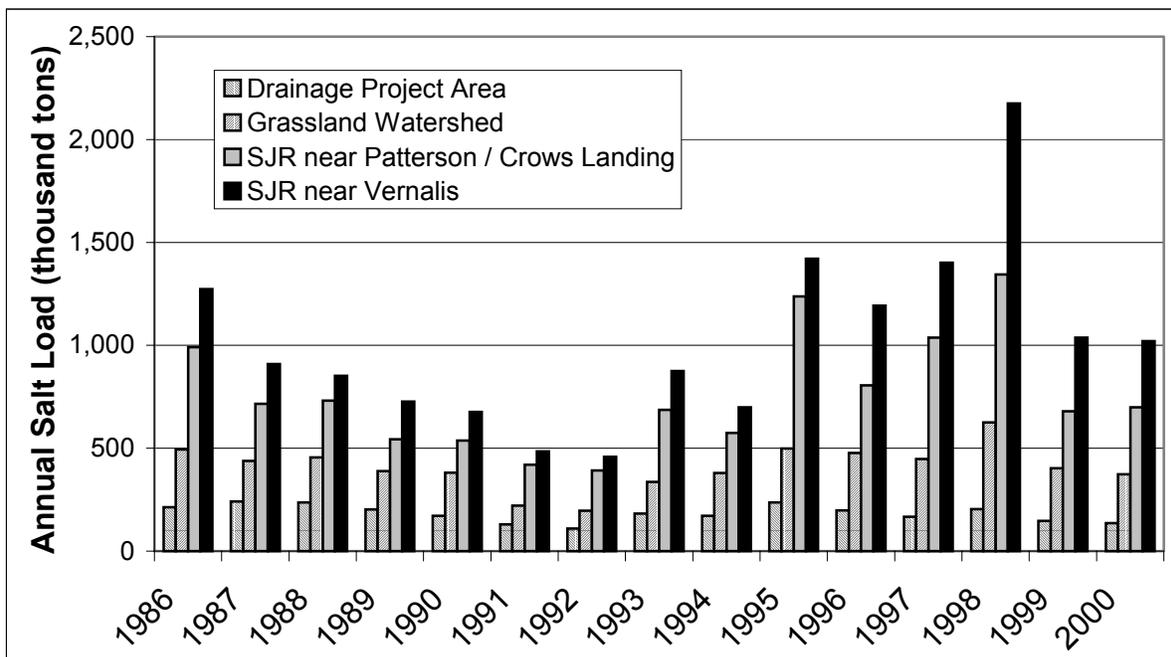


Figure 21. Annual Boron Loads from the Drainage Project Area, Grassland Watershed and the San Joaquin River at Crows Landing and Vernalis: Water Years 1986 through 2000

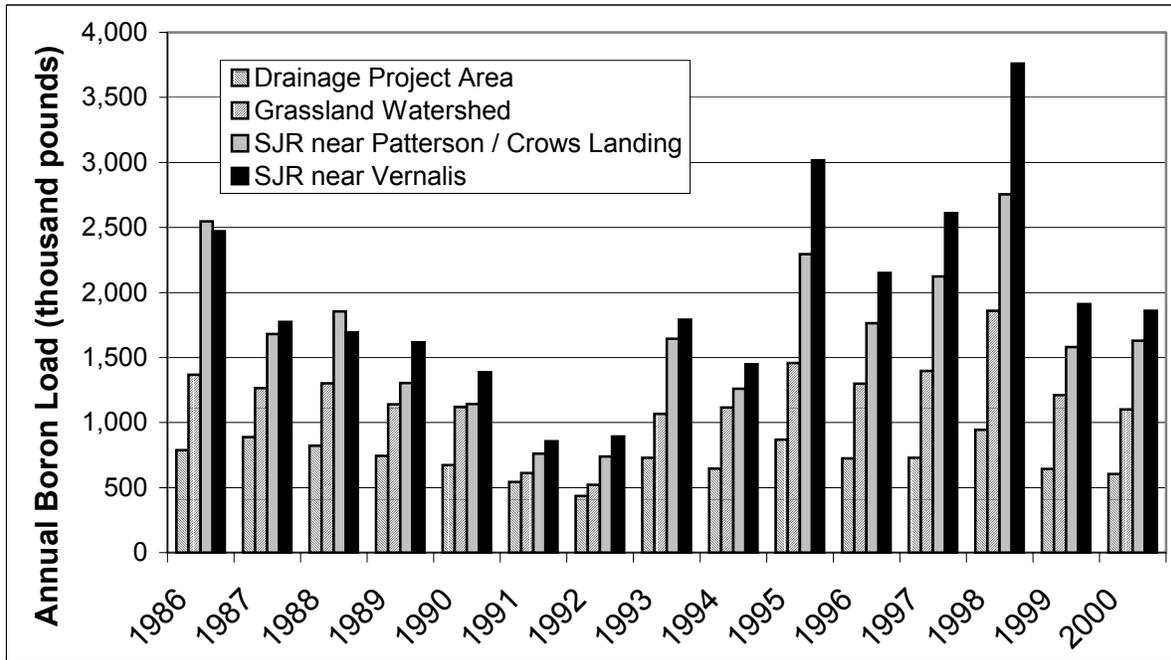
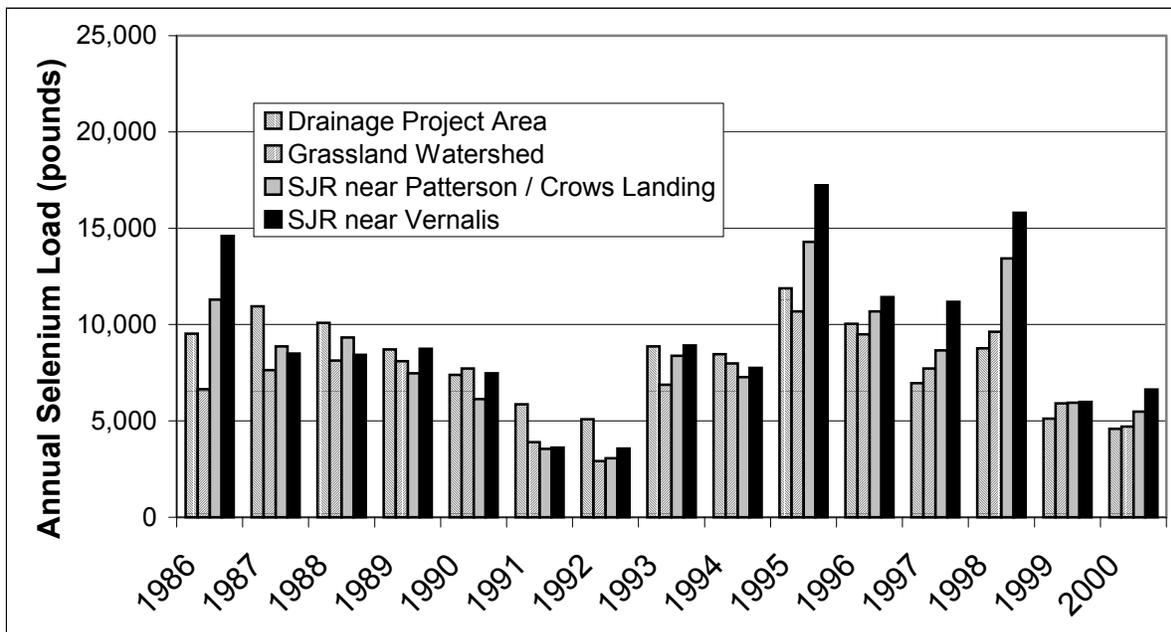


Figure 22. Annual Selenium Loads from the Drainage Project Area, Grassland Watershed and the San Joaquin River at Crows Landing and Vernalis: Water Years 1986 through 2000



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APPENDIX A
Grab Sample Water Quality Data

RWQCB Site I.D.	Site Name	Water Year(s)	Page
	San Joaquin River at:		
MER522	Lander Avenue	99-00	49
MER538	Fremont Ford	99-00	50
STC512	Hills Ferry Road	99	51
STC504	Crows Landing	99	52
STC504	Crows Landing	00	53
STC507	Patterson (Las Palmas)	99-00	54
STC510	Maze Blvd.	99-00	55
SJC501	Vernalis (Airport Way)	99	56
SJC501	Vernalis (Airport Way)	00	57
MER546	Merced River	99-00	59
STC513	Tuolumne River	99-00	59
STC514	Stanislaus River	99-00	59

Legend of Abbreviations

B = Boron
 Cl = Chloride
 Cr = Chromium
 Cu = Copper
 EC = Electrical Conductivity
 HDNS = Hardness
 Mo = Molybdenum
 NA = Not Available
 Ni = Nickel
 Pb = Lead
 Se = Selenium
 SO4 = Sulfate
 TSS = Total Suspended Solids
 Zn = Zinc

San Joaquin River at Fremont Ford (MER538)

WY 1999

Location: Latitude 37 18 34, Longitude 120 55 45. In NW 1/4, NW 1/4, T.7S, R.9E. West bank at Great Valley Grasslands State Park, S of Hwy 140, 5 miles NE of Gustine, River Mile 125.2.

Date	Time	Temp C	pH	EC umhos/cm	Se ug/L	B	Cl	SO4 mg/L	HDNS	Ca	Mg
10/01/98	7:35	20.0	7.2	711	0.5	0.66					
10/08/98	7:40	20.0	7.4	727	0.6	0.31					
10/15/98	8:05	17.8	7.6	709	0.7	0.31					
10/22/98	8:35	17.8	7.5	792	0.5	0.32					
10/29/98	12:40	17.8	NA	424	0.5	0.19	50	50	96	22	10
11/05/98	9:30	15.0	8.0	459	<0.4	0.2					
11/12/98	8:05	12.2	8.0	979	1.0	0.49					
11/18/98	17:15	14.4	7.7	1190	0.7	0.58					
11/24/98	13:05	15.6	7.6	1430	0.4	0.71					
12/03/98	9:00	14.4	7.8	426	<0.4	0.22					
12/09/98	13:30	10.6	6.8	300	<0.4	0.16					
12/17/98	7:20	9.4	7.8	337	<0.4	0.14					
12/22/98	11:50	6.7	8.3	738	<0.4	0.4					
12/30/98	15:20	9.4	7.6	1228	<0.4	0.57					
01/07/99	10:15	6.4	7.8	1430	0.8	0.7					
01/14/99	10:55	6.1	7.9	1340	0.7	0.69					
01/21/99	9:25	11.8	7.4	1280	1.0	0.7					
01/27/99	16:35	10.1	8.0	1020	0.5	0.55	130	140	230	NA	NA
02/04/99	8:45	10.0	7.7	1310	0.6	0.66					
02/10/99	17:35	10.6	8.0	472	<0.4	0.17					
02/18/99	11:05	12.7	7.9	1035	0.6	0.49					
02/25/99	8:45	12.6	7.9	839	0.6	0.37					
03/04/99	9:05	12.5	6.6	1310	0.8	0.57					
03/11/99	9:05	11.9	6.9	1530	0.7	0.73					
03/18/99	8:55	13.7	7.2	1560	1.1	0.86					
03/25/99	9:15	15.6	7.1	1390	0.8	0.85					
03/31/99	14:18	15.7	7.9	1644	0.7	0.93					
04/08/99	9:45	10.8	7.2	1630	0.7	0.95					
04/15/99	9:55	18.6	6.9	955	<0.4	0.41					
04/22/99	8:40	17.7	7.0	1540	0.7	0.65					
04/29/99	8:40	12.8	6.5	2060	0.7	0.66	370	250	370	74	44
05/06/99	8:00	18.2	7.5	1305	0.5	0.49					
05/13/99	8:50	18.2	7.2	1492	0.8	0.59					
05/20/99	8:20	18.7	7.3	1740	0.6	0.65					
05/27/99	8:40	21.4	7.4	1529	0.6	0.49					
06/03/99	11:30	19.0	6.7	1730	0.4	0.59					
06/10/99	8:15	19.0	7.4	1340	0.7	0.49					
06/17/99	8:55	22.6	7.1	1520	0.8	0.59					
06/24/99	9:43	25.7	7.4	1240	0.9	0.52					
07/01/99	10:30	27.6	7.5	1450	0.7	0.54					
07/08/99	9:00	23.1	7.2	1090	0.7	0.43					
07/15/99	11:40	26.8	7.9	972	0.9	0.44					
07/22/99	9:00	21.3	7.8	1120	0.7	0.52					
07/29/99	10:15	22.7	7.9	1050	0.6	0.51	140	130	220	48	24
08/05/99	9:05	22.8	7.3	1080	0.8	0.51					
08/12/99	8:30	21.1	7.1	970	0.7	0.37					
08/19/99	7:50	21.2	6.3	967	0.7	0.48					
08/26/99	8:15	24.5	8.1	1070	0.7	0.40					
09/02/99	10:15	21.4	6.9	1130	0.6	0.39					
09/09/99	12:25	24.8	8.3	936	0.7	0.38					
09/16/99	8:55	20.4	6.7	988	0.8	0.44					
09/23/99	9:15	22.6	6.8	1000	0.5	0.39					
09/30/99	8:50	20.2	7.2	1030	0.7	0.44					
Count		53	52	53	53	53	4	4	4	3	3
Min		6.1	6.3	300	<0.4	0.14	50	50	96	22	10
Max		27.6	8.3	2060	1.1	0.95	370	250	370	74	44
Mean		16.9	7.4	1123	0.6	0.51	173	143	229	48	26
Geo Mean		15.9	7.4	1041	0.6	0.47	135	123	206	43	22
Median		17.8	7.4	1090	0.7	0.49	135	135	225	48	24

San Joaquin River at Fremont Ford (MER538)

WY 2000

Location: Latitude 37 18 34, Longitude 120 55 45. In NW 1/4, NW 1/4, T.7S, R.9E. West bank at Great Valley Grasslands State Park, S of Hwy 140, 5 miles NE of Gustine, River Mile 125.2.

Date	Time	Temp C	pH	EC umhos/cm	Se ug/L	B	Cl	SO4 mg/L	HDNS	Ca	Mg
10/07/99	10:40	18.3	7.7	1050	0.7	0.50					
10/14/99	9:20	19.2	7.9	1300	0.7	0.69					
10/21/99	9:20	15.8	8.0	1180	0.7	0.62					
10/28/99	11:05	17.8	7.9	1370	0.5	0.60	180	150	270	56	31
11/04/99	12:15	17.6	7.3	1500	0.7	0.75					
11/11/99	8:40	14.3	NA	1200	1.0	0.72					
11/18/99	10:45	14.4	7.8	1610	0.7	0.87					
11/23/99	10:15	9.8	7.7	1660	0.4	0.77					
12/02/99	9:10	10.6	7.7	1710	0.6	0.89					
12/09/99	7:50	10.3	7.6	1790	0.9	0.90					
12/16/99	9:50	6.9	7.7	1960	0.7	0.97					
12/21/99	11:25	8.6	7.2	2090	0.9	1.0					
12/28/99	9:15	7.2	7.1	2560	0.4	1.1					
01/06/00	9:40	6.1	7.8	2360	<0.4	1.0					
01/13/00	9:30	9.3	7.2	2460	<0.4	1.2					
01/20/00	8:55	13.7	7.1	2300	0.6	1.1					
01/27/00	9:15	12.3	6.9	764	0.5	0.40	94	97	180	38	20
02/03/00	9:00	11.6	7.6	1770	0.6	1.1					
02/10/00	9:40	13.9	7.9	1950	1.0	1.2					
02/17/00	8:45	12.7	7.6	295	0.4	0.13					
02/24/00	12:45	11.2	7.2	627	0.9	0.34					
03/02/00	10:45	12.6	7.4	432	0.7	0.20					
03/09/00	12:40	13.5	7.6	518	0.5	0.24					
03/15/00	15:55	18.8	NA	665	0.5	0.32					
03/23/00	10:00	15.8	7.8	1030	0.9	0.62					
03/30/00	8:20	15.1	7.4	1500	0.9	0.87					
04/06/00	11:00	18.5	7.7	1630	0.6	0.67					
04/13/00	8:15	19.4	7.6	2180	0.5	0.82					
04/20/00	9:30	16.8	7.9	783	0.8	0.35					
04/27/00	8:37	19.1	NA	1070	0.6	0.38	160	140	230	49	26
05/04/00	11:30	22.8	7.8	1480	1.0	0.61					
05/11/00	8:25	15.7	7.7	1190	1.6	0.47					
05/18/00	8:37	18.6	7.9	1550	0.6	0.55					
05/25/00	11:10	23.6	7.9	1500	0.5	0.56					
06/01/00	8:35	20.2	7.9	1410	0.7	0.53					
06/08/00	8:30	21.2	7.7	1320	1.2	0.47					
06/15/00	10:10	27.2	7.7	1190	1.0	0.43					
06/22/00	8:20	25.4	7.6	1041	1.0	0.43					
06/29/00	12:50	28.7	8.5	1130	0.7	0.59					
07/06/00	9:15	21.5	8.0	824	0.7	0.36					
07/13/00	8:44	23.1	8.1	911	0.7	0.43					
07/20/00	8:25	22.0	6.3	990	0.8	0.63					
07/27/00	13:10	25.4	7.8	1070	1.0	0.49	140	130	220	49	24
08/03/00	8:10	26.5	7.7	971	0.7	0.55					
08/10/00	9:30	23.3	8.2	910	0.8	0.40					
08/17/00	9:15	23.7	7.9	1070	0.5	0.42					
08/24/00	9:07	21.8	8.1	978	0.5	0.44					
08/31/00	10:22	21.1	7.7	1060	<0.4	0.46	150	120	220	49	23
09/07/00	9:30	19.6	7.5	1030	<0.4	0.40					
09/14/00	9:10	22.6	7.0	1030	<0.4	0.40					
09/21/00	9:10	22.2	6.9	1320	0.6	0.59					
09/28/00	12:08	21.3	7.1	1190	0.8	0.46	180	130	231	49	26
Count		52	49	52	52	52	6	6	6	6	6
Min		6.1	6.3	295	<0.4	0.13	94	97	180	38	20
Max		28.7	8.5	2560	1.6	1.2	180	150	270	56	31
Mean		17.5	7.6	1317	0.7	0.62	151	128	225	48	25
Geo Mean		16.4	7.6	1211	0.6	0.56	147	127	224	48	25
Median		18.4	7.7	1190	0.7	0.56	155	130	225	49	25

San Joaquin River at Hills Ferry (STC512)

WY 1999

Location: Latitude 37 20 33, Longitude 121 58 38. In NE 1/4, SE 1/4, NE 1/4, Sec. 9, T.7S, R.9E. West bank, 0.9 mi. SE of Hills Ferry Road nr abandoned tallow factory, upstream of Merced River inflow, 3.3 mi. NE of Newman. River Mile 118.1.

Date	Time	Temp C	pH	EC umhos/cm	Se	Mo	Cr	Cu ug/L	Ni	Pb	Zn	B	Cl	SO4	HDNS	Ca	Mg	TSS mg/L	TDS	CO3	HCO3	Tot. Alk.	Na	K
10/01/98	10:25	21.1	7.7	830	2.1							0.24						87						
10/08/98	12:10	21.1	7.5	728	1.9							0.54						NA						
10/15/98	11:05	17.8	8.5	790	2.6							0.61						NA						
10/22/98	12:00	20.0	7.5	1290	3.5							0.99						NA						
10/29/98	15:30	18.3	NA	795	2.8	3.0	3.5	3.4	5.5	<5	9.9	0.74	87	130	180	39	19	NA	490	<1	130	110	75	6.1
11/05/98	12:55	16.1	7.8	797	1.9							0.61						74						
11/12/98	11:00	12.8	8.0	1312	3.1							1.0						58						
11/19/98	10:29	13.3	8.2	1480	3.0							1.1						89						
11/24/98	12:10	15.6	8.1	1350	2.0	7.1						1.0						96						
12/03/98	12:25	14.4	NA	746	1.3							0.60						76						
12/09/98	14:30	11.1	7.2	568	1.0							0.44						88						
12/17/98	10:32	9.4	7.7	591	0.9							0.42						52						
12/22/98	11:20	6.1	8.2	1090	2.1							0.83						33						
12/30/98	13:45	8.9	7.8	1667	3.5	8.7						1.2						41						
01/07/99	13:20	7.6	7.9	1820	3.2							1.4						30						
01/14/99	10:30	6.1	7.9	1715	2.9							1.3						31						
01/21/99	12:15	13.7	7.9	1530	2.8							1.2						100						
01/27/99	17:40	9.4	8.1	1225	2.3	5.6	2.7	4.1	5.1	<5	NA	0.95	150	200	260	54	31	54	760	<1	180	150	130	6.5
02/04/99	11:00	11.0	7.8	1672	3.0							1.2						80						
02/10/99	17:15	10.7	7.9	793	2.6							0.55						120						
02/18/99	10:50	12.6	7.7	1268	4.5							0.97						86						
02/25/99	12:10	13.6	7.9	1162	4.2	6.4						0.87						84						
03/04/99	11:20	13.6	7.8	1630	5.2							1.2						90						
03/11/99	12:25	13.3	8.0	1773	6.5							1.5						72						
03/18/99	12:05	16.0	8.1	1980	6.4							1.6						88						
03/25/99	12:45	18.0	7.9	1787	5.2	8.2						1.6						100						
03/30/99	16:10	16.4	7.9	2110	6.3							1.7						96						
04/08/99	13:20	12.1	6.9	2270	9.5							1.7						73						
04/15/99	12:20	22.2	7.2	1238	3.5							0.88						90						
04/22/99	13:05	18.3	7.3	1440	4.5							0.96						68						
04/29/99	11:50	15.2	7.6	2160	8.1	9.6	2.5	3.6	<5	<5	7.6	1.4	330	400	400	82	47	66	1300	<1	170	140	300	7.1
05/06/99	11:25	20.6	7.6	1366	4.3							0.94						100						
05/13/99	11:30	19.6	8.1	1679	6.2							1.2						75						
05/20/99	12:35	22.6	7.3	2340	7.7							1.8						100						
05/27/99	12:55	26.4	7.2	1962	6.9	12						1.5						170						
06/03/99	12:53	20.4	7.5	2170	6.8							1.7						120						
06/10/99	11:57	22.1	8.1	2050	8.4							1.9						160						
06/17/99	12:15	27.2	8.0	2350	10.7							2.3						170						
06/24/99	10:45	26.5	7.3	2080	9.5	12						1.9						160						
07/01/99	8:30	25.9	7.8	2270	9.3							2.2						140						
07/08/99	12:40	26.9	8.5	2020	11.1							2.1						160						
07/15/99	10:07	25.4	8.2	1870	7.5							1.9						160						
07/29/99	11:45	24.2	8.2	1650	5.5	11	5.9	7.1	8.7	<5	15	1.6	210	390	340	77	37	130	1000	<1	180	150	230	8.4
08/05/99	11:40	26.0	8.1	1700	8.4							1.9						120						
08/12/99	11:30	24.2	8.1	1580	5.2							1.4						130						
08/19/99	10:43	23.4	7.5	1710	6.5							1.7						100						
08/26/99	9:15	24.4	8.0	1730	6.0	9.9						1.6						110						
09/02/99	9:25	20.1	7.4	1460	6.7							1.3						140						
09/09/99	13:30	26.2	8.2	1590	7.2							1.4						130						
09/16/99	12:05	23.2	6.9	1480	5.5							1.3						140						
09/23/99	12:30	26.1	7.7	1560	4.5							1.3						88						
09/30/99	11:15	22.5	6.9	1350	3.0	8.1						0.99						140						
Count		52	50	52	52	12	4	4	4	4	3	52	4	4	4	4	4	48	4	4	4	4	4	4
Min		6.1	6.9	568	0.9	3.0	2.5	3.4	<5	<5	7.6	0.24	87	130	180	39	19	30	490	<1	130	110	75	6.1
Max		27.2	8.5	2350	11.1	12	5.9	7.1	8.7	<5	15	2.3	330	400	400	82	47	170	1300	<1	180	150	300	8.4
Mean		18.1	7.8	1530	5.0	8.4	3.7	4.6	5.5	2.5	11	1.25	194	280	295	63	34	99	888	0.5	165	138	184	7.0
Geo Mean		16.9	7.8	1442	4.2	7.9	3.4	4.3	5.0	2.5	10	1.1	173	252	282	60	32	92	834	0.5	164	136	161	7.0
Median		18.3	7.8	1585	4.5	8.4	3.1	3.9	5.3	2.5	9.9	1.25	180	295	300	65.5	34	93	880	0.5	175	145	180	6.8

San Joaquin River at Crows Landing (STC504)

WY 1999

Location: Latitude 37 25 55, Longitude 121 04 42. T.6S, R.8E. West bank, 100 yards S of Crows Landing Road Bridge, 4.2 miles NE of Crows Landing, River Mile 107.1

Date	Time	Temp C	pH	EC umhos/cm	Se	Diss.Se	Mo	Cr	Cu ug/L	Ni	Pb	Zn	B	Cl	SO4	HDNS	Ca	Mg	TSS mg/L	TDS	CO3	HCO3	Tot. Alk.	Na	K
10/01/98	10:50	20.6	8.0	372	0.9	NA	0.7						0.14						50						
10/08/98	12:35	18.9	7.5	313	0.7	0.7							0.19						50						
10/15/98	12:20	20.0	7.6	359	0.8	0.6							0.21						44						
10/22/98	12:30	19.4	7.7	786	1.6	3.1							0.45						40						
10/28/98	12:50	17.8	NA	592	2.5	2.5	3.0	2.7	2.9	<5	<5	7.4	0.47	60	87	140	32	14	57	360	<1	110	90	55	4.4
11/05/98	13:20	15.6	7.8	626	1.6	1.5							0.41						49						
11/12/98	11:43	13.9	7.8	922	2.0	1.9							0.60						34						
11/19/98	11:00	13.3	8.1	1050	1.7	1.9							0.67						39						
11/24/98	10:35	15.0	8.0	1020	1.3	1.6	5.1						0.67						32						
12/03/98	12:50	14.4	NA	869	1.4	1.3							0.63						52						
12/09/98	15:00	11.1	NA	481	0.9	0.9							0.43						56						
12/17/98	10:50	10.0	7.7	482	0.7	0.6							0.31						50						
12/22/98	10:00	6.7	7.7	778	1.4	1.3							0.52						26						
12/30/98	12:55	8.9	7.8	998	1.6	1.9	4.8						0.64						24						
01/06/99	16:30	8.2	7.8	1080	1.6	1.7							0.72						20						
01/14/99	9:45	6.7	7.9	1001	1.8	1.8							0.68						15						
01/21/99	12:50	13.4	7.9	940	1.3	1.4							0.68						49						
01/28/99	14:00	10.0	7.9	678	1.0	1.2	3.2	1.9	3.2	<5	<5	NA	0.47	74	100	145	31	17	43	400	<1	92	75	74	3.7
02/04/99	11:40	12.3	8.1	1045	2.1	2.1							0.72						51						
02/10/99	16:45	11.1	7.8	539	1.4	1.2							0.33						100						
02/18/99	10:15	11.8	7.7	637	2.0	2.0							0.45						54						
02/25/99	12:35	13.0	7.9	614	2.2	2.0	3.5						0.43						55						
03/04/99	11:46	13.5	8.1	958	2.7	2.9							0.64						79						
03/11/99	12:45	13.1	8.2	850	2.8	2.8							0.66						40						
03/18/99	12:35	15.6	8.1	1170	3.4	3.6							0.83						53						
03/25/99	13:10	17.8	7.9	1291	3.6	3.3	5.8						1.0						78						
03/30/99	16:30	16.7	7.6	1440	4.0	4.0							1.1						56						
04/08/99	13:50	12.4	7.7	1382	4.3	4.1							0.91						47						
04/15/99	12:45	20.3	8.0	609	1.5	2.1							0.41						81						
04/22/99	13:45	17.6	7.9	550	1.2	1.2							0.33						63						
04/29/99	12:30	14.7	8.0	669	2.0	2.1	2.7	2.5	4.0	<5	<5	12	0.39	81	99	130	29	15	84	390	<1	74	61	76	3.0
05/06/99	13:15	19.9	8.2	544	1.6	1.6							0.32						53						
05/13/99	12:12	18.2	8.4	610	1.9	1.6							0.39						48						
05/20/99	14:25	22.2	7.6	1197	2.8	3.4							0.78						49						
05/27/99	13:37	25.8	7.9	1175	3.7	3.7	6.3						0.83						50						
06/03/99	13:12	19.9	7.8	1340	3.6	3.7							0.94						68						
06/10/99	12:30	21.5	8.0	1210	4.0	4.1							0.93						83						
06/17/99	13:07	25.9	7.6	1420	6.0	5.6							1.2						60						
06/24/99	12:00	27.4	7.9	1320	4.5	4.5	6.4						1.0						59						
07/01/99	8:00	25.6	7.7	1460	4.3	4.3							1.2						88						
07/08/99	13:55	26.7	8.3	1270	5.1	5.0							1.1						76						
07/15/99	9:45	25.6	8.1	1430	5.1	5.2							1.2						76						
07/22/99	12:20	24.4	8.2	1200	3.7	3.6							1.1						62						
07/29/99	12:15	23.3	8.0	1320	4.2	4.3	7.5	4.5	5.5	7.7	<5	9.7	1.2	150	240	290	64	32	83	760	<1	180	150	180	7.3
08/05/99	13:20	26.1	8.1	1180	4.8	5.0							1.1						80						
08/12/99	12:50	23.7	7.9	1250	3.5	3.3							0.98						78						
08/19/99	12:45	25.0	8.0	1300	4.2	4.1							1.0						56						
08/26/99	9:35	24.8	8.1	1310	3.4	3.2	7.4						1.0						72						
09/02/99	8:40	19.5	7.2	1130	5.1	4.7							0.84						56						
09/09/99	13:55	24.9	7.0	1230	4.2	4.2							0.90						43						
09/16/99	12:40	24.4	7.7	1160	2.6	2.7							0.86						75						
09/23/99	13:30	25.0	7.9	1140	2.4	2.3							0.73						50						
09/30/99	12:30	22.6	7.6	1030	1.8	1.8	5.8						0.64						70						
Count		53	50	53	53	52	13	4	4	4	4	3	53	4	4	4	4	4	53	4	4	4	4	4	4
Min		6.7	7.0	313	0.7	0.6	0.7	1.9	2.9	<5	<5	7.4	0.14	60	87	130	29	14	15	360	<1	74	61	55	3.0
Max		27.4	8.4	1460	6.0	5.6	7.5	4.5	5.5	7.7	<5	12	1.2	150	240	290	64	32	100	760	<1	180	150	180	7.3
Mean		18.0	7.9	968	2.6	2.7	4.8	2.9	3.9	3.8	2.5	9.7	0.70	91	132	176	39	20	57	478	0.5	114	94	96	4.6
Geo Mean		17.0	7.9	903	2.3	2.3	4.2	2.8	3.8	3.3	2.5	9.5	0.63	86	120	166	37	18	53	455	0.5	108	89	86	4.3
Median		18.2	7.9	1030	2.2	2.4	5.08	2.6	3.6	2.5	2.5	9.7	0.68	77.5	99.5	142.5	31.5	16	54	395	0.5	101	82.5	75	4.05

San Joaquin River at Crows Landing (STC504)

WY 2000

Location: Latitude 37 25 55, Longitude 121 04 42. T.6S, R.8E. West bank, 100 yards S of Crows Landing Road Bridge, 4.2 miles NE of Crows Landing, River Mile 107.1

Date	Time	Temp C	pH	EC umhos/cm	Se	Mo	Cr	Cu ug/L	Ni	Pb	Zn	B	Cl	SO4	HDNS	Ca	Mg	TSS mg/L	TDS	CO3	HCO3	Tot. Alk.	Na	K
10/07/99	9:05	18.5	7.3	1070	2.3							0.78												
10/14/99	12:55	22.0	7.6	1270	2.1							0.93												
10/21/99	13:10	18.6	7.9	607	0.8							0.42												
10/28/99	9:20	17.3	7.7	888	1.2	4.3	2.8	3.8	5.0	<5	7.3	0.56	110	120	190	42	21	NA	NA	<1	150	130	110	5.3
11/04/99	13:25	19.2	7.1	961	1.6							0.66												
11/11/99	12:25	17.0	7.3	1010	1.7							0.70												
11/18/99	9:35	14.0	7.9	1150	2.0							0.82												
11/23/99	9:00	10.0	7.6	1220	1.4	5.7						0.78												
12/02/99	13:25	12.0	7.6	1260	1.7							0.90												
12/09/99	11:10	9.2	7.9	1290	1.7							0.83												
12/16/99	8:50	7.1	7.7	1370	2.3							0.89												
12/21/99	10:20	8.6	7.7	1420	2.6							0.91												
12/28/99	8:30	7.4	7.8	1510	3.0	5.7						0.89												
01/06/00	9:00	7.0	7.7	1480	2.1							0.91												
01/13/00	12:55	11.5	8.0	1540	2.1							0.99												
01/20/00	11:35	13.6	7.1	1320	2.2							0.84												
01/27/00	13:40	13.2	7.4	1060	1.8	5.5	4.0	5.8	6.7	<5	12	0.68	140	150	210	45	25	NA	630	<1	170	140	140	8.6
02/03/00	12:20	14.0	7.0	1490	2.0							0.72												
02/10/00	9:10	14.1	7.7	1690	4.6							1.4												
02/17/00	11:55	13.7	7.0	320	0.8							0.22												
02/23/00	NA	NA	NA	492	1.4	2.5						0.37												
03/02/00	10:30	12.5	7.6	421	1.3							0.31												
03/09/00	9:15	11.2	7.6	446	1.5							0.29												
03/16/00	8:30	15.2	NA	498	1.2							0.34												
03/23/00	10:26	15.7	8.0	695	2.2							0.52												
03/30/00	11:45	17.3	7.5	1260	3.6	5.9	2.6	3.8	<5	<5	5.1	0.90												
04/06/00	10:00	15.3	7.8	1380	3.3		1.8	2.9	<5	<5	2.7	0.95												
04/13/00	12:20	21.5	7.7	1510	3.2		1.2	3.0	<5	<5	<2	0.99												
04/20/00	9:00	16.2	8.0	679	2.8		3.0	5.5	5.2	<5	9.1	0.43												
04/27/00	13:00	20.9	NA	503	1.7	2.5	1.7	3.1	<5	<5	3.3	0.30	58	83	110	25	12	NA	280	<1	73	60	52	2.6
05/04/00	13:00	26.6	7.8	777	2.5		2.9	3.9	<5	<5	4.9	0.51												
05/11/00	12:27	17.6	7.8	775	2.9		2.7	4.2	<5	<5	5.6	0.50												
05/18/00	11:53	22.6	7.3	946	2.1		2.4	4.0	<5	<5	14	0.56												
05/25/00	12:10	24.0	7.7	1060	1.6	4.8	2.5	3.2	<5	<5	5.5	0.65												
06/01/00	9:15	20.6	7.6	1270	3.9		2.6	2.8	<5	<5	3.7	0.89												
06/08/00	12:41	21.8	7.8	1180	3.9		2.9	4.2	<5	<5	6.6	0.92												
06/15/00	8:40	26.4	7.8	1230	4.1		2.7	4.1	<5	<5	5.1	0.94												
06/22/00	11:50	28.2	7.9	1170	3.5		2.7	4.3	<5	<5	6.0	0.91												
06/29/00	9:45	25.7	8.1	1250	3.4	8.5	3.1	4.0	<5	<5	6.7	1.1												
07/06/00	8:40	21.3	8.0	1040	3.4							0.91												
07/13/00	11:30	24.0	9.5	1120	3.6							0.94												
07/20/00	12:35	25.6	6.9	1160	3.6							0.98												
07/27/00	12:00	24.4	6.6	1220	4.9	5.3	3.3	3.9	5.2	<5	NA	0.98	140	200	280	62	30	NA	770	<1	180	150	150	6.8
08/03/00	10:24	28.3	8.0	1140	3.3							0.99												
08/10/00	10:20	22.9	8.0	1070	3.1							0.90												
08/17/00	13:30	26.8	8.2	1160	2.2							0.90												
08/24/00	11:15	23.7	8.1	1050	2.7							0.77												
08/31/00	9:28	20.1	6.8	1080	3.4	5.6	2.5	2.9	<5	<5	3.2	0.86	120	180	240	56	25	NA	650	<1	160	130	120	5.7
09/07/00	8:40	19.0	7.1	1070	3.3							0.84												
09/14/00	12:15	24.2	7.8	844	1.6							0.49												
09/21/00	8:20	22.6	7.1	1040	2.8							0.65												
09/28/00	11:12	21.1	5.8	916	2.1	4.9	3.3	4.1	<5	<5	5.5	0.56	100	120	210	46	23	NA	560	<1	160	130	110	5.7
Count		51	49	52	52	12	19	19	19	19	18	52	6	6	6	6	6	0	5	6	6	6	6	6
Min		7.0	5.8	320	0.8	2.5	1.2	2.8	<5	<5	2.7	0.22	58	83	110	25	12	280	<1	73	60	52	2.6	
Max		28.3	9.5	1690	4.9	8.5	4.0	5.8	6.7	<5	14	1.4	140	200	280	62	30	770	<1	180	150	150	8.6	
Mean		18.3	7.6	1065	2.5	5.1	2.7	3.9	3.1	2.5	6.0	0.75	111	142	207	46	23	578	0.5	149	123	114	5.8	
Geo Mean		17.2	7.6	1005	2.3	4.8	2.6	3.8	2.9	2.5	5.2	0.70	107	136	199	44	22	548	0.5	143	118	108	5.4	
Median		18.6	7.7	1102	2.2	5.43	2.7	3.9	2.5	2.5	5.5	0.835	115	135	210	45.5	24	630	0.5	160	130	115	5.7	

San Joaquin River at Las Palmas Launching Facility (Patterson) (STC507) WY 1999

Location: Latitude 37 29 52, Longitude 121 04 54. In SW 1/4, NW 1/4, SW 1/4, Sec.15, T.5S, R.8E. West bank, 0.3 miles N of Patterson Bridge at NE corner of Las Palmas Launching Facility parking lot, 3.2 miles NE of Patterson, River Mile 98.6.

Date	Time	Temp C	pH	EC umhos/cm	Se ug/L	B	Cl	SO4	HDNS	Ca	Mg	TSS
10/08/98	13:10	20.6	7.6	356	0.6	0.19						NA
10/15/98	13:30	17.8	8.0	382	0.9	0.21						NA
10/22/98	12:55	18.9	7.6	855	1.7	0.46						NA
10/28/98	12:25	18.3	NA	648	2.1	0.42	65	91	150	34	15	NA
11/05/98	13:52	15.6	7.6	667	1.5	0.41						49
11/11/98	16:39	14.4	7.6	915	1.7	0.55						30
11/19/98	11:22	14.4	8.0	1100	1.8	0.69						NA
11/24/98	10:12	15.0	7.9	1090	1.3	0.67						NA
12/03/98	13:05	15.0	NA	922	1.2	0.63						36
12/09/98	10:00	11.1	NA	506	0.9	0.37						57
12/16/98	16:40	11.7	7.7	488	0.7	0.30						45
12/22/98	9:30	6.7	7.6	792	1.3	0.49						26
12/30/98	12:35	9.4	7.7	1053	1.6	0.63						24
01/06/99	15:35	9.3	7.7	1140	1.8	0.72						17
01/14/99	9:20	6.7	7.8	1028	1.6	0.65						15
01/21/99	13:15	13.6	7.9	980	1.4	0.68						49
01/28/99	14:15	9.8	8.0	655	1.0	0.44	76	100	140	NA	NA	34
02/04/99	12:10	11.3	8.0	1079	2.2	0.70						42
02/10/99	16:25	11.1	7.5	604	1.5	0.37						110
02/18/99	9:42	12.1	7.5	645	1.9	0.45						50
02/25/99	13:00	13.2	7.8	614	2.1	0.42						52
03/04/99	12:15	14.1	8.0	963	2.6	0.64						61
03/11/99	13:15	13.4	7.9	935	3.1	0.69						44
03/18/99	13:25	15.7	8.0	1100	3.2	0.82						47
03/25/99	13:30	18.0	7.7	1283	3.5	0.97						86
03/30/99	13:39	17.1	7.4	1389	4.0	1.0						45
04/08/99	14:10	12.6	7.9	1392	4.0	0.85						63
04/15/99	13:10	19.8	7.9	630	1.4	0.40						59
04/22/99	14:05	18.1	9.8	556	1.3	0.32						74
04/29/99	13:00	15.4	8.0	758	1.8	0.43	96	130	175	35	21	70
05/06/99	13:52	20.3	8.1	591	1.7	0.34						55
05/13/99	12:30	19.2	8.1	716	2.1	0.43						44
05/20/99	14:45	22.3	7.4	1170	2.9	0.70						41
05/27/99	14:00	25.5	7.8	1118	2.5	0.72						50
06/03/99	13:35	20.8	7.8	1330	2.9	0.91						58
06/10/99	12:50	22.6	8.1	1310	3.6	0.89						75
06/17/99	13:30	26.3	8.0	1320	4.2	0.97						70
06/24/99	12:50	27.7	6.6	1440	4.9	1.00						78
07/01/99	7:30	25.2	7.2	1290	3.6	0.97						100
07/08/99	15:35	27.6	8.4	1430	4.3	1.1						64
07/15/99	9:15	26.4	8.0	1360	3.9	0.99						100
07/22/99	13:00	26.4	8.1	1120	2.9	0.84						64
07/29/99	12:40	23.7	8.1	1210	3.4	0.87	140	200	260	59	28	85
08/05/99	13:40	26.5	8.1	1220	3.8	1.0						75
08/12/99	13:15	25.0	8.1	1270	3.2	0.87						54
08/19/99	13:32	25.1	8.0	1190	2.5	0.85						37
08/26/99	9:55	24.9	8.0	1220	2.8	0.86						63
09/02/99	8:13	19.5	6.9	1130	3.7	0.74						58
09/09/99	14:15	25.2	7.9	1320	2.8	0.86						51
09/16/99	13:15	23.5	7.8	1160	2.1	0.71						60
09/23/99	13:55	25.1	8.0	1210	2.0	0.68						43
09/30/99	13:35	23.6	7.5	1140	1.9	0.64						44

Count	52	49	52	52	52		4	4	4	3	3	46
Min	6.7	6.6	356	0.6	0.19	65	91	140	34	15	15	15
Max	27.7	9.8	1440	4.9	1.1	140	200	260	59	28	110	110
Mean	18.3	7.8	996	2.4	0.66	94	130	181	43	21	56	56
Geo Mean	17.2	7.8	942	2.1	0.62	90	124	176	41	21	51	51
Median	18.2	7.9	1095	2.1	0.69	86	115	162.5	35	21	53	53

San Joaquin River at Las Palmas Launching Facility (Patterson) (STC507) WY 200

Location: Latitude 37 29 52, Longitude 121 04 54. In SW 1/4, NW 1/4, SW 1/4, Sec.15, T.5S, R.8E. West bank, 0.3 miles N of Patterson Bridge at NE corner of Las Palmas Launching Facility parking lot, 3.2 miles NE of Patterson, River Mile 98.6.

Date	Time	Temp C	pH	EC umhos/cm	Se ug/L	B	Cl	SO4	HDNS	Ca	Mg	TSS
10/07/99	8:40	18.4	6.9	1060	2.1	0.68						
10/14/99	13:20	22.3	7.7	1200	1.8	0.80						
10/21/99	13:30	19.3	7.8	786	1.1	0.50						
10/28/99	9:00	17.3	7.7	878	1.4	0.50	100	110	190	42	20	NA
11/04/99	13:45	17.9	7.7	1020	1.6	0.61						
11/11/99	13:00	17.5	7.5	1030	1.8	0.66						
11/18/99	9:15	13.7	7.8	1130	2.0	0.73						
11/23/99	8:40	9.9	7.6	1210	1.3	0.71						
12/02/99	13:45	12.5	7.6	1260	1.5	0.82						
12/09/99	11:35	9.7	7.8	1260	1.5	0.74						
12/16/99	8:30	6.8	7.6	1390	2.3	0.80						
12/21/99	9:45	8.8	7.5	1410	2.4	0.88						
12/28/99	8:11	7.3	7.6	1540	2.8	0.88						
01/06/00	8:35	6.9	7.7	1460	2.1	0.87						
01/13/00	13:15	12.0	7.8	1430	1.6	0.84						
01/20/00	12:45	13.8	7.7	1220	2.1	0.75						
01/27/00	13:55	13.4	7.7	1040	1.8	0.65	130	140	210	43	24	NA
02/03/00	13:05	13.8	7.7	1450	1.8	1.10						
02/10/00	8:52	14.0	7.6	1690	3.7	1.3						
02/17/00	12:20	13.4	7.4	330	0.9	0.22						
02/24/00	9:31	10.6	7.6	518	1.4	0.36						
03/02/00	11:45	12.5	7.5	421	1.3	0.28						
03/09/00	8:45	11.1	7.5	448	1.3	0.28						
03/16/00	9:00	16.7	NA	530	1.3	0.33						
03/23/00	10:50	15.7	8.0	679	2.0	0.48						
03/30/00	12:10	16.6	7.8	1170	3.0	0.8						
04/06/00	8:40	17.3	7.7	1270	2.8	0.86						
04/13/00	12:40	21.2	7.9	1430	3.4	0.89						
04/20/00	8:45	16.6	7.8	898	3.3	0.59						
04/27/00	15:22	20.5	NA	553	1.6	0.31	57	120	130	29	14	NA
05/04/00	14:15	23.0	7.8	855	2.3	0.51						
05/11/00	12:45	18.0	7.7	782	2.6	0.48						
05/18/00	12:15	21.2	7.6	1010	2.0	0.56						
05/25/00	12:40	24.1	7.7	1180	1.7	0.67						
06/01/00	9:35	21.4	7.8	1360	3.2	0.86						
06/08/00	13:00	21.7	7.8	1250	4.1	0.90						
06/15/00	8:00	26.4	7.7	1210	4.3	0.86						
06/22/00	12:10	28.5	8.1	1180	3.1	0.83						
06/29/00	9:15	25.7	7.9	1350	3.2	1.1						
07/06/00	8:15	21.5	7.9	1060	3.2	0.84						
07/13/00	12:24	24.9	8.2	1200	3.6	0.91						
07/20/00	13:00	26.2	7.9	1300	3.0	0.92						
07/27/00	11:05	23.5	7.7	1180	4.0	0.87	130	190	270	59	29	NA
08/03/00	11:35	28.0	8.1	1100	2.9	0.9						
08/10/00	10:45	23.5	8.0	1070	2.7	0.77						
08/17/00	13:55	27.5	8.2	1100	1.8	0.75						
08/24/00	11:45	23.7	8.0	1080	2.4	0.74						
08/31/00	8:58	20.1	7.5	1120	2.8	0.76	120	170	250	57	26	NA
09/07/00	8:05	19.6	7.4	1050	2.7	0.72						
09/14/00	12:35	25.2	7.9	982	1.4	0.51						
09/21/00	7:50	22.2	6.7	1070	2.2	0.56						
09/28/00	10:45	21.3	7.3	1020	1.8	0.52	120	130	230	51	24	NA

Count	52	50	52	52	52	6	6	6	6	6	6	0
Min	6.8	6.7	330	0.9	0.22	57	110	130	29	14	14	14
Max	28.5	8.2	1690	4.3	1.3	130	190	270	59	29	29	29
Mean	18.2	7.7	1080	2.3	0.71	110	143	213	47	23	23	23
Geo Mean	17.1	7.7	1030	2.2	0.67	106	141	208	46	22	22	22
Median	18.2	7.7	1110	2.1	0.75	120	135	220	47	24	24	24

San Joaquin River at Maze Blvd. (State Highway 132) (STC510) WY 1999

Location: Latitude 37 38 31, Longitude 121 13 40. In SW 1/4, NW 1/4, SW 1/4, Sec.29, T.3S, R.7E.

West bank, 400 feet S of Maze Blvd. Bridge, upstream of Blewett Drain, River Mile 77.2.

Date	Time	Temp C	pH	EC umhos/cm	Se ug/L	B	Cl	SO4	HDNS	Ca	Mg
						← mg/L →					
10/08/98	14:40	21.1	7.7	296	0.5	0.13					
10/15/98	14:50	18.9	8.2	310	0.5	0.15					
10/22/98	14:10	20.6	7.8	676	1.3	0.32					
10/28/98	10:35	18.3	NA	519	1.1	0.28	55	63	120	28	13
11/05/98	14:50	15.6	7.8	515	0.9	0.28					
11/11/98	16:00	13.3	7.7	786	1.0	0.4					
11/19/98	11:53	14.4	7.3	928	1.1	0.41					
11/24/98	9:40	15.0	7.6	902	0.8	0.49					
12/03/98	14:20	14.4	NA	711	0.9	0.41					
12/09/98	9:15	11.1	NA	396	0.6	0.24					
12/16/98	16:10	11.7	7.6	348	<0.4	0.17					
12/22/98	8:30	8.3	7.9	372	0.6	0.21					
12/30/98	11:45	10.0	7.7	720	1.0	0.39					
01/06/99	14:57	9.7	7.5	794	0.9	0.42					
01/14/99	8:45	7.8	7.6	864	1.2	0.47					
01/21/99	14:30	14.1	7.8	688	0.8	0.38					
01/28/99	16:00	10.3	7.9	310	<0.4	0.18	66	81	71	NA	NA
02/04/99	13:00	11.1	8.3	493	0.9	0.28					
02/10/99	15:50	11.2	7.3	377	0.7	0.21					
02/18/99	9:00	11.6	7.7	251	0.5	0.14					
02/25/99	13:35	12.5	7.8	271	0.8	0.16					
03/04/99	13:05	12.7	8.2	404	0.9	0.22					
03/11/99	14:10	12.8	8.3	340	0.8	0.21					
03/18/99	14:15	15.1	8.3	439	1.0	0.29					
03/25/99	14:15	16.1	8.2	554	1.3	0.37					
03/31/99	15:55	13.7	8.2	NA	1.5	0.43					
04/08/99	15:20	11.4	8.2	573	1.4	0.32					
04/15/99	14:20	20.2	8.0	381	0.6	0.21					
04/22/99	14:50	18.1	7.7	356	0.9	0.18					
04/29/99	14:35	15.2	8.2	296	0.6	0.14	29	33	65	14	7.4
05/06/99	14:25	19.0	8.3	283	0.6	0.15					
05/13/99	13:00	17.6	8.4	310	0.8	0.16					
05/20/99	15:30	20.7	7.9	838	1.7	0.44					
05/27/99	15:10	26.2	8.3	772	1.2	0.41					
06/03/99	14:35	21.2	7.8	845	1.4	0.47					
06/10/99	13:55	23.4	8.1	853	1.6	0.49					
06/17/99	14:00	25.8	8.1	820	1.8	0.49					
06/24/99	13:40	27.9	8.1	936	2.5	0.50					
07/01/99	6:55	25.2	7.1	811	1.7	0.51					
07/08/99	16:15	26.2	8.6	822	2.0	0.51					
07/15/99	8:35	24.7	7.7	833	1.7	0.47					
07/22/99	13:55	25.1	8.2	761	1.6	0.48					
07/29/99	13:40	24.6	8.0	747	1.6	0.48	83	97	180	38	20
08/05/99	14:10	25.5	8.1	794	1.9	0.56					
08/12/99	13:50	25.3	7.5	804	1.8	0.48					
08/19/99	14:15	25.5	8.1	800	1.2	0.47					
08/26/99	11:00	25.6	7.2	818	1.6	0.49					
09/02/99	7:34	19.4	6.9	800	2.3	0.48					
09/09/99	14:45	23.9	8.2	758	1.3	0.41					
09/16/99	14:25	24.2	7.9	698	1.0	0.35					
09/23/99	15:00	25.3	8.2	725	0.9	0.36					
09/30/99	14:35	24.0	7.7	752	1.1	0.36					
Count		52	49	51	52	52	4	4	4	3	3
Min		7.8	6.9	251	<0.4	0.13	29	33	65	14	7.4
Max		27.9	8.6	936	2.5	0.56	83	97	180	38	20
Mean		18.1	7.9	617	1.1	0.35	58	69	109	27	13
Geo Mean		17.1	7.9	571	1.0	0.32	54	64	100	25	12
Median		18.2	7.9	711	1.0	0.375	60.5	72	95.5	28	13

San Joaquin River at Maze Blvd. (State Highway 132) (STC510) WY 2000

Location: Latitude 37 38 31, Longitude 121 13 40. In SW 1/4, NW 1/4, SW 1/4, Sec.29, T.3S, R.7E.

West bank, 400 feet S of Maze Blvd. Bridge, upstream of Blewett Drain, River Mile 77.2.

Date	Time	Temp C	pH	EC umhos/cm	Se ug/L	B	Cl	SO4	HDNS	Ca	Mg
						← mg/L →					
10/07/99	8:05	18.1	8.4	625	1.0	0.35					
10/14/99	14:00	22.5	7.7	741	0.9	0.43					
10/21/99	14:30	19.6	7.9	534	0.7	0.30					
10/28/99	8:05	16.8	7.8	690	0.6	0.35	77	77	160	35	17
11/04/99	15:00	18.6	8.0	716	1.1	0.39					
11/11/99	15:05	17.4	7.5	843	1.3	0.48					
11/18/99	8:45	13.6	7.6	898	1.2	0.53					
11/23/99	8:10	10.2	7.4	967	<0.4	0.51					
12/02/99	14:45	12.4	7.6	935	1.1	0.54					
12/09/99	12:15	10.1	7.8	972	1.0	0.52					
12/16/99	8:05	7.1	7.7	966	1.2	0.50					
12/21/99	8:55	8.6	6.9	1020	1.5	0.58					
12/28/99	7:50	7.4	7.3	1060	1.7	0.54					
01/06/00	8:00	7.3	7.4	1050	1.3	0.57					
01/13/00	14:08	11.8	7.9	1040	1.0	0.56					
01/20/00	13:40	13.5	7.8	918	1.4	0.50					
01/27/00	14:45	13.8	7.4	817	1.2	0.47	19	21	170	34	20
02/03/00	13:50	13.4	7.8	1050	1.3	1.1					
02/10/00	8:15	13.6	7.4	1270	2.3	0.93					
02/17/00	13:25	13.3	7.6	252	0.7	0.16					
02/24/00	9:00	10.3	7.6	303	0.9	0.18					
03/02/00	12:45	11.9	7.6	258	0.8	0.16					
03/09/00	8:10	10.4	7.4	238	0.7	0.13					
03/16/00	9:35	15.4	NA	290	0.8	0.16					
03/23/00	11:15	15.8	7.0	386	1.2	0.24					
03/30/00	13:05	15.9	8.1	498	1.2	0.32					
04/06/00	8:00	16.1	7.6	746	1.4	0.45					
04/13/00	13:50	21.1	7.9	850	1.3	0.46					
04/20/00	8:05	14.2	7.9	444	1.6	0.26					
04/27/00	15:27	20.3	NA	395	1.0	0.19	44	52	95	21	10
05/04/00	15:20	21.3	7.8	426	1.1	0.22					
05/11/00	13:43	16.6	7.7	384	1.5	0.21					
05/18/00	13:45	21.7	7.6	695	1.2	0.34					
05/25/00	14:00	24.0	7.8	603	0.9	0.29					
06/01/00	10:10	21.8	7.9	859	1.3	0.43					
06/08/00	14:45	21.9	7.3	886	2.2	0.54					
06/15/00	7:30	25.7	7.8	720	2.3	0.44					
06/22/00	13:40	28.7	8.0	856	2.0	0.50					
06/29/00	8:50	24.9	7.3	831	1.8	0.48					
07/06/00	7:30	21.2	7.6	777	1.6	0.49					
07/13/00	13:02	24.7	8.3	727	1.6	0.45					
07/20/00	14:10	26.6	8.5	755	1.5	0.46					
07/27/00	9:45	22.0	7.7	692	2.0	0.45	84	93	160	34	18
08/03/00	12:40	27.0	8.3	635	1.4	0.38					
08/10/00	11:15	23.8	8.1	720	1.4	0.39					
08/17/00	14:30	27.1	8.2	648	1.0	0.35					
08/24/00	12:34	22.6	7.0	406	0.7	0.23					
08/31/00	7:35	18.4	7.5	520	0.7	0.28	62	65	120	26	13
09/07/00	7:35	19.3	7.4	573	0.7	0.31					
09/14/00	13:30	23.8	7.9	561	0.4	0.25					
09/21/00	7:15	21.4	6.8	458	0.5	0.20					
09/28/00	9:45	20.4	7.2	677	1.0	0.31	87	79	160	34	17
Count		52	50	52	52	52	6	6	6	6	6
Min		7.1	6.8	238	<0.4	0.13	19	21	95	21	10
Max		28.7	8.5	1270	2.3	1.1	87	93	170	35	20
Mean		17.8	7.7	696	1.2	0.40	62	65	144	31	16
Geo Mean		16.8	7.7	646	1.1	0.36	55	59	141	30	15
Median		18.3	7.7	718	1.2	0.41	69.5	71	160	34	17

San Joaquin River at Airport Way (SJC501); a.k.a. "Vernalis"

WY 1999

Location: Latitude 37 40 32, Longitude 121 15 51. In SE 1/4, SW 1/4, NW 1/4, Sec.13, T.3S, R.6E. West bank, south of Airport Way Bridge, 3.2 miles NE of Vernalis River Mile 72.3.

Date	Time	Temp C	pH	EC umhos/cm	Se	Mo	Cr	Cu ug/L	Ni	Pb	Zn	B	Cl	SO4	HDNS	Ca	Mg	TSS mg/L	TDS	CO3	HCO3	Tot. Alk.	Na	K
10/08/98	15:05	20.6	7.7	231	0.3							<0.05												
10/15/98	15:10	18.9	7.8	245	0.5							0.11												
10/22/98	14:30	18.9	7.9	433	0.6							0.19												
10/28/98	9:20	16.1	NA	368	0.8	2.44	1.8	2.5	<5	<5	5.7	0.19	38	41	90	21	9.2	NA	220	<1	84	69	31	3.2
11/05/98	15:10	15.6	7.6	418	0.7							0.21												
11/11/98	15:40	14.4	7.7	587	0.7							0.27												
11/19/98	12:10	14.4	7.5	659	0.7							0.32												
11/24/98	9:20	13.9	7.1	653	0.7							0.33												
12/03/98	14:40	15.0	NA	529	0.7							0.28												
12/09/98	8:45	11.1	NA	339	0.5							0.20												
12/16/98	15:40	12.8	7.7	306	<0.4							0.15												
12/22/98	8:15	6.7	7.8	354	0.5							0.19												
12/30/98	11:25	10.0	7.2	530	0.6							0.29												
01/06/99	14:30	9.9	7.8	568	0.6							0.28												
01/14/99	8:30	7.8	7.1	669	0.9							0.35												
01/21/99	14:50	13.2	7.8	489	0.5							0.27												
01/28/99	16:30	10.5	7.9	218	<0.4	<1.0	1.8	4	<5	<5	NA	0.12	20	25	55	12	6.0	53	150	<1	72	59	21	1.9
02/04/99	13:30	11.0	7.7	354	0.6							0.21												
02/10/99	15:30	11.4	7.5	299	0.5							0.15												
02/18/99	8:30	11.9	7.8	206	<0.4							0.11												
02/25/99	13:50	13.1	7.9	214	0.5							0.13												
03/04/99	13:25	12.3	8.1	314	0.6							0.15												
03/11/99	14:30	13.0	8.0	286	0.7							0.17												
03/18/99	14:51	14.5	7.3	355	0.8							0.23												
03/25/99	14:40	15.9	7.9	432	1.0							0.28												
03/31/99	16:15	13.3	8.1	NA	1.1							0.30												
04/08/99	15:50	10.6	8.2	446	1.0							0.24												
04/15/99	14:35	18.6	8.0	321	<0.4							0.17												
04/22/99	15:15	17.9	7.8	293	0.7							0.13												
04/29/99	14:50	15.3	8.1	250	0.5	1.0	2.5	4	<5	<5	12	0.11	27	31	58	12	6.5	53	140	<1	42	34	23	1.7
05/06/99	15:00	19.9	8.2	240	0.4							0.11												
05/13/99	13:30	17.9	8.3	260	0.7							0.12												
05/20/99	15:50	18.8	8.2	494	0.9							0.23												
05/27/99	15:46	24.1	7.7	474	0.7							0.24												
06/03/99	14:56	19.6	8.0	497	0.6							0.25												
06/10/99	14:20	21.5	8.2	482	0.8							0.25												
06/17/99	14:15	23.8	8.2	440	0.8							0.24												
06/24/99	13:57	25.1	8.5	503	1.1							0.26												
07/01/99	6:37	23.3	6.8	547	1.0							0.32												
07/08/99	16:35	25.1	8.5	584	1.2							0.33												
07/15/99	8:25	22.5	6.9	620	1.1							0.33												
07/22/99	14:16	25.2	8.2	564	0.9							0.32												
07/29/99	14:05	24.2	8.0	560	1.1	2.5	3.7	5.5	6.4	<5	9.2	0.35	160	190	140	30	16	77	340	<1	100	83	61	4.0
08/05/99	14:49	24.3	8.0	605	1.3							0.40												
08/12/99	14:10	24.4	7.9	588	1.0							0.33												
08/19/99	14:35	24.8	8.0	589	0.8							0.32												
08/26/99	11:15	27.4	7.9	589	0.9							0.32												
09/02/99	7:10	18.5	6.8	622	1.7							0.36												
09/09/99	15:05	23.5	8.2	621	1.0							0.32												
09/16/99	14:45	23.8	8.0	573	0.7							0.27												
09/23/99	15:15	24.8	8.2	569	0.6							0.27												
09/30/99	15:10	24.3	7.8	590	0.8							0.27												
Count		52	49	51	52	4	4	4	4	4	3	52	4	4	4	4	4	45	4	4	4	4	4	4
Min		6.7	6.8	206	<0.4	<1.0	1.8	2.5	<5	<5	5.7	<0.05	20	25	55	12	6	11	140	<1	42	34	21	1.7
Max		27.4	8.5	669	1.7	2.5	3.7	5.5	6.4	<5	12	0.40	160	190	140	30	16	190	340	<1	100	83	61	4.0
Mean		17.6	7.8	451	0.7	1.6	2.5	4.0	3.5	2.5	9.0	0.24	61	72	86	19	9	55	213	0.5	75	61	34	2.7
Geo Mean		16.7	7.8	426	0.7	1.3	2.3	3.9	3.2	2.5	8.6	0.22	43	50	80	17	9	49	199	0.5	71	58	31	2.5
Median		17.9	7.9	482	0.7	1.7	2.2	4.0	2.5	2.5	9.2	0.25	32.5	36	74	16.5	7.85	48	185	0.5	78	64	27	2.55

San Joaquin River at Airport Way (SJC501); a.k.a. "Vernalis"

WY 2000

Location: Latitude 37 40 32, Longitude 121 15 51. In SE 1/4, SW 1/4, NW 1/4, Sec.13, T.3S, R.6E. West bank, south of Airport Way Bridge, 3.2 miles NE of Vernalis River Mile 72.3.

Date	Time	Temp C	pH	EC umhos/cm	Se	Mo	Cr	Cu ug/L	Ni	Pb	Zn	B	Cl	SO4	HDNS	Ca	Mg	TSS mg/L	TDS	CO3	HCO3	Tot. Alk.	Na	K
10/07/99	7:45	17.6	7.5	549	0.8							0.29												
10/14/99	14:40	22.1	7.7	570	0.7							0.32												
10/21/99	14:57	19.9	7.8	476	0.6							0.25												
10/28/99	7:50	16.5	7.8	591	<0.4	2.3	2.3	3.0	<5	<5	7.2	0.28	65	62	140	31	15	NA	NA	<1	130	100	64	3.8
11/04/99	15:15	18.4	7.9	620	0.9							0.32												
11/11/99	15:40	17.8	7.5	710	1.0							0.39												
11/18/99	8:35	12.9	7.0	747	1.0							0.42												
11/23/99	7:50	9.9	6.8	816	1.0							0.42												
12/02/99	15:15	13.4	7.6	788	0.8							0.44												
12/09/99	12:38	10.3	7.7	821	0.9							0.42												
12/16/99	7:45	6.6	7.9	831	0.9							0.42												
12/21/99	9:10	8.8	6.8	858	1.3							0.46												
12/28/99	7:30	7.5	7.1	885	1.5							0.44												
01/06/00	7:45	6.9	6.7	884	1.1							0.46												
01/13/00	14:25	11.4	7.9	843	0.8							0.43												
01/20/00	14:00	13.3	7.7	776	1.3							0.43												
01/27/00	15:12	13.5	7.4	640	0.8	3.3	NA	NA	NA	NA	NA	0.34	78	86	140	28	16	NA	390	<1	130	110	74	8.1
02/03/00	14:20	13.1	7.8	884	1.0							0.58												
02/10/00	8:00	13.4	6.4	1070	1.9							0.73												
02/17/00	13:40	13.3	7.6	228	0.7							0.16												
02/24/00	8:40	9.8	7.4	266	0.8							0.16												
03/02/00	13:00	11.8	7.5	246	0.7							0.15												
03/09/00	7:50	10.1	7.5	210	0.6							0.11												
03/16/00	9:55	15.6	NA	265	0.8							0.14												
03/23/00	11:24	16.0	7.4	350	1.1							0.21												
03/30/00	13:25	16.0	7.9	433	1.0		1.8	3.0	<5	<5	4.6	0.26												
04/06/00	7:40	15.5	7.4	564	1.0		1.1	2.8	<5	<5	3.1	0.33												
04/13/00	14:00	20.0	7.8	548	0.7		1.0	3.3	<5	<5	2.8	0.27												
04/20/00	7:45	14.0	8.2	361	1.2		1.4	3.6	<5	<5	5.5	0.20												
04/27/00	15:04	20.6	NA	313	0.7	1.3	1.9	3.2	<5	<5	6.9	0.14	30	38	77	17	8.2	NA	160	<1	64	52	28	2.1
05/04/00	15:35	21.2	7.8	338	0.8		1.1	2.2	<5	<5	<2	0.17												
05/11/00	14:00	16.5	7.6	321	1.2							0.16												
05/18/00	14:10	21.0	7.6	432	0.8		1.4	3.2	6.1	<5	6.6	0.21												
05/25/00	14:23	22.2	7.8	405	0.5	1.6	1.6	2.6	<5	<5	NA	0.19												
06/01/00	10:25	19.6	7.8	489	0.6		2.2	2.5	<5	<5	4.0	0.23												
06/08/00	15:07	20.2	7.6	480	1.2		1.9	3.5	<5	<5	NA	0.26												
06/15/00	7:00	24.0	7.5	476	1.6		1.8	3.5	5.2	<5	5.3	0.28												
06/22/00	13:55	28.5	8.2	661	1.3		2.6	3.9	5.3	<5	7.0	0.34												
06/29/00	7:40	23.8	6.5	684	1.2	3.9	2.2	4.2	<5	<5	6.8	0.39												
07/06/00	7:05	20.0	7.0	644	1.3							0.39												
07/13/00	13:37	26.2	8.1	624	1.2							0.38												
07/20/00	14:30	26.1	8.5	651	1.2							0.39												
07/27/00	9:20	21.5	7.1	588	1.7	1.8	1.7	2.7	<5	<5	NA	0.35	70	80	140	30	16	NA	340	<1	110	90	61	4.0
08/03/00	13:00	27.5	8.4	550	1.1							0.32												
08/10/00	11:30	23.4	8.1	632	1.2							0.34												
08/17/00	14:50	27.4	8.2	606	0.8							0.32												
08/24/00	12:56	23.1	7.7	361	0.5							0.20												
08/31/00	7:20	18.3	7.2	449	0.6	1.8	2	2.4	<5	<5	3.6	0.23	49	51	110	24	12	NA	260	<1	83	68	44	3.1
09/07/00	7:25	19.0	7.4	518	0.5							0.27												
09/14/00	13:50	23.6	7.9	484	<0.4							0.22												
09/21/00	6:51	21.3	7.1	392	<0.4							0.16												
09/28/00	9:10	19.3	6.7	562	1.1	2.4	2.5	3.2	<5	<5	4.5	0.25	70	61	130	30	15	NA	360	<1	120	95	56	3.7
Count		52	50	52	52	8	17	17	17	17	14	52	6	6	6	6	6	0	5	6	6	6	6	6
Min		6.6	6.4	210	<0.4	1.3	1.0	2.2	<5	<5	2.8	0.11	30	38	77	17	8.2		160	<1	64	52	28	2.1
Max		28.5	8.5	1070	1.9	3.9	2.6	4.2	6.1	<5	7.2	0.73	78	86	140	31	16		390	<1	130	110	74	8.1
Mean		17.5	7.5	567	0.9	2.3	1.8	3.1	3.0	2.5	4.9	0.31	60	63	123	27	14		302	0.5	106	86	55	4.1
Geo Mean		16.5	7.5	529	0.8	2.2	1.7	3.1	2.9	2.5	4.4	0.28	58	61	120	26	13		288	0.5	103	83	52	3.8
Median		18.1	7.6	563	0.9	2.05	1.8	3.2	2.5	2.5	5.0	0.305	67.5	61.5	135	29	15		340	0.5	115	92.5	58.5	3.75

Eastside Tributary Rivers

Stanislaus River at Caswell Park (STC514)

Location: Lat 37 42, Long 120 10. Right bank of the Stanislaus R, 7 miles upstream of the confluence with the San Joaquin R (River mile 74.9).

WY1999		Temp	EC	Se	Mo	Cr	Cu	Ni	Pb	Zn	B	Cl	SO4	HDNS	Ca	Mg	
Date	Time	C	pH	umhos/cm			ug/L						mg/L				
10/28/98	9:55	14.4	NA	77	<0.4						<0.05	3.1	3.8	30	7.6	2.6	
01/28/99	16:45	10.0	7.8	76	<0.4						<0.05	2.7	3.3	32	NA	NA	
04/29/99	15:25	14.4	8.3	69	<0.4						<0.05	2.6	3.1	26	6.2	2.5	
07/29/99	14:35	21.9	7.7	85	<0.4						<0.05	3.1	3.7	34	8.3	3.1	
Count		4	3	4	4						4	4	4	4	3	3	
Min		10.0	7.7	69	<0.4						<0.05	2.6	3.1	26	6.2	2.5	
Max		21.9	8.3	85	<0.4						<0.05	3.1	3.8	34	8.3	3.1	
Mean		15.2	7.9	77	0.2						0.025	2.9	3.5	31	7.4	2.7	
Geo Mean		14.6	7.9	77	0.2						0.025	2.9	3.5	30	7.3	2.7	
Median		14.4	7.8	77	0.2						0.025	2.9	3.5	31	7.6	2.6	
WY2000																	
10/28/99	7:05	15.8	7.9	117	<0.4						<0.05	4.2	4.9	42	10	3.9	
01/27/00	15:33	12.8	7.8	131	<0.4						<0.05	6.5	6.5	42	9.7	4.3	
04/27/00	16:25	17.1	NA	73	<0.4	<1	<1	1.9	<5	<5	<0.05	2.6	3.2	29	7.0	2.9	
05/25/00	14:54	18.5	7.6	69	<0.4	<1	<1	<1	<5	<5	<0.05						
06/08/00	15:36	17.0	7.6	68	<0.4	<1	<1	1.8	<5	<5	<0.05						
06/22/00	14:15	25.3	8.2	130	<0.4	<1	<1	1.7	<5	<5	<0.05						
06/29/00	8:00	22.2	6.5	119	<0.4	1.2	<1	1.6	<5	<5	<0.05						
07/27/00	8:55	20.1	8.3	104	<0.4	<1	<1	1.7	<5	<5	NA	<0.05	3.7	4.5	39	9.3	3.8
08/31/00	6:30	17.8	6.6	99	<0.4	<1	<1	1.7	<5	<5	2	<0.05	3.8	4.0	36	8.6	3.4
09/28/00	8:37	18.1	7.9	110	<0.4	<1	<1	1.3	<5	<5	<2	<0.05	4.8	4.3	39	9.4	3.7
Count		10	9	10	10	6	8	8	8	8	7	10	6	6	6	6	
Min		12.8	6.5	68	<0.4	<1	<1	<1	<5	<5	<2	<0.05	2.6	3.2	29	7.0	2.9
Max		25.3	8.3	131	<0.4	1.2	<1	1.9	<5	<5	3.9	<0.05	6.5	6.5	42	10	4.3
Mean		18.5	7.6	102	0.2	0.6	0.5	1.5	2.5	2.5	2.2	0.025	4.3	4.6	38	9.0	3.7
Geo Mean		18.2	7.6	99	0.2	0.6	0.5	1.4	2.5	2.5	2.0	0.025	4.1	4.5	38	8.9	3.6
Median		18.0	7.8	107	0.2	0.5	0.5	1.7	2.5	2.5	2.4	0.025	4.0	4.4	39	9.4	3.8

Tuolumne River at Shiloh Fishing Access (STC513)

Location: Lat 37 36, Long 120 07. Left bank of the Tuolumne R, at Shiloh Road Bridge, 7 miles upstream of the confluence San Joaquin R (Riv. Mi. 83.7)

WY1999		Temp	EC	Se	Mo	Cr	Cu	Ni	Pb	Zn	B	Cl	SO4	HDNS	Ca	Mg	
Date	Time	C	pH	umhos/cm			ug/L						mg/L				
10/28/98	11:10	17.2	NA	143	<0.4						<0.05	9.7	5.8	45	11	4.5	
01/28/99	15:45	11.4	8.2	53	<0.4						<0.05	2.9	2.7	20	NA	NA	
04/29/99	14:10	15.0	8.6	53	<0.4						<0.05	3.7	3	18	4.2	1.8	
07/29/99	13:20	24.9	7.8	217	<0.4						<0.05	16	9	67	15	7	
Count		4	3	4	4						4	4	4	4	3	3	
Min		11.4	7.8	53	<0.4						<0.05	2.9	2.7	18	4.2	1.8	
Max		24.9	8.6	217	<0.4						<0.05	16	9	67	15	7	
Mean		17.1	8.2	117	0.2						0.025	8.1	5.1	38	10.1	4.4	
Geo Mean		16.5	8.2	97	0.2						0.025	6.4	4.5	32	8.8	3.8	
Median		16.1	8.2	98	0.2						0.025	6.7	4.4	33	11.0	4.5	
WY2000																	
10/28/99	8:30	15.8	7.8	187	<0.4						<0.05	14	7.7	57	13	5.7	
01/27/00	14:20	13.7	8.1	147	<0.4						<0.05	9.6	6.3	46	10	4.9	
04/27/00	14:54	20.7	NA	104	<0.4	<1	<1	1.4	<5	<5	<0.05	5.8	4.6	35	8.0	3.6	
05/25/00	13:32	23.9	7.5	105	<0.4	<1	<1	1.5	<5	<5	<0.05						
06/08/00	14:19	20.9	7.6	223	<0.4	<1	<1	2	<5	<5	<2	<0.05					
06/22/00	13:10	28.2	8.3	244	<0.4	<1	<1	1.5	<5	<5	<2.6	<0.05					
06/29/00	8:50	24.4	7.8	240	<0.4	1.3	<1	1.5	<5	<5	2.9	<0.05					
07/27/00	10:25	21.5	8.5	136	<0.4	<1	<1	1.1	<5	<5	NA	<0.05	8.3	5.2	42	9.7	4.2
08/31/00	8:15	17.4	8.2	109	<0.4	<1	<1	1.2	<5	<5	<2	<0.05	6.4	4.4	35	8	3.5
09/28/00	10:10	19.2	7.7	224	<0.4	<1	<1	1.2	<5	<5	<2	<0.05	17	9	63	15	6.3
Count		10	9	10	10	6	8	8	8	8	7	10	6	6	6	6	
Min		13.7	7.5	104	<0.4	<1	<1	1.1	<5	<5	<2	<0.05	5.8	4.4	35	8.0	3.5
Max		28.2	8.5	244	<0.4	1.3	0	2	<5	<5	3.4	<0.05	17	9	63	15	6.3
Mean		20.6	7.9	172	0.2	0.6	0.5	1.4	2.5	2.5	2.1	0.025	10.2	6.2	46	10.6	4.7
Geo Mean		20.2	7.9	163	0.2	0.6	0.5	1.4	2.5	2.5	1.8	0.025	9.4	6.0	45	10.3	4.6
Median		20.8	7.8	167	0.2	0.5	0.5	1.45	2.5	2.5	2.6	0.025	9.0	5.8	44	9.9	4.6

Merced River at Hatfield Park (MER546)

Location: Lat 37 20 59, Long 120 57 28. 3.5 miles northeast of Newman, 0.5 miles upstream of confluence with the San Joaquin R (River mile 118.2)

WY1999		Temp	EC	Se	Mo	Cr	Cu	Ni	Pb	Zn	B	Cl	SO4	HDNS	Ca	Mg	
Date	Time	C	pH	umhos/cm			ug/L						mg/L				
10/29/98	15:15	18.3	NA	206	<0.4						<0.05	15	12	55	15	4.9	
01/27/99	17:05	10.6	7.9	51	<0.4						<0.05	2.5	2.7	19	NA	NA	
04/29/99	12:05	14.2	8.5	69	<0.4						<0.05	3.2	4.1	24	6.1	2.2	
07/29/99	11:15	22.0	7.5	331	<0.4						<0.05	26	20	90	23	8.3	
Count		4	3	4	4						4	4	4	4	3	3	
Min		10.6	7.5	51	<0.4						<0.05	2.5	2.7	19	6.1	2.2	
Max		22.0	8.5	331	<0.4						<0.05	26	20	90	23	8.3	
Mean		16.3	8.0	164	0.2						0.025	11.7	9.7	47	14.7	5.1	
Geo Mean		15.7	8.0	124	0.2						0.025	7.5	7.2	39	12.8	4.5	
Median		16.3	7.9	138	0.2						0.025	9.1	8.1	40	15.0	4.9	
WY2000																	
10/28/99	10:50	16.8	7.8	140	<0.4						<0.05	14	12	35	8.2	3.6	
01/27/00	13:25	13.0	8.3	115	<0.4						<0.05	2.9	4.4	24	5.9	2.3	
04/27/00	12:34	18.6	NA	61	<0.4	<1	<1	2	<5	<5	<2	<0.05					
05/25/00	11:29	22.8	7.5	157	<0.4	<1	<1	1.4	<5	<5	<2	<0.05					
06/08/00	12:20	21.3	7.6	230	<0.4	<1	<1	1.8	<5	<5	<2	<0.05					
06/22/00	11:30	27.0	8.0	306	<0.4	<1	<1	2.4	<5	<5	5.2	<0.05					
06/29/00	10:15	25.2	8.0	258	<0.4	2.4	<1	1.3	<5	<5	2.2	<0.05					
07/27/00	12:30	24.1	7.6	380	0.5	1.5	<1	1.3	<5	<5	NA	<0.05	33	23	100	26	9.4
08/31/00	9:54	20.0	6.9	313	<0.4	1.03	<1	1.5	<5	<5	3.2	<0.05	26	18.0	82	21	7.3
09/28/00	11:50	20.6	8.5	256	<0.4	1.46	<1	1.6	<5	<5	<2	<0.05	20	15	70	18	6.2
Count		10	9	10	10	6	8	8	8	8	7	9	5	5	5	5	
Min		13.0	6.9	61	<0.4	<1	<1	1.3	<5	<5	<2	<0.05	2.9	4.4	24	5.9	2.3

APPENDIX B
Automated Daily Composite Water Quality Data

RWQCB Site I.D.	Site Name	Period of Record	Page
MER504S	San Joaquin River at Crows Landing	10/98-9/99	62
MER504S	San Joaquin River at Crows Landing	10/99-9/00	63
MER504S	Crows Landing: 4-Day Averages	10/98-9/99	64
MER504S	Crows Landing: 4-Day Averages	10/99-9/00	65

Legend of Abbreviations

B	Boron
EC	Electrical Conductivity
NA	Not Available
Se	Selenium

San Joaquin River at Crows Landing (STC504S)

WY 1999

Location: Latitude 37 25 55, Longitude 121 04 42. T.6S, R.8E. West bank, 100 yards south of Crows Landing Road Bridge, 4.2 miles NE of Crows Landing, River Mile 107.1

AUTOSAMPLER DATA: 24 hour composite samples

DATA SUMMARY

Date	EC umhos/cm	Se ug/L	B mg/L																				
10/01/98	364	0.6	0.26	12/01/98	946	1.8	0.57	02/01/99	945	1.6	0.65	04/01/99	1520	1.8	1.1	06/01/99	1270	3.3	0.91	08/01/99	1230	3.8	1.2
10/02/98	408	0.7	0.25	12/02/98	755	1.5	0.50	02/02/99	989	1.7	0.70	04/02/99	1540	1.8	1.1	06/02/99	1210	3.9	0.98	08/02/99	1200	4.2	1.2
10/03/98	305	0.7	0.17	12/03/98	867	1.5	0.59	02/03/99	1030	2.4	0.72	04/03/99	1630	1.7	1.1	06/03/99	1290	4.0	1.0	08/03/99	1220	4.5	1.2
10/04/98	NA	NA	NA	12/04/98	673	1.2	0.45	02/04/99	1050	2.4	0.69	04/04/99	1520	1.9	1.1	06/04/99	1390	3.9	0.97	08/04/99	1160	4.4	1.2
10/05/98	NA	NA	NA	12/05/98	630	1.3	0.43	02/05/99	1080	1.8	0.74	04/05/99	1520	2.0	1.1	06/05/99	1210	3.5	0.91	08/05/99	1210	4.7	1.2
10/06/98	NA	NA	NA	12/06/98	597	1.4	0.41	02/06/99	1110	2.2	0.77	04/06/99	1480	2.4	1.1	06/06/99	1180	3.3	0.91	08/06/99	1290	4.6	1.1
10/07/98	NA	NA	NA	12/07/98	527	1.1	0.35	02/07/99	1120	2.5	0.77	04/07/99	1430	2.4	0.99	06/07/99	1120	3.0	0.88	08/07/99	1330	4.6	1.1
10/08/98	NA	NA	NA	12/08/98	497	1.0	0.34	02/08/99	1090	2.5	0.76	04/08/99	1380	2.3	0.93	06/08/99	1080	3.1	0.91	08/08/99	1300	3.9	1.0
10/09/98	NA	NA	NA	12/09/98	488	1.7	0.34	02/09/99	1040	2.3	0.73	04/09/99	1340	4.6	0.91	06/09/99	1160	3.0	0.98	08/09/99	1310	4.2	1.1
10/10/98	NA	NA	NA	12/10/98	495	0.7	0.36	02/10/99	756	1.6	0.47	04/10/99	1160	4.0	0.75	06/10/99	1190	4.2	1.0	08/10/99	1210	3.8	1.1
10/11/98	NA	NA	NA	12/11/98	424	0.8	0.30	02/11/99	394	1.2	0.25	04/11/99	895	2.5	0.56	06/11/99	1290	4.5	1.0	08/11/99	1200	4.0	1.0
10/12/98	NA	NA	NA	12/12/98	460	0.9	0.30	02/12/99	391	1.2	0.25	04/12/99	897	1.8	0.56	06/12/99	1310	4.7	1.0	08/12/99	1270	3.6	1.0
10/13/98	NA	NA	NA	12/13/98	484	0.9	0.32	02/13/99	434	1.1	0.27	04/13/99	755	2.0	0.48	06/13/99	1480	5.0	1.2	08/13/99	1330	3.2	1.0
10/14/98	NA	NA	NA	12/14/98	453	0.6	0.32	02/14/99	498	1.3	0.32	04/14/99	626	1.3	0.41	06/14/99	1340	4.3	1.0	08/14/99	1370	3.3	1.0
10/15/98	NA	NA	NA	12/15/98	449	0.5	0.32	02/15/99	563	1.6	0.40	04/15/99	624	1.3	0.40	06/15/99	1230	3.8	0.95	08/15/99	1310	3.2	1.1
10/16/98	323	1.0	0.22	12/16/98	450	0.6	0.32	02/16/99	600	1.6	0.42	04/16/99	631	1.9	0.42	06/16/99	1260	3.6	0.95	08/16/99	1320	3.5	1.1
10/17/98	326	0.9	0.23	12/17/98	480	0.6	0.33	02/17/99	614	1.8	0.43	04/17/99	606	1.2	0.35	06/17/99	1380	4.8	1.1	08/17/99	1240	3.2	1.1
10/18/98	425	1.1	0.29	12/18/98	535	0.7	0.38	02/18/99	631	1.9	0.45	04/18/99	579	1.6	0.36	06/18/99	1540	5.0	1.2	08/18/99	1280	3.3	1.1
10/19/98	513	1.1	0.33	12/19/98	722	1.2	0.49	02/19/99	602	2.0	0.42	04/19/99	557	1.5	0.33	06/19/99	1640	5.7	1.3	08/19/99	1270	3.6	0.99
10/20/98	590	1.4	0.39	12/20/98	731	1.6	0.49	02/20/99	545	1.8	0.37	04/20/99	553	1.5	0.34	06/20/99	1720	6.1	1.4	08/20/99	1320	4.3	1.1
10/21/98	709	1.6	0.44	12/21/98	712	1.4	0.50	02/21/99	510	1.8	0.33	04/21/99	542	1.5	0.33	06/21/99	1490	6.0	1.2	08/21/99	1340	4.2	1.1
10/22/98	753	1.6	0.45	12/22/98	709	1.3	0.50	02/22/99	463	1.6	0.30	04/22/99	549	1.6	0.32	06/22/99	1510	6.0	1.2	08/22/99	1210	4.3	0.97
10/23/98	781	1.7	0.47	12/23/98	NA	NA	NA	02/23/99	496	1.8	0.33	04/23/99	437	1.3	0.26	06/23/99	1580	6.9	1.3	08/23/99	1150	4.2	0.95
10/24/98	733	1.7	0.46	12/24/98	827	1.4	0.57	02/24/99	525	1.9	0.36	04/24/99	420	1.2	0.23	06/24/99	1480	5.8	1.2	08/24/99	1120	4.0	0.92
10/25/98	698	2.0	0.46	12/25/98	838	1.1	0.58	02/25/99	603	2.3	0.42	04/25/99	414	1.3	0.25	06/25/99	1370	4.5	1.1	08/25/99	1160	3.6	0.95
10/26/98	602	1.8	0.40	12/26/98	895	1.4	0.63	02/26/99	637	2.2	0.45	04/26/99	420	1.3	0.25	06/26/99	1310	3.7	0.94	08/26/99	1280	3.6	1.0
10/27/98	614	2.0	0.41	12/27/98	974	2.2	0.66	02/27/99	669	2.3	0.48	04/27/99	504	1.4	0.29	06/27/99	1380	4.2	1.1	08/27/99	1400	3.8	1.1
10/28/98	591	2.4	0.41	12/28/98	989	1.9	0.66	02/28/99	691	2.4	0.50	04/28/99	573	1.6	0.33	06/28/99	1380	4.7	1.1	08/28/99	1370	5.7	1.2
10/29/98	599	1.9	0.43	12/29/98	1000	1.7	0.65	03/01/99	778	2.8	0.55	04/29/99	613	1.7	0.37	06/29/99	1250	4.0	1.0	08/29/99	1270	5.2	1.1
10/30/98	594	1.8	0.43	12/30/98	1000	1.6	0.65	03/02/99	840	2.9	0.60	04/30/99	729	2.6	0.41	06/30/99	1410	4.8	1.2	08/30/99	1190	5.0	0.96
10/31/98	615	1.8	0.44	12/31/98	1020	1.5	0.66	03/03/99	845	2.8	0.61	05/01/99	764	3.0	0.45	07/01/99	1450	4.6	1.2	08/31/99	1200	5.4	1.0
11/01/98	616	1.5	0.42	01/01/99	1020	1.5	0.65	03/04/99	875	2.8	0.61	05/02/99	636	2.7	0.37	07/02/99	1530	5.2	1.2	09/01/99	1170	5.4	0.93
11/02/98	578	1.4	0.40	01/02/99	1050	2.3	0.67	03/05/99	803	2.1	0.59	05/03/99	546	2.1	0.32	07/03/99	1530	4.8	1.2	09/02/99	1080	4.2	0.82
11/03/98	564	1.2	0.37	01/03/99	1060	2.1	0.66	03/06/99	824	2.3	0.61	05/04/99	553	2.2	0.34	07/04/99	1500	4.7	1.2	09/03/99	1170	4.0	0.89
11/04/98	572	1.5	0.37	01/04/99	1050	1.9	0.66	03/07/99	861	2.3	0.63	05/05/99	553	2.1	0.33	07/05/99	1370	4.1	1.1	09/04/99	1220	4.0	0.90
11/05/98	610	1.5	0.40	01/05/99	1070	1.6	0.66	03/08/99	852	2.4	0.62	05/06/99	561	2.2	0.33	07/06/99	1310	4.6	1.1	09/05/99	1210	4.4	0.93
11/06/98	648	1.8	0.41	01/06/99	1100	2.2	0.71	03/09/99	853	2.7	0.65	05/07/99	575	1.9	0.32	07/07/99	1340	5.3	1.2	09/06/99	1150	4.2	0.90
11/07/98	714	1.9	0.45	01/07/99	1020	1.5	0.67	03/10/99	878	2.7	0.64	05/08/99	500	1.5	0.28	07/08/99	1310	5.0	1.1	09/07/99	1180	4.2	0.91
11/08/98	763	1.8	0.49	01/08/99	1060	1.5	0.69	03/11/99	940	2.8	0.70	05/09/99	508	1.6	0.29	07/09/99	1380	5.6	1.2	09/08/99	1190	3.3	0.87
11/09/98	763	1.5	0.49	01/09/99	1050	1.5	0.69	03/12/99	887	2.6	0.66	05/10/99	510	1.4	0.30	07/10/99	1300	5.1	1.1	09/09/99	1260	3.5	0.91
11/10/98	817	1.6	0.52	01/10/99	1070	2.3	0.71	03/13/99	921	2.7	0.67	05/11/99	592	1.7	0.35	07/11/99	1420	5.9	1.2	09/10/99	1210	3.6	0.83
11/11/98	859	1.7	0.55	01/11/99	996	2.0	0.70	03/14/99	1050	2.9	0.74	05/12/99	684	2.2	0.42	07/12/99	1340	4.8	1.1	09/11/99	1200	2.9	0.79
11/12/98	908	1.9	0.59	01/12/99	1050	2.0	0.73	03/15/99	1110	3.0	0.81	05/13/99	631	1.8	0.40	07/13/99	1320	4.4	1.0	09/12/99	1130	2.7	0.74
11/13/98	922	1.8	0.61	01/13/99	1020	1.7	0.69	03/16/99	1170	3.4	0.89	05/14/99	620	1.5	0.37	07/14/99	1450	5.1	1.2	09/13/99	1060	2.8	0.70
11/14/98	928	1.6	0.60	01/14/99	991	1.7	0.67	03/17/99	1140	3.7	0.90	05/15/99	664	1.8	0.40	07/15/99	1450	5.2	1.3	09/14/99	1030	2.6	0.69
11/15/98	957	1.6	0.63	01/15/99	996	1.6	0.67	03/18/99	1150	3.5	0.87	05/16/99	907	2.4	0.56	07/16/99	1360	4.1	1.1	09/15/99	1000	2.3	0.67
11/16/98	1010	1.8	0.66	01/16/99	1000	1.8	0.66	03/19/99	1220	3.5	0.83	05/17/99	1050	2.8	0.65	07/17/99	1350	4.4	1.1	09/16/99	1130	2.7	0.83
11/17/98	1020	1.9	0.67	01/17/99	928	1.5	0.65	03/20/99	1240	3.4	0.86	05/18/99	1140	3.6	0.74	07/18/99	1330	4.1	1.2	09/17/99	1200	4.4	0.88
11/18/98	1020	1.7	0.67	01/18/99	1000	2.7	0.63	03/21/99	1270	3.6	0.93	05/19/99	1180	3.9	0.77	07/19/99	1280	4.1	1.1	09/18/99	1190	3.2	0.85
11/19/98	1040	1.7	0.67	01/19/99	1010	1.8	0.67	03/22/99	1270	3.5	0.95	05/20/99	1200	3.6	0.77	07/20/99	1280	4.6	1.1	09/19/99	1090	2.8	0.76
11/20/98	1020	1.6	0.69	01/20/99	979	1.6	0.67	03/23/99	1320	3.8	0.97	05/21/99	1220	3.2	0.75	07/21/99	1280	4.3					

San Joaquin River at Crows Landing (STC504S)

WY 2000

Location: Latitude 37 25 55, Longitude 121 04 42. T.6S, R.8E. West bank, 100 yards south of Crows Landing Road Bridge, 4.2 miles NE of Crows Landing, River Mile 107.1

AUTOSAMPLER DATA: 24 hour composite samples

DATA SUMMARY

Date	EC	Se	B																
	umhos/cm	ug/L	mg/L																
10/01/99	996	1.6	0.65	12/01/99	1210	2.5	0.82	02/01/00	1280	1.8	0.97	06/01/00	1340	4.3	1.0	08/01/00	1070	3.5	0.89
10/02/99	984	2.0	0.64	12/02/99	1240	1.7	0.86	02/02/00	1360	1.8	1.0	06/02/00	1290	4.2	0.94	08/02/00	1160	3.5	1.0
10/03/99	1040	2.2	0.71	12/03/99	1240	1.7	0.84	02/03/00	1450	2.0	1.1	04/03/00	NA	NA	NA	08/03/00	1150	3.2	0.99
10/04/99	990	1.8	0.72	12/04/99	1240	1.5	0.82	02/04/00	1530	2.3	1.2	04/04/00	NA	NA	NA	06/04/00	1250	3.5	0.88
10/05/99	1040	2.0	0.78	12/05/99	1240	1.9	0.84	02/05/00	1610	2.6	1.2	04/05/00	NA	NA	NA	06/05/00	1410	3.9	1.0
10/06/99	1080	2.4	0.84	12/06/99	1280	1.9	0.84	02/06/00	1590	2.7	1.3	04/06/00	1350	3.3	0.94	06/06/00	1370	4.6	1.0
10/07/99	1040	2.1	0.82	12/07/99	1300	1.6	0.81	02/07/00	1610	2.8	1.3	04/07/00	1390	4.1	0.99	06/07/00	1290	4.2	0.96
10/08/99	1040	2.0	0.77	12/08/99	1310	1.8	0.83	02/08/00	1670	3.1	1.4	04/08/00	1370	4.1	0.98	06/08/00	1210	4.6	0.94
10/09/99	1010	1.9	0.73	12/09/99	1310	1.9	0.85	02/09/00	1690	3.3	1.4	04/09/00	1450	3.9	0.97	06/09/00	1230	4.5	0.93
10/10/99	1000	1.8	0.73	12/10/99	1300	2.3	0.83	02/10/00	1680	4.1	1.4	04/10/00	1420	3.9	0.96	06/10/00	1160	4.0	0.90
10/11/99	962	1.6	0.74	12/11/99	1310	2.5	0.82	02/11/00	1650	4.7	1.3	04/11/00	1430	4.1	0.96	06/11/00	1180	4.3	0.96
10/12/99	1090	1.7	0.81	12/12/99	1330	2.3	0.87	02/12/00	1610	3.9	1.2	04/12/00	1460	4.3	1.0	06/12/00	1150	4.8	0.98
10/13/99	1210	2.1	0.92	12/13/99	1320	1.9	0.84	02/13/00	1310	2.4	0.89	04/13/00	1510	4.2	1.1	06/13/00	1130	5.2	0.95
10/14/99	1230	2.1	0.91	12/14/99	1340	2.1	0.84	02/14/00	654	1.7	0.42	04/14/00	1610	3.2	1.1	06/14/00	1170	5.6	0.97
10/15/99	1170	1.6	0.83	12/15/99	1340	2.3	0.88	02/15/00	466	1.3	0.30	04/15/00	1530	3.3	1.0	06/15/00	1220	4.8	0.99
10/16/99	1050	1.3	0.75	12/16/99	1370	2.5	0.90	02/16/00	336	1.0	0.22	04/16/00	1460	4.1	0.99	06/16/00	1270	4.6	1.0
10/17/99	876	0.9	0.61	12/17/99	1350	1.9	0.88	02/17/00	324	0.8	0.21	04/17/00	1230	3.5	0.87	06/17/00	1330	4.4	1.1
10/18/99	677	0.6	0.47	12/18/99	1390	2.1	0.91	02/18/00	372	0.9	0.24	04/18/00	1110	3.6	0.81	06/18/00	1310	4.4	1.0
10/19/99	640	0.7	0.45	12/19/99	1400	2.9	0.92	02/19/00	397	1.0	0.26	04/19/00	1000	3.6	0.75	06/19/00	1130	3.5	0.87
10/20/99	619	0.7	0.42	12/20/99	1410	2.4	0.89	02/20/00	449	1.4	0.31	04/20/00	879	3.2	0.63	06/20/00	1130	3.5	0.88
10/21/99	618	0.6	0.41	12/21/99	1350	2.9	0.86	02/21/00	482	0.9	0.34	04/21/00	562	2.4	0.42	06/21/00	1210	4.0	0.98
10/22/99	654	0.7	0.44	12/22/99	1410	2.7	0.89	02/22/00	493	1.2	0.36	04/22/00	552	2.0	0.38	06/22/00	1200	3.3	0.94
10/23/99	773	1.2	0.51	12/23/99	1430	2.4	0.88	02/23/00	492	1.3	0.34	04/23/00	539	1.6	0.35	06/23/00	1410	4.8	1.2
10/24/99	771	1.2	0.50	12/24/99	1430	2.2	0.90	02/24/00	496	0.9	0.35	04/24/00	528	1.6	0.34	06/24/00	1390	4.7	1.2
10/25/99	760	1.1	0.48	12/25/99	1450	2.5	0.91	02/25/00	452	0.9	0.31	04/25/00	503	1.5	0.32	06/25/00	1380	4.3	1.2
10/26/99	839	1.1	0.54	12/26/99	1460	2.7	0.92	02/26/00	413	0.9	0.29	04/26/00	493	1.7	0.30	06/26/00	1260	3.5	1.0
10/27/99	882	1.4	0.55	12/27/99	1460	2.4	0.90	02/27/00	502	0.8	0.36	04/27/00	508	1.9	0.34	06/27/00	1070	3.1	0.87
10/28/99	870	1.6	0.56	12/28/99	1490	3.9	0.91	02/28/00	566	1.1	0.39	04/28/00	508	1.7	0.32	06/28/00	1190	3.4	0.99
10/29/99	875	1.4	0.55	12/29/99	1500	2.6	0.91	02/29/00	455	1.0	0.31	04/29/00	516	1.8	0.32	06/29/00	1360	4.0	1.2
10/30/99	884	1.4	0.57	12/30/99	1510	2.6	0.94	03/01/00	374	1.2	0.26	04/30/00	515	2.0	0.33	06/30/00	1260	3.5	1.1
10/31/99	931	2.0	0.61	12/31/99	1470	2.5	0.90	03/02/00	405	0.9	0.28	05/01/00	506	1.8	0.32	07/01/00	1250	3.6	1.0
11/01/99	943	2.3	0.61	01/01/00	1460	2.4	0.91	03/03/00	461	0.9	0.32	05/02/00	517	1.7	0.32	07/02/00	1400	4.9	1.2
11/02/99	962	2.0	0.67	01/02/00	1380	2.2	0.88	03/04/00	517	1.2	0.36	05/03/00	656	2.3	0.40	07/03/00	1280	5.0	1.1
11/03/99	950	1.7	0.61	01/03/00	1390	2.4	0.91	03/05/00	587	1.3	0.38	05/04/00	788	2.6	0.50	07/04/00	1110	3.3	0.93
11/04/99	971	1.8	0.64	01/04/00	1410	2.2	0.90	03/06/00	547	1.3	0.36	05/05/00	820	2.6	0.53	07/05/00	1080	3.6	0.88
11/05/99	1010	1.8	0.65	01/05/00	1440	2.3	0.92	03/07/00	438	1.0	0.28	05/06/00	877	3.0	0.58	07/06/00	1030	3.4	0.82
11/06/99	997	1.2	0.64	01/06/00	1430	2.3	0.90	03/08/00	391	1.1	0.26	05/07/00	904	3.4	0.61	07/07/00	1090	3.8	0.87
11/07/99	NA	NA	NA	01/07/00	1500	2.2	0.92	03/09/00	441	1.1	0.28	05/08/00	795	2.9	0.54	07/08/00	1150	3.6	0.90
11/08/99	NA	NA	NA	01/08/00	1470	2.3	0.92	03/10/00	444	1.2	0.28	05/09/00	741	2.6	0.52	07/09/00	1180	4.1	0.92
11/09/99	NA	NA	NA	01/09/00	1440	2.5	0.90	03/11/00	401	1.0	0.24	05/10/00	759	2.6	0.51	07/10/00	1100	3.9	0.86
11/10/99	NA	NA	NA	01/10/00	1440	2.5	0.87	03/12/00	441	1.0	0.26	05/11/00	766	2.4	0.50	07/11/00	1110	3.8	0.90
11/11/99	NA	NA	NA	01/11/00	1460	2.6	0.90	03/13/00	485	1.2	0.31	05/12/00	736	2.3	0.49	07/12/00	1140	3.9	0.90
11/12/99	1020	2.1	0.70	01/12/00	1500	2.2	0.93	03/14/00	497	1.0	0.32	05/13/00	688	2.3	0.46	07/13/00	1180	4.9	0.95
11/13/99	1010	1.5	0.68	01/13/00	1520	2.4	0.96	03/15/00	527	1.1	0.35	05/14/00	753	2.4	0.49	07/14/00	NA	NA	NA
11/14/99	1020	1.5	0.67	01/14/00	1490	2.1	0.94	03/16/00	521	1.0	0.35	05/15/00	926	2.7	0.56	07/15/00	NA	NA	NA
11/15/99	1060	1.6	0.69	01/15/00	1460	2.0	0.91	03/17/00	605	1.2	0.41	05/16/00	959	2.9	0.58	07/16/00	NA	NA	NA
11/16/99	1080	1.6	0.70	01/16/00	1430	2.0	0.88	03/18/00	654	1.3	0.47	05/17/00	938	2.5	0.57	07/17/00	NA	NA	NA
11/17/99	1120	1.7	0.72	01/17/00	1390	1.9	0.88	03/19/00	644	1.3	0.46	05/18/00	910	2.1	0.56	07/18/00	NA	NA	NA
11/18/99	1130	1.6	0.73	01/18/00	1360	2.1	0.84	03/20/00	623	1.3	0.46	05/19/00	967	1.8	0.59	07/19/00	NA	NA	NA
11/19/99	1140	1.4	0.74	01/19/00	1360	2.3	0.88	03/21/00	606	1.2	0.46	05/20/00	942	1.6	0.58	07/20/00	NA	NA	NA
11/20/99	1190	1.5	0.79	01/20/00	1350	2.2	0.89	03/22/00	624	1.4	0.47	05/21/00	989	1.9	0.64	07/21/00	NA	NA	NA
11/21/99	1200	1.5	0.80	01/21/00	1390	3.1	0.99	03/23/00	678	1.6	0.50	05/22/00	1050	1.8	0.69	07/22/00	NA	NA	NA
11/22/99	1220	1.7	0.80	01/22/00	1370	2.9	0.97	03/24/00	762	1.8	0.58	05/23/00	996	1.9	0.67	07/23/00	NA	NA	NA
11/23/99	1210	1.6	0.78	01/23/00	1360	2.7	0.95	03/25/00	831	1.8	0.6	05/24/00	989	1.8	0.66	07/24/00	NA	NA	NA
11/24/99	1240	1.6	0.82	01/24/00	1280	2.5	0.88	03/26/00	845	2.3	0.65	05/25/00	1050	1.7	0.68	07/25/00	NA	NA	NA
11/25/99	1280	2.0	0.84	01/25/00	1240	2.3	0.84	03/27/00	1030	2.4	0.80	05/26/00	1120	2.2	0.77	07/26/00	NA	NA	NA
11/26/99	1250	1.5	0.80	01/26/00	1220	1.8	0.82	03/28/00	1170	2.5	0.91	05/27/00	1150	2.7	0.81	07/27/00	NA	NA	NA
11/27/99	1240	1.3	0.79	01/27/00	1080	1.7	0.73	03/29/00	1240	2.8	0.95	05/28/00	1110	2.3	0.80	07/28/00	1340	4.5	1.1
11/28/99	1270	2.1	0.85	01/28/00	920	1.9	0.69	03/30/00	1250	3.0	0.94	05/29/00	1180	3.3	0.86	07/29/00	1290	4.6	1.0
11/29/99	1240	1.8	0.82	01/29/00	989	1.7	0.75	03/31/00	1260	3.0	0.91	05/30/00	1210	3.5	0.88	07/30/00	1160	3.8	0.94
11/30/99	1220	1.8	0.82	01/30/00	1110	1.7	0.81					05/31							

San Joaquin River at Crows Landing (STC504S)

WY 1999

Location: Latitude 37 25 55, Longitude 121 04 42. T.6S, R.8E. West bank, 100 yards south of Crows Landing Road Bridge, 4.2 miles NE of Crows Landing, River Mile 107.1

AUTOSAMPLER DATA: 24 hour composite samples; 4-DAY AVERAGES

Date	EC umhos/cm	Se ug/L	B mg/L																				
10/01/98	371	0.6	0.26	12/01/98	1030	2.3	0.66	02/01/99	812	1.4	0.56	04/01/99	1420	2.9	1.1	06/01/99	1210	3.2	0.85	08/01/99	1280	4.1	1.2
10/02/98	389	0.7	0.27	12/02/98	952	2.0	0.61	02/02/99	884	1.5	0.61	04/02/99	1470	2.5	1.1	06/02/99	1220	3.4	0.89	08/02/99	1250	4.0	1.2
10/03/98	369	0.7	0.24	12/03/98	900	1.7	0.58	02/03/99	957	1.8	0.66	04/03/99	1530	2.0	1.1	06/03/99	1240	3.6	0.93	08/03/99	1230	4.2	1.2
10/04/98	359	0.7	0.23	12/04/98	810	1.5	0.53	02/04/99	1000	2.0	0.69	04/04/99	1550	1.8	1.1	06/04/99	1290	3.8	0.97	08/04/99	1200	4.2	1.2
10/05/98	357	0.7	0.21	12/05/98	731	1.4	0.49	02/05/99	1040	2.1	0.71	04/05/99	1550	1.9	1.1	06/05/99	1280	3.8	0.97	08/05/99	1200	4.5	1.2
10/06/98	305	0.7	0.17	12/06/98	692	1.4	0.47	02/06/99	1070	2.2	0.73	04/06/99	1530	2.0	1.1	06/06/99	1270	3.7	0.95	08/06/99	1220	4.6	1.2
10/07/98	NA	NA	NA	12/07/98	607	1.3	0.41	02/07/99	1090	2.2	0.74	04/07/99	1480	2.2	1.1	06/07/99	1230	3.4	0.92	08/07/99	1250	4.6	1.2
10/08/98	NA	NA	NA	12/08/98	563	1.2	0.38	02/08/99	1100	2.3	0.76	04/08/99	1450	2.3	1.0	06/08/99	1150	3.2	0.90	08/08/99	1280	4.5	1.1
10/09/98	NA	NA	NA	12/09/98	527	1.3	0.36	02/09/99	1090	2.4	0.76	04/09/99	1410	2.9	0.98	06/09/99	1140	3.1	0.92	08/09/99	1310	4.3	1.1
10/10/98	NA	NA	NA	12/10/98	502	1.1	0.35	02/10/99	1000	2.2	0.68	04/10/99	1330	3.3	0.90	06/10/99	1140	3.3	0.94	08/10/99	1290	4.1	1.1
10/11/98	NA	NA	NA	12/11/98	476	1.0	0.34	02/11/99	821	1.9	0.55	04/11/99	1190	3.3	0.79	06/11/99	1180	3.7	1.0	08/11/99	1260	4.0	1.1
10/12/98	NA	NA	NA	12/12/98	467	1.0	0.33	02/12/99	646	1.6	0.43	04/12/99	1070	3.2	0.70	06/12/99	1240	4.1	1.0	08/12/99	1250	3.9	1.1
10/13/98	NA	NA	NA	12/13/98	466	0.8	0.32	02/13/99	494	1.3	0.31	04/13/99	927	2.6	0.59	06/13/99	1320	4.6	1.1	08/13/99	1250	3.6	1.0
10/14/98	NA	NA	NA	12/14/98	455	0.8	0.31	02/14/99	429	1.2	0.27	04/14/99	793	1.9	0.50	06/14/99	1360	4.6	1.1	08/14/99	1290	3.5	1.0
10/15/98	NA	NA	NA	12/15/98	462	0.7	0.32	02/15/99	472	1.3	0.31	04/15/99	726	1.6	0.46	06/15/99	1340	4.5	1.0	08/15/99	1320	3.3	1.0
10/16/98	323	1.0	0.22	12/16/98	459	0.7	0.32	02/16/99	524	1.4	0.35	04/16/99	659	1.6	0.43	06/16/99	1330	4.2	1.0	08/16/99	1330	3.3	1.1
10/17/98	325	1.0	0.23	12/17/98	458	0.6	0.32	02/17/99	569	1.6	0.39	04/17/99	622	1.4	0.40	06/17/99	1300	4.1	1.0	08/17/99	1310	3.3	1.1
10/18/98	358	1.0	0.25	12/18/98	479	0.6	0.34	02/18/99	602	1.7	0.43	04/18/99	610	1.5	0.38	06/18/99	1350	4.3	1.1	08/18/99	1290	3.3	1.1
10/19/98	397	1.0	0.27	12/19/98	547	0.8	0.38	02/19/99	612	1.8	0.43	04/19/99	593	1.5	0.37	06/19/99	1460	4.8	1.1	08/19/99	1280	3.4	1.1
10/20/98	464	1.1	0.31	12/20/98	617	1.0	0.42	02/20/99	598	1.9	0.42	04/20/99	574	1.4	0.35	06/20/99	1570	5.4	1.3	08/20/99	1280	3.6	1.1
10/21/98	559	1.3	0.36	12/21/98	675	1.2	0.47	02/21/99	572	1.9	0.39	04/21/99	558	1.5	0.34	06/21/99	1600	5.7	1.3	08/21/99	1300	3.9	1.1
10/22/98	641	1.4	0.40	12/22/98	719	1.4	0.50	02/22/99	530	1.8	0.36	04/22/99	550	1.5	0.33	06/22/99	1590	6.0	1.3	08/22/99	1290	4.1	1.0
10/23/98	708	1.6	0.44	12/23/98	717	1.4	0.50	02/23/99	504	1.7	0.33	04/23/99	520	1.5	0.31	06/23/99	1580	6.3	1.3	08/23/99	1260	4.2	1.0
10/24/98	744	1.7	0.46	12/24/98	749	1.3	0.52	02/24/99	499	1.8	0.33	04/24/99	487	1.4	0.29	06/24/99	1520	6.2	1.2	08/24/99	1210	4.2	0.99
10/25/98	741	1.8	0.46	12/25/98	791	1.3	0.55	02/25/99	522	1.9	0.35	04/25/99	455	1.3	0.27	06/25/99	1490	5.8	1.2	08/25/99	1160	4.0	0.95
10/26/98	704	1.8	0.45	12/26/98	853	1.3	0.59	02/26/99	565	2.0	0.39	04/26/99	423	1.3	0.25	06/26/99	1440	5.2	1.1	08/26/99	1180	3.8	1.0
10/27/98	662	1.9	0.43	12/27/98	884	1.5	0.61	02/27/99	609	2.1	0.43	04/27/99	440	1.3	0.26	06/27/99	1390	4.6	1.1	08/27/99	1240	3.8	1.0
10/28/98	626	2.0	0.42	12/28/98	924	1.7	0.63	02/28/99	650	2.3	0.46	04/28/99	478	1.4	0.28	06/28/99	1360	4.3	1.1	08/28/99	1300	4.2	1.1
10/29/98	602	2.0	0.41	12/29/98	966	1.8	0.65	03/01/99	694	2.4	0.50	04/29/99	528	1.5	0.31	06/29/99	1330	4.2	1.0	08/29/99	1330	4.6	1.1
10/30/98	600	2.0	0.42	12/30/98	992	1.9	0.66	03/02/99	745	2.6	0.53	04/30/99	605	1.8	0.35	06/30/99	1360	4.4	1.1	08/30/99	1310	4.9	1.1
10/31/98	600	2.0	0.43	12/31/98	1000	1.7	0.66	03/03/99	789	2.7	0.57	05/01/99	670	2.2	0.39	07/01/99	1370	4.5	1.1	08/31/99	1260	5.3	1.1
11/01/98	606	1.7	0.43	01/01/99	1010	1.6	0.65	03/04/99	835	2.8	0.59	05/02/99	686	2.5	0.40	07/02/99	1410	4.6	1.2	09/01/99	1210	5.2	1.0
11/02/98	601	1.6	0.42	01/02/99	1020	1.7	0.66	03/05/99	841	2.7	0.60	05/03/99	669	2.6	0.39	07/03/99	1480	4.8	1.2	09/02/99	1160	5.0	0.93
11/03/98	593	1.5	0.41	01/03/99	1040	1.8	0.66	03/06/99	837	2.5	0.61	05/04/99	625	2.5	0.37	07/04/99	1500	4.8	1.2	09/03/99	1160	4.8	0.91
11/04/98	583	1.4	0.39	01/04/99	1050	1.9	0.66	03/07/99	841	2.4	0.61	05/05/99	572	2.3	0.34	07/05/99	1480	4.7	1.2	09/04/99	1160	4.4	0.89
11/05/98	581	1.4	0.39	01/05/99	1060	2.0	0.66	03/08/99	835	2.3	0.61	05/06/99	553	2.2	0.33	07/06/99	1430	4.5	1.2	09/05/99	1170	4.2	0.89
11/06/98	599	1.5	0.39	01/06/99	1070	2.0	0.67	03/09/99	848	2.4	0.63	05/07/99	561	2.1	0.33	07/07/99	1380	4.7	1.2	09/06/99	1190	4.2	0.91
11/07/98	636	1.7	0.41	01/07/99	1060	1.8	0.68	03/10/99	861	2.5	0.64	05/08/99	547	1.9	0.32	07/08/99	1330	4.8	1.1	09/07/99	1190	4.2	0.91
11/08/98	684	1.8	0.44	01/08/99	1060	1.7	0.68	03/11/99	881	2.7	0.65	05/09/99	536	1.8	0.31	07/09/99	1340	5.1	1.2	09/08/99	1180	4.0	0.90
11/09/98	722	1.8	0.46	01/09/99	1060	1.7	0.69	03/12/99	890	2.7	0.66	05/10/99	523	1.6	0.30	07/10/99	1330	5.3	1.2	09/09/99	1200	3.8	0.90
11/10/98	764	1.7	0.49	01/10/99	1050	1.7	0.69	03/13/99	907	2.7	0.67	05/11/99	528	1.5	0.31	07/11/99	1350	5.4	1.2	09/10/99	1210	3.6	0.88
11/11/98	801	1.7	0.51	01/11/99	1040	1.8	0.70	03/14/99	950	2.8	0.69	05/12/99	574	1.7	0.34	07/12/99	1360	5.3	1.2	09/11/99	1220	3.3	0.85
11/12/98	837	1.7	0.54	01/12/99	1040	1.9	0.71	03/15/99	992	2.8	0.72	05/13/99	604	1.8	0.37	07/13/99	1350	5.0	1.1	09/12/99	1200	3.2	0.82
11/13/98	877	1.8	0.57	01/13/99	1030	2.0	0.71	03/16/99	1060	3.0	0.78	05/14/99	632	1.8	0.39	07/14/99	1380	5.0	1.1	09/13/99	1150	3.0	0.77
11/14/98	904	1.8	0.59	01/14/99	1010	1.9	0.70	03/17/99	1120	3.2	0.84	05/15/99	650	1.8	0.40	07/15/99	1390	4.9	1.2	09/14/99	1110	2.8	0.73
11/15/98	929	1.8	0.61	01/15/99	1010	1.8	0.69	03/18/99	1140	3.4	0.87	05/16/99	706	1.9	0.43	07/16/99	1400	4.7	1.2	09/15/99	1060	2.6	0.70
11/16/98	953	1.7	0.63	01/16/99	1000	1.7	0.67	03/19/99	1170	3.5	0.87	05/17/99	811	2.1	0.50	07/17/99	1400	4.7	1.2	09/16/99	1060	2.6	0.72
11/17/98	978	1.7	0.64	01/17/99	980	1.7	0.66	03/20/99	1190	3.5	0.87	05/18/99	940	2.6	0.59	07/18/99	1370	4.4	1.2	09/17/99	1090	3.0	0.77
11/18/98	1000	1.8	0.66	01/18/99	982	1.9	0.65	03/21/99	1220	3.5	0.87	05/19/99	1070	3.2	0.68	07/19/99	1330	4.2	1.1	09/18/99	1130	3.1	0.81
11/19/98	1020	1.8	0.67	01/19/99	985	2.0	0.65	03/22/99	1250	3.5	0.89	05/20/99	1140	3.5	0.73	07/20/99	1310	4.3	1.1	09/19/99	1150	3.3	0.83
11/20/98	1030	1.7	0.68	01/20/99	979	1.9	0.66	03/23/99	1280	3.6	0.93	05/21/99	1180	3.6	0.76	07/21/99	1290	4.3	1.1	09			

San Joaquin River at Crows Landing (STC504S)

WY 2000

Location: Latitude 37 25 55, Longitude 121 04 42. T.6S, R.8E. West bank, 100 yards south of Crows Landing Road Bridge, 4.2 miles NE of Crows Landing, River Mile 107.1

AUTOSAMPLER DATA: 24 hour composite samples; 4-DAY AVERAGES

Date	EC umhos/cm	Se ug/L	B mg/L																				
10/01/99	529	0.8	0.36	12/01/99	1230	2.0	0.83	02/01/00	1140	1.7	0.86	04/01/00	1260	2.9	0.9	06/01/00	1240	3.6	0.92	08/01/00	1140	3.8	0.9
10/02/99	691	1.2	0.46	12/02/99	1230	2.0	0.83	02/02/00	1240	1.7	0.92	04/02/00	1290	3.0	0.9	06/02/00	1270	3.8	0.94	08/02/00	1100	3.6	0.9
10/03/99	855	1.6	0.57	12/03/99	1230	1.9	0.84	02/03/00	1320	1.8	0.99	04/03/00	1300	3.1	0.9	06/03/00	1270	3.8	0.93	08/03/00	1100	3.4	0.9
10/04/99	1000	1.9	0.68	12/04/99	1230	1.8	0.84	02/04/00	1410	2.0	1.07	04/04/00	1320	3.1	0.9	06/04/00	1280	3.9	0.92	08/04/00	1160	3.5	1.0
10/05/99	1010	2.0	0.71	12/05/99	1240	1.7	0.84	02/05/00	1490	2.2	1.13	04/05/00	1360	3.2	0.9	06/05/00	1300	3.8	0.92	08/05/00	1220	3.7	1.1
10/06/99	1040	2.1	0.76	12/06/99	1250	1.8	0.84	02/06/00	1540	2.4	1.20	04/06/00	1350	3.3	0.9	06/06/00	1320	3.9	0.94	08/06/00	1230	3.6	1.1
10/07/99	1040.0	2.1	0.79	12/07/99	1260	1.7	0.83	02/07/00	1590	2.6	1.25	04/07/00	1370	3.7	1.0	06/07/00	1330	4.1	0.96	08/07/00	1230	3.8	1.0
10/08/99	1050.0	2.1	0.80	12/08/99	1280	1.8	0.83	02/08/00	1620	2.8	1.30	04/08/00	1370	3.8	1.0	06/08/00	1320	4.3	0.98	08/08/00	1170	3.6	1.0
10/09/99	1040.0	2.1	0.79	12/09/99	1300	1.8	0.83	02/09/00	1640	3.0	1.35	04/09/00	1390	3.8	0.97	06/09/00	1280	4.5	0.96	08/09/00	1100	3.3	0.9
10/10/99	1020.0	2.0	0.76	12/10/99	1310	1.9	0.83	02/10/00	1660	3.3	1.38	04/10/00	1410	4.0	0.98	06/10/00	1220	4.3	0.93	08/10/00	1070	3.2	0.9
10/11/99	1000.0	1.8	0.74	12/11/99	1310	2.1	0.83	02/11/00	1670	3.8	1.38	04/11/00	1420	4.0	0.97	06/11/00	1200	4.3	0.9	08/11/00	1080	3.1	0.9
10/12/99	1020.0	1.7	0.75	12/12/99	1310	2.3	0.84	02/12/00	1660	4.0	1.33	04/12/00	1440	4.0	0.97	06/12/00	1180	4.4	0.9	08/12/00	1110	3.3	0.9
10/13/99	1070.0	1.8	0.80	12/13/99	1320	2.3	0.84	02/13/00	1560	3.8	1.20	04/13/00	1460	4.1	1.01	06/13/00	1160	4.6	0.9	08/13/00	1140	3.4	1.0
10/14/99	1120.0	1.8	0.85	12/14/99	1330	2.2	0.84	02/14/00	1310	3.2	0.95	04/14/00	1500	3.9	1.04	06/14/00	1160	5.0	1.0	08/14/00	1130	3.3	0.9
10/15/99	1180.0	1.9	0.87	12/15/99	1330	2.1	0.86	02/15/00	1010	2.3	0.70	04/15/00	1530	3.7	1.05	06/15/00	1170	5.1	1.0	08/15/00	1100	3.1	0.9
10/16/99	1170	1.8	0.85	12/16/99	1340	2.2	0.87	02/16/00	691	1.6	0.46	04/16/00	1530	3.7	1.05	06/16/00	1200	5.0	1.0	08/16/00	1080	2.9	0.9
10/17/99	1080	1.5	0.78	12/17/99	1350	2.2	0.88	02/17/00	445	1.2	0.29	04/17/00	1460	3.5	0.99	06/17/00	1250	4.8	1.0	08/17/00	1070	2.6	0.9
10/18/99	944	1.1	0.67	12/18/99	1360	2.2	0.89	02/18/00	375	1.0	0.24	04/18/00	1330	3.6	0.92	06/18/00	1280	4.5	1.0	08/18/00	1100	2.5	0.9
10/19/99	811	0.9	0.57	12/19/99	1380	2.4	0.90	02/19/00	357	0.9	0.23	04/19/00	1200	3.7	0.86	06/19/00	1260	4.2	1.0	08/19/00	1150	2.5	0.9
10/20/99	703	0.7	0.49	12/20/99	1390	2.3	0.90	02/20/00	386	1.0	0.26	04/20/00	1050	3.5	0.77	06/20/00	1230	3.9	1.0	08/20/00	1190	2.7	0.9
10/21/99	639	0.7	0.44	12/21/99	1390	2.6	0.90	02/21/00	425	1.0	0.29	04/21/00	888	3.2	0.65	06/21/00	1200	3.8	0.9	08/21/00	1210	3.1	1.0
10/22/99	633	0.7	0.43	12/22/99	1390	2.7	0.89	02/22/00	455	1.1	0.32	04/22/00	748	2.8	0.55	06/22/00	1170	3.6	0.9	08/22/00	1180	3.1	1.0
10/23/99	666	0.8	0.45	12/23/99	1400	2.6	0.88	02/23/00	479	1.2	0.34	04/23/00	633	2.3	0.45	06/23/00	1240	3.9	1.0	08/23/00	1140	3.1	1.0
10/24/99	704	0.9	0.47	12/24/99	1410	2.5	0.88	02/24/00	491	1.0	0.35	04/24/00	545	1.9	0.37	06/24/00	1300	4.2	1.1	08/24/00	1090	3.1	0.92
10/25/99	740	1.1	0.48	12/25/99	1430	2.4	0.90	02/25/00	483	1.1	0.34	04/25/00	531	1.7	0.35	06/25/00	1350	4.3	1.1	08/25/00	1060	2.6	0.85
10/26/99	786	1.2	0.51	12/26/99	1440	2.5	0.90	02/26/00	463	1.0	0.32	04/26/00	516	1.6	0.33	06/26/00	1360	4.3	1.2	08/26/00	1090	2.5	0.9
10/27/99	813	1.2	0.52	12/27/99	1450	2.5	0.91	02/27/00	466	0.9	0.33	04/27/00	508	1.7	0.33	06/27/00	1280	3.9	1.1	08/27/00	1100	2.3	0.9
10/28/99	838	1.3	0.53	12/28/99	1470	2.9	0.91	02/28/00	483	0.9	0.34	04/28/00	503	1.7	0.32	06/28/00	1230	3.6	1.0	08/28/00	1090	2.3	0.9
10/29/99	867	1.4	0.55	12/29/99	1480	2.9	0.91	02/29/00	484	1.0	0.34	04/29/00	506	1.8	0.32	06/29/00	1220	3.5	1.0	08/29/00	1090	2.5	0.9
10/30/99	878	1.5	0.56	12/30/99	1490	2.9	0.92	02/30/00	474	1.0	0.33	04/30/00	512	1.8	0.33	06/30/00	1220	3.5	1.0	08/30/00	1060	2.5	0.9
10/31/99	890	1.6	0.57	12/31/99	1490	2.9	0.92	03/01/00	474	1.0	0.33	05/01/00	511	1.8	0.32	07/01/00	1270	3.6	1.1	08/31/00	1060	2.7	0.9
11/01/99	908	1.8	0.59	01/01/00	1490	2.5	0.92	03/02/00	450	1.0	0.31	05/02/00	514	1.8	0.32	07/02/00	1320	4.0	1.1	09/01/00	1090	3.0	0.9
11/02/99	930	1.9	0.62	01/02/00	1460	2.4	0.91	03/03/00	424	1.0	0.29	05/03/00	549	1.9	0.34	07/03/00	1300	4.2	1.1	09/02/00	1110	3.1	0.88
11/03/99	947	2.0	0.63	01/03/00	1430	2.4	0.90	03/04/00	439	1.0	0.31	05/04/00	617	2.1	0.39	07/04/00	1260	4.2	1.1	09/03/00	1100	3.2	0.87
11/04/99	957	1.9	0.63	01/04/00	1410	2.3	0.90	03/05/00	493	1.1	0.34	05/05/00	695	2.3	0.44	07/05/00	1220	4.2	1.0	09/04/00	1050	3.1	0.82
11/05/99	974	1.8	0.64	01/05/00	1410	2.3	0.90	03/06/00	528	1.2	0.36	05/06/00	785	2.6	0.50	07/06/00	1130	3.8	0.9	09/05/00	974	2.6	0.75
11/06/99	983	1.6	0.64	01/06/00	1420	2.3	0.91	03/07/00	522	1.2	0.35	05/07/00	847	2.9	0.56	07/07/00	1080	3.5	0.9	09/06/00	935	2.6	0.71
11/07/99	994	1.6	0.64	01/07/00	1450	2.2	0.91	03/08/00	491	1.2	0.32	05/08/00	849	3.0	0.57	07/08/00	1090	3.6	0.9	09/07/00	940	2.8	0.72
11/08/99	1010	1.5	0.65	01/08/00	1460	2.3	0.92	03/09/00	454	1.1	0.30	05/09/00	829	3.0	0.56	07/09/00	1110	3.7	0.9	09/08/00	977	3.2	0.75
11/09/99	997	1.2	0.64	01/09/00	1460	2.3	0.91	03/10/00	429	1.1	0.28	05/10/00	800	2.9	0.55	07/10/00	1130	3.8	0.9	09/09/00	1030	3.5	0.78
11/10/99	NA	NA	NA	01/10/00	1460	2.4	0.90	03/11/00	419	1.1	0.27	05/11/00	765	2.6	0.52	07/11/00	1140	3.9	0.9	09/10/00	1050	3.6	0.78
11/11/99	NA	NA	NA	01/11/00	1450	2.5	0.90	03/12/00	432	1.1	0.27	05/12/00	751	2.5	0.51	07/12/00	1130	3.9	0.9	09/11/00	1050	3.7	0.75
11/12/99	1020	2.1	0.70	01/12/00	1460	2.4	0.90	03/13/00	443	1.1	0.27	05/13/00	737	2.4	0.49	07/13/00	1130	4.1	0.9	09/12/00	1010	3.5	0.70
11/13/99	1010	1.8	0.69	01/13/00	1480	2.4	0.92	03/14/00	456	1.1	0.28	05/14/00	736	2.3	0.49	07/14/00	1140	4.2	0.9	09/13/00	954	3.2	0.62
11/14/99	1020	1.7	0.68	01/14/00	1490	2.3	0.93	03/15/00	488	1.1	0.31	05/15/00	776	2.4	0.50	07/15/00	1160	4.4	0.9	09/14/00	903	2.9	0.57
11/15/99	1030	1.7	0.69	01/15/00	1490	2.2	0.94	03/16/00	508	1.1	0.33	05/16/00	832	2.6	0.52	07/16/00	1180	4.9	1.0	09/15/00	861	2.4	0.51
11/16/99	1040	1.5	0.69	01/16/00	1480	2.1	0.92	03/17/00	538	1.1	0.36	05/17/00	894	2.6	0.55	07/17/00	NA	NA	NA	09/16/00	854	2.0	0.48
11/17/99	1070	1.6	0.70	01/17/00	1440	2.0	0.90	03/18/00	577	1.2	0.40	05/18/00	933	2.5	0.57	07/18/00	NA	NA	NA	09/17/00	875	1.8	0.47
11/18/99	1100	1.6	0.71	01/18/00	1410	2.0	0.88	03/19/00	606	1.2	0.42	05/19/00	944	2.3	0.58	07/19/00	NA	NA	NA	09/18/00	895	1.7	0.48
11/19/99	1120	1.6	0.72	01/19/00	1390	2.1	0.87	03/20/00	632	1.3	0.45	05/20/00	939	2.0	0.58	07/20/00	NA	NA	NA	09/19/00	907	1.6	0.50
11/20/99	1140	1.6	0.75	01/20/00	1370	2.1	0.87	03/21/00	632	1.3	0.46												

