

CALIFORNIA REGIONAL WATER QUALITY CONTROL BBOARD
CENTRAL VALLEY REGION

Board Members

Paul E. Simpson, Chair
Clifford C. Wisdom, Vice Chair
Karen Vercrease
John S. Corkins
Hugh V. Johns
W. Steve Tompkins
W. M. "Walt" Winn

William H. Crooks, Executive Officer

The staff involved in the
preparation of this report are:

Kathryn K. Belden, Geology Assistant
D. W. Westcot, Senior Land and Water Use Analyst
R. I. Waters, Geology Assistant

Special thanks to the field sampling crew: E.W.James, Engineering Geologist;
R.R.Thomasson, Engineering Assistant; L. F. Pratt, Associate Land and
Water Use Analyst

TABLE OF CONTENTS

	<u>Page</u>
INTRODUCTION	1
STUDY AREA	1
METHODS	3
RESULTS	6
REFERENCES	8
APPENDIX A	
Summary of Constituent Ranges for U.S. Bureau of Reclamation Water Quality Data	22
U.S. Bureau of Reclamation Water Quality Data for Selected Monitoring Sites	23

LIST OF TABLES

Table 1	Drainage Flow Monitoring Sites In Western San Joaquin County	3
Table 2	Summary of Selected Constituent Ranges For Drainage Flow Monitoring Sites That Flow Into The San Joaquin River and Delta From Western San Joaquin County	7
Table 3	Water Quality Data For Drainage Monitoring Sites That Flow Into The San Joaquin River and Delta From Western San Joaquin County	9

LIST OF FIGURES

Figure 1	Zone Location Map of Drainage Monitoring Sites That Flow Into The San Joaquin River and Delta From Western San Joaquin County	2
Figure 2	Location Map of Zone 1 Monitoring Sites	4
Figure 3	Location Map of Zones 2 and 3 Monitoring Sites	5

INTRODUCTION

The Agricultural Unit of the Central Valley Regional Water Quality Control Board (Regional Board) initiated a water quality monitoring program in April 1986 to evaluate the effects of subsurface agricultural drainage water discharges from Western San Joaquin County on the Western Delta Sloughs and the San Joaquin River water quality. The study area is agricultural land located on the western side of the San Joaquin River within western San Joaquin County. The purpose of this monitoring program was to compile a data base for selected inorganic constituents found in the agricultural drains that are discharging into the Delta and San Joaquin River. This data base will be used in the development and evaluation of the need for an agricultural drainage reduction program.

The majority of the subsurface agricultural drainage pollutant load is discharged to the San Joaquin River via Mud Slough (north) and Salt Slough in Merced County (James et al., 1988a and 1988b, Westcot et al., 1989a and Chilcott et al., 1989). The impact of these discharges, however, is highly modified by numerous surface discharges downstream of these two sloughs. The importance of these downstream discharges is manifested by the finding that the majority of the San Joaquin River from Salt Slough and Mud Slough (north) inflows downstream to Vernalis in many months of the year is made up entirely of agricultural return flows.

The San Joaquin River is thus highly modified by the time it reaches the Delta. The river is further modified in the Delta by localized extractions and discharges. The main influences on the San Joaquin River flow in the Delta are the U.S. Bureau of Reclamation and State Water Project extraction pumps located near Tracy. The majority of the river flow returns to these pumps. The quality of the San Joaquin River is also influenced by localized subsurface drainage water discharges upstream and downstream of the project extraction pumps. Little information is available on the quality and magnitude of these localized discharges.

The most significant discharges occur from the western side of the San Joaquin River in both San Joaquin County and Contra Costa County. A previous report detailed the characteristics of drainage water entering from the eastern portion of Contra Costa County (Westcot et al., 1989c). The objective of this study is to characterize the discharges known to enter the San Joaquin River from the western portion of San Joaquin County. The goal is to develop a data base that can be used in assessing beneficial use impairment and to determine whether there is a need for regulatory actions.

STUDY AREA

The study area consists of the western portion of San Joaquin County that drains into the San Joaquin River and Delta waterways (Figure 1). Drainage discharges occur throughout the southern uplands section of the South Delta Area (Department of Water Resources, 1987) and many of these discharges find their way to the lower section of the San Joaquin River which extends from approximately the Delta-Mendota Canal Intake near the Contra Costa County line south to Greenwood Road near the Stanislaus County line. Major portions of the irrigated land within this area have subsurface drainage systems.

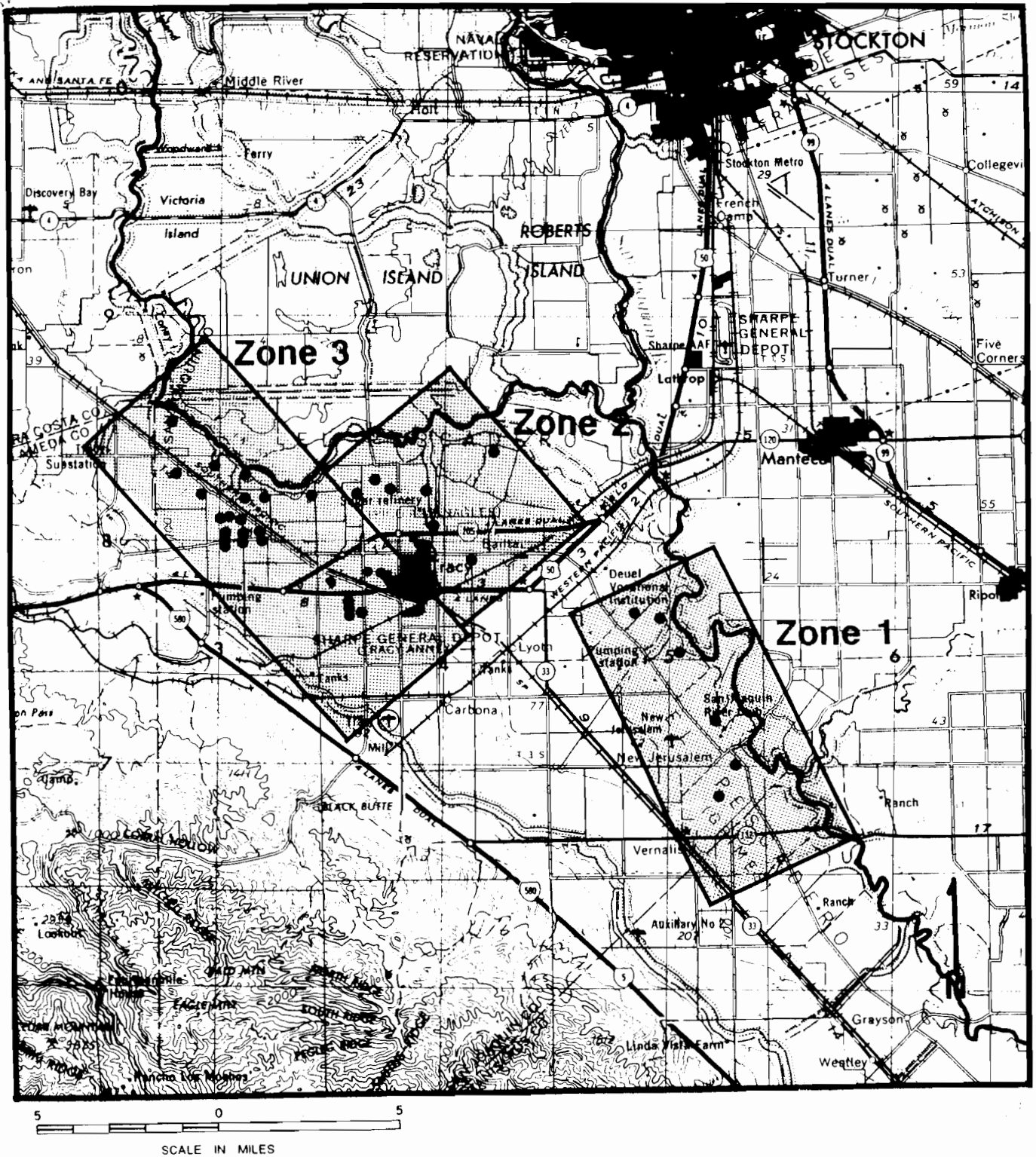


Figure 1. Zone Location Map of Drainage Monitoring Sites That Flow Into The San Joaquin River and Delta From Western San Joaquin County.

The study area was divided into three zones determined by localized water distribution and management influences. Zone 1 is influenced by the New Jerusalem Drainage District and discharges directly to the San Joaquin River upstream of the Mossdale Bridge at Interstate 5 Highway. Zone 2 is influenced by the Delta sloughs while Zone 3 is influenced by the west side Coast Range streams. Both Zones 2 and 3 discharge to Old River Channel in the Delta.

Monitoring sites and their locations are listed in Table 1 and shown on Figures 2 and 3. Water quality monitoring was conducted on all of these sites.

Table 1. Drainage flow monitoring sites in Western San Joaquin County

Zone 1. Southern Sites	Zone 3. Northwestern Sites
SJC001 New Jerusalem Tile Drain	SJC003 Grant Line Road Tile Drain Sump
* SJC028 Crichton Road Drain	SJC004 Bethany/Lammers Tile Drain
SJC029 Wright Road Collector Drain	SJC005 Patterson Pass Road Tile Drain
* SJC030 Yasui Surface Drain	SJC006 Moitoso Tile Drain
SJC031 Yasui (Fisk) Ranch Tile Drain	SJC007 Krohn Road Drain
* SJC042 San Joaquin River Club	SJC008 Pimentel Tile Drain
	SJC010 Westside Irrigation District Main Drain
	SJC013 Costa Brothers East Tile Drain
	SJC014 Costa Brothers West Tile Drain
	SJC015 Castro Tile Drain
	SJC016 Earp Tile Drain
	SJC017 Freeman Tile Drain
	SJC018 Costa Tile Drain
	SJC019 Moitoso and Castro Tile Drain
	SJC022 City of Tracy Tile Drain
	* SJC032 Kelso Road Drain
	SJC033 Mountain House Creek
	* SJC034 Westside Irrigation District Disch. Pump
	* SJC035 Naglee/Burk Pump # 6
	SJC036 Kelso Road/Byron Hwy Tile Drain Sump
	SJC037 Spirow Nicholaw Tile Drain
	SJC038 JM Laurence Jr. East Tile Drain
	SJC039 JM Laurence Jr. West Tile Drain
	SJC040 Sequeira Tile Drain
	SJC041 Reeve Road Tile Drain

* Sites with tailwater drainage, not used in statistical calculations.

METHODS

The study was initiated in April 1986 and periodic sampling was conducted through the end of May 1988. The frequency of sample collection for this monitoring program varied but generally grab samples were collected monthly during the irrigation season. Additional samples were taken at selected times during the nonirrigation season. This sampling frequency was supplemented by sampling at selected sites by other agencies (Appendix A).

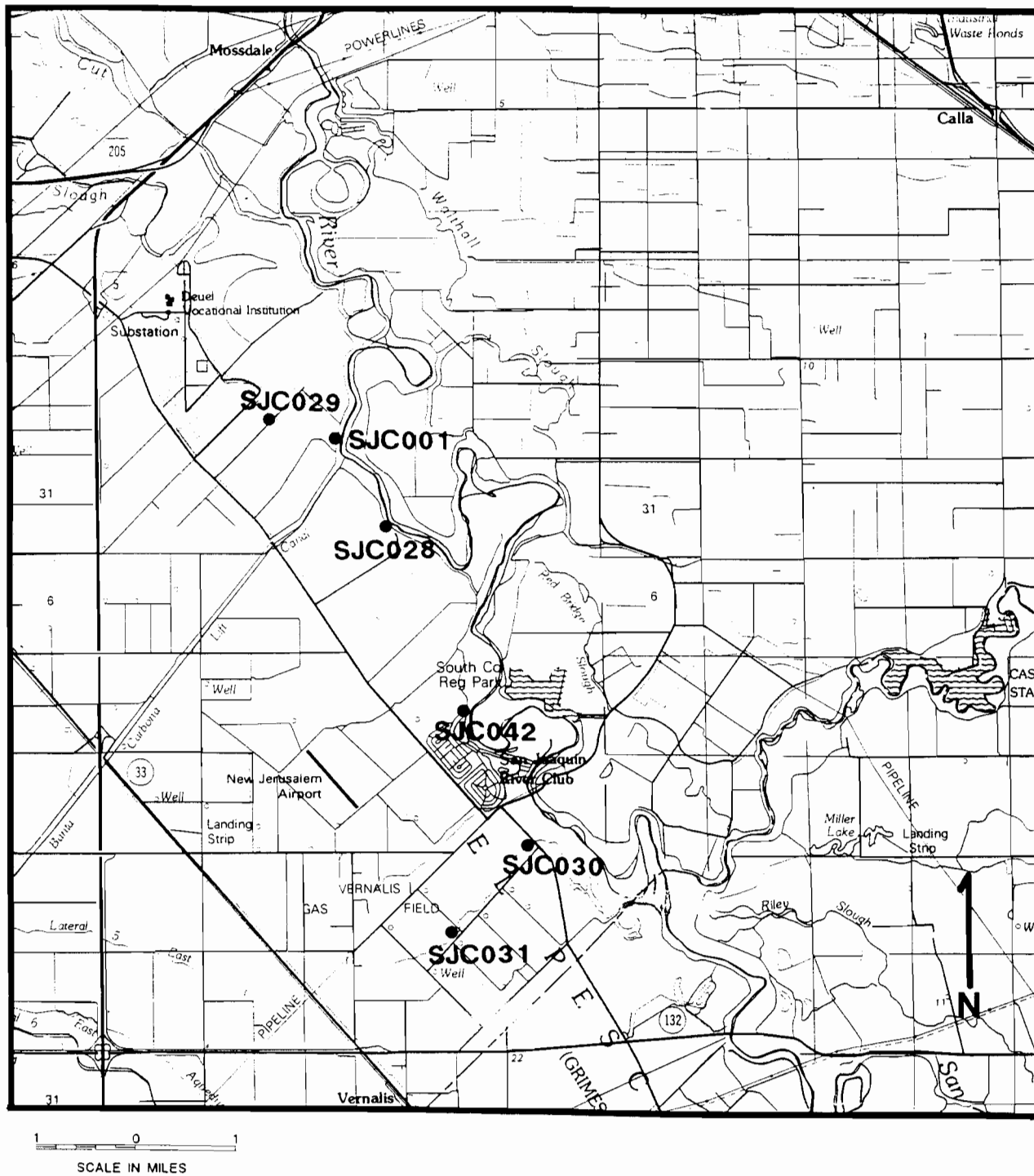


Figure 2. Location Map of Zone 1 Monitoring Sites.

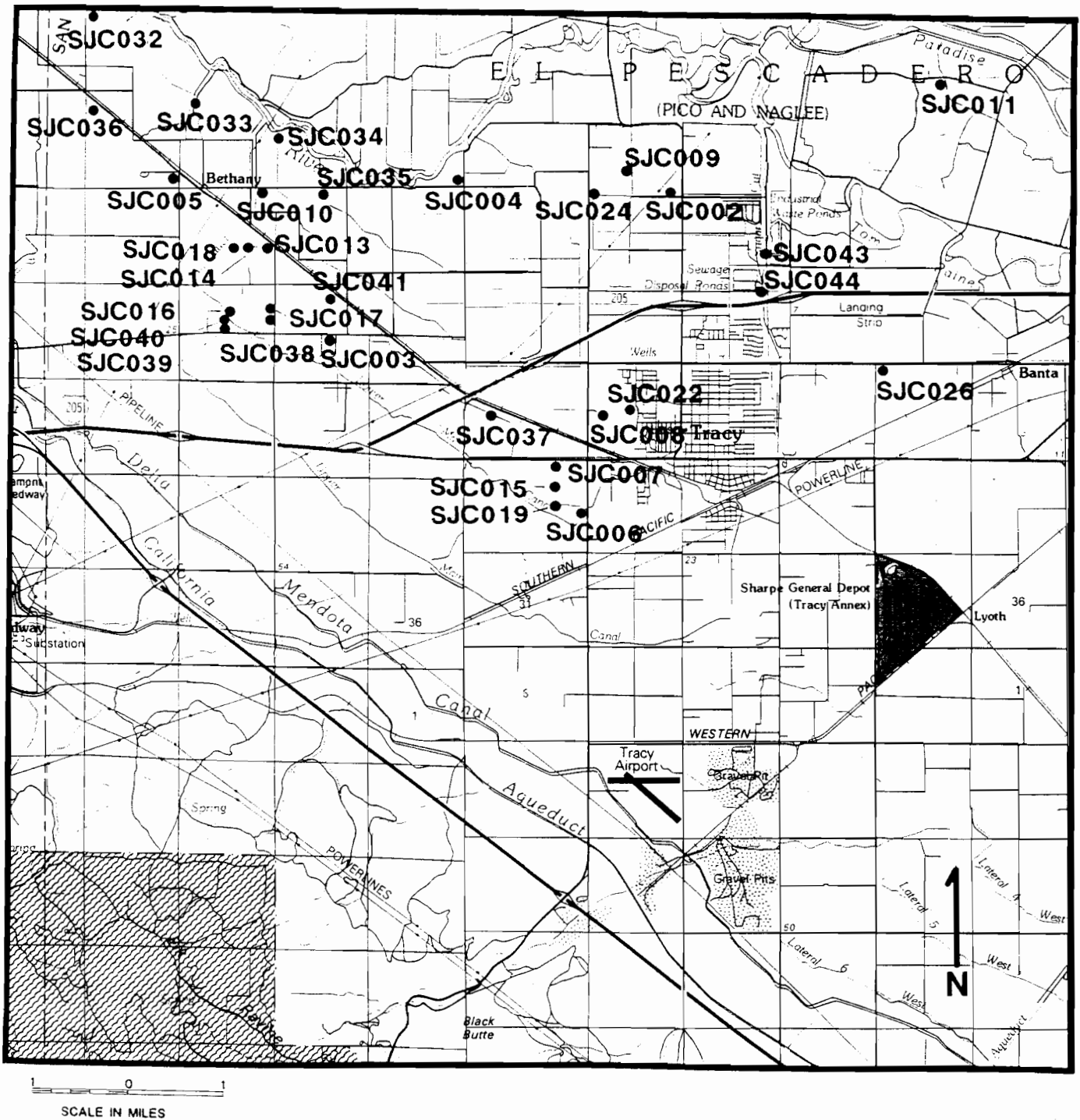


Figure 3. Location Map of Zones 2 and 3 Monitoring Sites.

All samples were analyzed for total recoverable selenium, boron, chloride, sulfate, total alkalinity and electrical conductivity (EC). Selected sites during 1986 were tested for total recoverable copper, chromium, lead, mercury, molybdenum, nickel, and zinc. Water temperature, pH, EC and sample time were recorded in the field at each site. All samples were collected in polyethylene bottles. All sample bottles were washed and acid rinsed in the laboratory prior to use and rinsed three times with water to be sampled prior to sample collection. Selenium and other trace element samples were preserved by lowering the pH to less than 2 using ultra-pure nitric acid fixation techniques. All samples were kept on ice until preservation or submittal to the laboratory for analysis.

A quality control and quality assurance program was conducted utilizing spike and duplicate samples in the laboratory. Blind replicate samples were collected at 10 percent of the sites and 50 percent of the blind replicates were spiked for laboratory quality assurance. All reported results fall within the quality assurance tolerance guidelines.

RESULTS

Concentrations of the measured constituents varied between discharge sites, time of year, and between years. Median values for selected constituents are listed in Table 2. Water quality for the individual sites and sampling dates are given in Table 3. The median salinity (EC) was 2,500 $\mu\text{mhos/cm}$ for Zone 1, 2,600 $\mu\text{mhos/cm}$ for Zone 2, and 2,300 $\mu\text{mhos/cm}$ for Zone 3. This compares with a median EC of 6,100 $\mu\text{mhos/cm}$ for drains coming from the Panoche Fan area (Chilcott et al., 1988). The median boron concentration was highest in Zone 3 (3.0 mg/L) and lowest in Zone 2 (1.5 mg/L). These compare with a median of 7.9 mg/l from subsurface drains in the Panoche Fan area (Chilcott et al., 1988). The overall median boron concentrations (2.5 mg/L) are approximately equal to those reported in the Contra Costa County area (2.8 mg/L) (Chilcott et al., 1988 and Westcot et al., 1989c) but are higher than drains in the western Stanislaus County area (1.5 mg/L) (Westcot et al., 1989). Boron has been known to cause crop toxicity problems in this area and even though subsurface drains have been in operation for over 20 years, boron concentrations continue to be high. The median chloride concentrations for Zones 1, 2, and 3 were 350 mg/L, 360 mg/L, and 390 mg/L respectively and with an overall median concentration of 380 mg/l for all zones. This compares to a median concentration of 2400 mg/l for drains coming from the Panoche Fan area (Chilcott et al., 1988) and 270 mg/L for the western Stanislaus County (Westcot et al., 1989). The median sulfate concentrations for Zones 1, 2, and 3 were 480 mg/L, 352 mg/L, 320 mg/L respectively and with an overall median concentration of 360 mg/L for all zones. This compares to the significantly higher median concentration of 2336 mg/L for drains coming from the Panoche Fan area (Chilcott et al., 1988) and is similar to the median value of 340 mg/L for the western Stanislaus County (Westcot et al., 1989).

Selenium concentrations from the monitored sites are low. Median selenium concentrations for Zones 1, 2, and 3 were 4.6, 1.6, and 2.1 $\mu\text{g/L}$ respectively and with an average median concentration of 2.3 $\mu\text{g/L}$ for the entire study area. Although total recoverable selenium varied from 0.4 to 13.5 $\mu\text{g/L}$, the

concentrations did not vary seasonally. The 4.6 $\mu\text{g/L}$ found in Zone 1 compares well with the median concentration of 5 $\mu\text{g/L}$ found by the U.S. Bureau of Reclamation for the New Jerusalem Tile Drain (SJC001) (U.S.B.R., 1987, U.S.B.R., 1989) This site represents drainage from approximately 11,000 acres of land in Zone 1. The median concentration for the Panoche Fan area was 120 $\mu\text{g/L}$ and 2 $\mu\text{g/L}$ for western Stanislaus County (Chilcott et al., 1988). Concentrations of other trace elements (Mo, Cr, Cu, Ni, Pb, and Zn) are also low and continue to follow the general pattern suggested by Chilcott et al., 1988. Seasonal variability was not notable.

Table 2. Summary of selected constituent ranges for drainage monitoring sites that flow into the San Joaquin River and Delta from Western San Joaquin County.

		EC	B	Cl	SO ₄	Ca	Mg	Na	K	Total		
		umhos/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Alkalinity	Hardness	TDS
										mg/L	mg/L	mg/L
Zone 1	Minimum	1730	1.2	190	200					96		
	Median	2500	2.8	350	480					280		
	Maximum	9400	15	1720	300					450		
	Data Count	15	19	19	17					13		
Zone 2	Minimum	1500	0.2	200	150	186	99	284	0.4	76	850	1800
	Median	2800	1.5	360	352	280	198	474	0.9	290	1500	2800
	Maximum	6850	5.1	1430	1250	445	282	561	2.0	520	240	4200
	Data Count	27	38	38	34	3	3	3	3	27	3	3
Zone 3	Minimum	410	0.4	43	31	28	16	89	1.0	72	120	440
	Median	2550	3.0	390	320	79	44	310	2.2	300	293	1275
	Maximum	4000	9.4	1100	110	129	68	351	9.0	510	590	1500
	Data Count	80	110	110	96	4	4	4	4	76	4	4
Total of all Zones	Minimum	410	0.2	43	31	28	16	89	0.4	72	120	440
	Median	2600	2.5	380	360	129	68	350	1.4	290	590	1500
	Maximum	9400	15	1720	3000	445	282	561	9.0	520	2400	4200
	Data Count	122	167	167	147	7	7	7	7	116	7	7

		Se	Mo	Cu	Cr	Ni	Pb	Zn	Hg
		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Zone 1	Minimum	2.0	<5	<1	<1	<5	<5	<1	<0.5
	Median	4.6	17	1	5	<5	<5	<1	<0.5
	Maximum	13.5	35	6	26	<5	<5	1	<0.5
	Data Count	13	6	6	6	6	6	6	5
Zone 2	Minimum	0.4	<5	<1	<1	<5	<5	<1	<0.5
	Median	1.6	6	<1	<1	<5	<5	<1	<0.5
	Maximum	3.5	82	61	14	15	<5	74	1
	Data Count	17	18	18	18	18	18	18	22
Zone 3	Minimum	0.5	<5	<1	<1	<1	<1	<1	<0.5
	Median	2.1	<5	<1	<1	<5	<5	<1	<0.5
	Maximum	6.3	30	70	12	32	21	70	1
	Data Count	52	56	56	56	56	56	56	39
Total of all Zones	Minimum	0.4	<5	<1	<1	<5	<5	<1	<0.5
	Median	2.3	<5	<1	<1	<5	<5	<1	<0.5
	Maximum	13.5	82	70	26	32	21	74	1
	Data Count	82	80	80	80	80	80	80	66

The median concentration of selenium in Zone 1 (4.6 $\mu\text{g/L}$) warrants further periodic monitoring as the U.S. Environmental Protection Agency criterion for the protection of freshwater aquatic life is 5 $\mu\text{g/L}$.

REFERENCES

- California Department of Water Resources, 1987. Sacramento-San Joaquin Delta Atlas, 71 pages.
- Chilcott, J.E., Westcot, D.W., Belden, K.K., and O'Conner, K.A., 1989. Agricultural Drainage Contribution to Water Quality in the Grassland Area of Western Merced County, California: October 1987 through September 1988. Central Valley Regional Water Quality Control Board Report, 46 pages.
- Chilcott, J.E., Westcot, D.W., Werner, K., and Belden, K.K., 1988. Water Quality Survey of Tile Drainage Discharges in the San Joaquin River Basin. Central Valley Region Water Quality Control Board Report, 65 pages.
- James, E.W., Westcot, D.W., Grewell, B.J., Belden, K.K., Boyd, T.F., Waters, R.I., and Thomasson, R.R., 1988a. Agricultural Drainage contribution to Water Quality in the Grassland Area of Western Merced County, California. Central Valley Region Water Quality Control Board Report, 169 pages.
- James, E.W., Westcot, D.W., Grewell, B.J., Belden, K.K., and Boyd, T.F., 1988b. Water Quality of the Lower San Joaquin River: Lander Avenue to Vernalis, May 1985 to March 1988. Central Valley Region Water Quality Control Board Report, 95 pages.
- United States Bureau of Reclamation, 1987. Water Quality Analyses, West Side-San Joaquin Valley, January 1987.
- United States Bureau of Reclamation, 1989. Unpublished data per John Fields, Mid Pacific Region, 16 May, 1989.
- Westcot, D.W., Grewell, B.J., and Belden, K.K., 1989a. Water Quality of the Lower San Joaquin River: Lander Avenue to Mossdale Bridge, October 1987 to September 1988. Central Valley Regional Water Quality Control Board Report, 46 pages.
- Westcot, D.W., James, E.W., Waters, R.I., and Thomasson, R.R., 1989b. Quality of Agricultural Drainage Discharging to the San Joaquin River from the Western Portion of Stanislaus County, California. April 1985 to October 1988. Central Valley Region Water Quality Control Board Report, 122 pages.
- Westcot, D.W., Pratt, L.F. and Belden, K.K., 1989c. Quality of Agricultural Drainage Discharging to the San Joaquin River and Delta From the Eastern Portion of Contra Costa County, California. December 1985 to September 1987. Central Valley Regional Water Quality Control Board Report, 17 pages.