From: Dennis Westcot
To: glenn hoffman
CC: Mark Gowdy
Date: 10/7/2009 9:00 PM
Subject: Re: Drainage Effluent in Western San Joaquin County
Attachments: Evaluation of Table 1.doc; Data Files for Tile Drains in San Joaquin County .xls; WQ survey of tile drainage discharge in the SJR dated 1988.pdf

Glenn:

I think I have answers to all your questions.

You asked: As I review the information you sent to me, I notice in Table 1 on page 3 of the "Quality of Agricultural Drainage Discharging to the San Joaquin River and Delta from the Western Portion of San Joaquin County, CA, April, 1986 to May, 1988" many drains that I was not aware of before. Is it true that drains listed in my Table 3.10 are the same as those listed in Table 1 by the same number?
Answer: The drains you have listed in Table 3.10 are the same as those listed in Table 1 on page 3 of the report we provided you but Table 1 contains more drains than listed in Table 3.10. The difference in designations developed when the legislature wanted a quick look at all tile drains to see if they were discharging selenium. The westside was broken up into seven (7) zones and the site numbers were assigned based on the zone the drain was in. Western San Joaquin County was in Zone "C" and thus the "C" before the site number as you show in your Table 3.10. The site numbers were then changed to designate the County the drain discharge was in. Thus the site numbers became "SJC" for San Joaquin County. All the data from both designation came from the same site.

You asked: Besides some of the drains that you identify as receiving tailwater drainage (irrigation return flow?) there are other drains in Table 1 that I did not include in my Table 3.10. Will you verify which of these drains are subsurfave drains only and that all of them are in the South Delta.

Answer: I have attached a Table entitled "Evaluation of Drainage Flow Monitoring Sites in Western San Joaquin County Shown in Table 1" which shows the drains that are subsurface tile drains and those that may be compromised by tailwater or other sources. In addition, for those that are considered tile drains, I have sent you by mail a copy of your Figure 3.18 with these drains marked on it. All of the drains that you previously had marked on Figure 3.18 are tile drains and not compromised by tailwater or other sources. The reason I am sending it by mail is that it would not scan well and would likely be difficult to read.

You asked: It is not clear to me from Table 1 if the effluent is only from subsurface drains. Also if some of the drains are not from agriculture, like perhaps San Joaquin River Club, I need to know this so the data are not included in my report.

Answer: The attached Table entitled "Evaluation of Drainage Flow Monitoring Sites in Western San Joaquin County Shown in Table 1" shows the drains that are subsurface tile drains and those that may be compromised by tailwater or other sources.

You asked: In addition, data for drain EC is given from 1977 to 1984 and from 2001 to 2006 for New Jerusalem. I would like to use these data in my report. How do I reference the report(s) containing these data?

Answer: I can see the confusion that may develop trying to understand all the various data sources as many agencies were monitoring and reporting their results. A brief history may help. Initial monitoring of the New Jerusalem Drainage District began shortly after the District began operation in the early 70s. This was done on a yearly basis (that is the data we provided you on page 5 of the attachment to our comments).

Beginning in 1982, the USBR began monitoring representative tile and collector drainage systems to get a better perspective on what the quality of drainage would be that was discharged to a master drain out of

the valley. Their effort was to develop the design and environmental documents necessary to build the drain out of the valley. That effort continued until the mid-1980s when selenium was found at Kesterson Reservoir and all work on a drain out of the valley was stopped. The data remained with the USBR but it was given to the Regional Board and was put in the 1988 report by Jeanne Chilcott. The representative drains they used in San Joaquin County were the Grant Line Road Drain Sump, the Tracy Blvd Tile Drain Sump and the New Jerusalem Drainage District outlet. Each of these represented a different area of San Joaquin County.

After the discovery of selenium, the Regional Board and water districts began a quick synoptic survey of drainage systems to see if other systems were discharging elevated levels of selenium. This quick synoptic survey was reported in the 1988 report entitled "Water Quality Survey of Tile Drainage Discharges in the San Joaquin River Basin" by Jeanne Chilcott. You cited this report and it forms the basis of your Table 3.10 and Figure 3.18. I have attached a pdf file of the report in case you do not have one available.

Based on the initial results from the synoptic survey, the Regional Board was instructed to begin a more comprehensive monitoring effort on the tile drainage systems. It was estimated that it would take 2 years to characterize the tile drainage discharges because of seasonal differences. The results of that 2-year effort are in a series of reports divided up by counties. The report for San Joaquin County is entitled "Quality of Agricultural Drainage Discharges to the San Joaquin River and Delta from the Western Portion of San Joaquin County, California. April 1986 to May 1988" by Kathryn Belden. We provided you a full copy of that report with the package I recently sent you. This was an extensive monitoring of all the known tile drains in the San Joaquin County area.

The only monitoring that has been conducted since has been the State's Surface Water Ambient Monitoring Program (SWAMP). This program has continued monitoring the New Jerusalem Drainage District outfall as it goes directly to surface waters. We provided you with a copy of the latest data from the SWAMP as part of Attachment #2 to our comments on the draft report. The SWAMP data should be reported as coming from the SWAMP database maintained by the State Water Resources Control Board.

Because of the numerous data sources, I have down loaded the database that shows all the existing data for tile drainage in Western San Joaquin County (attached). Feel free to use any and/or all of the data as I have put in a column which shows the reference to the data. The references are the ones we have provided you in our comments or the ones you already had in your report. I have also asked the Regional Board to check to see if there is any more recent data and they are checking. If there is, it is likely for the New Jerusalem Drainage District and being monitored through the Irrigated Lands Program. I will forward any data I receive.

Let me know if you have any additional questions.

Dennis W. Westcot
Project Administrator
San Joaquin River Group Authority

Evaluation of Drainage Flow Monitoring Sites in Western San Joaquin County Shown in Table 1

SJC001 New Jerusalem Drainage District - This is the main outlet for the district and is a closed system and does not allow surface water into it. OK TO USE

SJC028 Crichett Road Drain - This is an open drain and has tailwater in it. DO NOT USE.

SJC029 Wright Road Collector Drain - This is an open drain but use to only lower the groundwater table near the Duel Vocational Institute. OK TO USE.

SJC030 Yasui Surface Drain - This is an open drain and has tailwater in it. DO NOT USE.

SJC031 Yasui (Fisk) Ranch Tile Drain - This is a tile drain but there is evidence that a septic tank system from a mobile home park is tied into it. DO NOT USE.

SJC042 San Joaquin River Club - This is a lake fed by high groundwater and also receives surface runoff. DO NOT USE.

SJC002 Tracy Blvd Tile Drain Sump - This is a Tile Drain. OK TO USE.

SJC009 Lammers/Corral Hollow Tile Drain Sump - This is a Tile Drain. OK TO USE.

SJC011 Delta Avenue Tile Drain - This is a Tile Drain. OK TO USE.

SJC024 Corral hollow/Bethany Tile Drain Sump - This is a Tile Drain. OK TO USE.

SJC026 Chrisman Road Tile Drain - This is a Tile Drain. OK TO USE.

SJC043 **Discharge to Sugar Cut - This is a surface drain and collects both subsurface water and surface runoff. DO NOT USE**

SJC044 Larch Road Drain - This is a Tile Drain. OK TO USE.

SJC003 Grant Line Road Tile Drain Sump - This is a Tile Drain. OK TO USE.

SJC004 Bethany/Lammers Tile Drain - This is a Tile Drain. OK TO USE.

SJC005 Patterson Pass Road Tile Drain - This is a Tile Drain. OK TO USE.

SJC006 Moitoso Tile Drain - This is a Tile Drain. OK TO USE.

SJC007 Krohn Road Drain - This is a Tile Drain. OK TO USE.

SJC008 Pimentel Tile Drain - This is a Tile Drain. OK TO USE.

SJC010	Westside Irrigation District Main Drain - Collects only high groundwater and does not receive surface water. OK TO USE
SJC013	Costa Brothers East Tile Drain - This is a Tile Drain. OK TO USE.
SJC014	Costa Brothers West Tile Drain - This is a Tile Drain. OK TO USE.
SJC015	Castro Tile Drain - This is a Tile Drain. OK TO USE.
SJC016	Earp Tile Drain - This is a Tile Drain. OK TO USE.
SJC017	Freeman Tile Drain - This is a Tile Drain. OK TO USE.
SJC018	Costa Tile Drain - This is a Tile Drain. OK TO USE.
SJC019	Moitoso and Castro Tile Drain - This is a Tile Drain. OK TO USE.
SJC022	**City of Tracy Tile Drain - Don't trust this one as it receives surface drainage and drains an urban area where it is suspected that surface water is tied into the tile drain. DO NOT USE.**
SJC032	**Kelso Road Drain - Receives surface runoff and tailwater. DO NOT USE.**
SJC033	**Mountain House Creek - Collects high groundwater but also receives tailwater and rainfall runoff. DO NOT USE.**
SJC034	**Westside Irrigation District Discharge Pump - Collects high groundwater but also receives tailwater and rainfall runoff. DO NOT USE.**
SJC035	**Naglee/Burk Pump #6 - Collects high groundwater but also receives tailwater. DO NOT USE.**
SJC036	Kelso Road/Byron Hwy Tile Drain Sump - This is a Tile Drain. OK TO USE.
SJC037	Spirow Nicholaw Tile Drain - This is a Tile Drain. OK TO USE.
SJC038	JM Laurence Jr East Tile Drain - This is a Tile Drain. OK TO USE.
SJC039	JM Laurence Jr West Tile Drain - This is a Tile Drain. OK TO USE.
SJC040	Sequeira Tile Drain - This is a Tile Drain. OK TO USE.
SJC041	Reeve Road Tile Drain - This is a Tile Drain. OK TO USE.

Grant Line Road Tile Drain Sump

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
SJC003	9/23/82	2,710	3.2	3
SJC003	11/22/82	2,970	3.0	3
SJC003	12/14/82	3,010		3
SJC003	1/21/83	3,350	0.6	3
SJC003	2/22/83	3,580		3
SJC003	4/18/83	2,690	2.6	3
SJC003	5/16/83	3,270	2.9	3
SJC003	6/13/83	2,990	3.3	3
SJC003	7/18/83	3,030	2.2	3
SJC003	8/15/83	2,960	3.9	3
SJC003	9/12/83	2,860	3.8	3
SJC003	10/17/83	3,010	2.8	3
SJC003	8/12/86	2,800	2.9	1
SJC003	10/23/86		3.0	1
SJC003	12/22/86	2,600	3.0	1
SJC003	6/12/87	2,700	2.8	1
SJC003	8/16/87		2.6	1
Count		15	15	
Average		2,969	2.8	
Median		2,970	2.9	
Minimum		2,600	0.6	
Maximum		3,580	3.9	
Standard Deviation		269	0.7	

Patterson Pass Road Tile Drain

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
SJC005	4/22/86	2,200	3.5	1
C5	6/16/86	2,500	1.0	2
SJC005	8/12/86	1,400	2.3	1
SJC005	10/30/86	2,200	4.7	1
SJC005	12/23/86	2,200	4.2	1
SJC005	4/7/87	2,700	3.6	1
C5	6/2/87	2,540	4.4	2
SJC005	6/17/87	2,300	3.8	1
SJC005	8/26/87		4.6	1
Count		8	9	
Average		2,255	3.6	
Median		2,400	3.8	
Minimum		1,400	1.0	
Maximum		2,700	4.7	
Standard Deviation		393	1.2	

Moitoso Tile Drain

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
SJC006	8/11/86	1,600	1.4	1
SJC006	10/23/86		1.2	1
SJC006	12/22/86	1,700	1.2	1
SJC006	6/12/87	1,550	1.7	1
SJC006	8/26/87		1.4	1
Count		3	5	
Average		1,617	1.4	
Median		1,600	1.4	
Minimum		1,550	1.2	
Maximum		1,700	1.7	
Standard Deviation		76	0.2	

Krohn Road Tile Drain

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
SJC007	8/11/86	2,500	2.3	1
SJC007	10/23/86		1.4	1
SJC007	12/22/86	1,900	1.4	1
SJC007	4/7/87	2,150	1.6	1
SJC007	6/17/87	1,850	1.4	1
Count		4	5	
Average		2,100	1.6	
Median		2,025	1.4	
Minimum		1,850	1.4	
Maximum		2,500	2.3	
Standard Deviation		297	0.4	

Pimental Tile Drain

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
SJC008	8/11/86	2,200	1.8	1
SJC008	6/12/87	2,150	1.7	1
SJC008	8/26/87		1.9	1
Count		2	3	
Average		2,175	1.8	
Median		2,175	1.8	
Minimum		2,150	1.7	
Maximum		2,200	1.9	
Standard Deviation		35	0.1	

Westside Irrigation District Main Drain

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
SJC010	4/22/86	2,000	2.0	1
C10	6/16/86	1,900	1.8	2
SJC010	8/13/86	2,100	2.6	1

SJC010	10/30/86	2,600	3.3	1
SJC010	12/23/86	2,800	3.3	1
SJC010	4/7/87	2,250	2.6	1
C10	6/2/87	2,290	2.5	2
SJC010	6/17/87	2,250	2.5	1
SJC010	8/26/87		2.9	1
Count		8	9	
Average		2,274	2.6	
Median		2,250	2.6	
Minimum		1,900	1.8	
Maximum		2,800	3.3	
Standard Deviation		300	0.5	

Costa Brothers East Tile Drain

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
C13	6/16/86	4,000	3.3	2
SJC013	8/12/86	4,000	6.2	1
C13	6/2/87	4,230		2
Count		3	2	
Average		4,077	4.8	
Median		4,000	4.8	
Minimum		4,000	3.3	
Maximum		4,230	6.2	
Standard Deviation		133	2.1	

Costa Brothers West Tile Drain

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
C14	6/16/86	3,100	3.3	2
SJC014	8/12/86	3,900	5.3	1
SJC014	10/30/86	3,400	3.9	1
SJC014	4/7/87	3,500	3.6	1
SJC014	6/2/87	3,550	4.7	1
C14	6/17/87	4,040	5.7	2
SJC014	8/26/87		4.3	1
Count		6	7	
Average		3,582	4.4	
Median		3,525	4.3	
Minimum		3,100	3.3	
Maximum		4,040	5.7	
Standard Deviation		342	0.9	

Castro Tile Drain

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
SJC015	10/23/86		2.4	1
SJC015	12/23/86	2,400	2.4	1

SJC015	4/7/87	2,400	2.2	1
SJC015	6/12/87	2,300	2.3	1
SJC015	8/26/87		2.2	1
Count		3	5	
Average		2,367	2.3	
Median		2,400	2.3	
Minimum		2,300	2.2	
Maximum		2,400	2.4	
Standard Deviation		58	0.1	

Earp Tile Drain

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
C16	6/16/86	2,500	2.5	2
SJC016	8/12/86	2,800	3.0	1
SJC016	10/23/86		2.8	1
SJC016	12/22/86	2,900	3.1	1
SJC016	4/7/87	3,050	2.9	1
C16	6/2/87	2,990	2.9	2
SJC016	6/17/87	2,800	2.9	1
SJC016	8/26/87		2.5	1
Count		6	8	
Average		2,840	2.8	
Median		2,850	2.9	
Minimum		2,500	2.5	
Maximum		3,050	3.1	
Standard Deviation		194	0.2	

Freeman Tile Drain

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
C17	6/16/86	2,990	4.7	2
SJC017	8/12/86	3,400	5.5	1
SJC017	10/23/86		5.9	1
SJC017	12/22/86	3,600	5.4	1
SJC017	4/7/87	3,800	4.7	1
C17	6/2/87	3,840	5.3	2
SJC017	6/17/87	3,800	5.4	1
SJC017	8/26/87		5.0	1
Count		6	8	
Average		3,572	5.2	
Median		3,700	5.4	
Minimum		2,990	4.7	
Maximum		3,840	5.9	
Standard Deviation		330	0.4	

Costa Tile Drain

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
SJC018	8/12/86	3,500	4.1	1
SJC018	10/30/86	3,200	4.3	1
SJC018	12/23/86	3,200	4.4	1
SJC018	4/7/87	3,250	3.8	1
SJC018	6/17/87	3,800	4.6	1
SJC018	8/26/87		4.4	1
Count		5	6	
Average		3,390	4.3	
Median		3,250	4.4	
Minimum		3,200	3.8	
Maximum		3,800	4.6	
Standard Deviation		261	0.3	

Moitoso and Castro Tile Drain

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
SJC019	8/11/86	2,000	1.8	1
SJC019	10/23/86		1.6	1
SJC019	12/22/86	1,900	1.7	1
SJC019	4/7/87	1,900	1.6	1
SJC019	6/12/87	2,150	2.0	1
SJC019	8/26/87		1.8	1
Count		4	6	
Average		1,988	1.8	
Median		1,950	1.8	
Minimum		1,900	1.6	
Maximum		2,150	2.0	
Standard Deviation		118	0.2	

Chrisman Road Tile Drain

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
SJC026	8/11/86	2,000	2.6	1
SJC026	10/23/86		2.4	1
SJC026	12/22/86	2,100	2.4	1
SJC026	6/12/87	2,000	2.5	1
SJC026	8/26/87		2.3	1
Count		3	5	
Average		2,033	2.4	
Median		2,000	2.4	
Minimum		2,000	2.3	
Maximum		2,100	2.6	
Standard Deviation		58	0.1	

Wright Road Collector Drain

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
SJC029	8/11/86	9,400	15.0	1
SJC029	10/23/86	8,200	11.0	1
SJC029	12/22/86	8,100	10.0	1
SJC029	4/7/87	9,350	8.7	1
SJC029	6/12/87	8,450	10.4	1
SJC029	8/26/87		8.8	1
Count		5	6	
Average		8,700	10.7	
Median		8,450	10.2	
Minimum		8,100	8.7	
Maximum		9,400	15.0	
Standard Deviation		629	2.3	

Kelso Road-Byron HWY Tile Drain Sump

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
SJC036	4/22/86	2,100	4.1	1
C36	6/16/86	2,300	4.7	2
SJC036	8/12/86	1,500	3.3	1
SJC036	10/30/86	2,100	5.1	1
SJC036	12/23/86	2,100	4.8	1
SJC036	4/7/87	2,050	4.4	1
C36	6/2/87	2,350	4.9	2
SJC036	6/17/87	2,150	4.5	1
SJC036	8/26/87		4.8	1
Count		8	9	
Average		2,081	4.5	
Median		2,100	4.7	
Minimum		1,500	3.3	
Maximum		2,350	5.1	
Standard Deviation		258	0.5	

Spirow Nicholaw Tile Drain

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
C37	6/16/86	3,100	3.5	2
SJC037	8/11/86	3,100	3.4	1
SJC037	10/23/86		3.7	1
SJC037	12/22/86	3,100	3.9	1
SJC037	4/7/87	3,200	3.6	1
C37	6/2/87	3,060	3.6	2
SJC037	6/12/87	3,000	3.5	1
SJC037	8/26/87		3.4	1
Count		6	8	
Average		3,093	3.6	
Median		3,100	3.6	

Minimum		3,000	3.4
Maximum		3,200	3.9
Standard Deviation		65	0.2

JM Lawrence Jr West Tile Drain

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
C38	6/16/86	3,400	2.9	2
SJC038	8/12/86	3,400	3.2	1
SJC038	10/23/86		3.1	1
SJC038	12/22/86	3,600	3.1	1
SJC038	4/7/87	3,700	2.8	1
C38	6/2/87	3,550	3.0	2
SJC038	6/17/87	3,500	3.1	1
SJC038	8/26/87		2.9	1
Count		6	8	
Average		3,525	3.0	
Median		3,525	3.1	
Minimum		3,400	2.8	
Maximum		3,700	3.2	
Standard Deviation		117	0.1	

JM Lawrence Jr East Tile Drain

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
C39	6/16/86	2,300	2.2	2
SJC039	8/12/86	2,300	2.3	1
SJC039	10/23/86		2.3	1
SJC039	12/22/86	2,500	2.4	1
SJC039	4/7/87	2,600	2.2	1
C39	6/2/87	2,380	2.3	2
SJC039	6/17/87	2,300	2.3	1
SJC039	8/26/87		2.1	1
Count		6	8	
Average		2,397	2.3	
Median		2,340	2.3	
Minimum		2,300	2.1	
Maximum		2,600	2.4	
Standard Deviation		127	0.1	

Sequeria Tile Drain

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
SJC040	8/12/86	3,500	3.8	1
SJC040	10/23/86		3.5	1
SJC040	12/22/86	3,700	3.6	1
SJC040	6/17/87	3,500	3.2	1
Count		3	4	

Average	3,567	3.5
Median	3,500	3.6
Minimum	3,500	3.2
Maximum	3,700	3.8
Standard Deviation	115	0.2

Reeve Road Tile Drain

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
C41	6/16/86	4,000	5.9	2
SJC041	8/12/86	3,600	6.3	1
SJC041	10/30/86	3,900	6.3	1
C41	6/2/87	4,170	5.4	2
SJC041	6/17/87	3,900	6.2	1
SJC041	8/26/87		5.7	1
Count		5	6	
Average		3,914	6.0	
Median		3,900	6.1	
Minimum		3,600	5.4	
Maximum		4,170	6.3	
Standard Deviation		207	0.4	

Larch Road Tile Drain

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
SJC044	8/11/86	2,700	4.5	1
SJC044	12/22/86	3,000	5.1	1
SJC044	4/7/87	2,950	4.9	1
SJC044	6/12/87	2,450	4.3	1
Count		4	4	
Average		2,775	4.7	
Median		2,825	4.7	
Minimum		2,450	4.3	
Maximum		3,000	5.1	
Standard Deviation		253	0.4	

Tracy Boulevard Tile Drain Sump

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
SJC002	9/23/82	3,350	1.3	3
SJC002	11/22/82	3,480	1.3	3
SJC002	12/14/82	3,690		3
SJC002	1/21/83	3,510	0.8	3
SJC002	2/22/83	3,800		3
SJC002	3/28/83	3,720		3
SJC002	4/18/83	3,496	1.2	3
SJC002	5/16/83	3,650	1.1	3
SJC002	6/13/83	3,140	1.4	3
SJC002	7/18/83	3,680	1.5	3
SJC002	8/15/83	3,470	2.1	3
SJC002	9/12/83	3,430	1.5	3
SJC002	10/17/83	3,660	1.5	3
SJC002	1/23/84	3,330		3
SJC002	3/12/84	3,600	1.1	3
SJC002	5/21/84	3,560	1.2	3
SJC002	6/18/84	3,220	1.1	3
SJC002	7/23/84	2,810	1.1	3
SJC002	8/20/84	3,450	1.4	3
SJC002	9/24/84	3,620	1.8	3
SJC002	10/18/84	3,540	1.7	3
SJC002	11/12/84	3,390	1.5	3
SJC002	12/10/84	3,500	1.4	3
SJC002	1/14/84	3,870	0.8	3
SJC002	2/14/85	3,510	1.1	3
SJC002	3/14/85	3,690	1.2	3
SJC002	4/11/85	3,310	1.2	3
SJC002	5/9/85	3,920	1.2	3
SJC002	6/6/85	2,660	1.2	3
SJC002	7/12/85	3,040	1.4	3
SJC002	8/9/85	2,820	1.4	3
SJC002	9/13/85	3,090	1.4	3
SJC002	10/7/85	3,580	1.6	3
SJC002	11/4/85	3,570	1.7	3
SJC002	12/6/85	3,410		3
SJC002	1/9/86	3,690		3
SJC002	4/22/86	2,500	0.9	1
SJC002	5/9/86	3,470	1.0	3
C2	6/16/86	3,400	1.0	2
SJC002	8/8/86	2,960	1.3	3
SJC002	8/11/86	2,800	1.2	1
SJC002	10/23/86		1.6	1
SJC002	12/22/86	3,100	0.8	1
C2	6/2/87	3,210	1.3	2
SJC002	6/12/87	3,050	1.1	1
SJC002	8/26/87		1.0	1
Count		44	40	
Average		3,381	1.3	

Median	3,470	1.3
Minimum	2,500	0.8
Maximum	3,920	2.1
Standard Deviation	329	0.3

Bethany-Lammers Road Tile Drain Sump

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
SJC004	4/22/86	2,200	0.6	1
SJC004	8/12/86	2,100	0.7	1
SJC004	6/12/87	1,950	0.6	1
SJC004	8/26/87		0.7	1
Count		3	4	
Average		2,083	0.7	
Median		2,100	0.7	
Minimum		1,950	0.6	
Maximum		2,200	0.7	
Standard Deviation		126	0.1	

Lammers-Corral Hollow Road Tile Drain Sump

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
SJC009	4/22/86	4,500	0.8	1
SJC009	8/11/86	4,500	1.0	1
SJC009	10/23/86		1.0	1
SJC009	12/22/86	3,900	1.0	1
SJC009	6/12/87	4,600	0.9	1
SJC009	8/26/87		1.1	1
Count		4	6	
Average		4,375	1.0	
Median		4,500	1.0	
Minimum		3,900	0.8	
Maximum		4,600	1.1	
Standard Deviation		320	0.1	

Delta Avenue Tile Drain

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
C11n	6/16/86	2,300	2.4	2
C11s	6/16/86	3,300	0.9	2
SJC011	10/23/86		0.3	1
SJC011	12/22/86	1,500	0.2	1
SJC011	4/7/87	1,700	0.2	1
C11n	6/2/87	2,900		2
SJC011	6/12/87	2,700	0.5	1
SJC011	8/26/87		0.3	1
Count		6	7	
Average		2,400	0.7	

Median	2,500	0.3
Minimum	1,500	0.2
Maximum	3,300	2.4
Standard Deviation	701	0.8

Corral Hollow-Bethany Road Tile Drain Sump

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
SJC024	4/22/86	6,200	1.4	1
SJC024	8/11/86	5,900	1.6	1
SJC024	10/30/86	6,100	1.9	1
SJC024	4/7/87	6,850	2.0	1
SJC024	6/12/87	5,750	1.6	1
SJC024	8/26/87		1.5	1
Count		5	6	
Average		6,160	1.7	
Median		6,100	1.6	
Minimum		5,750	1.4	
Maximum		6,850	2.0	
Standard Deviation		423	0.2	

Tracy Boulevard Tile Drain Sump

Regional Board Site #	Sample Date	EC (µmmhos/cm)	Boron (mg/L)	Source Reference
SJC001	1977	2,603		4
SJC001	1978	3,200		4
SJC001	1979	3,000		4
SJC001	1980	2,600		4
SJC001	1982	2,200		4
SJC001	8/19/82	2,440	3.5	3
SJC001	9/23/82	2,670	3.0	3
SJC001	11/22/82	2,400		3
SJC001	12/14/82	2,730		3
SJC001	1983	2,400		4
SJC001	1/21/83	2,990	0.8	3
SJC001	2/22/83	2,910		3
SJC001	3/28/83	3,720		3
SJC001	4/18/83	2,980	2.8	3
SJC001	5/16/83	2,960	3.2	3
SJC001	6/13/83	3,180	4.1	3
SJC001	7/18/83	3,060	2.6	3
SJC001	8/15/83	3,190	4.2	3
SJC001	9/12/83	2,680	3.7	3
SJC001	10/17/83	2,600	2.9	3
SJC001	1984	2,000		4
SJC001	1/23/84	2,420		3
SJC001	3/12/84	2,620	2.5	3
SJC001	4/2/84	2,500	2.3	3
SJC001	4/23/84	2,840	2.8	3
SJC001	5/21/84	2,930	2.9	3
SJC001	6/18/84	3,050	2.8	3
SJC001	7/23/84	3,010	2.8	3
SJC001	8/20/84	2,820	2.7	3
SJC001	9/24/84	2,670	2.9	3
SJC001	10/9/84	2,960	3.0	3
SJC001	11/12/84	2,300	2.4	3
SJC001	12/10/84	2,300	2.4	3
SJC001	2/14/85	2,240	2.4	3
SJC001	3/14/85	2,250	2.4	3
SJC001	4/11/85	2,650	3.0	3
SJC001	5/9/85	2,810	2.6	3
SJC001	6/6/85	2,880	2.9	3
SJC001	7/12/85	2,820	3.0	3
SJC001	8/9/85	2,810	2.8	3
SJC001	9/13/85	2,840	3.0	3
SJC001	10/11/85	2,240	2.6	3
SJC001	11/8/85	2,230	2.4	3
SJC001	12/6/85	2,100		3
SJC001	1/10/86	2,250		3
SJC001	5/9/86	2,940	2.5	3
SJC001	8/8/86	2,850	3.0	3
SJC001	8/11/86	2,500	2.5	1

SJC001	10/23/86		2.4	1
SJC001	12/22/86	2,200	2.4	1
SJC001	4/7/87	2,500	3.0	1
SJC001	6/12/87	2,350	2.8	1
SJC001	8/26/87		2.4	1
SJC001	2/19/88	2,300	2.8	1
SJC001	3/30/88	2,550	3.1	1
SJC001	4/22/88	2,650	2.8	1
SJC001	5/25/88	2,650	2.5	1
SJC001	10/24/00	2,380	2.3	4
SJC001	11/28/00	2,390	2.4	4
SJC001	12/27/00	2,550	2.7	4
SJC001	1/23/01	2,480	2.5	4
SJC001	2/20/01	2,600	2.7	4
SJC001	3/27/01	2,760	2.6	4
SJC001	4/24/01	2,420	2.3	4
SJC001	5/29/01	2,540	2.3	4
SJC001	6/26/01	2,580		4
SJC001	7/24/01	2,740		4
SJC001	8/28/01	2,340	2.2	4
SJC001	9/25/01	2,230	2.2	4
SJC001	10/23/01	2,440	2.6	4
SJC001	11/27/01	2,340	2.5	4
SJC001	12/26/01	2,670	2.8	4
SJC001	1/29/02	2,790	2.8	4
SJC001	2/26/02	2,590		4
SJC001	3/26/02	1,730	1.6	4
SJC001	4/23/02	2,570	2.5	4
SJC001	5/28/02	2,390	2.3	4
SJC001	6/18/02	2,560	2.5	4
SJC001	7/31/02	2,560		4
SJC001	8/27/02	2,370		4
SJC001	9/24/02	2,430	2.4	4
SJC001	10/15/02	2,280		4
SJC001	10/29/02	2,290	2.2	4
SJC001	11/19/02	2,260	2.2	4
SJC001	12/17/02	2,060		4
SJC001	3/25/03	2,300	2.3	4
SJC001	4/22/03	2,660	2.8	4
SJC001	5/27/03	2,510	2.7	4
SJC001	6/24/03	2,280	2.2	4
SJC001	7/29/03	2,410		4
SJC001	8/26/03	2,550		4
SJC001	9/23/03	2,440		4
SJC001	10/28/03	2,250		4
SJC001	11/28/03	2,320		4
SJC001	2/24/04	2,240		4
SJC001	6/23/04	2,530		4
SJC001	7/28/04	2,190		4
SJC001	8/25/04	2,510		4
SJC001	9/29/04	2,240		4

SJC001	11/22/04	2,540		4
SJC001	1/26/05	2,650		4
SJC001	2/23/05	2,620		4
SJC001	3/31/05	2,550		4
SJC001	4/26/05	2,770		4
SJC001	5/24/05	2,550		4
SJC001	6/28/05	2,450		4
SJC001	7/26/05	2,320		4
SJC001	8/23/05	2,340		4
SJC001	9/27/05	2,290		4
SJC001	10/25/05	2,220		4
SJC001	11/29/05	2,190		4
Count		109	68	
Average		2,549	2.6	
Median		2,540	2.6	
Minimum		1,730	0.8	
Maximum		3,720	4.2	
Standard Deviation		300	0.5	

SOURCE REFERENCES USED IN THIS SPREADSHEET

Reference #	Description of the Reference
1	Belden, K. K., D. W. Westcot and R. I. Waters. 1989. Quality of Agricultural Drainage Discharging to the San Joaquin River and Delta From the Western Portion of San Joaquin County, California; April 1986 to May 1988. California Regional Water Quality Control Board, Unpublished Data Report, Sacramento, CA 25 p. This report was a follow up to the synoptic survey of tile drainage discharges reported in Reference # 2 below. The staff at the Regional Board conducted a more intensive monitoring effort to determine the overall characteristics of all subsurface drainage discharges or open surface drains that may receive seepage or direct discharges from tile drain sumps. The samples reported in this report were taken as part of that effort.
2	Chilcott, J., D. Westcot, K. Werner and K. Belden. 1988. Water Quality Survey of Tile Drainage Discharges in the San Joaquin River Basin. California Regional Water Quality Control Board, Unpublished Data Report, Sacramento, CA 65 p. This report was prepared as part of the State efforts to locate sources of selenium. The staff at the Regional Board was charged by the legislature to go out in the field and locate all subsurface drainage and monitor it to determine if selenium was present. The samples reported in this report were taken as part of that effort. This was a quick synoptice survey to see the extent of selenium levels. This effort was to be followed by a more intensive sampling effort which is reported as Reference #1. The site number in this report are designated with a "C" and are the same as those later designated with a "SJC".
3	United States Bureau of Reclamation. 1987. Water Quality Analyses, Westside San Joaquin Valley. January 1987. and United States Bureau of Reclamation. 1989. Unpublished data Provided by Joh Field of the Mid Pacific Region Office. 16 May 1989. Both of these reports are cited in Reference #1 above and the data is taken from reference #1. The data was developed as part of the USBR efforts to characterize the quality of drainage water that may eventually enter a valley wide drain. The USBR conducted similar surveys throughout the westside of the San Joaquin Valley. They took representative drainage sumps in each of the westside areas to sample.
4	Regional Board Files. Unpublished data. These samples were taken as part of the Regional Board's efforts to characterize discharges to the San Joaquin River.

WATER QUALITY SURVEY OF TILE DRAINAGE DISCHARGES IN THE SAN JOAQUIN RIVER BASIN

California Regional Water Quality Control Board
Central Valley Region
3443 Routier Road
Sacramento, California 95827-3098

October 1988

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

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Special acknowledgment goes to the staff of the Sacramento Office of the Regional Board who assisted in the field data collection. Special thanks goes to the land owners and the water and drainage districts within the basin without whose cooperation this program would not have been possible.

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I. SUMMARY AND RECOMMENDATIONS

During April and June 1986, and June 1987, staff of the Central Valley Regional Water Quality Control Board completed three extensive surveys of subsurface drainage water being discharged from individual tile drainage systems in the San Joaquin River Basin. Additional data was collected from open waterways flowing into, through and past the study area. Results from 314 sites have been delineated by seven zones represented by either geologic setting or drainage patterns. The zones presented include Zone A (western portion of the Delta), Zone B (areas east of the San Joaquin River), Zone C (areas within San Joaquin County and west of the San Joaquin River), Zone D (areas in Stanislaus County west of the San Joaquin River), Zone E (an area west of the San Joaquin River that is primarily in the Basin Trough as described by Deverel et al.(1984)), Zone F (discharges located in the Panoche Fan area that flow toward the San Joaquin River), and Zone G (open waterways which flow into, through and past the study area).

Review of analytical results presents a general overview of subsurface drainage water quality in the San Joaquin River Basin and also areas and constituents of potential concern to water quality. Information from the analyses of major ions portrays the subsurface drainage water as alkaline with a pH greater than 7.0 and with median specific conductances between zones ranging from 865 umhos/cm in Zone B to 5,940 umhos/cm in Zone F. Drainage along the westside of the river downstream of the Grassland area has either sodium or non-dominant cation makeup with 75 percent of the samples showing no anion dominance and roughly 15 percent showing slight sulfate dominance. The drainage east of the San Joaquin River also shows either sodium or non-dominant cation composition. The eastside drainage water does not appear to have dominant anions. Water from the Panoche Fan Area, however, shows greater than 60 percent sodium dominance for cations. In addition, 95 percent of the samples show sulfate dominance. Over 50 percent of these drain water samples are potentially saturated or close to saturation with calcium sulfate (gypsum).

Thirteen trace elements were analyzed on most of the samples collected. These trace elements included arsenic, boron, cadmium, chromium, copper, lead, mercury, manganese, molybdenum, nickel, selenium, silver and zinc. With the exception of silver, detectable levels of each element were found in at least one sample. Only six of these trace elements, arsenic, boron, chromium, molybdenum, nickel and selenium were detected frequently. Concentrations varied throughout the discharge zones. Arsenic concentrations ranged from less than 1 ug/L to 63 ug/L with most of the positive values associated with Zones B and E which are areas whose soils are predominantly derived from the Sierra Nevada. High boron concentrations were detected in all subsurface drainage from the western side of the San Joaquin River and Delta. Little or no boron was detected in samples from Zones B and E. Median boron concentrations in the zones west of the San Joaquin River and Delta ranged from 1.2 mg/L in Zone D to 8 mg/L in Zone F. These median values exceed the 0.7 mg/L level considered safe for all types of agriculture including sensitive crops(Ayers and Westcot, 1985).

Chromium concentrations ranged from less than 1 to 268 ug/L for all samples collected in the Panoche Fan Area where 85 percent of the samples contained detectable levels of chromium with a median value of 18 ug/L. Elevated molybdenum concentrations were found in samples taken from the eastside areas(Zone B), basin trough area(Zone E) and the Panoche Fan Area(Zone F). Molybdenum concentrations in these areas ranged from 1 to 724 ug/L. Nickel, although detected in every zone except the Western Delta(Zone A), was predominantly reported below the 5 ug/L detection limit. The Panoche Fan Area(Zone F) showed the greatest number of positive nickel results, yet over over 80 percent of the nickel concentrations measured in this zone were below 10 ug/L. Selenium was detected in at least one sample from each discharge zone. The highest concentrations were detected in samples collected west of the San Joaquin River. A majority of these samples were from the Panoche Fan area which also showed the highest median selenium concentration at 108 ug/L.

Although additional elements were detected during the surveys, reported concentrations were either close to the detection limit or instances of positive results appeared isolated. Recommendations for future monitoring programs can be summarized by element:

Arsenic: Although detected throughout the study area, further monitoring should be limited to areas showing elevated concentrations with the emphasis on seasonal changes. No routine monitoring of arsenic should be proposed for dischargers unless the occurrence of arsenic becomes more widespread;

Boron: Continued discharger monitoring of boron is essential as it occurs frequently at highly elevated levels. Continued monitoring of boron on a seasonal basis would help determine impacts on agricultural supply waters. Boron monitoring on discharges from the eastside of the basin is of limited value;

Cadmium: Further confirmation sampling should be done at all sites showing concentrations in excess of the detection level used in this survey. Further monitoring of discharge sources should be considered when an acceptable method of analysis can be established which would provide information on the low level concentrations;

Chromium: Since total recoverable chromium was analyzed during the survey, follow up monitoring should distinguish both hexavalent and trivalent forms of chromium in areas of elevated concentrations. This monitoring would better relate to existing water quality criteria. Discharger monitoring should continue to include total chromium until such time as further studies can be completed;

Copper: Only 24 sites out of the 314 sampled showed copper at concentrations greater than 10 ug/L. Confirmation samples should be collected before further discharger monitoring is initiated. This additional study should include dissolved as well as total recoverable copper in addition to water hardness values;

Lead: Few samples had detectable levels of lead though positive values were scattered throughout the study area. Further investigation is needed to establish the reasons for elevated concentrations in the selected samples. Further widespread sampling should not be instituted until significantly lower detection levels can be achieved in the salty drainage water;

Manganese: Scattered positive values make recommendations difficult. Future studies should first focus on confirming the elevated levels already detected and secondly focus on downstream monitoring to determine if elevated concentrations are appearing in the San Joaquin River and Delta. Further discharger monitoring should not be instituted until these studies are completed and more information is known about the criteria levels needed to protect aquatic resources;

Mercury: Fourteen sites showed detectable levels of mercury ranging from 0.7 to 2.3 ug/L. These positive results should be confirmed and limited monitoring in the vicinity of the areas should be conducted. Because of the scattered nature of the areas where positive values were found, no discharger monitoring is proposed until the actual levels or sources are better defined;

Molybdenum: Discharger monitoring of molybdenum should be continued to determine the impact of elevated drainage water concentrations on agricultural water supplies. Open waterways in the Grassland Area show some canals exceeding the 10 ug/L water quality criterion suggested for irrigated agriculture(Ayers and Westcot, 1985). Seasonal variations in concentrations should be measured;

Nickel: Does not appear to be an element of concern. The present survey showed very low levels in the drainage water discharges. Because of its interaction with sediment, only dissolved samples downstream should be used for in-stream monitoring. Further monitoring may be necessary depending upon the limitations proposed in the Delta Hearing process. Discharger monitoring is not proposed at this time;

Selenium: Continued monitoring of selenium is needed to determine the impact of discharge of elevated drainage water concentrations on the aquatic resources. Further limited monitoring for seasonal changes is proposed for areas outside the Panoche Fan Area, however discharger monitoring is only proposed in the Grassland and Panoche Fan Areas;

Silver: Does not appear to be an element present at the detection levels used in this study;

Zinc: Extensive efforts would be needed by dischargers to avoid potential sources of zinc contamination, therefore it is recommended that in-stream monitoring be conducted for zinc in lieu of continued source monitoring. Source monitoring should only be reinstituted if the established in-stream criterion is being approached or exceeded.

The monitoring programs conducted in this study were for total recoverable trace elements. As most of the water quality criteria

are based on acid-soluble samples, it is not recommended that dissolved testing be conducted at the discharge source. First, the data developed for total recoverable becomes the most conservative case and second, the tile drainage discharges are normally free of sediment or other particulate matter which would give greatly different results from those obtained through a total recoverable sample. It is not recommended that the dischargers take on this additional expense until it is clearly shown that the total recoverable sample is not giving a true picture of the total load being discharged by individual tile drainage systems.

II. INTRODUCTION

a. Background

The potential impact of agricultural drainage on the beneficial uses of surface waters is being studied (SWRCB, 1987). Programs on the Federal, State and local levels have been initiated to investigate these potential impacts, find solutions and regulate the discharges of agricultural drainage. The State Water Resources Control Board and the Central Valley Regional Water Quality Control Board have initiated efforts to formulate water quality standards and implement regulatory programs.

The Central Valley Regional Water Quality Control Board has the primary responsibility for regulating the discharge of agricultural drainage in the San Joaquin Valley. This program will rely upon the cooperation of local water districts and drainage agencies in regulating agricultural discharges. An important part of formulating programs to control the pollutants in agricultural discharges is information about sources including the geographic distribution of sources and concentrations.

The California Legislature, through the Governor's 1985-86 budget, provided funding to state agencies and the University of California for an intensive look at selenium and its impact in California. Part of the funding was designated specifically for use in monitoring municipal and industrial discharges and agricultural subsurface drainage discharges for selenium and other trace elements. A report on the municipal and industrial discharges has been prepared as a separate report and this report will concentrate on selenium and trace elements in the agricultural subsurface drainage water discharges.

Due to the importance of selenium in the San Joaquin River Basin, the Central Valley Regional Water Quality Control Board sought to sample as many tile drainage sumps or other subsurface drainage discharges at the farm level as possible. This sampling was conducted in cooperation with local water, drainage, and resource management agencies within an area from Fresno County north to Contra Costa County. Prior to this sampling survey, a number of agencies and individuals were sampling the waterways and discharge points, but in most cases these samples represented a combination of tile drainage water, surface runoff from irrigated fields and natural runoff from

surface and ground waters. Additional emphasis was needed on monitoring at the farm level to give the local district managers a reliable data base upon which to make management decisions. To ensure proper quality control and sampling uniformity, all samples were to be collected by the Regional Water Quality Control Boards, and data analysis done in cooperation with the local agencies.

b. Purpose

The purpose is to provide local water management agencies and the Regional Board with sound water quality monitoring data on individual tile drainage systems, including changes in water quality with time. At the same time, this survey provides a data base planned and coordinated on a large geographic basis. The data developed will be used by local agencies and/or the Regional Board to:

a) develop follow-up water quality monitoring programs in areas where further data is needed;

b) evaluate existing water quality data programs and the need for increased quality control and quality assurance programs;

c) develop relationships between monitored parameters to decrease the need for monitoring numerous parameters;

d) increase the local agency's understanding of the geographical distribution of trace element concentrations within their agency boundaries, and the Regional Board's understanding of the geographical distribution of trace element concentrations throughout the San Joaquin Valley and Delta;

e) evaluate management options available to minimize the discharge of toxic elements. Evaluation will rely heavily on flow data being developed by the local agencies; and

f) evaluate the need for developing regulatory programs.

c. Scope

A survey was conducted of all tile drainage discharges within cooperating local water management agency boundaries. The survey area was the San Joaquin River Basin and Delta from Contra Costa County in the north to Fresno County in the south. Samples were collected once in April 1986 to represent the early irrigation season and a second time in June 1986 to represent the mid-irrigation season. The program was expanded in June 1987 to include 100 additional sampling locations as well as to confirm high levels of selenium detected during the 1986 surveys.

Sampling was done in cooperation with local agency personnel. Sites were sampled for standard minerals and trace elements. Regional Board staff were responsible for transport of samples to laboratories. Analyses were done by the Department of Water Resources Laboratory at Bryte (trace elements), U. S. Bureau of Reclamation Laboratory in

Sacramento (trace elements), South Dakota State University Laboratory in Brookings, SD (trace elements), Anlab Analytical Laboratory in Sacramento and California Water Laboratory in Modesto(standard minerals). In addition to laboratory internal QA/QC programs, a quality assurance program was also operated by the Regional Board. The program included site-anonymous sample IDs, duplicates, spikes, check samples and splits sent to different laboratories.

Data analysis was conducted jointly with local water and drainage management agencies. Data analysis includes interpretation of data in light of conditions when sampling was done, comparison of data with existing data, and assessment of data quality.

III. PROCEDURES

a. Sampling

During the three synoptic surveys, water samples were collected for selected minerals and metals from subsurface tile drain sumps, gravity tile drains and open drains receiving tile drainage. In addition to collecting samples for laboratory analyses, field work included electrical conductance (EC) and temperature measurements at each site and pH measurements at selected sites. Sample collection and preservation were conducted in accordance with U. S. Environmental Protection Agency and U. S. Geological Survey guidelines as outlined in National Handbook of Recommended Methods for Water Data Acquisition. For each of the surveys conducted for this study, the elements of concern were divided into three groups, each having similar collection and preservation techniques. The groups consisted of (1) minerals, (2) trace elements, and (3) selenium.

The minerals analyses requested were similar for all surveys. During the first and third surveys, minerals analyses consisted of EC, boron, chloride, sulfate, and total alkalinity. During the second survey, the minerals analyses included all analyses of the first synoptic survey as well as calcium, magnesium, sodium, potassium, carbonate alkalinity, bicarbonate alkalinity, and total hardness. Methods of collection and preservation were identical for all surveys with the only difference being in sample container size -- 1 liter for the partial scan and 1/2 gallon for the full mineral scan. In both cases, acid-washed polyethylene bottles were supplied by the laboratory. Containers used to collect the sample, as well as the sample bottle, were rinsed three times with water before the final collection. Once capped, the bottle was stored immediately on ice and transferred to the analyzing laboratory within 24 hours.

Trace element analyses included total recoverable arsenic, cadmium, copper, chromium, lead, manganese, nickel, molybdenum, silver, zinc, and selenium. The samples were collected in either 1 pint or 1 liter nitric acid-washed polyethylene bottles. The size depended on the analyzing laboratory. The same collection procedures were applied to the trace elements as were applied to the minerals, including each container being rinsed three times before the sample was taken. Since the analyses were for total concentration, each sample was acidified

with one ml Ultrex (ultra-pure) nitric acid per pint within 4 hours. The sample was then stored in a cool dark room until transferred for laboratory analysis.

Selenium samples were collected in 1 pint nitric acid-washed polyethylene bottles provided by the Regional Board. Sample collection was identical to that for trace elements, including the acidification process. The samples were again stored in a cool dark room until transfer to the analyzing laboratory. Selenium analyses were conducted by three separate laboratories -- U.S. Bureau of Reclamation (USBR), California Department of Water Resources (DWR), and South Dakota State University (SDSU).

Field methods were modified during the June 1987 survey to include an additional sample from each of the sample locations for mercury analysis. The mercury sample was collected in a washed and acid rinsed amber glass bottle that was rinsed three times with the drainage water prior to sample collection. The mercury sample was not filtered and was preserved with a potassium dichromate solution.

b. Quality Assurance

The Regional Board Agricultural Unit practices a standard quality assurance procedure with all its sampling programs. The procedure includes submitting duplicates, spikes, and standards with all sample sets submitted to analyzing laboratories. Additional blank samples containing 2 ml Ultrex (ultra-pure) nitric acid in 500 ml distilled water are also submitted at random to check possible contamination problems.

For minerals, the procedure includes collecting a minimum of 10 percent duplicates. The duplicates are submitted without being identified as such to provide a true measure of the laboratory capability. In addition, one mineral check sample is submitted with each sampling run of 10 or more samples. The check samples contain known quantities of sodium, calcium, magnesium, bicarbonate, chloride, sulfate, and boron, and are prepared by Regional Board staff. During the third survey, selected duplicate samples were spiked with known quantities of boron and chloride. These blind spikes were used as an arbitrary check on the ability of the laboratory to recover salts from a complex matrix.

Trace element (including selenium) quality assurance also includes the collection of 10 percent duplicates. However, for trace elements, only half of the extra samples are actually submitted as duplicates. The other half of the samples undergo a spiking procedure developed and conducted by Regional Board staff. The duplicate in the set is spiked with concentrations roughly equal to that expected in the original sample. In this manner, laboratory recoveries can be calculated.

In addition to the standard quality assurance methods during the synoptic survey one other method was incorporated -- samples from the same sites were submitted to more than one laboratory for the same

analysis. The extra step was an attempt to develop a comparison basis for sample sets sent to different laboratories.

All quality assurance samples analyzed by the laboratories fell within acceptable ranges of accuracy before being included in the final data set. A full analyses of the quality assurance results is in the Regional Board files.

IV. FORMAT FOR DATA PRESENTATION

Three comprehensive surveys of tile drainage in the San Joaquin Valley were conducted by Regional Board staff and local agency personnel in April and June, 1986 and in June 1987. Water samples were collected at a total of 314 sites which included subsurface tile drainage sumps, surface drains receiving tile drainage water, and creeks entering the agricultural drainage problem areas. Most of the collection was done with the assistance of drainage district personnel familiar with site locations.

This report focuses on reporting the laboratory analysis of the major-ion and trace-element data for subsurface tile drainage discharges in the San Joaquin River Basin. Additional data has been collected by the U. S. Bureau of Reclamation and the U. S. Geological Survey for shallow groundwater and selected subsurface drainage discharges, however that data is not reported here as the focus of this study was to monitor only actively discharging subsurface tile drainage systems.

The sampling sites were widely scattered throughout the San Joaquin River Basin and Delta. Previous studies (Deverel et al., 1984) have shown that shallow groundwater quality is closely associated with the differing soils and topographic position in the basin. The data collected in this study have not been analyzed for this association. The data have been grouped into 7 drainage problem zones within the basin. The discharge zones established for this study are partly set on common discharge points into the River or its tributaries but often are set on the existence of localized areas of shallow groundwater which has necessitated the installation of tile drainage. This approach gives a better picture of the quality of discharges entering the San Joaquin River from a particular area. In most cases one zone may represent subsurface discharges from one or more of the physiographic areas defined by Deverel et al.(1984).

The data is presented by the 7 zones. One of these zones (Zone G) represents the open waterways within the basin and does not characterize subsurface tile drainage water. In Zone F, there are 12 samples that were taken from open drains within this area and do not characterize the subsurface discharges; these samples while noted in the data tables, were not included in the data analysis. The discharge zones established (Fig. 1) and their characteristics are:

Zone A Subsurface tile drains along the western portion of the Delta. Most are located within Contra Costa County from the Clifton

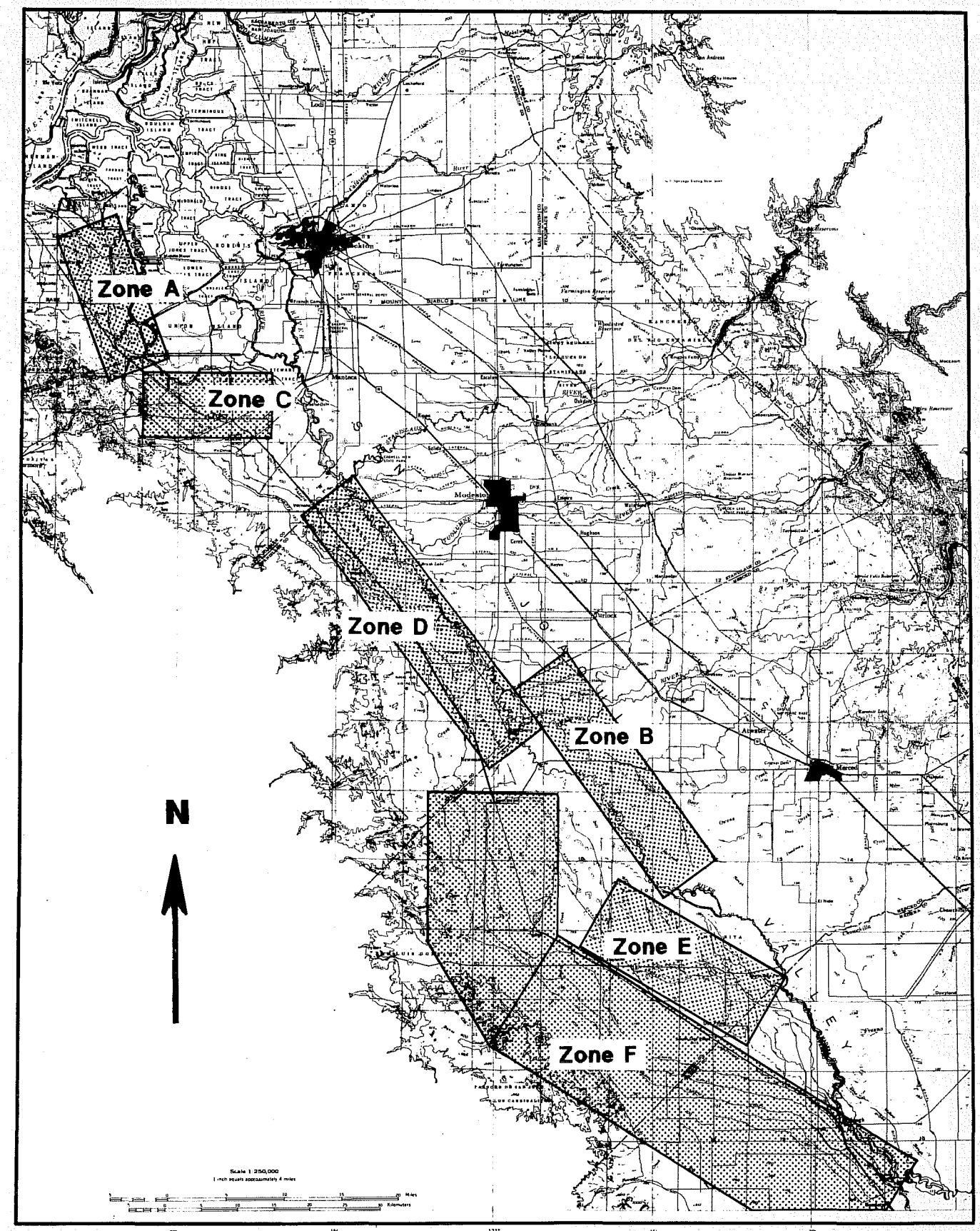


Figure 1. Discharge Zones Monitored During the Central Valley Regional Water Quality Control Board Tile Drainage Survey, 1986 - 1987.

Court Forebay north to the Contra Costa County Water District Intake Canal in Rock Slough. Eleven discharge sites were sampled within this zone;

Zone B Subsurface tile drains in scattered locations on the Eastern side of the San Joaquin River in Stanislaus and Merced Counties. The majority of these sites are near (within 2 miles) the San Joaquin River or a main eastside tributary. These drains are normally associated with localized zones of high groundwater rather than a widespread shallow groundwater condition more common to the western portion of the river basin. Nine widely scattered sites were sampled in this zone;

Zone C Subsurface tile drains in the western portion of San Joaquin County principally from the Delta Mendota pumping plant to just east of the City of Tracy. The majority of the drains lie along a line approximately 1 - 3 miles upslope from the San Joaquin River. Fourteen discharge sites were sampled within this zone;

Zone D Subsurface tile drains in the portion of Stanislaus County that lies west of the San Joaquin River. The majority of the drains lie approximately 1 - 4 miles upslope of the San Joaquin River and principally between the towns of Patterson and Newman and east of State Highway 33. Twenty-five discharge sites were sampled within this zone;

Zone E Subsurface tile drains in the portion of Merced County that is west of the San Joaquin River and lies primarily in the basin trough, an area whose sediment is derived chiefly from the Sierra Nevada to the east (Deverel et al., 1984). The drains are scattered throughout this zone which is bounded on the South by the City of Dos Palos and on the west by the old Santa Fe Grade Railroad right-of-way. Eighteen discharge sites were monitored within this zone;

Zone F Subsurface tile drains located principally in the Panoche Fan Area and discharge their flows through the Grassland Area to the San Joaquin River. The drains are located along a line from the town of Mendota to Los Banos with drains both upslope and downslope of the Delta-Mendota Canal. Scattered drains are located between Los Banos and the City of Gustine. A total of one hundred and seventy-three discharge sites were monitored within this zone;

Zone G These sites are all open waterways that either drain into the subsurface drainage areas or directly into the San Joaquin River. Because of the diversity of concentrations likely in these open waterways the data for this zone has been separated into 3 types of open waterways. The first is the San Joaquin River, which receives all the drainage water, the second is the open channels within the Grasslands Area which receive varying portions of agricultural drainage water and the third is selected creeks from the Coast Range that drain into the

drainage area or directly into the San Joaquin River. A total of sixty-four sites were monitored during this survey.

The discharge zones designated in this report provide an initial basis for assessing priorities for future water quality sampling and the differences in water quality for the various zones in the basin. Actual sampling locations have been presented by zone in Appendix A. Water quality assessment and comparisons were made on each of the discharge zones. Assessment of general chemical composition of the subsurface drainage water was based on the relative concentrations of the major ions - - calcium, magnesium, sodium, potassium, bicarbonate plus carbonate, chloride, and sulfate in each drainage zone. In addition to the major ions, an assessment was made of 13 trace elements including selenium. All water quality data for both standard minerals and trace elements for each sampling location is presented in Appendix B.

V. DISTRIBUTION OF MAJOR IONS AND TRACE ELEMENTS

a. Major Ions

Median (50 percent of the values are higher and 50 percent lower) and ranges for all major ions and related measurements are summarized for all of the subsurface tile drainage discharge samples collected (Table 1) and for each of the different discharge zones except Zone G (Table 2). The median specific conductance and field measured pH indicate

Table 1. Physical Properties and Major Ions in Subsurface Tile Drainage samples collected in the San Joaquin River Basin, 1986 - 1987.

	Minimum	Median	Maximum
pH	6.2	8.0	8.6
EC (umhos/cm)	580	4600	23000
Temperature (F)	57	64	89
Total Dissolved Solids (mg/l)	400	3400	22800
Ca (mg/L)	13	300	950
Mg (mg/L)	9	100	460
Na (mg/L)	37	520	4000
K (mg/L)	0.4	3.9	15
Cl (mg/L)	11	490	4900
SO4 (mg/L)	15	1788	12000
CO3 (mg/L)	0	0	50
HCO3 (mg/L)	80	210	760
Total Alkalinty (mg/L)	80	210	760
Hardness (mg/L)	68	1100	3300

Table 2. Physical Properties and Major Ions in Subsurface Tile Drainage Samples Presented by Discharge Zone, 1986 - 1987.

	Zone A			Zone B			Zone C		
	MIN	MED	MAX	MIN	MED	MAX	MIN	MED	MAX
pH	7.7	8.1	8.3	7.9	8.5	8.6	8.0	8.2	8.5
EC (umhos/cm)	780	1749	2870	580	865	2300	1900	3025	4230
TEMP (F)	63	64	70	64	65	69	63	64	69
TDS (mg/l)	500	1100	1700	480	710	1500	1200	1800	2900
Ca (mg/L)	23	33	82	13	47	97	38	130	200
Mg (mg/L)	17	55	90	8.6	19	45	38	72	110
Na (mg/L)	86	190	360	37	95	450	170	370	600
K (mg/L)	0.4	1.5	5.1	1.5	2.8	6.7	0.6	1.7	3.3
Cl (mg/L)	87	230	540	29	67	360	260	522	840
SO4 (mg/L)	110	185	450	15	54	210	160	450	1421
CO3 (mg/L)	0	0	0	0	8	20	0	0	16
HCO3 (mg/L)	80	310	380	110	240	760	160	320	420
T.Alk (mg/L)	80	310	380	110	255	760	160	320	420
Hard (mg/L)	190	300	540	68	205	410	230	530	1000

	Zone D			Zone E			Zone F		
	MIN	MED	MAX	MIN	MED	MAX	MIN	MED	MAX
pH	6.2	8.1	8.6	8.0	8.3	8.5	6.6	8.0	8.5
EC (umhos/cm)	630	2100	7500	880	1500	8000	690	6100	23000
TEMP (F)	58.5	66	89	60	63	68	57	64	71
TDS (mg/l)	500	1400	4800	680	930	5600	400	4800	22800
Ca (mg/L)	36	100	370	65	88	950	48	420	790
Mg (mg/L)	19	58	270	22	46	180	20	140	460
Na (mg/L)	75	270	1000	120	160	1300	55	820	4000
K (mg/L)	1.1	2.9	5.5	1.3	2.6	9.7	0.4	4.9	15
Cl (mg/L)	65	240	1400	87	240	1100	11	2400	4900
SO4 (mg/L)	92	335	2300	94	200	2400	68	2336	12000
CO3 (mg/L)	0	0	50	0	0	16	0	0	40
HCO3 (mg/L)	100	240	500	120	200	290	100	190	650
T.Alk (mg/L)	100	260	500	120	220	420	92	190	650
Hard (mg/L)	190	490	1800	90	330	1300	100	1790	3300

that most of the subsurface drainage water is alkaline (a pH greater than 7) and slightly saline, although median specific conductance (EC) varied between discharge zones. For example, Zones A, B, and E showed a median EC of less than 2,000 umhos/cm. Data for EC from the other zones indicates that Zone F, the Panoche Fan, had a significantly higher major ion concentration (median EC of 6,100 umhos/cm) followed by Zone C (San Joaquin County) at 3,025 and Zone D (Stanislaus County) at 2,100 umhos/cm.

Water hardness is a controlling factor in trace element toxicity. Normal toxicity appears to diminish as water hardness increases for some trace elements. Subsurface tile drainage water samples collected in the 6 discharge zones showed median hardness values ranging from 200 to 1,800 mg/L. Hardness values appeared to follow closely the total major ion concentrations. Thus the Panoche Fan (Zone F), San Joaquin County (Zone C) and Stanislaus County (Zone D) showed the highest concentrations. The hardness in the open waterways (Zone G) was also high. Channels within the Grassland area averaged 715 mg/L of total hardness with a median value of 770 mg/L. The natural westside creeks had an average hardness of 940 mg/L, but extreme values may be influencing this as the median value was 500 mg/L which is still considered high. These hardness values demonstrate the relatively poor quality water that comes from these natural streams.

The chemical composition of subsurface tile drainage water samples from three representative zones are depicted in simplified Piper diagrams (Fig. 2, 3, and 4) which show the relative contributions of major cations and anions to the total ion content of the water. Percentage scales along the sides of the diagrams indicate the relative concentration (in milliequivalents per liter) of each major ion. Cations are shown in the left triangle and anions in the right triangle. The central diamond integrates the data for cations and anions but is not essential to interpreting the data. Each water sample is represented by a point on the diagram.

The diagram with data for samples from Zone D (Fig. 2) which represents westside drainage downstream of the Grassland Area has 100 percent of the data points in either the sodium or no-dominant-type part of the cation triangle. The anion triangle shows that greater than 90 percent of the samples show no-dominant type for anions or they are slightly sulfate dominated. Over 75 percent fall in the no-dominant-type part of the triangle.

The diagram with data for samples from Zone E (Fig. 3) which represents areas on the eastside of the San Joaquin River also has 100 percent of the data points in either the sodium or no-dominant-type part of the cation triangle. The anion triangle however shows that all but one sample showed no-dominant type for anions.

In contrast, the diagram with data for samples from Zone F (Fig. 4) which represents subsurface tile drainage from the Panoche Fan Area has greater than 60 percent of the data points in the sodium-dominant-type part of the cation diagram. The anion triangle

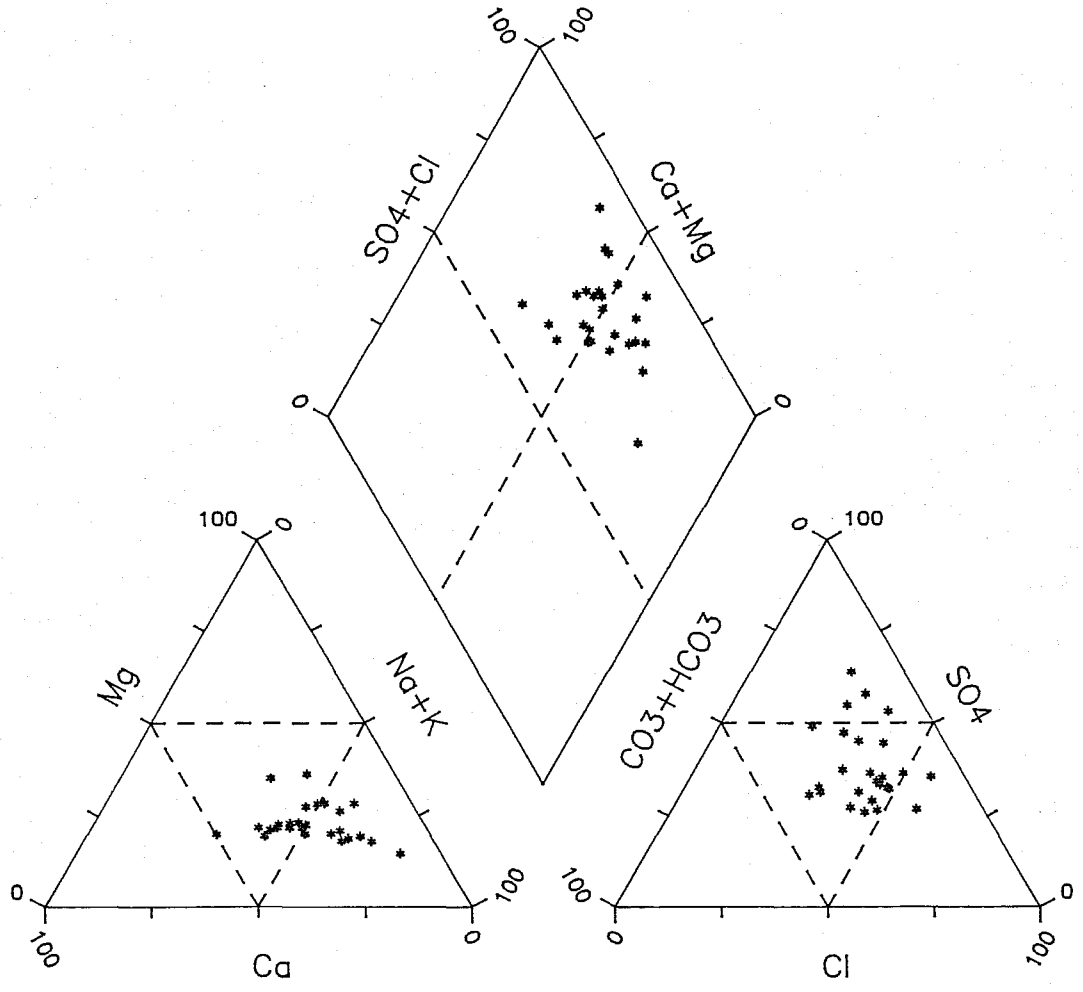


Figure 2. Chemical Composition of Subsurface Tile Drainage in Zone D.

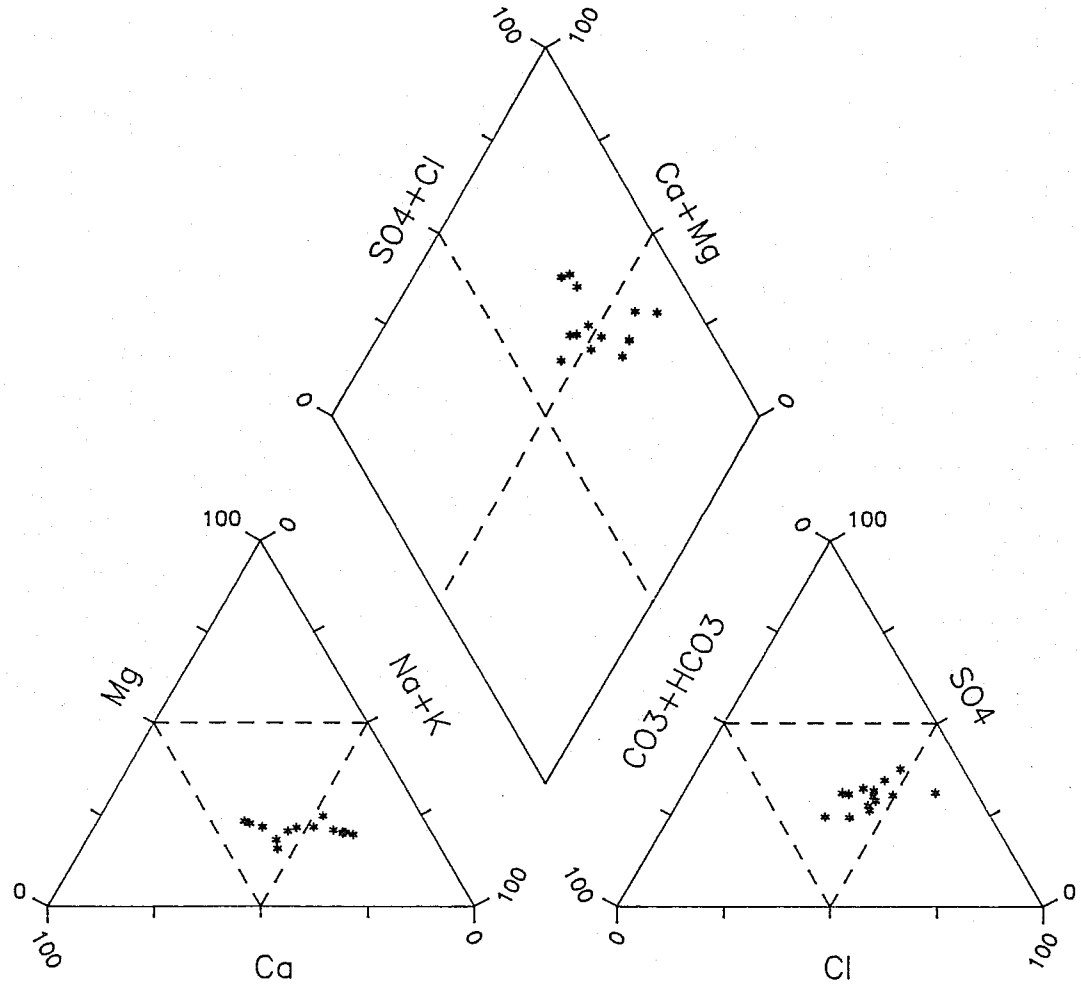


Figure 3. Chemical Composition of Subsurface Tile Drainage in Zone E.

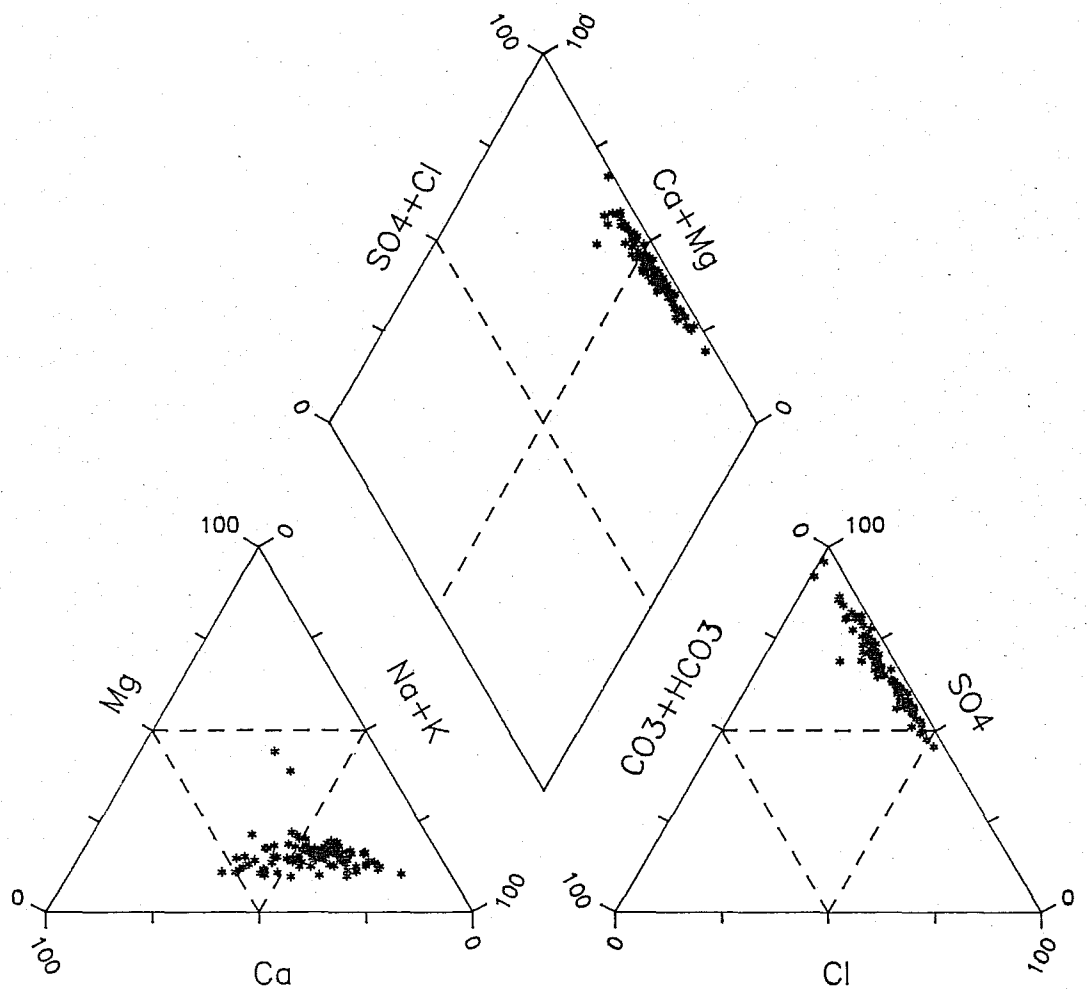


Figure 4. Chemical Composition of Subsurface Tile Drainage in Zone F.

Table 3. Summary of Trace Element Concentrations in Subsurface Tile Drainage samples collected in the San Joaquin River Basin, 1986 - 1987.

	Minimum	Median	Maximum
B (mg/L)	<0.05	5.6	61
As (ug/L)	<1	2	63
Cd (ug/L)	<5	<5	57
Cr (ug/L)	<1	10	268
Cu (ug/L)	<1	<5	180
Pb (ug/L)	<2	<5	42
Mn (ug/L)	<5	10	4660
Hg (ug/L)	<0.2	<0.2	4
Mo (ug/L)	<5	17	724
Ni (ug/L)	<1	<5	230
Se (ug/L)	<1	47	2812
Ag (ug/L)	<5	<5	4
Zn (ug/L)	<1	1	1280

shows that greater than 95 percent of the samples show sulfate or strongly sulfate dominance. A similar characteristic was found by Deverel et al.(1984) for groundwater samples from the alluvial fan zone of the westside of the San Joaquin River, a large majority of which covers the Panoche Fan Area. In addition to this sodium-sulfate type water, the median calcium concentration shown in Table 2 for Zone F indicates that over 50 percent of the subsurface tile drainage water samples are saturated or close to saturation with calcium sulfate (gypsum), a common mineral in soils from the western portion of the San Joaquin River Basin.

b. Trace Elements

Median and ranges of the 13 trace elements that were determined are summarized in Table 3 for all the samples collected in the San Joaquin River Basin and in Table 4 for each of the discharge zones except Zone G. With the exception of silver, all of the trace elements were detected in at least one sample, however only 6 of these trace elements occur broadly at various levels across all the discharge zones. The frequency of occurrence of these six elements; arsenic, boron, chromium, molybdenum, nickel and selenium are summarized, by zone, in Table 5. A discussion of the data for each of the trace elements follows.

Table 4. Trace Element Concentrations in Subsurface Tile Drainage Samples Presented by Discharge Zone, 1986 - 1987.

	Zone A			Zone B			Zone C		
	MIN	MED	MAX	MIN	MED	MAX	MIN	MED	MAX
B (mg/L)	0.6	2.9	6.8	<0.05	0.1	0.5	0.5	3.0	5.9
As (ug/L)	1.0	1.5	28	1	6	63	1.0	3	9
Cd (ug/L)	<5	<5	<5	<5	<5	<10	<5	<5	<5
Cr (ug/L)	<1	4	15	1	<5	5	<1	<5	11
Cu (ug/L)	<1	<5	11	1	<5	12	<1	<5	8
Pb (ug/L)	<5	<5	<5	<5	<5	<10	<5	<5	7
Mn (ug/L)	<5	9	720	8	294	3700	<5	41	2520
Hg (ug/L)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	-
Mo (ug/L)	1	<5	41	1	6	165	<5	6	18
Ni (ug/L)	<5	<5	<5	1	<5	7	<5	<5	9
Se (ug/L)	<1	1	3.5	<1	<1	1	<1	3	6
Ag (ug/L)	<5	<5	<5	<5	<5	<5	<5	<5	<5
Zn (ug/L)	<1	<5	14	<1	<5	34	<1	<5	31

	Zone D			Zone E			Zone F		
	MIN	MED	MAX	MIN	MED	MAX	MIN	MED	MAX
B (mg/L)	0.3	1.2	9.6	0.1	0.6	17	0.3	7.9	61
As (ug/L)	<1	1	57	<1	4	53	<1	1.0	10
Cd (ug/L)	<5	<5	<10	<5	<10	<10	<5	<5	57
Cr (ug/L)	<2	6	268	<1	<5	<10	<1	16	160
Cu (ug/L)	<5	<5	180	<1	<5	14	<1	<5	52
Pb (ug/L)	<5	<5	42	<2	<5	21	<2	<5	14
Mn (ug/L)	<5	15	4660	106	695	3690	<5	6	308
Hg (ug/L)	-	-	-	<0.2	<0.2	<0.2	<0.2	<0.2	4
Mo (ug/L)	1	<5	32	<5	14	232	1	29	724
Ni (ug/L)	<5	<5	230	<5	<5	8	<5	<5	69
Se (ug/L)	<1	2	8	<1	<1	5	<1	120	2812
Ag (ug/L)	-	-	-	<5	<5	<5	<5	<5	<5
Zn (ug/L)	<5	6	92	<1	<10	84	<1	<5	1280

Table 5. Frequency Distribution for Selected Trace Element Concentrations Presented by Discharge Zone.

		Zone A		Zone B		Zone C		Zone D		Zone E		Zone F		Total	
	Range	%	n=	%	n=	%	n=	%	n=	%	n=	%	n=	%	n=
Selenium	<2	67	14	100	13	25	7	32	17	94	45	5	20	22	116
(ug/L)	2-10	33	7		0	75	21	68	36	6	3	7	24	18	91
	11-100		0		0		0		0		0	35	126	24	126
	101-500		0		0		0		0		0	47	167	32	167
	>500		0		0		0		0		0	6	22	4	22
	total		21		13		28		53		48		359		522
Molybdenum	<5	81	17	50	7	43	12	78	28	10	5	15	56	25	125
(ug/L)	5-25	14	3	36	5	57	16	17	6	73	35	33	120	36	185
	26-100	5	1		0		0	5	2	4	2	41	149	30	154
	101-500		0	14	2		0		0	13	6	10	37	9	45
	>500		0		0		0		0		0	1	1	<1	1
	total		21		14		28		36		48		363		510
Boron	<1	5	1	100	15	4	1	33	18	71	34	4	14	16	83
(mg/L)	1-5	90	20		0	78	22	65	36	23	11	22	76	32	165
	6-10	5	1		0	18	5	2	1		0	44	155	31	162
	11-25		0		0		0		0	6	3	27	92	18	95
	>25		0		0		0		0		0	4	14	3	14
	total		22		15		28		55		48		351		519
Arsenic	<5	75	9	51	4	71	10	89	35	55	17	95	161	86	236
(ug/L)	5-10	17	2	25	2	29	4	5	2	35	11	4	7	11	28
	11-25		0	12	1		0	3	1	7	2	1	2	2	6
	26-100	8	1	12	1		0	3	1	3	1		0	1	4
	>100		0		0		0		0		0		0		0
	total		12		8		14		39		31		170		274
Chromium	<5	57	12	93	14	75	21	31	12	71	34	15	55	29	148
(ug/L)	5-10	38	8	7	1	21	6	33	13	27	13	19	69	21	110
	11-25	5	1		0	4	1	23	9	2	1	35	126	27	138
	26-100		0		0		0	10	4		0	30	108	22	112
	>100		0		0		0	3	1		0	1	5	1	6
	total		21		15		28		39		48		363		514
Nickel	<5	100	22	93	14	83	24	81	33	79	38	58	181	67	312
(ug/L)	5-10		0	7	1	17	5	10	4	17	8	26	80	21	98
	11-25		0		0		0	3	1	4	2	11	34	8	37
	26-100		0		0		0	3	1		0	4	13	3	14
	>100		0		0		0	3	1		0	1	1	1	2
	total		22		15		29		40		48		309		463
Total	<1000	23	3	75	6		0	17	5	66	10	9	15	16	39
Dissolved	1000-2500	77	10	25	2	87	13	69	20	27	4	16	27	30	76
Solids	2501-5000		0		0	13	2	14	4		0	32	55	24	61
(mg/L)	5001-10,000		0		0		0		0	7	1	40	70	28	71
	>10,000		0		0		0		0		0	3	6	2	6
	total		13		8		15		29		15		173		253

% Percentage of samples in range.

n= Number of samples in range.

Arsenic: Arsenic was detected at elevated levels in several samples throughout the various zones ranging as high a 63 ug/L. However the median values are relatively low with the lowest median values being found in discharge zones on the western side of the San Joaquin River (Zones A, C, D, and F). Slightly higher median arsenic concentrations were found in subsurface tile drainage water samples from the basin trough (Zone E) and the eastern portion (Zone B) of the River Basin. All the discharge zones showed arsenic concentrations in greater than 70 percent of the samples collected to be less than 5 ug/L except for discharge Zone B and E where over 50 percent of the samples showed concentrations in excess of 5 ug/L. Figure 5 shows frequency distributions for representative discharge zones. Zone E is similar to Zone B while Zone C and D would be similar to Zone A. Zones F stands alone. This reflects findings in drainage systems in the Tulare Lake Basin where high arsenic levels are associated with geologic formations in the Sierra Nevada (DWR, 1985).

Boron: High boron was detected in all subsurface drainage water samples collected from the west side of the San Joaquin River except those samples taken in discharge Zone E (basin trough). Boron showed strong median concentrations (greater than 2.5 ug/L) in discharges from Contra Costa County (Zone A), San Joaquin County (Zone C) and the Panoche Fan (Zone F). The highest concentrations were detected in discharge samples from the Panoche Fan (Zone F). Figure 6 shows the frequency of detection of boron in samples from three representative discharge zones from the westside of the San Joaquin Valley. Boron concentrations in samples from discharges from the eastside discharges (Zone B) showed very low boron levels with a median value of 0.1 mg/L, far below the 0.7 mg/L level considered important for sensitive agricultural crops (Ayers and Westcot, 1985). The median value for the basin trough (Zone E) discharge samples was 0.5 mg/L, also below the agricultural use criterion. Greater than 80 percent of all the samples collected from these two latter discharge zones had boron concentrations less than 1.0 mg/L.

Cadmium: In only one zone (Zone F) did cadmium concentrations exceed the detection level. All median values were below the detection level. The detection levels (5 ug/L and 10 ug/L) however were higher than normally used because of salt matrix interferences. The detection levels were too high to evaluate the discharges in relation to water quality criteria. Further monitoring, using a lower detection level, is needed to quantify the levels present. In addition further confirmation sampling should be done at all the sites where values were detected in excess of the detection level, especially those showing greater than 10 ug/L total recoverable cadmium in the discharge.

Chromium: Chromium concentrations ranged from 1 to 268 ug/L for samples collected from all discharge zones. Median concentrations varied however depending upon discharge zone, with the highest median value being from the Panoche Fan Area (Zone F). In the Panoche Fan discharge zone, 85 percent of the samples contained detectable concentrations of chromium, the highest of any of the discharge zones. Frequency diagrams for the occurrence of chromium in samples from

Figure 5. Frequency Distribution for Arsenic in Subsurface Tile Drainage Waters.

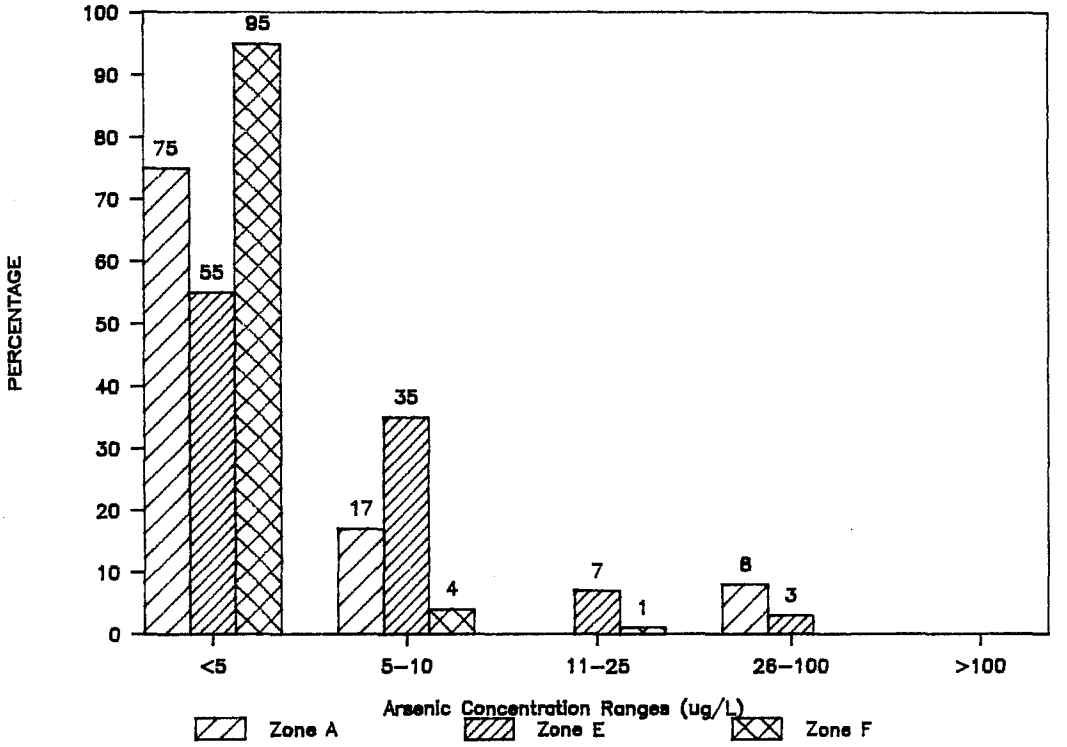
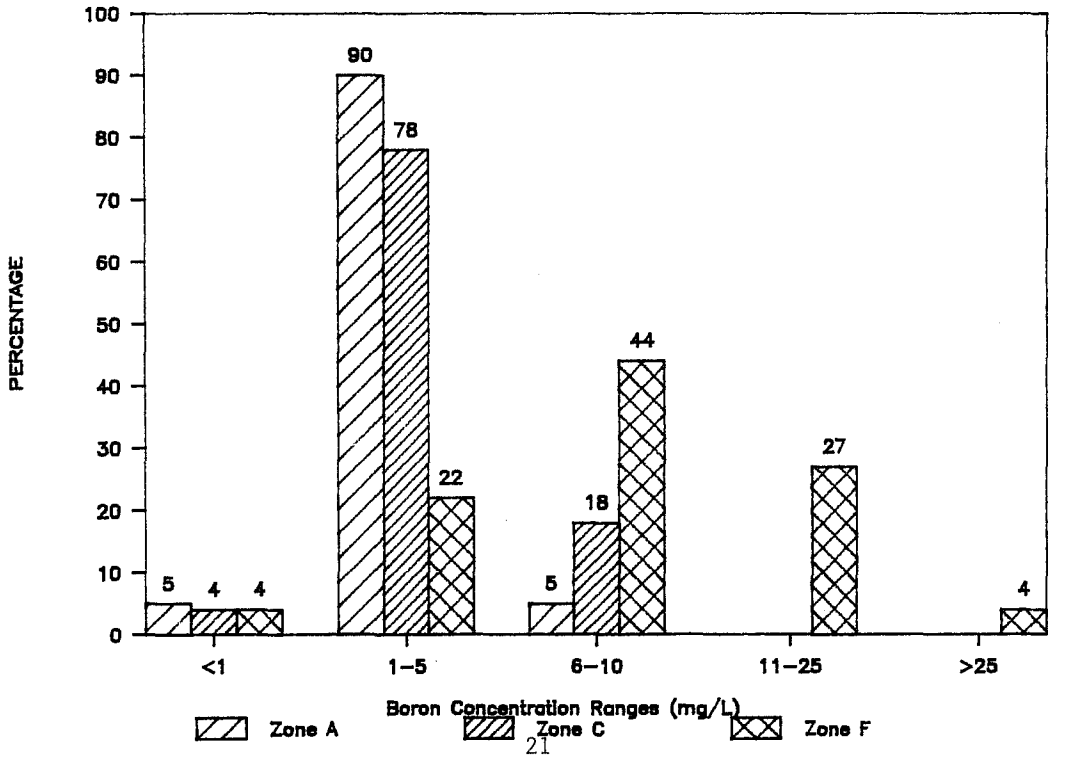


Figure 6. Frequency Distribution for Boron in Subsurface Tile Drainage Waters.



discharge Zones C, D, and F are shown in Figure 7. All three discharge zones show a higher frequency of detection at levels elevated above the detection limit. Over 65 percent of the samples showed detectable chromium above 10 ug/L in Zone F while in Zone D only 36 percent showed this level. Zone C showed only 25 percent of the samples collected with concentrations above the detection level with only 4 percent showing concentrations greater than 10 ug/L. For chromium, discharge Zone C was similar to discharge Zones A, B, and E. Total recoverable chromium concentrations reported here include both the hexavalent and trivalent forms of chromium in unknown proportions, therefore it is difficult to relate to existing water quality criteria which are specific to hexavalent or trivalent forms of this trace element. A follow up monitoring should include a determination of both forms of chromium, especially for discharges from the Panoche Fan Area (Zone F).

Copper: Copper was above detection in one or more samples from all of the discharge zones. The median concentration however was always less than the detection limit except in the Panoche Fan Area (Zone F) where it only slightly exceeded detection at 6 ug/L as the median value. Similar results were obtained during the study of Deverel et al.(1984) for a similar area and actual median concentrations in shallow groundwater were in the 2 - 3 ug/L range.

Lead: Lead was found above detection in 5 of the 7 discharge zones. The median concentrations for all zones were below the detection limit. Further investigation is needed to establish the reasons for the elevated levels found in some samples.

Manganese: Manganese was detected at widely varying concentrations throughout the river basin. The highest median concentrations were associated with sites on the eastside of the San Joaquin River (Zone B) and in the basin trough (Zone E). The lowest median concentration was found in the Panoche Fan Area (Zone F) with a median value of 6 ug/L, only slightly above the 5 ug/L detection level. Because of the widely scattered nature of the concentrations and sites showing elevated levels, no conclusions can be drawn.

Mercury: Mercury was checked on samples from only 5 of the 7 discharge zones. In all discharge zones sampled, except Zone F, mercury concentrations were below the detection limit of 0.2 ug/L in all samples. In Zone F, 14 sites showed slightly elevated mercury levels with positive values ranging from 0.5 ug/L to 4.0 ug/L. Further sampling will be needed to confirm the existence of mercury at these sites as most concentrations were near the analytical detection levels and the sites, except for one group of six sites, were widely scattered with no continuous trend showing detectable mercury concentrations.

Molybdenum: Molybdenum appears to be associated with discharges from throughout the river basin. Highest recorded and median values are associated with discharges occurring in the eastside area(Zone B), basin trough area(Zone E) and the Panoche Fan Area (Zone F). Median values for these zones respectively, are 6, 14, and 26 ug/L. Figure 8

Figure 7. Frequency Distribution for Chromium in Subsurface Tile Drainage Waters.

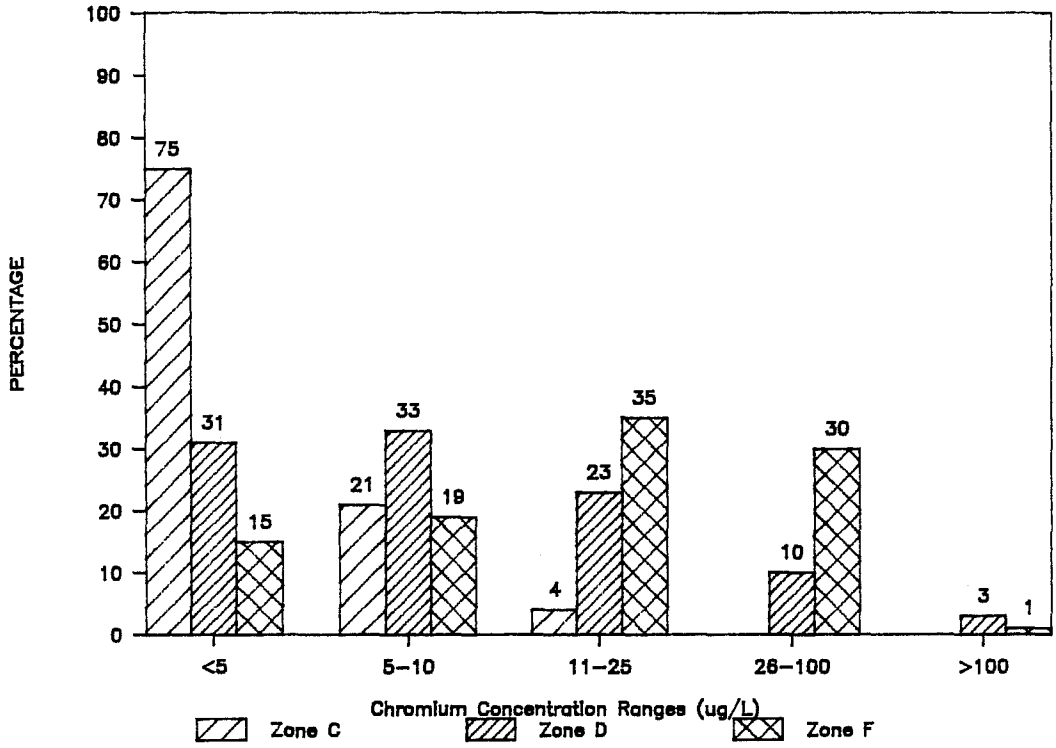
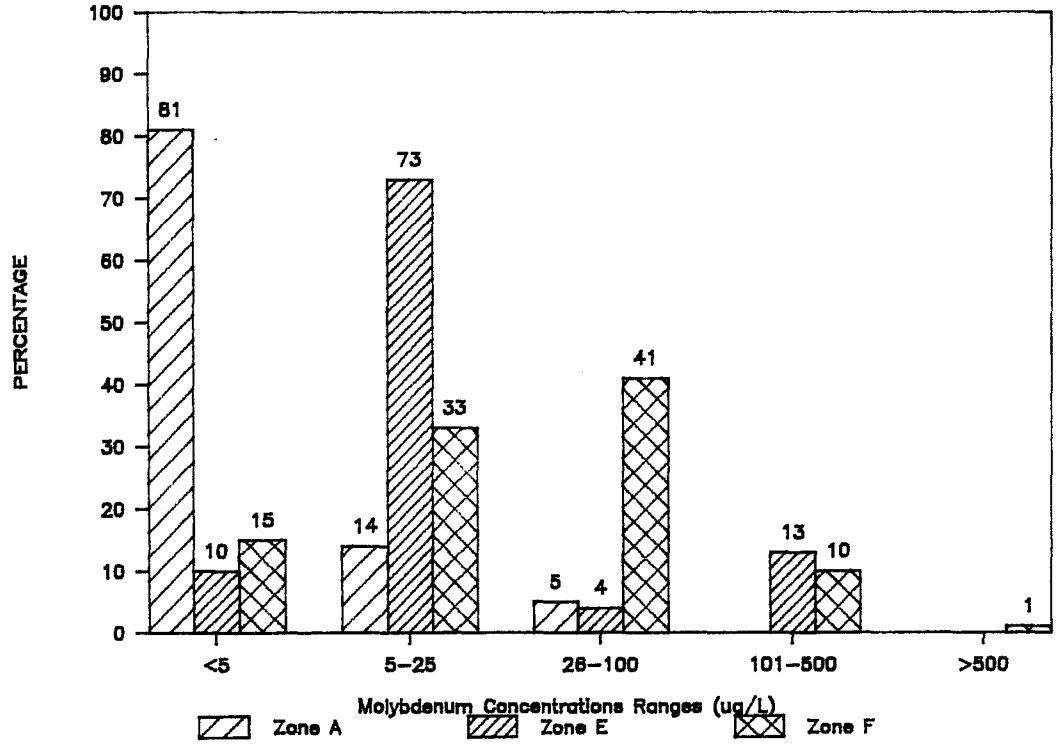


Figure 8. Frequency Distribution for Molybdenum in Subsurface Tile Drainage Waters.



shows the frequency distribution for 3 discharge zones which indicates the widely scattered nature of the samples collected from the various discharge zones although similarities do occur. For example discharge Zone D shows a similar pattern to Zone A while discharge Zones C and D show frequency distributions intermediate between Zones A and F. Zone F is the only zone that shows greater than 50 percent of the samples collected with molybdenum concentrations greater than 25 ug/L. Because of the large number of samples that exceed 5 ug/L, especially in the Panoche Fan and Basin Trough discharge zones, continued monitoring of the San Joaquin River and its tributaries is needed to ensure compliance with the existing 10 ug/L water quality criterion suggested for irrigated agricultural water use; a major water use in the basin. Data for Zone G shows that a number of the open waterways in the Grassland Area do exceed the 10 ug/L molybdenum criterion although the median concentration is 6 ug/L.

Nickel: Nickel was detected in at least one sample from each discharge zone except from the Contra Costa County Area (Zone A). The median concentration in all zones however was less than the 5 ug/L detection level. The distribution of sample concentrations for all discharge zones except Zone F (Panoche Fan Area) showed greater than 80 percent of all samples below the 5 ug/L detection level. Figure 9 shows the nickel concentrations of Zone F in relation to Zone B(east of the San Joaquin River) and Zone D (west of the San Joaquin River). For Zone F, the Panoche Fan, over 80 percent of the sample concentrations were less than 10 ug/L.

Selenium: Selenium was detected above the 1 ug/L detection level in at least one sample from each discharge zone. Higher concentrations (greater than 10 ug/L) and the highest levels recorded (greater than 500 ug/L) were from samples taken from the Panoche Fan Area (Zone F). The three zones depicted in Figure 10 are characteristic of the discharge zones. For example, discharge Zone D shows a similar pattern to Zone C while discharge Zone E on the figure has a similar pattern to discharge Zones A and B. From the data collected during this survey, the majority of the selenium being discharged in the San Joaquin River Basin from subsurface tile drains is from the Panoche Fan Area. The other discharge zones, although of lower concentration, do have sites that could cause localized water quality problems or if the volume of discharge is large, could cause excessive loading of selenium into certain aquatic resources. It is recommended that, in addition to continued selenium testing in the Panoche Fan Area, further selenium testing be done in selected higher concentration areas outside the Panoche Fan Area (Zone F) to ensure that seasonal or other temporal changes will not drive up the selenium levels. This program was only conducted as a one-time grab sample and was not meant to assess changes with time. For example, the largest direct discharge to the San Joaquin River downstream of the Grassland Area (New Jerusalem Drainage District) averaged 5 ug/L of total recoverable selenium over an 18 month period while individual grab samples showed concentrations from less than 1 ug/L to 10 ug/L during this same period(USBR, 1987).

Figure 9. Frequency Distribution for Nickel in Subsurface Tile Drainage Waters.

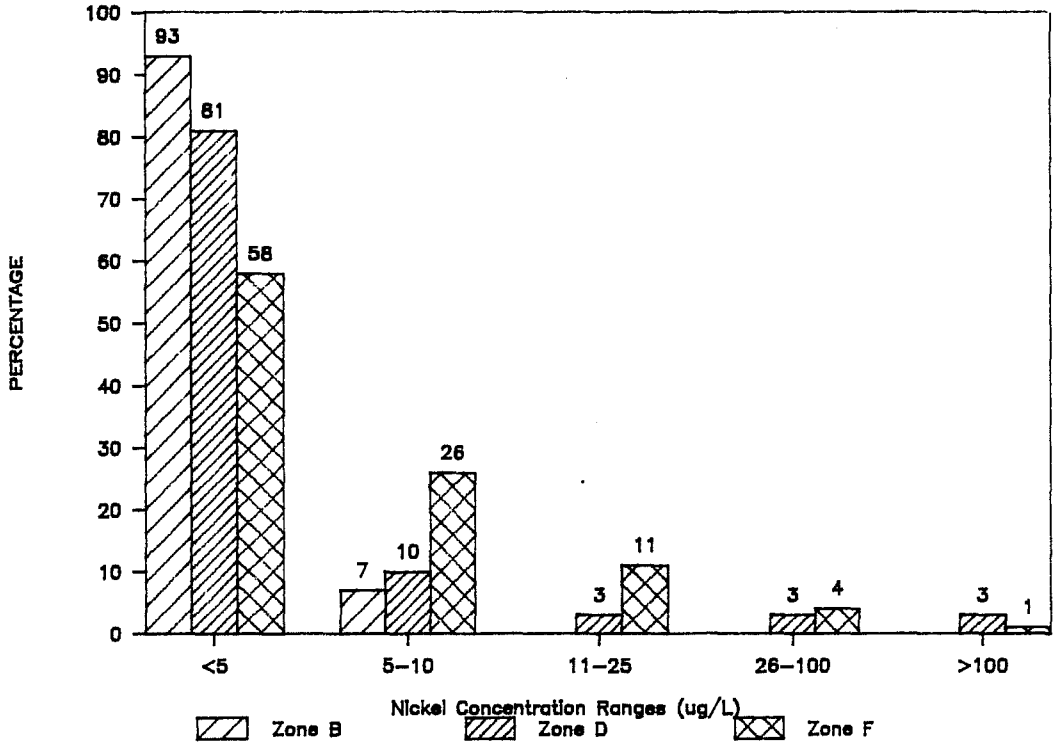
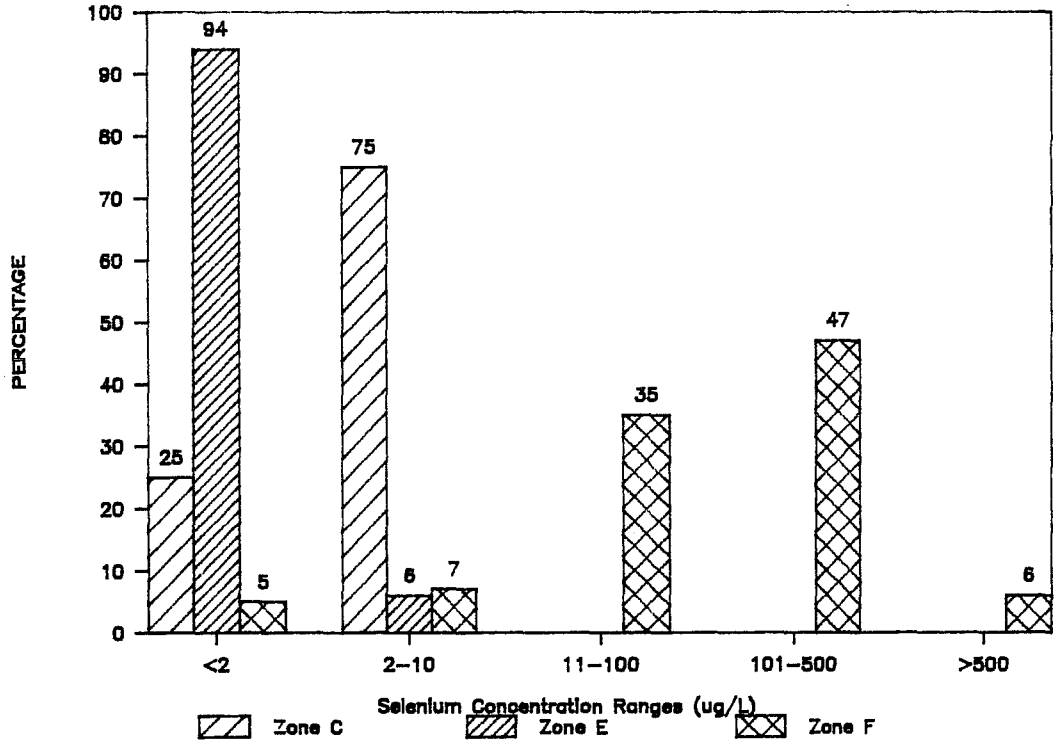


Figure 10. Frequency Distribution for Selenium in Subsurface Tile Drainage Waters.



Silver: Silver was not detected above the 5 ug/L detection limit in any of the samples tested. Further testing of shallow groundwater in the Panoche Fan Area (Zone F) by the U. S. Bureau of Reclamation showed no samples above the 1 ug/L detection level used in that study (Deverel et al., 1984).

Zinc: Zinc was detected above the 1 ug/L detection level in at least one sample in each of the discharge zones. The distribution of higher values was not related to any particular discharge zone and almost all zones had median values at or only slightly above the detection limit. The highest median value was 7 ug/L from the basin trough area (Zone E). As zinc coatings are often used on parts of piping and pumps, the widely scattered higher values may be related to contamination from these sources rather than actual concentrations in the shallow groundwater being discharged. Extensive efforts would be needed to avoid these potential sources of contamination, therefore it is recommended that in-stream monitoring be conducted for zinc in lieu of continued source monitoring, and only if the established criterion is being approached or exceeded should further source monitoring be conducted at the subsurface tile drainage discharges.

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Deverel, S. J., Gilliom, R. J., Fujii, R., Izbicki, J. A., and Fields, J. C., 1984. Areal distribution of selenium and other inorganic constituents in shallow ground water of the San Luis Drain Service Area, San Joaquin Valley, California; a preliminary report. U. S. Geological Survey Water Resources Investigation Report 84-4319. 67pp.

DWR, 1985. San Joaquin Valley Drainage Monitoring Program Annual Report. California Department of Water Resources. 56pp.

SWRCB, 1987. Technical committee report to the California State Water Resources Control Board on regulation of agricultural drainage to the San Joaquin River. California State Water Resources Control Board, Sacramento, California. 300pp.

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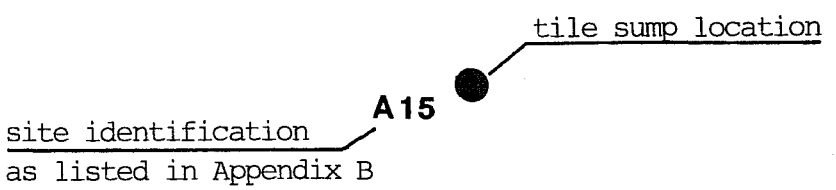
APPENDIX A

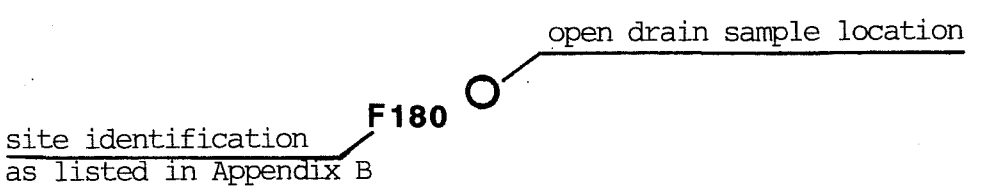
Sampling Location Within the San Joaquin River Basin

KEY TO SUBSURFACE TILE DRAINAGE

SITE LOCATION MAPS

Figure A-1 relates the discharge zone maps to the San Joaquin River Basin. All maps are oriented north to south when reading top to bottom. The following key applies to all sites indicated on the discharge zone maps.





The following scale is appropriate for all discharge zone maps.

SCALE 1:100 000

1 0 1 2 3 4 5 6 7 8 9 10
KILOMETERS

1 0 1 2 3 4 5
MILES

5000 0 5000 10000 15000 20000 25000
FEET

CONTOUR INTERVAL 50 METERS

WITH SUPPLEMENTARY CONTOURS AT 10-METER INTERVALS

NATIONAL GEODETIC VERTICAL DATUM OF 1929

To convert meters to feet multiply by 3.2808

To convert feet to meters multiply by 0.3048

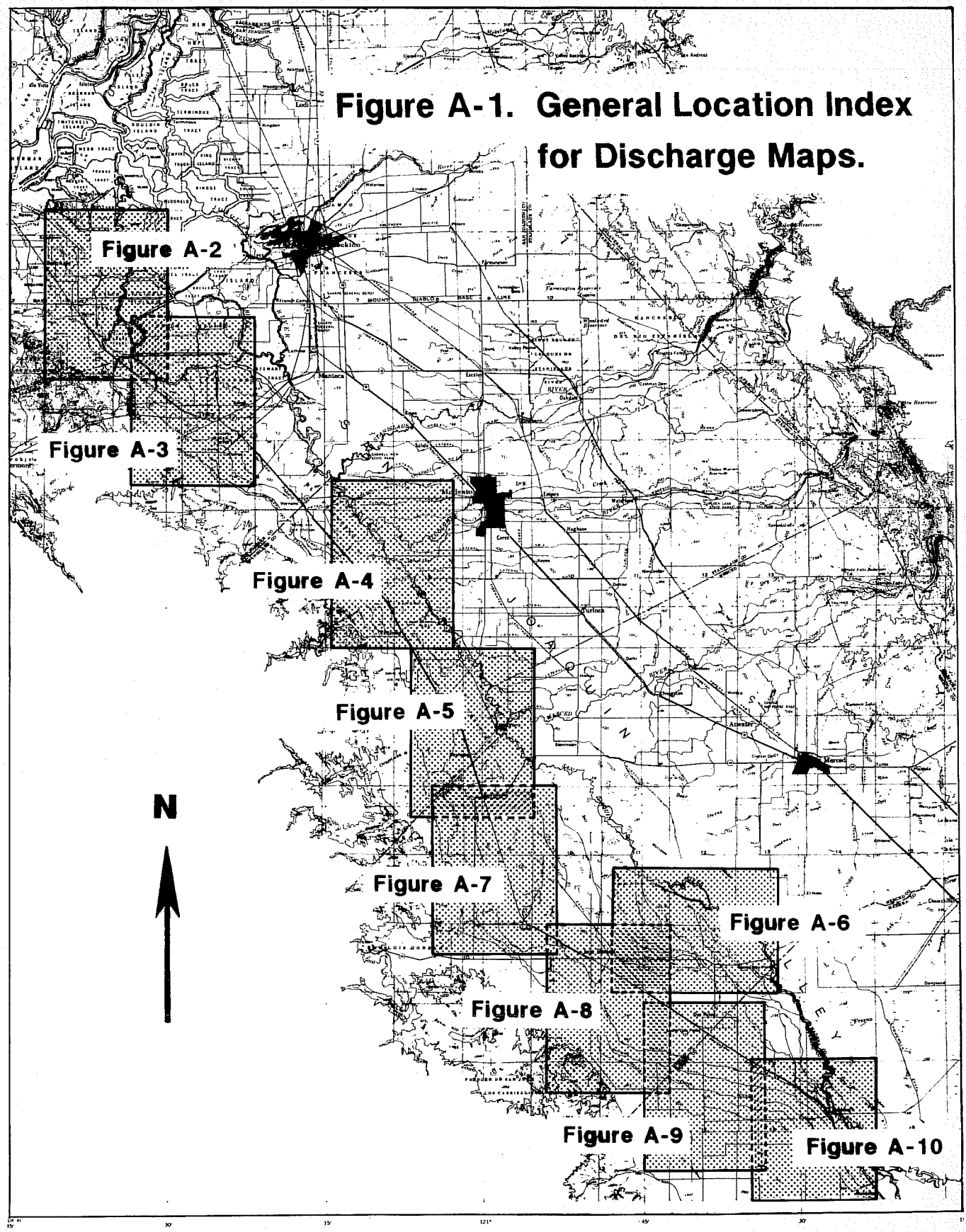


Figure A-1. General Location Index for Discharge Maps.
Figure A-2
Figure A-3
Figure A-4
Figure A-5
Figure A-6
Figure A-7
Figure A-8
Figure A-9
Figure A-10
N

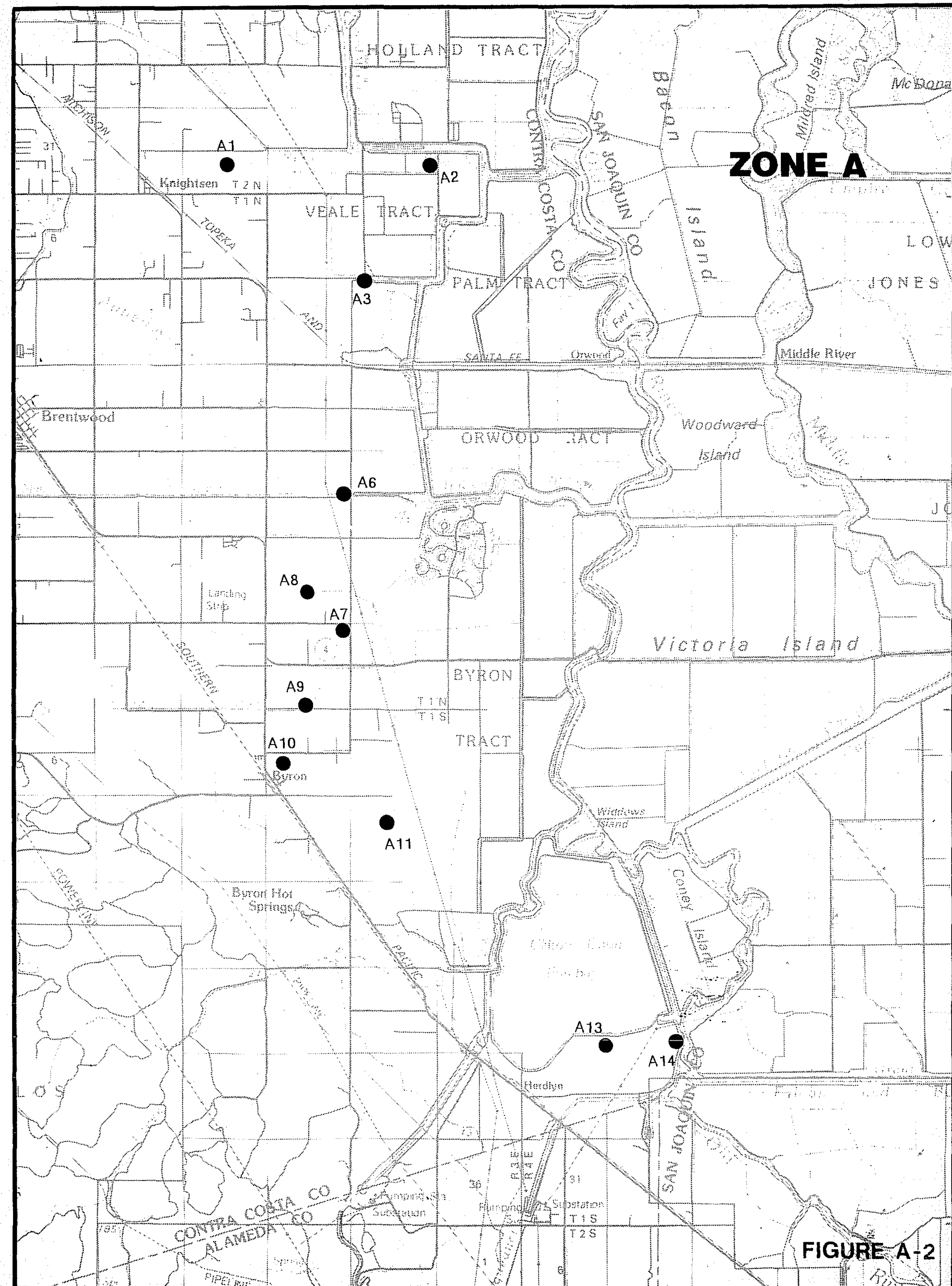


FIGURE A-2

T2N
T1N

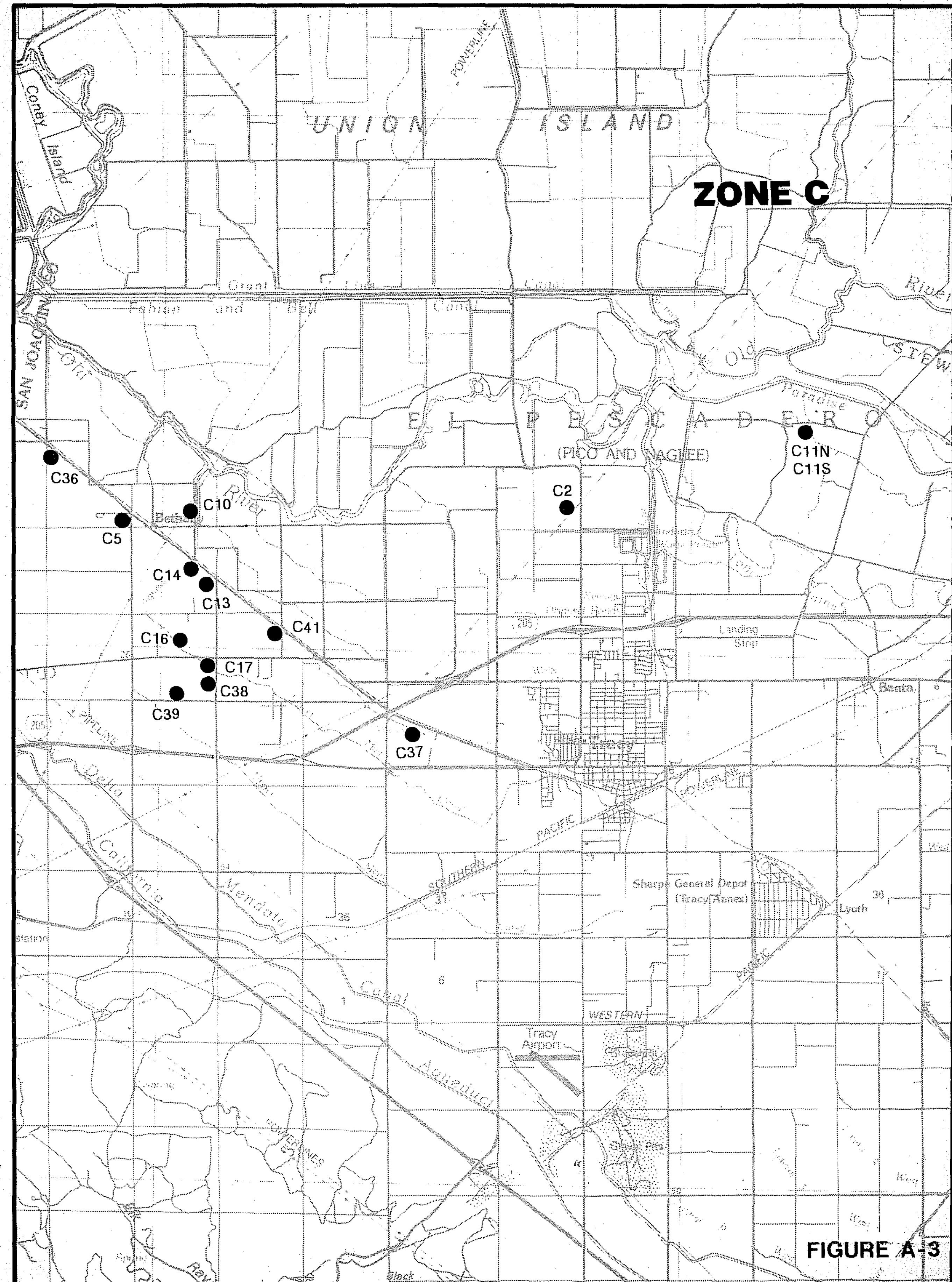
T1N
T1S

T1S
T2S

R3E | R4E

ZONE B: EAST OF THE SAN JOAQUIN RIVER

SITE ID	LOCATION	TOWNSHIP-RANGE-SECTION
B1	Near Sand Slu & Turner Is. Rds	T8S-R11E-S34
B2	Nr Hayden Rd & Le Grande Canal	T7S-R15E-S23
B3	Near Lander Ave and 4th Ave	T7S-R10E-S14
B4	Near Geer Rd and Lateral No. 7	T6S-R10E-S20
B5	Near August and Washington Rds	T6S-R10E-S18
B6	Alhem Ranch No. 4	T6S-R9E-S21
B7	Alhem Ranch No. 3	T6S-R9E-S21
B8	Columbus Ave & Lateral No. 8	T6S-R10E-S33
B9	At August and Faith Home Rds.	T6S-R10E-S18



ZONE C
UNION ISLAND
Coney Island
SAN JOAQUIN
EL PESCADERO
(PICO AND NAGLEE)
C36
C5
C10
C14
C13
C16
C41
C17
C38
C39
C37
C2
C11N
C11S
T1S
T2S
T2S
T3S
Tracy
Banta
Lyoth
Sharpe General Depot
(Tracy Annex)
Tracy Airport
SOUTHERN PACIFIC
WESTERN
POWERLINE
Delta
California
Mendota
Canal
Aqueduct
Landing Strip
R4E
R5E
R5E
R6E

FIGURE A-3

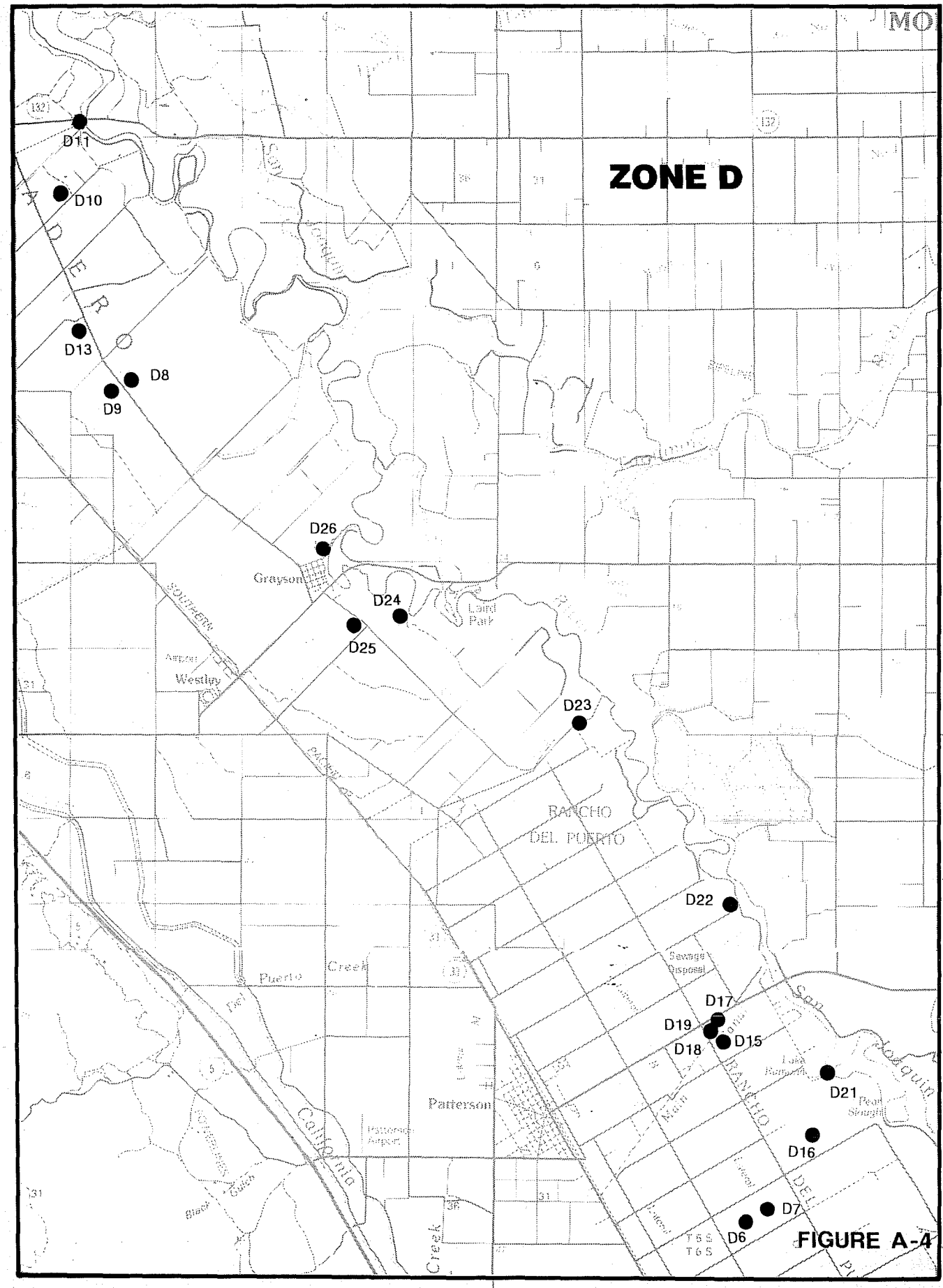

ZONE D
D11
D10
D13
D8
D9
D26
D24
D25
D23
D22
D17
D19
D15
D18
D21
D16
D7
D6
Graysonville
Westley
Patterson
Puerto Creek
RANCHO DEL PUERTO
T3S
T4S
T4S
T5S
T5S
T6S
R7E
R8E

FIGURE A-4

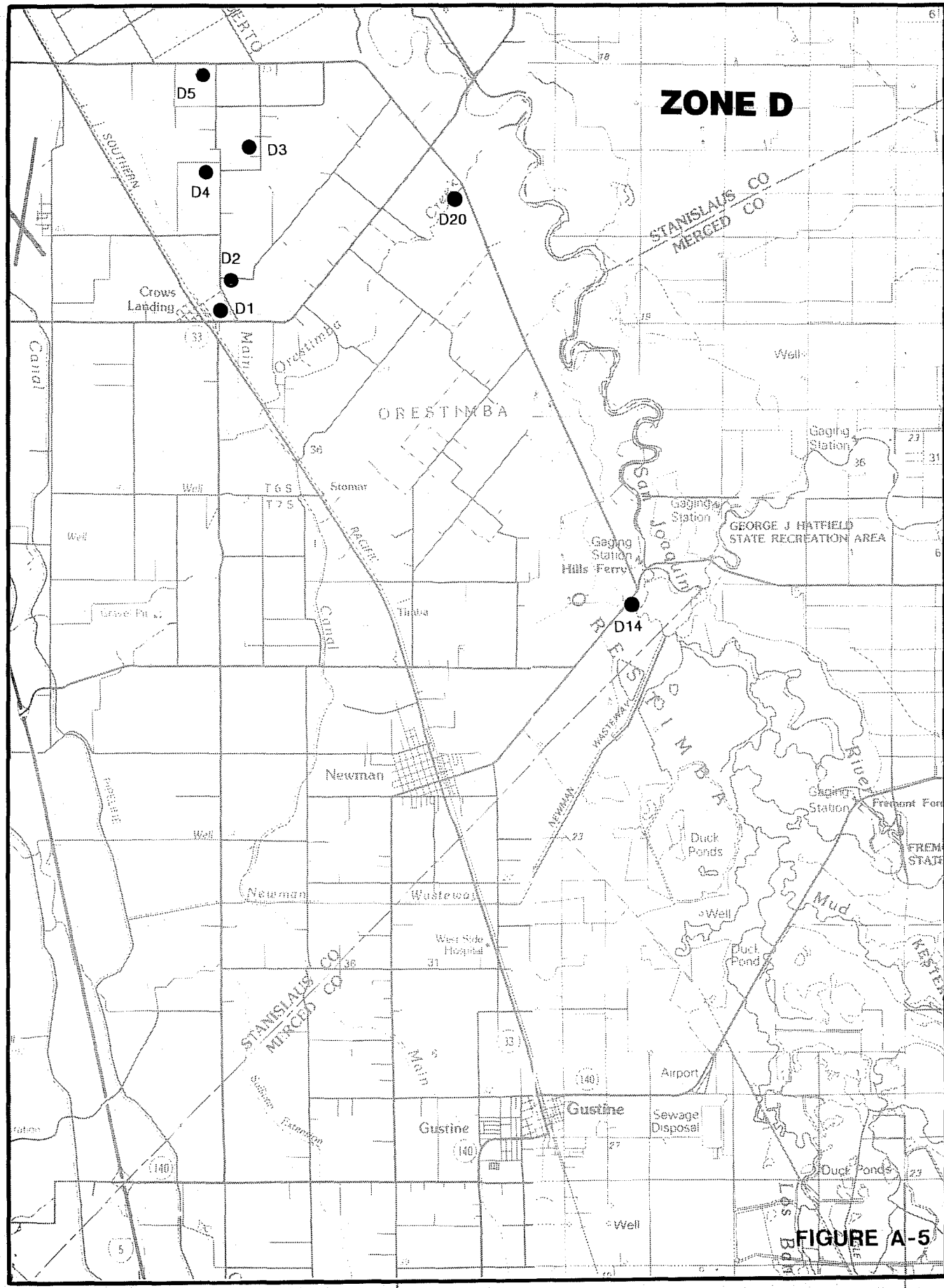
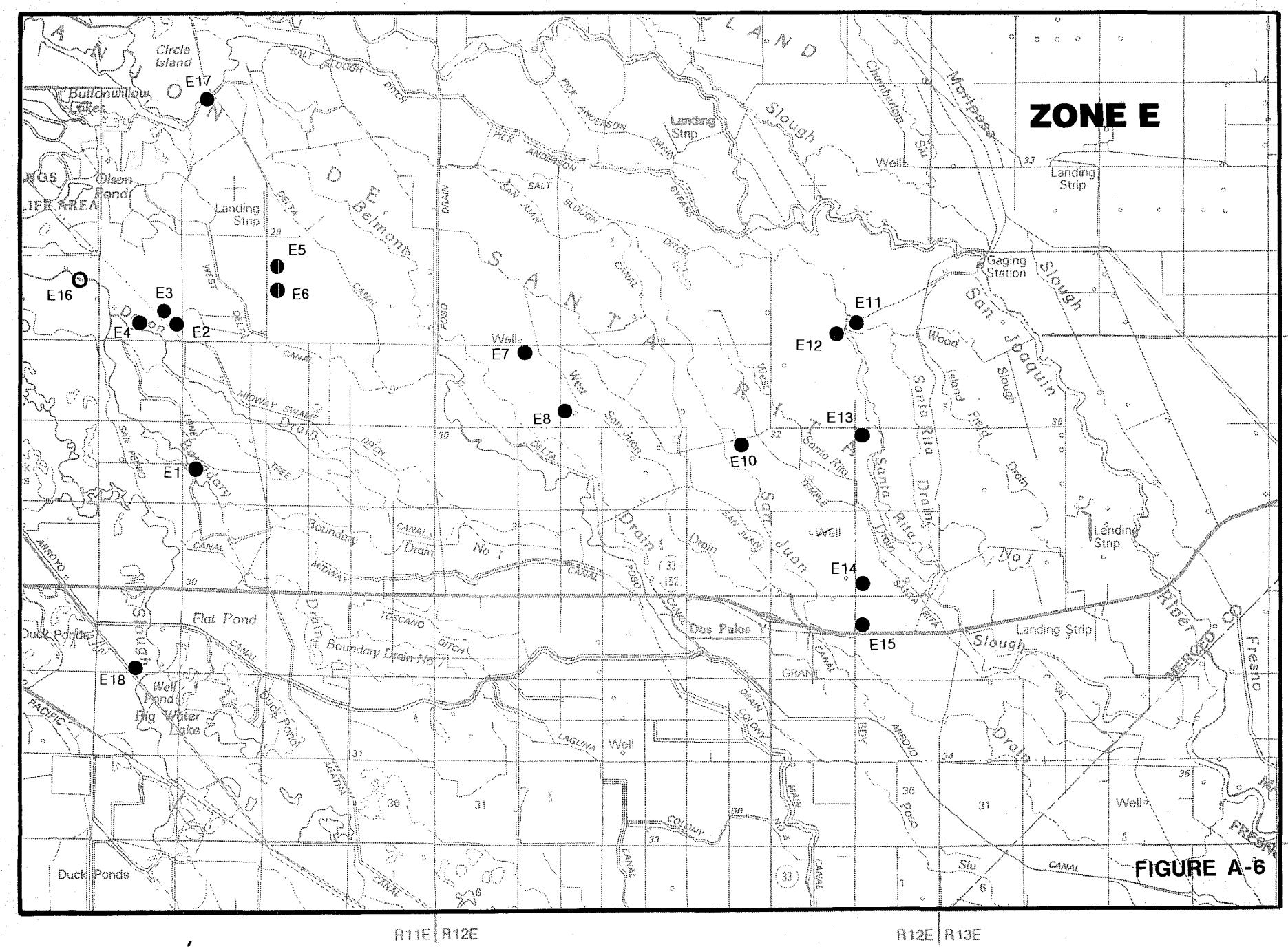
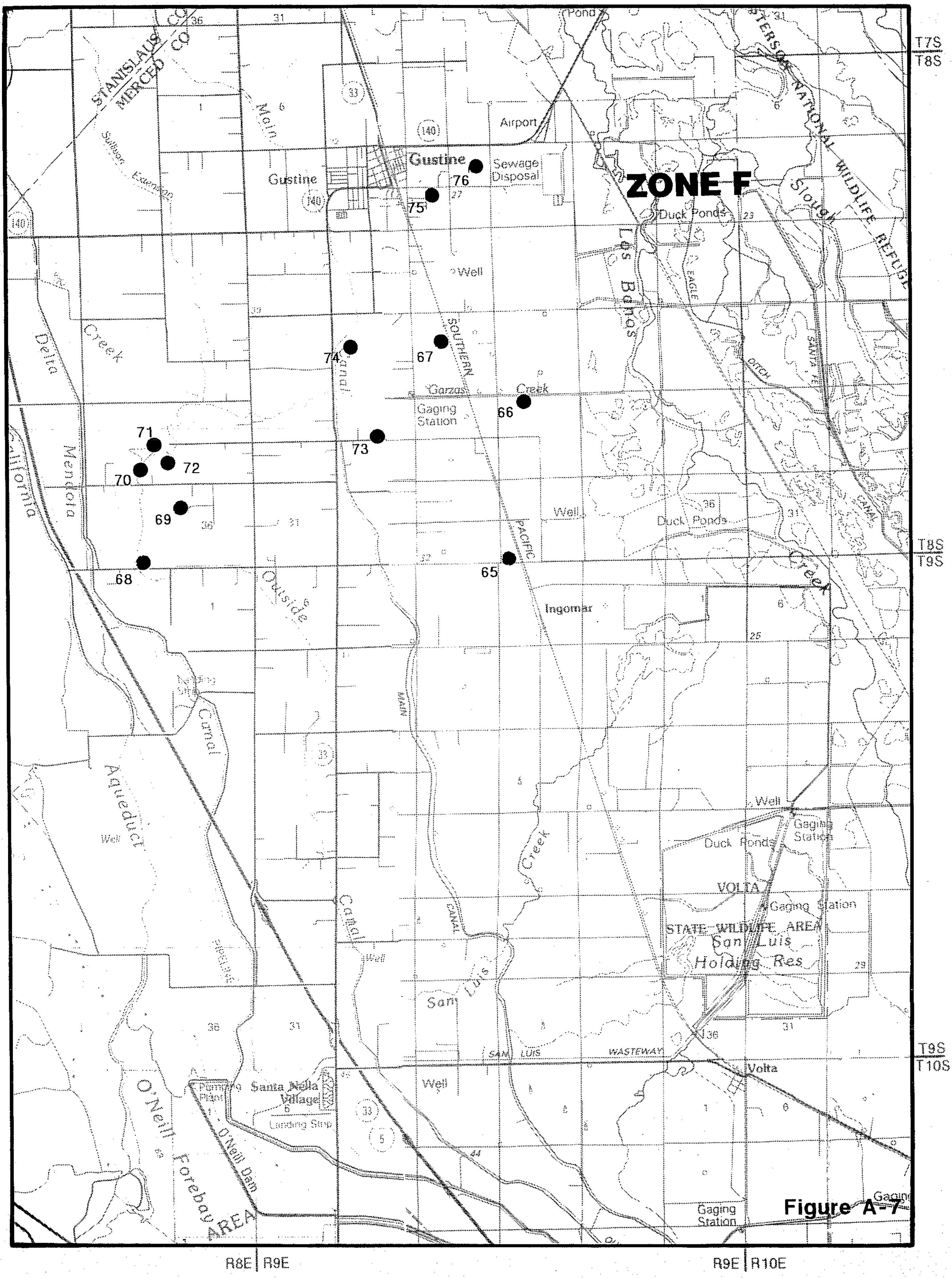
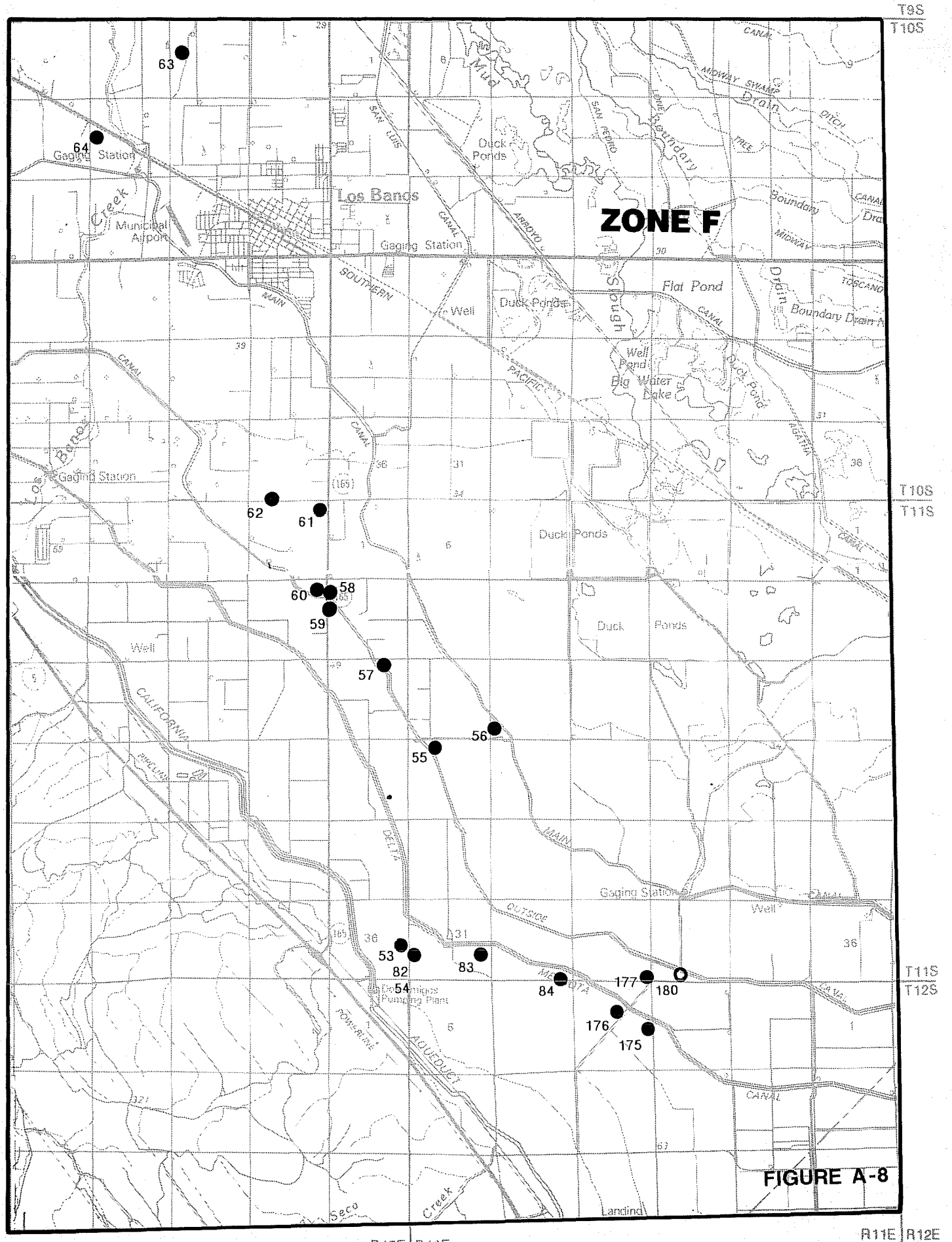

ZONE D
D5
D3
D4
D20
D2
D1
D14
Crows Landing
ORESTIMBA
Newman
Gustine
Hills Ferry
GEORGE J HATFIELD STATE RECREATION AREA
STANISLAUS CO
MERCED CO
San Joaquin River
Main Canal
Delta-Mendota Canal
Airport
Sewage Disposal
Duck Ponds
Wastewater
Well
Gaging Station
T6S
T7S
T8S
R8E
R9E
R10E

FIGURE A-5


ZONE E
E1
E2
E3
E4
E5
E6
E7
E8
E10
E11
E12
E13
E14
E15
E16
E17
E18
T9S
T10S
T10S
T11S
R11E
R12E
R12E
R13E
FIGURE A-6


ZONE F
76
75
74
67
66
65
73
71
72
70
69
68
Gustine
Sewage Disposal
Airport
Duck Ponds
Los Banos
Well
Garzas Creek
Gaging Station
SOUTHERN PACIFIC
Ingomar
Delta Creek
Mendota
California Aqueduct
Outside Canal
Main Canal
STANISLAUS CO
MERCED CO
San Luis Creek
VOLTA
STATE WILDLIFE AREA
San Luis Holding Res
SAN LUIS WASTEWAY
Volta
Santa Nella Village
O'Neill Forebay
O'Neill Dam
Landing Strip
T7S
T8S
T9S
T10S
R8E
R9E
R10E
Figure A-7


ZONE F
T9S
T10S
T10S
T11S
T11S
T12S
R10E
R11E
R11E
R12E
Los Banos
Gaging Station
Municipal Airport
Duck Ponds
Flat Pond
Big Water Lake
Well
Landing
63
64
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175

FIGURE A-8

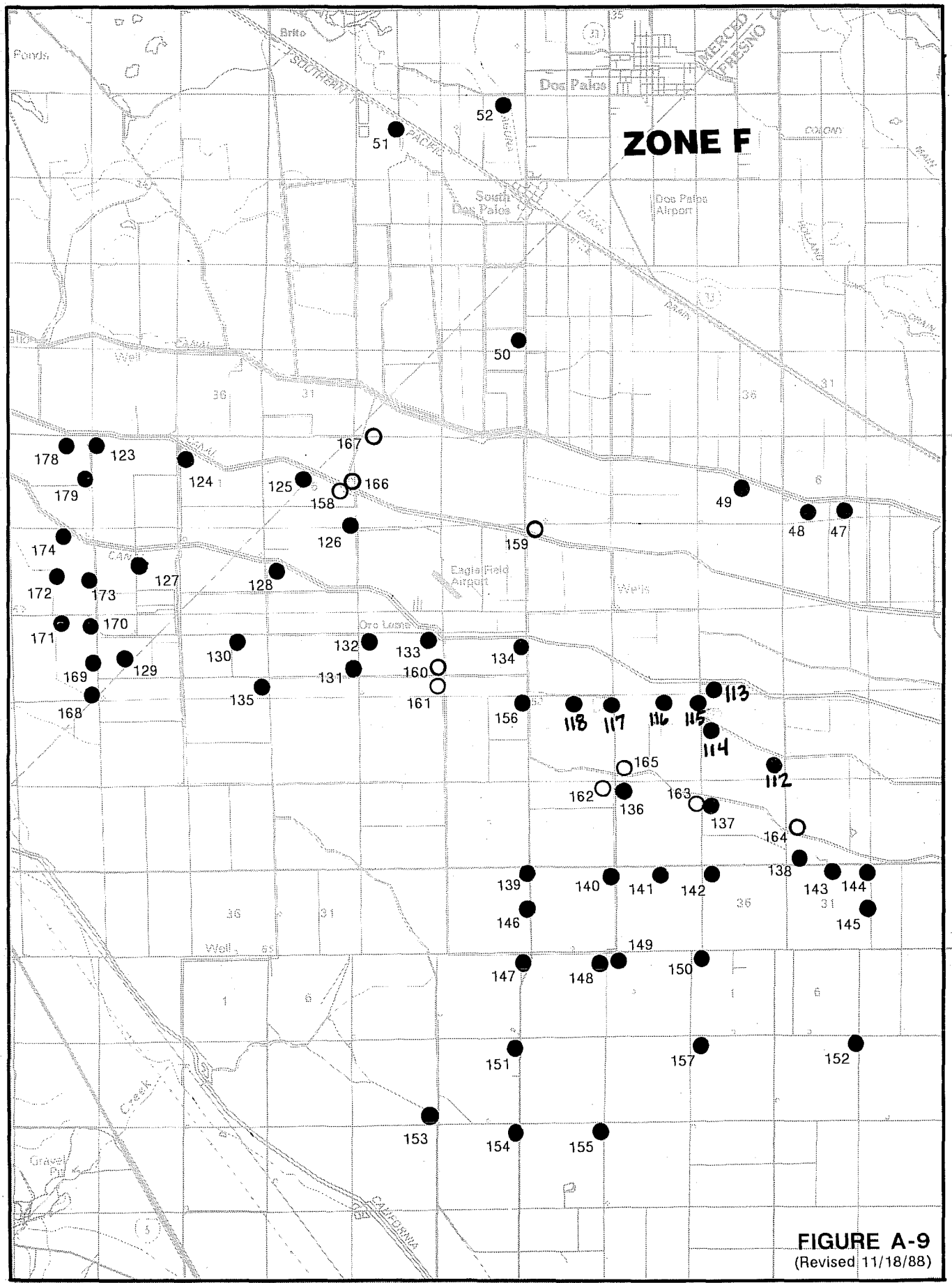
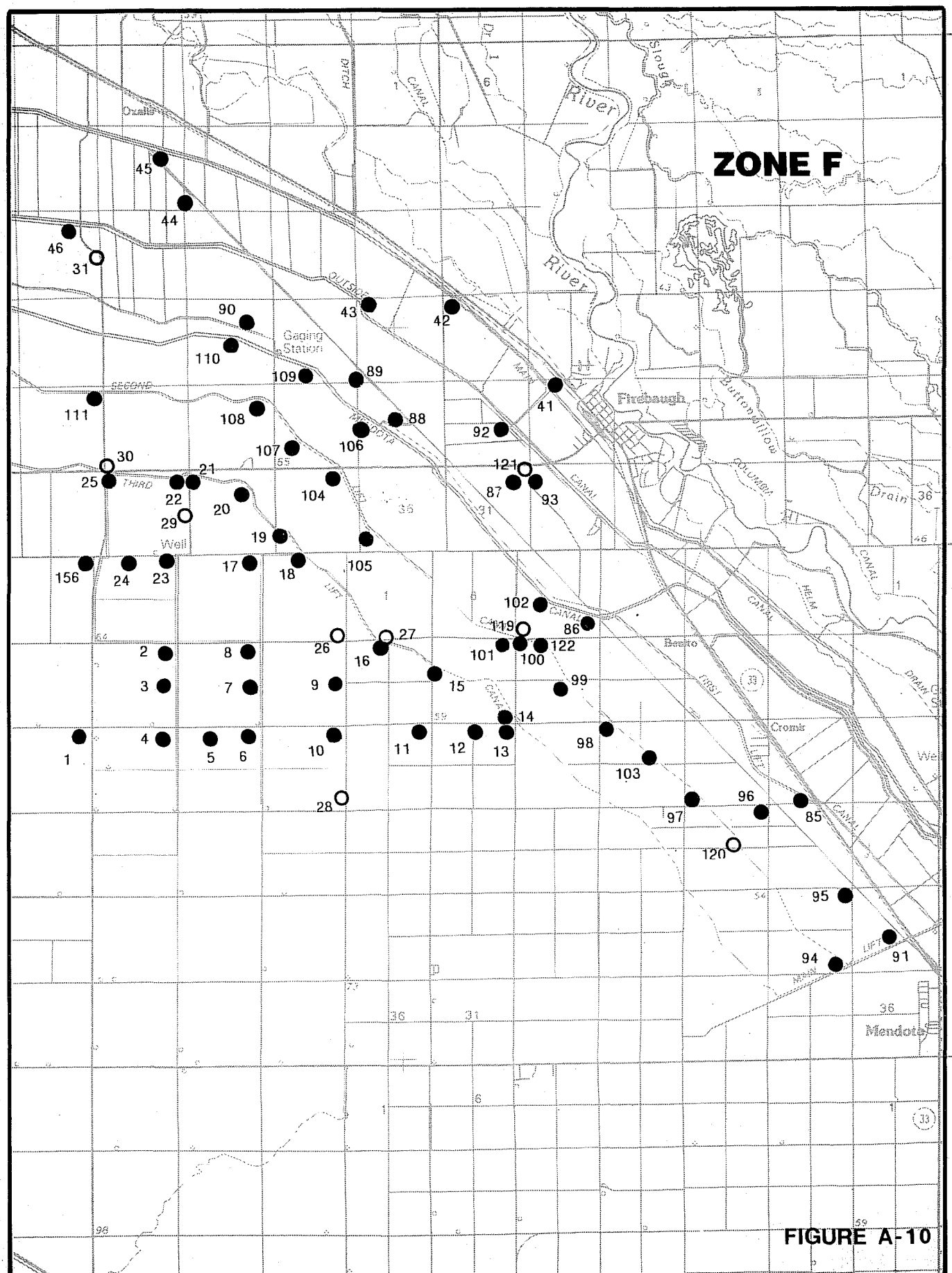


FIGURE A-9
(Revised 11/18/88)


ZONE F
T11S
T12S
T12S
T13S
T13S
T14S
R13E
R14E
R14E
R15E
River
Firebaugh
Mendota
Gaging Station
Well
Drain
CANAL
LIFT
1
2
3
4
5
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7
8
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12
13
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122
156

FIGURE A-10

ZONE G: OPEN WATER WAYS

SITE ID	LOCATION	TOWNSHIP-RANGE-SECTION
SAN JOAQUIN RIVER		
G1	SJR at Lander Ave.	T4S-R10E-S27
G2	SJR at Mossdale	T2S-R6E-S3
G3	SJR at Airport Way	T3S-R6E-S13
G4	SJR at Maze Blvd.	T3S-R7E-S29
G5	SJR at Laird Slough	T4S-R7E-S25
G6	SJR at Patterson Bridge	T5S-R8E-S22
G7	SJR at Crows Landing	T6S-R9E-S7
G8	SJR at Hills Ferry	T7S-R9E-S9
G9	SJR at Fremont Ford (HWY 140)	T7S-R9E-S24
GRASSLANDS		
G10	Almond Drain W of OHSLA Club	T11S-R11E-S6
G11	CCID Main at Almond Drive	T11S-R11E-S7
G12	Charleston at CCID Main	T11S-R11E-S29
G13	Camp 13 North of CCID Main	T11S-R11E-S27
G14	Firebaugh Drain at Camp 13	T11S-R11E-S27
G15	Hamburg Drain at Camp 13	T11S-R11E S27
G16	Helm Canal at Weir	T11S-R12E-S31
G17	Agatha Canal N of CCID Main	T11S-R12E-S31
G18	Panoche @ O'Banion Gaging Stat	T11S-R12E-S32
G19	Mercy Springs at Agatha	T11S-R12E-S31
G20	Rice Drain at Mallard Road	T11S-R12E-S7
G22	Santa Fe Canal at HWY 152	T10S-R11E-S17
G23	San Luis Canal at HWY 152	T10S-R11E-S18
G24	Santa Fe Canal @ Henry Miller	T10S-R10E-S1
G25	City Ditch Discharge	T9S-R11E-S19
G26	Boundary Drain at DFG Pumps	T9S-R11E-S32
G27	Salt Slough at Hereford Rd.	T9S-R11E-S22
G28	Salt Slough at Wolfson Ranch	T9S-R11E-S7
G29	Salt Slough at Lander Ave.	T8S-R10E-S10
G31	Newman Wasteway at STP	T7S-R9E-S16
G32	Garzas Creek at Hunt Road	T8S-R9E-S20
G33	CCID Main at Gun Club Rd.	T8S-R9E-S17
G34	Los Banos Creek at Gun Club Rd	T8S-R9E-S14
G35	Eagle Ditch at Gun Club Rd.	T8S-R9E-S13
G36	Santa Fe Canal At Gun Club Rd.	T8S-R10E-S19
G37	Mud Slough at Gun Club Rd.	T8S-R10E-S20
G38	Fremont Canal at Gun Club Rd.	T8S-R10E-S15
G39	Mud Slough at HWY 140	T7S-R9E-S26
G40	Los Banos Creek at HWY 140	T7S-R9E-S35
G41	Mud Slough at Newman Gun Club	T7S-R9E-S23
G42	Newman Wasteway at HWY 33	T7S-R9E-S16
G43	Kern Canon Creek	T5S-R7E-S7
CREEKS		
G44	Black Gultch	T5S-R7E-S34
G46	Corral Hollow	T3S-R4E-S24
G47	Crow	T7S-R7E-S24
G48	Deer	T1N-R2E-S20
G49	Del Puerto	T5S-R7E-S29
G51	Garzas	T8S-R8E-S17
G52	Hospital	T4S-R6E-S7
G53	Ingram	T4S-R6E-S35
G54	Kellogg	T1S-R3E-S7
G55	Los Banos Ck above Dam	T11S-R9E-S12
G57	Lone Tree	T4S-R5E-S1
G58	Little Panoche Ck above Dam	T13S-R10E-S35
G59	Little Panoche Ck below Dam	T13S-R11E-S20
G60	Marsh	T1S-R2E-S2
G61	Mountain House	T2S-R4E-S19
G62	Orestimba	T7S-R8E-S19
G63	Ortigalita	T11S-R10E-S31
G64	Panoche	T15S-R12E-S10
G65	Quinto	T9S-R8E-S15
G66	Romero	T9S-R8E-S27
G67	Salado	T6S-R7E-S10
G68	Sand	T1N-R2E-S8
G69	Silver	T15S-R12E-S31

APPENDIX B

Water Quality Data for the Sampling Sites Within the San Joaquin River Basin

APPENDIX B Table 1. Subsurface Tile Drainage Physical Properties and Chemical Concentrations.
Zone A - Contra Costa County

RWQCB ID	DATE	pH	EC	TEMP	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
			umhos/cm	F	mg/L											ug/L											
A1	06/13/86	8.1	1600	64	1000	38	67	180	1.5	200	200	380	380	410	1.9	2	<5	<5	<5	<5		6	<5	<5	3	<5	<5
A1	06/01/87		1620							167	155				1.8			1	<1	<5			3	<5	2		<1
A2	06/13/86	8.2	2700	64	1700	82	90	360	5.1	540	360	370	370	540	2.2	28	<5	<5	<5	<5		720	<5	<5	<1	<5	<5
A2	06/01/87		2870							417	450				2.3			3	2	<5	<0.2		10	<5	1		6
A3	06/13/86	8.3	1900	63	1300	51	62	190	1.8	260	260	295	295	360	2.5	2	<5	5	<5	<5		9	41	<5	1	<5	<5
A3	06/01/87		2220							279	312				3.3			3	<1	<5	<0.2		3	<5	3		1
A6	06/13/86	7.7	1900	64	1300	31	55	240	0.9	240	270	330	330	300	4.5	1	<5	<5	<5	<5		12	<5	<5	<1	<5	<5
A6	06/01/87		2050							232	237				4.7			2	<1	<5	<0.2		4	<5	1		<1
A7	06/13/86	8.1	1600	64	1100	31	42	210	1.0	230	180	280	280	240	3.0	1	<5	7	<5	<5		<5	<5	<5	1	<5	<5
A7	06/01/87		1720							219	146				2.9			4	<1	<5	<0.2		1	<5	2		<1
A8	06/13/86	8.2	1600	64	1000	26	56	190	0.7	200	170	270	270	300	3.1	1	<5	6	<5	<5		9	<5	<5	1	<5	<5
A8	06/01/87		1810							200	161				3.7			<1	<1	<5	<0.2		2	<5	2		<1
A9	06/13/86	8.0	1400	64	830	28	53	140	0.5	160	130	310	310	260	2.3	1	<5	5	<5	<5		7	<5	<5	2	<5	<5
A9	06/01/87		1440							147	111				2.8			3	<1	<5			2	<5	1		<1
A10	06/13/86	8.2	1300	64	850	23	56	160	0.4	150	130	320	320	250	2.6	1	<5	5	<5	<5		11	<5	<5	1	<5	<5
A10	06/01/87		1440							138	113				2.4			3	<1	<5			2	<5	<1		<1
A11	06/13/86	7.9	1800	64	1200	32	43	260	1.9	240	190	370	370	250	4.7	2	<5	6	<5	<5		<5	<5	<5	1	<5	<5
A11	06/01/87		2490							303	250				6.8			3	<1	<5			3	<5	2		<1
A13	06/13/86	8.0	2200	66	1500	63	47	340	2.4	430	250	130	130	380	4.0	5	<5	15	11	<5		500	18	<5	1	<5	14
A14	06/13/86	8.3	780	70	500	37	17	86	2.7	87	110	80	80	190	0.6	7	<5	10	8	<5		440	10	<5	1	<5	10

APPENDIX B Table 2. Subsurface Tile Drainage Physical Properties and Chemical Concentrations.
Zone B - Eastside San Joaquin River

RWQCB ID	DATE	pH	EC	TEMP	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
			umhos/cm	F	mg/L											ug/L											
B1	06/12/86	8.1	2000	65	1300	97	45	190	3.1	360	210	260	260	410	0.1	11	<5	<5	<5	<5		3700	7	<5		<5	34
B1	06/02/87		1320							195	160				0.1			<1	<1	<5	<0.2		10	2	<1		2
B2	06/12/86	8.5	640	69	480	36	21	37	2.0	43	50	190	198	170	<0.05	2	<5	<5	<5	<5		9	<5	<5	<1	<5	<5
B2	06/02/87		580							29	15				<0.05			1	<1	<5	<0.2		1	<1	<1		<1
B3	06/12/86	8.2	2300	65	1500	13	12	450	6.7	220	110	760	760	80	0.5	63	<5	<5	12	<5		1190	133	<5	<1	<5	<5
B4	06/12/86	7.9	850	65	560	58	17	66	1.5	110	54	110	110	240	0.1	2	<5	<5	<5	<5		8	<5	<5	1	<5	<5
B4	06/02/87		670							85	39				0.1			<1	2	<5	<0.2		2	1	<1		1
B4	06/02/87		668							86	39				0.1			<1	2	<5	<0.2		2	1	<1		1
B5	06/12/86	8.5	900	66	710	78	26	69	5.8	42	62	250	266	330	0.2	8	<5	5	7	<5		218	<5	<5	1	<5	<5
B5	06/12/86															8	<10	<2	<10	<10				<5			<10
B5	06/02/87		1070							63	67				0.1			<1	5	<5	<0.2		7	3	1		3
B6	06/12/86	8.4	1100	64	710	17	10	190	2.4	89	39	410	418	84	0.2	4	<5	<5	<5	<5		354	165	<5	<1	<5	<5
B7	06/12/86	8.5	800	64	560	13	9	120	1.7	67	43	220	228	68	0.2	1	<5	<5	<5	<5		294	7	<5	<1	<5	<5
B8	06/12/86	8.6	900		710	77	23	67	5.7	41	61	230	250	330	0.2												
B8	06/02/87		662							34	48				0.1			<1	2	<5	<0.2		6	7	1		7
B9	06/02/87		865							57	59				0.1			<1	1	<5	<0.2		4	<1	<1		<1

APPENDIX B Table 3. Subsurface Tile Drainage Physical Properties and Chemical Concentrations.
Zone C - San Joaquin County

RWQCB ID	DATE	pH	EC umhos/cm	TEMP F	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
					mg/L											ug/L											
C2	06/16/86	8.1	3400	63	2300	170	110	330	0.6	600	530	310	310	1000	1.0	3	<5	<5	<5	<5		84	13	<5	1	<5	<5
C2	06/02/87		3210							568	535				1.3			<1	<1	<5			18	<5	3		2
C5	06/16/86	8.3	2500	63	1500	43	43	400	1.0	450	260	330	330	310	1.0	2	<5	10	<5	<5		62	<5	<5	3	<5	<5
C5	06/02/87		2540							424	383				4.4			6	1	<5			2	<5	4		1
C10	06/16/86	8.5	1900	69	1200	110	45	210	3.1	280	250	220	236	470	1.8	3	<5	<5	<5	<5		72	<5	7	1	<5	31
C10	06/02/87		2290							367	425				2.5			5	3	<5			3	<5	2		9
C11n	06/16/86	8.1	2300	63	1300	130	75	170	2.4	500	240	160	160	710	1.0	9	<5	<5	<5	<5		2520	10	<5	<1	<5	<5
C11n	06/02/87		2900							642	390				0.5			<1	<1	<5			6	<5	3		7
C11s	06/16/86	8.1	3300	64	1800	180	110	300	0.9	730	410	210	210	940	1.0	2	<5	<5	<5	<5		386	9	9	1	<5	<5
C13	06/16/86	8.0	4000	65	2300	140	80	600	3.3	800	620	320	320	610	4.9	1	<5	5	<5	<5		74	<5	6	4	<5	<5
C13	06/02/87		4230							728	982				5.6			4	1	<5			2	<5	4		<1
C14	06/16/86	8.0	3100	64	2200	130	64	390	2.0	490	590	420	420	530	3.3	2	<5	<5	<5	<5		42	<5	<5	1	<5	<5
C14	06/02/87		4040							539	830				5.7			2	2	<5			3	<5	4		<1
C16	06/16/86	8.2	2500	65	1600	62	44	370	2.1	440	240	320	320	280	2.5	6	<5	<5	<5	<5		41	8	<5	3	<5	<5
C16	06/02/87		2990							476	510				2.9			<1	1	<5			4	<5	1		<1
C17	06/16/86	8.2	4000	63	2700	180	76	570	1.9	840	600	310	310	630	4.7	4	<5	<5	<5	<5		<5	8	<5	4	<5	<5
C17	06/02/87		3840							677	630				5.3			1	5	<5			9	<5	4		<1
C36	06/16/86	8.4	2300	63	1400	39	38	350	0.9	260	160	340	348	230	4.7	2	<5	8	<5	<5		6	6	<5	2	<5	<5
C36	06/02/87		2350							373	284				4.9			6	<1	<5			2	<5	2		1
C37	06/16/86	8.0	3100	63	2200	150	73	370	1.5	560	640	240	240	620	3.5	2	<5	11	<5	<5		<5	<5	<5	4	<5	<5
C37	06/02/87		3060							505	704				3.6			2	<1	6			3	<5	4		1
C38	06/16/86	8.2	3400	64	2300	88	72	490	1.5	680	450	410	410	470	2.9	5	<5	<5	<5	<5		23	8	5	2	<5	<5
C38	06/02/87		3550							654	449				3.0			<1	<1	<5			5	<5	1		1
C39	06/16/86	8.3	2300	64	1500	41	38	350	1.7	395	220	360	360	270	2.2	6	<5	<5	<5	<5		<5	13	<5	3	<5	<5
C39	06/02/87		2380							379	255				2.3			<1	<1	7			13	<5	2		<1
C41	06/16/86	8.3	4000	64	2900	200	99	500	0.9	600	1000	260	260	810	5.9	2	<5	<5	<5	<5		<5	6	8	6	<5	<5
C41	06/02/87		4170							625	1421				5.4			1	1	5			7	<5	5		2

APPENDIX B Table 4. Subsurface Tile Drainage Physical Properties and Chemical Concentrations.
Zone D - Stanilaus County

RWQCB ID	DATE	pH	EC	TEMP	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
			umhos/cm	F	mg/L											ug/L											
D1	04/10/86	6.2	1000	59						86	120		250		0.4	<1	<10	<2	<10	<10		1	<5	2		14
D1	06/11/86	8.3	990	62	640	110	27	75	3.0	94	130	210	210	360	0.4	1	<5	<5	<5	<5		56	<5	<5	2	<5	5
D2	04/10/86	7.0	880	63						70	98		210		0.5	<1	<10	13	<10	<10		3	<5	2		10
D2	06/11/86	8.2	960	64	630	82	28	94	1.1	92	130	180	180	280	0.4	1	<5	<5	6	<5		19	<5	<5	1	<5	16
D3	04/10/86	6.8	3700	61						350	1000		380		2.1	<1	<10	3	<10	<10		2	<5	2		<10
D3	06/11/86	8.1	3400	64	2700	310	110	410	3.1	300	1100	270	270	1100	1.9	1	<5	<5	<5	<5		<5	<5	<5	3	<5	<5
D3	06/13/86	8.0	2100	65	1400	64	58	230	2.4	310	370	280	280	430	1.8	2	<5	6	<5	13		<5	<5	<5	<1	<5	<5
D4	04/10/86	6.9	2200	62						220	400		280		1.0	<1	<10	<2	14	<10		2	<5	1		12
D4	06/11/86	7.9	1700	65	1100	130	53	190	1.7	140	300	180	180	580	0.6	1	<5	5	47	<5		14	<5	<5	<1	<5	6
D5	06/11/86	8.0	2500	62	1900	230	88	330	2.7	260	680	180	180	630	1.2	1	<5	<5	<5	<5		<5	<5	<5	2	<5	<5
D5	07/28/87		2200	68						280					1.1										4		
D6	04/10/86	7.0	2300	62						240	360		340		0.9	<1	<10	6	<10	<10		1	<5	3		<10
D6	06/11/86	8.1	2900	63	2100	190	94	390	3.0	470	470	230	230	690	1.1	1	<5	<5	<5	<5		<5	<5	<5	3	<5	<5
D7	04/10/86	7.1	2300	62						240	330		340		0.9	<1	<10	6	<10	<10		1	<5	3		<10
D7	06/11/86	8.1	2300	62	1500	160	78	300	2.8	320	340	240	240	530	0.7	1	<5	5	<5	<5		<5	<5	<5	2	<5	<5
D8	04/10/86	7.3	2400	64						380	340		270		1.8	<1	<10	29	<10	<10		1	<5	2		<10
D8	06/11/86	8.3	2200	65	1500	150	63	250	2.6	330	300	230	230	570	1.5	1	<5	41	5	<5		85		230	2	<5	5
D9	04/10/86	7.1	2900	63						410	590		320		3.1	<1	<10	21	<10	<10		1	<5	2		12
D9	06/11/86	8.2	1300	61	800	84	38	140	3.8	180	190	150	150	350	0.9	57	<5	268	180	42		3900		8	<1	<5	92
D9	07/28/87		1900	65						200					1.1										2		
D10	06/11/86	8.3	2800	64	2000	99	75	530	2.8	310	550	310	310	430	4.5	1	<5	38	<5	<5		81	11	<5	6	<5	<5
D10	06/13/86	7.9	2700	63	1800	100	63	330	2.8	390	580	240	240	490	3.0	1	<5	21	<5	<5		<5	<5	<5	2	<5	<5
D10	07/28/87		2000	68						320					1.5										2		
D11	06/11/86	8.2	2500	62	1800	110	65	400	3.0	230	630	260	260	480	3.6	1	<5	10	<5	<5		<5	32	<5	4	<5	<5
D12	06/11/86	8.4	1700	65	1100	140	43	170	5.4	240	180	200	216	510	0.9	2	<5	10	<5	<5		93	<5	<5	2	<5	9
D13	04/10/86	7.3	2100	64						310	290		260		1.8	<1	<10	17	<10	<10				<5			10
D13	06/11/86	8.3	780	72	670	48	22	92	3.1	89	92	100	100	210	0.3	16	<5	69	39	12		940	<5	56	<1	<5	61
D14	06/11/86	8.3	2000	64	1300	92	100	220	5.5	220	290	420	420	600	1.3	2	<5	11	<5	<5		130	<5	<5	2	<5	<9

APPENDIX B Table 4. (cont.)

RWQCB ID	DATE	pH	EC	TEMP	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
			umhos/cm	F	mg/L											ug/L											
D14	07/28/87		1400	64						230					0.9										1		
D15	06/11/86	8.2	2200	62	1500	130	87	280	3.0	240	350	330	330	520	1.0	2	<5	11	<5	<5		11	<5	<5	3	<5	<5
D15	07/28/87		730	65						110					0.4										<1		
D16	04/10/86	7.2	2200	63						230	370		320		1.0	<1	<10	6	<10	<10			1	<5	4		10
D16	07/28/87		990	66						140					0.7										2		
D17	04/10/86	7.1	3700	62						470	800		140		1.9	<1	<10	11	<10	<10			2	<5	3		<10
D17	07/28/87		850	68						110					1.1										2		
D18	06/13/86	8.2	2700	65	1900	80	58	360	2.5	550	350	260	260	480	2.4	5	<5	5	<5	<5		15	5	<5	2	<5	<5
D19	06/13/86	8.6	2100	63	1400	95	51	270	2.9	360	310	290	340	530	0.6	4	<5	<5	<5	<5		140	19	6	3	<5	<5
D19	07/28/87		670	67						95					1.1										1		
D20	06/13/86	8.3	2100	64	1300	36	34	330	3.1	280	250	360	360	240	2.2	3	<5	<5	<5	<5		<5	<5	<5	<1	<5	3
D20	07/28/87		4900	72						1100					1.6										<1		
D21	06/13/86	8.2	1800	69	1200	56	48	160	3.4	270	210	290	290	350	1.4	2	<5	7	<5	<5		12	10	<5	<1	<5	9
D21	07/28/87		900	72						110					1.6										3		
D22	06/13/86	7.7	6200	64	4400	370	270	510	2.5	1400	1200	340	340	1800	1.6	4	<5	<5	<5	<5		4660	6	11	<1	<5	<5
D22	07/16/87		1500	85						220					1.3										5		
D23	06/13/86	8.0	2100	64	1300	74	58	190	2.1	300	300	240	240	400	2.2	2	<5	11	6	<5		<5	<5	<5	<1	<5	<5
D23	07/16/87		1700	84						280					1.2										5		
D24	06/13/86	8.2	810	64	500	45	19	87	5.4	65	200	150	150	190	0.6	3	<5	9	5	<5		122	<5	8	<1	<5	8
D24	07/16/87		630	83						190					1.6										2		
D25	06/13/86	8.1	7500	63	4800	200	260	1000	2.4	1200	2300	500	500	1500	9.6	5	<5	7	<5	<5		300	29	<5	8	<5	<5
D25	07/16/87		1400	89						230					1.2										5		
D26	06/13/86	8.0	1800	62	1100	62	32	200	2.0	280	260	200	200	250	1.3	1	<5	23	6	<5		25	<5	8	<1	<5	<5
D26	07/16/87		750	79						130					0.5										2		

APPENDIX B Table 5. Subsurface Tile Drainage Physical Properties and Chemical Concentrations.
Zone E - Basin Trough, Merced County

RWQCB ID	DATE	pH	EC	TEMP	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
			umhos/cm	F	mg/L											ug/L											
E1	04/03/86		1800	63						320	350		140		1.2	2	<10	<10	<10	<2			8	<5	2		<10
E1	06/12/86	8.3	2100	66	1300	79	51	300	4.3	420	300	120	120	370	0.8	2	<5	<5	<5	<5		1280	10	<5	<1	<5	<5
E1	06/02/87		1490							240	174				0.6			<1	<3	<5	<0.2		9	<5	2		1
E2	04/03/86		3900	63						690	750		420		1.9	3	<10	<10	<10	<2			20	<5	1		<10
E2	06/12/86	8.3	2000	62	1300	91	56	310	4.3	280	270	260	260	360	0.5	3	<5	<5	<5	<5		1140	26	<5	<1	<5	<5
E2	06/02/87		2530							360	324				0.7			<1	<3	<5	<0.2		24	<5	1		4
E3	04/03/86		2100	63						320	350		340		1.3	8	<10	<10	<10	<2			111	8	1		<10
E3	06/12/86	8.2	2400	65	1600	110	66	360	4.3	370	380	280	280	90	0.7	2	<5	<5	<5	<5		1050	20	<5	<1	<5	<5
E3	06/02/87		2530							382	253				0.7			<1	<1	<5	<0.2		11	<5	1		2
E4	04/03/86		2500	63						490	360		330		1.3	2	<10	<10	<10	<2			17	6	1		<10
E4	06/12/86	8.4	1500	68	920	65	38	210	4.4	240	200	160	168	300	0.5	53	<5	<5	5	<5		500	12	6	<1	<5	17
E4	06/02/87		2450							410	177				0.6			<1	<3	<5	<0.2		15	<5	1		2
E5	04/03/86		2800	60						820	1400		360		1.4	5	<10	<10	<10	<2			149	<5	2		12
E5	06/12/86	8.5	1400	64	860	70	46	180	3.8	200	210	200	216	330	0.3	5	<5	<5	<5	<5		106	30	<5	2	<5	<5
E5	06/02/87		2560							256	94				0.9			<1	<1	<5	<0.2		142	<5	2		2
E6	04/03/86		1500	61						140	120				1.3	13	<10	<10	<10	<2			15	7	<1		20
E6	06/02/87		1040							87	175				0.4			<1	2	<5	<0.2		14	<5	1		1
E7	04/03/86		1200	63						170	190				0.9	3	<10	<10	<10	<2			24	<5	<1		12
E7	06/12/86	8.4	1200	63	760	73	36	160	1.8	140	150	180	188	260	0.3	3	<5	<5	<5	<5		1050	23	<5	<1	<5	<5
E7	06/02/87		1030							109	113				0.4			<1	<1	<5	<0.2		18	<5	1		3
E8	06/02/87		1070							138	175				0.3			<1	2	<5	<0.2		11	<5	1		10
E10	04/03/86		1500	62						240	200				1.1	<1	<10	<10	<10	2			6	<5	<1		9
E10	06/12/86	8.4	1100	63	720	80	34	140	2.6	180	140	170	186	300	0.2	2	<5	<5	<5	21		210	<5	<5	<1	<5	7
E10	06/02/87		1420							213	167				0.3			<1	<1	<5	<0.2		9	<5	1		5
E11	04/03/86		880	61						94	110				1.2	6	<10	<10	<10	<2			12	<5	1		22
E11	06/12/86	8.3	1000	64	680	87	22	120	1.3	120	110	220	220	280	0.1	13	<5	<5	<5	<5		108	13	<5	<1	<5	6
E11	06/02/87		1210							155	133				0.2			<1	2	<5	<0.2		17	<5	4		2
E12	04/03/86		1100	62						150	160				0.9	5	<10	<2	10	<10			9	<5	<1		13

APPENDIX B Table 5. (cont.)

RWQCB ID	DATE	pH	EC	TEMP	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
			umhos/cm	F	mg/L											ug/L											
E12	06/12/86	8.3	1100	64	690	88	26	120	1.6	140	110	190	190	290	0.1	6	<5	<5	<5	<5		480	6	<5	<1	<5	<5
E12	06/02/87		1150							149	138				0.2			<1	<1	<5	<0.2		10	<5	1		1
E13	04/03/86		1600	63						290	280				1.1	4	<10	<2	11	<10			16	<5	<1		13
E13	06/12/86	8.2	1500	66	980	140	47	140	2.5	210	190	200	200	430	0.1	4	<5	<5	<5	<5		1130	17	<5	<1	<5	<5
E13	06/02/87		1630							235	255				0.2			<1	<1	<5	<0.2		16	<5	<1		1
E14	04/03/86		1900	60						380	300				1.0	5	<10	<2	14	<10			12	<5	<1		84
E14	06/12/86	8.0	1700	64	1100	160	54	150	1.8	240	200	250	250	560	0.1	6	<5	<5	<5	<5		780	16	<5	1	<5	<5
E14	06/02/87		1700							287	208				0.1			<1	<1	<5	<0.2		15	<5	<1		5
E15	04/03/86		1100	62						140	150				0.4	3	<10	<2	<10	<10			11	<5	1		<10
E15	06/12/86	8.4	1400	66	930	120	41	140	1.8	200	170	170	186	430	0.2	4	<5	<5	<5	<5		204	14	<5	2	<5	<5
E15	06/02/87		1290							178	182				0.2			<1	3	10	<0.2		14	<5	1		2
* E16	04/03/86		2400	50						490	460		170		1.4	2	<10	<10	<10	<2			12	<5	<1		11
* E16	06/12/86	8.1	980	69	600	46	26	130	4.4	150	160	80	80	210	0.5	10	<5	6	9	<5		610	<5	10	<1	<5	19
* E16	06/02/87		1350							206	548				0.6			<1	5	<5	<0.2		6	7	2		12
* E17	04/03/86		730	58						110	170		100		0.9	7	<10	<10	<10	4			4	11	1		27
* E17	06/12/86	8.0	460	71	290	32	12	49	2.9	48	54	70	70	120	0.1	9	<5	13	8	<5		380	<5	11	<1	<5	26
* E17	06/02/87		872							120	181				0.4			7	7	<5	<0.2		3	10	2		21
E18	04/03/86		8000	63						1100	2400		410		17.0	2	<10	<2	<10	<10			232	<5	1		<10
E18	06/12/86	8.0	7000		5600	950	180	1300	9.7	950	2200	290	290	1300	13.0	4	<5	<5	<5	<5		3690	200	6	4	<5	<5
E18	06/02/87		7290							871	1940				10.5			<1	<1	<5	<0.2		192	<5	5		2

* Open Drain

APPENDIX B Table 6. Subsurface Tile Drainage Physical Properties and Chemical Concentrations.
Zone F - Panoche Fan Area

RWQCB ID	DATE	pH	EC	TEMP	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
			umhos/cm	F	mg/L											ug/L											
F1	04/03/86	6.9	6900	61						890	2300		210		7.1	1	<10	24	<10	<10			12	<5	104		<10
F1	06/12/86	8.0	6100	64	5700	630	170	1100	8.3	670	2500	160	160	2200	5.6	1	<5	36	<5	<5		<5	62	<5	128	<5	<5
F1	06/02/87		7650							1078	3496				5.9			22	<3	<5	<0.2		15	<5	192		<1
F2	04/03/86	7.2	9600	60						1900	2500		270		11	1	<10	19	<10	<10			22	11	269		<10
F2	06/12/86	7.9	9400	64	7800	670	200	1800	11	1900	2900	180	180	2400	9.2	1	<5	19	<5	<5		11	21	11	295	<5	<5
F2	06/02/87		8450							1312	3674				7.8			7	<3	<5	<0.2		28	9	177		1
F3	04/03/86	7.2	8600	60						1800	2100		280		6.9	2	<10	30	19	<10			16	22	64		19
F3	06/12/86	7.8	9000	65	6100	490	120	1500	11	1600	2300	180	180	1700	5.7	1	<5	33	6	<5		8	22	13	53	<5	12
F3	06/02/87		9540							1944	3251				8.2			11	<3	<5	<0.2		18	7	111		3
F4	04/03/86	7.2	6600	60						1000	2000		180		6.9	1	<10	20	<10	<10			27	10	112		<10
F4	06/12/86	8.1	6300	65	5600	490	170	980	9.4	990	2500	150	150	1550	5.6	1	<5	25	<5	<5		18	33	10	132	<5	<5
F4	06/02/87		6450							855	3071				6.1			17	<3	<5	<0.2		22	10	99		2
F5	04/03/86	7.3	5700	60						820	2000		240		4.7	1	<10	21	<10	<10			20	<5	68		<10
F5	06/12/86	7.9	4900	65	4300	430	110	790	8.8	650	2000	170	170	1500	4.2	<1	<5	24	<5	<5		<5	31	<5	52	<5	<5
F5	06/02/87		4970							522	2564				4.5			14	<3	<5	<0.2		29	<5	44		<1
F6	04/03/86	7.3	6200	60						900	2200		200		5.9	1	<10	14	<10	<10			20	<5	59		<10
F6	06/12/86	8.2	5400	65	4800	510	130	770	7.2	630	2200	160	160	1900	4.3	<1	<5	18	<5	<5		5	23	<5	50	<5	<5
F6	06/02/87		5410							608	2919				4.8			6	<3	<5	<0.2	6	19	<5	60		1
F7	04/03/86	7.3	7600	60						1300	2500		250		10	1	<10	18	<10	<10			27	12	91		12
F7	06/12/86	8.0	7100	65	5900	510	150	1300	11	1200	2500	190	190	1800	6.3	1	<5	26	<5	<5		<5	27	<5	76	<5	<5
F7	06/02/87		7470							1090	3560				6.6			13	2	<5	<0.2		25	8	83		1
F8	04/03/86	7.3	8000	60						1500	2500		240		9.7	1	<10	17	<10	<10			27	11	75		<10
F8	06/12/86	8.0	7500	66	6400	580	190	1400	9.6	1300	2800	210	210	2200	7.5	1	<5	20	<5	<5		<5	31	9	74	<5	<5
F8	06/02/87		4870							631	1788				3.8			11	<3	<5	<0.2		26	7	51		1
F9	04/03/86	7.5	7900	60						1600	2300		170		11	1	<10	26	<10	<10			22	<5	192		<10
F9	06/12/86	8.1	9000	64	6800	600	200	1300	8.0	1500	2600	190	190	2300	8.6		<5	41	<5	<5		<5	18	<5	178	<5	<5
F9	06/02/87		8900							1498	3861				8.4			36	<3	<5	<0.2		20	<5	177		3
F10	04/03/86	7.2	9500	61						2000	2300		220		10.6	<1	<10	32	<10	<10			13	<5	337		<10
F10	06/12/86	8.0	9000	64	7500	730	220	1600	9.7	1700	2700	140	140	2200	8.8		<5	46	<5	<5		<5	14	<5	298	<5	<5

APPENDIX B Table 6. (cont.)

RWQCB ID	DATE	pH	EC umhos/cm	TEMP F	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
					mg/L										ug/L												
F10	06/02/87		9200							2022	3916				8.9			42	<3	<5	<0.2		15	<5	285		<1
F11	04/03/86	7.2	5800	60						810	2200		230		8.1	1	<10	23	<10	<10			22	6	73		<10
F11	06/12/86	8.1	6500	63	5600	560	190	980	7.7	630	2600	190	190	1800	6.6		<5	36	<5	<5		<5	21	<5	95	<5	<5
F11	06/02/87		5940							1052	3327				5.6			23	<3	<5	<0.2		26	<5	79		2
F12	04/03/86	7.3	7200	60						1200	2400		230		9.0	1	<10	5	<10	<10			28	10	134		<10
F12	06/12/86	8.1	8000	65	6900	630	210	1500	8.6	1200	3100	200	200	2200	8.1		<5	14	6	<5		11	37	7	168	<5	6
F12	06/02/87		7620							665	3671				5.8			7	2	<5	<0.2		33	6	125		2
F13	04/03/86	7.2	11000	60						2000	3100		250		0.3	2	<10	17	<10	<10			25	8	371		10
F13	06/12/86	8.1	11100	64	9500	650	310	1900	8.5	2100	3900	170	170	2400	12		<5	30	<5	<5		<5	30	5	394	<5	<5
F13	06/02/87		11500							1944	4598				13			8	<3	<5	<0.2		26	<5	422		2
F14	04/03/86	7.5	7400	60						860	2800		250		10	<1	<10	7	<10	<10			39	7	219		<10
F14	06/12/86	8.2	8400	63	7400	570	200	1800	9.6	840	3700	200	200	2300	10		<5	10	<5	<5		40	41	6	253	<5	<5
F14	06/02/87		7140							483	3465				8.7			<1	<3	<5	<0.2		64	<5	52		6
F15	04/03/86	7.3	6100	60						570	2500		250		8.1	<1	<10	5	<10	<10			34	5	162		<10
F15	06/12/86	8.2	8200	63	6300	530	250	1400	9.0	760	3800	190	190	2400	9.9		<5	24	<5	<5		9	44	<5	256	<5	<5
F15	06/02/87		8550							780	5367				10.6			8	<3	<5	<0.2		51	<5	248		2
F16	04/03/86	6.6	14750	57						136	1000		100		2.5	1	<10	<10	<10	<2			12	8	35		<10
F16	06/12/86	7.9	8300	64	7100	720	210	1300	9.9	1200	2800	160	160	2400	9.0		<5	45	<5	<5		32	19	10	301	<5	6
F16	06/02/87		11100							1828	4400				13			40	<3	<5	<0.2		34	<5	521		4
F17	04/03/86	7.1	6100	60						890	2100		210		8.5	1	<10	26	<10	<2			30	<5	112		11
F17	06/12/86	8.2	5900	67	4700	480	170	980	9.0	650	2100	180	180	1800	6.5		<5	28	<5	<5		<5	33	<5	103	<5	<5
F17	06/02/87		5930							720	2826				6.2			19	<3	<5	<0.2		36	<5	106		3
F18	04/03/86	7.2	11000	60						2200	2600		200		16	<1	<10	41	<10	<2			33	11	334		<10
F18	06/12/86	8.1	8600	66	7300	570	210	1700	9.6	1300	2500	200	200	2300	10		<5	36	<5	<5		19	32	10	296	<5	<5
F18	06/02/87		11000							2019	4167				11			46	<3	<5	<0.2		34	6	341		8
F19	04/03/86	7.2	8200	59						910	2600		220		11	<1	<10	16	<10	<2			38	8	308		<10
F19	06/12/86	8.3	8500	65	7600	560	240	1600	11	810	3600	160	160	2400	13		<5	21	<5	<5		<5	46	6	282	<5	<5
F19	06/02/87		8740							911	5000				12			13	<3	<5	<0.2		54	<5	334		4
F20	04/03/86	7.5	4500	60						460	1500		230		7.5	1	<10	<10	<10	9			24	9	93		12
F20	06/12/86	8.1	8000	67	7500	600	240	1800	11	940	3400	180	180	2400	11		<5	27	<5	<5		<5	39	<5	281	<5	<5
F20	06/02/87		7380							745	4260				9.0			4	<3	<5	<0.2		50	8	160		3

APPENDIX B Table 6. (cont.)

RWQCB ID	DATE	pH	EC	TEMP	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
			umhos/cm	F	mg/L											ug/L											
F21	04/03/86	7.2	11000	59						1800	3000		270		15	1	<10	20	<10	<2			17	18	409		17
F21	06/12/86	8.3	10000	63	9400	610	220	2200	12	1500	3800	240	240	2400	14	1	<5	19	<5	<5		6	13	17	338	<5	8
F21	06/02/87		11100							1385	5233				15			11	<3	<5	<0.2		22	16	382		4
F22	04/03/86	7.2	7600	60						760	2200		200		15	1	<10	18	<10	<2			45	11	235		15
F22	06/12/86	8.3	7600	66	7200	510	150	1600	8.9	860	3000	200	200	1900	12	1	<5	26	<5	<5		<5	35	<5	275	<5	<5
F22	06/02/87		7650							770	3700				11			10	<1	<5	<0.2		43	7	228		3
F23	04/03/86	7.4	8000	60						1100	2300		240		13	1	<10	24	<10	<2			37	12	182		<10
F23	06/12/86	8.1	8000	65	6900	480	150	1700	9.9	840	3200	260	260	1800	9.2	1	<5	35	<5	<5		<5	24	13	194	<5	<5
F23	06/02/87		7860							942	3828				8.8			18	<3	<5	<0.2		38	9	160		4
F24	04/03/86	7.0	23000	59						4900	4800		450		33	1	<10	11	10	<10			15	13	2478		<10
F24	06/12/86	8.1	16000	64	14100	670	300	3400	13	3600	4300	300	300	3300	24	1	<5	22	6	<5		<5	13	10	1830	<5	<5
F24	06/02/87		14000							2502	4988				17			13	<3	<5	<0.2		26	8	974		2
F25	04/03/86	7.4	9600	60						1500	3400		230		23	2	<10	31	<10	<2			76	6	727		13
F25	06/12/86	8.3	8000	64	7700	490	190	1600	8.2	830	3200	190	190	2100	14	1	<5	36	<5	<5		<5	52	5	940	<5	<5
F25	06/02/87		9730							1133	5425				15			43	1	6	<0.2		77	10	731		5
* F26	04/03/86	8.1	8800	63						1800	2300		210		11	2	<10	34	<10	<10			14	7	289		16
* F26	06/12/86	8.4	3200	69	2300	200	73	430	8.6	420	850	170	170	860	2.7	2	<5	28	7	<5		62	10	9	62	<5	<5
* F26	06/02/87		5040							803	1829				3.9			74	59	8	<0.2		3	51	102		120
* F27	04/03/86	8.2	1450	66						190	700		110		2.3	13	<10	78	56	14			1	81	28		150
* F27	06/12/86	8.2	3600	72	2700	270	96	460	6.5	400	1200	130	130	1100	3.3		<5	28	23	<5		390	<5	53	22	<5	37
* F27	06/02/87		2950							322	1468				2.6			32	10	<5	<0.2		4	19	38		37
* F28	04/03/86	8.0	4000	67						550	1400		140		4.8	4	<10	23	10	<2			11	13	58		23
* F28	06/12/86	8.0	3200	75	2000	210	74	490	5.6	320	830	120	120	820	2.8		<5	22	7	<5		119	10	18	28	<5	16
* F28	06/02/87		3230							391	1210				2.8			47	22	<5	<0.2		3	48	38		70
* F29	04/03/86	8.3	8200	73						1500	2200		150		12	1	<10	21	<10	<2			24	10	247		13
* F29	06/12/86	8.1	1700	74	1000	92	28	210	6.5	200	360	98	98	370	1.3	13	<5	62	28	<5		440	<5	55	42	<5	27
* F29	06/02/87		1900							237	675				1.4			44	22	<5	<0.2		2	32	30		65
* F30	04/03/86	8.0	3800	64						520	1200		140		4.8	2	<10	12	11	<2			12	10	88		11
* F30	06/12/86	8.1	1800	67	1200	180	36	220	11	240	420	100	100	370	1.2		<5	190	158	<5		1830	<5	400		<5	145
* F30	06/02/87		683							340	162				0.4			5	3	6	<0.2		2	<5	3		6
* F31	04/03/86	8.4	2800	60						330	870		110		2.9	2	<10	<10	<10	<2			11	10	62		15

APPENDIX B Table 6. (cont.)

	RWQCB ID	DATE	pH	EC	TEMP	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
				umhos/cm	F	mg/L											ug/L											
*	F31	06/12/86	8.2	2800	69	2100	180	65	380	7.5	380	790	110	110	820	2.4	3	<5	20	6	<5		58	10	8	34	<5	<5
*	F31	06/02/87		3270							398	1381				3.2			11	3	<5	<0.2		11	6	75		8
	F41	05/05/86															2	<5	6	<5	<5		<5	102		15	<5	12
	F41	06/23/87	8.0	5100		4400	420	180	720	2.0	200	2500	150	150	1790	14			9	2	<5	<0.2		154	<5	26		4
	F42	05/05/86															3	<5	6	<5	<5		5	45		29	<5	33
	F42	06/23/87	8.0	9500		7900	430	250	1900	3.1	740	4300	170	170	1864	26			8	<3	5	<0.2		235	<5	44		2
	F43	05/05/86															2	<5	5	<5	<5		11	36		5	<5	<5
	F44	05/05/86															4	15	<5	5	<5		<5	56		62	<5	9
	F44	06/23/87	8.1	3900		3000	220	66	660	3.4	240	1500	250	250	821	7.1			<1	3	<5	<0.2		105	5	25		5
	F45	05/05/86															3	<5	<5	<5	8		<5	188		33	<5	18
	F46	05/05/86															4	<5	<5	<5	<5		23	186		60	<5	24
	F46	06/23/87	8.2	1400		930	110	27	180	3.4	100	380	170	170	353	1.6			<1	<1	<5	<0.2		17	<5	5		<1
	F47	05/05/86															3	5	13	<5	<5		6	195		159	<5	60
	F47	05/16/86															2	<5	14	<5	<5		6	170		150	<5	31
	F47	06/23/87	7.9	10000		9200	530	270	1900	3.6	810	5200	120	120	2434	21			6	2	8	0.6		242	<5	152		4
	F48	05/05/86															2	12	9	<5	<5		13	38		73	<5	45
	F48	06/23/87	8.1	3000		2100	160	68	480	3.6	260	900	220	220	651	4.1			2	<1	6	<0.2		56	8	26		2
	F49	05/05/86															2	5	14	<5	<5		<5	160		202	<5	43
	F49	06/23/87	8.0	7000		5200	230	120	1300	4.2	650	2400	210	210	1027	14			8	<3	5	0.7		123	6	132		3
	F50	06/23/87	7.9	7000		5600	360	250	1200	4.1	850	2400	290	290	1903	31			14	2	<5	1.1		39	<5	11		1
	F51	06/23/87	7.9	5000		4200	560	180	590	6.7	500	2000	280	280	2139	5.9			3	2	6	<0.2		126	8	3		1
	F52	06/23/87	8.0	5900		4300	300	210	860	3.6	950	1600	310	310	1317	3.0			<1	1	<5	<0.2		141	<5	2		2
	F53	06/23/87	7.8	7100		5400	580	140	960	3.5	1100	2100	160	160	2024	5.9			8	<3	<5	<0.2		8	<5	215		5
	F54	05/19/86															2	6	6	5	<5		7	9		193	<5	26
	F54	06/23/87	7.8	5300		4300	450	110	630	3.5	500	2000	180	180	1576	3.6			14	<3	<5	<0.2		7	<5	145		7
	F55	05/05/86															1	<5	<5	<5	<5		<5	<5		<1	<5	8
	F55	06/23/87																	4	<1	<5	<0.2		3	<5	1		3
	F56	05/05/86															1	<5	17	<5	<5		14	12		10	<5	<5
	F56	06/23/87	8.1	1300		760	64	45	170	0.8	180	140	220	220	345	9.9			16	<3	<5	0.5		11	<5	12		7
	F56	06/23/87	8.0	7600		5200	300	300	950	2.5	550	2300	420	420	1984													
	F57	06/23/87	8.1	1800		1100	130	60	200	4.0	220	220	320	320	555	1.5			23	2	<5	<0.2		2	<5	3		6

APPENDIX B Table 6. (cont.)

RWQCB ID	DATE	pH	EC	TEMP	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
			umhos/cm	F	mg/L											ug/L											
F58	05/05/86															1	57	<5	5	<5		<5	<5		0	<5	31
F58	06/23/87	8.2	690		400	48	20	57	1.2	84	68	140	140	202	0.3			<1	<1	<5	<0.2		7	<5	1		<1
F59	05/05/86															10	49	39	40	6		300	<5		<1	<5	82
F60	05/05/86															1	<5	<5	<5	<5		<5	6		<1	<5	<5
F60	06/23/87	8.0	710		410	50	22	55	1.2	100	76	140	140	215	0.3			3	<1	<5	<0.2		8	<5	<1		<1
F61	05/05/86															2	5	42	<5	<5		34	5		9	<5	<5
F61	06/23/87	7.8	6200		5000	380	220	930	3.8	850	2200	340	340	1854	11			42	<3	6	0.8		4	<5	11		1
F62	05/05/86															4	<5	31	<5	<5		13	<5		4	<5	<5
F62	06/23/87	7.8	3400		2400	210	120	410	4.4	390	780	400	400	936	6.8			<1	<3	<5	<0.2		2	<5	3		<1
F63	06/23/87	8.0	2800		1800	110	100	410	3.9	340	400	480	480	686	2.1			<1	<1	<5	<0.2		20	<5	4		2
F64	06/23/87	8.1	1900		1200	110	85	180	1.6	240	260	370	370	624	1.4			<1	<1	<5	<0.2		6	<5	<1		<1
F65	06/23/87	7.5	2000		1300	140	72	230	13	190	420	320	320	621	1.8			6	6	<5	<0.2		10	6	4		8
F66	06/23/87	8.0	3700		2500	130	150	580	1.3	400	720	650	650	942	2.4			<1	<3	<5	<0.2		36	<5	1		<
F67	06/23/87	8.0	1700		1100	130	81	160	5.4	240	260	330	330	658	0.9			3	<1	<5	<0.2		4	<5	1		<1
F68	06/23/87																	3	<1	<5	<0.2		6	<5	1		<1
F69	06/23/87	8.0	1900		1200	140	73	200	1.2	260	220	370	370	616	0.8			<1	<1	<5	<0.2		3	<5	1		<1
F70	06/23/87	8.1	1000		610	63	41	100	0.5	150	80	210	210	319	0.4			<1	<1	<5	<0.2		5	<5	1		<1
F71	06/23/87	8.0	1100		670	73	44	100	0.4	140	130	200	200	363	0.4			1	<1	<5	<0.2		6	<5	<1		<1
F72	06/23/87	8.1	920		550	72	36	78	0.7	100	75	240	240	328	0.3			<1	<1	<5	<0.2		3	<5	1		<1
F73	06/23/87	8.1	1400		860	85	53	160	0.8	150	190	310	310	430	0.8			<1	<1	<5	<0.2		3	<5	<1		<
F74	06/23/87	8.2	1100		700	95	35	98	0.9	140	140	230	230	381	0.5			2	<1	<5	<0.2		2	<5	1		2
F75	06/23/87	8.2	2300		1500	110	96	310	0.7	240	460	430	430	670	1.8			7	<3	<5	<0.2		7	<5	6		1
F76	06/23/87	8.1	3400		2500	131	150	510	0.9	330	900	510	510	860	2.9			3	<3	<5	<0.2		13	<5	3		1
F77	06/23/87	7.9	4200		3400	180	220	540	3.9	400	1300	510	510	1430	3.3			3	<3	<5	<0.2		8	<5	2		1
F78	06/23/87	8.0	5900		5100	390	400	730	8.4	490	2500	590	590	2496	4.4			<1	5	<5	<0.2		26	20	1		2
F79	06/23/87	7.8	8000		6800	300	380	1400	1.7	650	3700	510	510	2313	4.9			3	<3	<5	<0.2		29	6	10		2
F80	05/05/86															2	22	36	6	<5		16	150		186	<5	20
F81	05/05/86															<1	14	25	9	<5		<5	254			<5	29
F82	04/03/86	7.0	5200	62						480	2100		250		5.2	1	<10	2	<10	<10			62	<5	161		10
F82	06/12/86	7.8	4400	64	2600	650	83	500	5.0	11	1800	180	180	1600	3.1	2	<5	<5	<5	<5		8	<5	<5	96	<5	<5
F83	04/03/86	7.0	5600	62						720	2100		160		7.1	<1	<10	14	<10	<10			8	<5	148		12

APPENDIX B Table 6. (cont.)

RWQCB ID	DATE	pH	EC umhos/cm	TEMP F	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
					mg/L											ug/L											
F83	06/12/86	8.1	5500	65	4800	640	96	740	4.0	910	2400	160	160	1800	5.2	1	<5	13	<5	<5		11	<5	<5	150	<5	<5
F83	06/02/87		5520							615	1990				5.5			10	<1	<5	<0.2		6	<5	130		2
F84	04/03/86	7.1	5900	61						1300	2000		170		7.4	<1	<10	13	<10	<10			8	<5	236		<10
F84	06/12/86	8.0	6700	65	5300	710	120	1100	5.1	1250	2500	220	220	2100	6.4	1	<5	13	<5	<5		<5	7	<5	225	<5	11
F84	06/02/87		7310							1199	2300				5.5			100	<1	<5	<0.2		4	<5	235		1
F85	04/03/86	8.1	3900	61						180	1600		130		8.0	2	<5	17	<5	<5		43	102		196	<5	<5
F85	06/12/86	8.2	3400	66	3000	410	72	420	2.7	140	1700	120	120	2400	6.2	2	<5	5	<5	<5		26	99	<5	8	<5	<5
F85	06/02/87		2120							86	2336				2.5			<1	<1	6	<0.2		60	<5	9		<1
F86	04/03/86	8.0	5200	60						440	2500		200		8.4	1	<5	18	<5	<5		5	35		236	<5	<5
F86	06/12/86	8.2	3700	65	2800	310	100	400	3.6	270	1600	300	300	1300	4.8	1	<5	28	<5	<5		<5	31	<5	69	<5	<5
F86	06/02/87		2910							574	1421				2.8			6	<1	<5	<0.2		26	<5	33		<1
F87	04/03/86		12500	60						1900	5000		190		22	2	<5	22	<5	<5		<5	146		429	<5	<5
F87	06/12/86	8.1	10000	64	8700	460	240	2300	9.4	31	4700	190	190	2300	20	3	<5	20	6	<5		16	115	10	310	<5	23
F87	06/02/87		9160							735	4110				16			20	<1	<5	<0.2		121	8	200		2
F88	04/03/86		5800	60						380	3100		200		11	2	<5	13	<5	<5		19	100		57	<5	<5
F88	06/02/87		5940							222	2500				10			10	<1	<5	<0.2		106	<5	53		4
F89	04/03/86		9000	60						690	5300		240		21	2	<5	14	<5	<5		14	188		200	<5	<5
F89	06/12/86	8.4	8200	67	7300	290	190	1800	7.1	550	3700	220	228	1500	19	3	<5	22	<5	<5		45	149	11	125	<5	<5
F89	06/02/87		9880							715	4090				21			15	<1	<5	<0.2		146	8	197		2
F90	04/03/86		1450	60						150	810		200		2.5	1	<5	<5	<5	<5		16	44		56	<5	<5
F90	06/12/86	8.3	2000		1700	220	61	220	3.7	120	740	190	190	790	1.9	1	<5	7	<5	<5		40	29	6	12	<5	10
F90	06/02/87		2790							191	950				3.6			1	<1	<5	<0.2		52	<5	32		1
F91	04/03/86		7000	60						540	3300		190		13	6	<5	33	22	5		308	92		105	<5	45
F91	06/12/86	7.8	22000	65	22800	410	460	610	15	2400	12000	210	210	3000	61	3	<5	12	<5	<5		16	724	12	308	<5	<5
F91	06/02/87		14700							1364	6585				34			10	3	<5	<0.2		286	9	181		<1
F92	04/03/86		5300	60						340	2400		240		11	2	<5	22	<5	<5		6	86		50	<5	<5
F92	06/12/86	8.2	5100	66	4600	380	140	885	4.6	260	2500	170	170	1500	9.8	2	<5	20	<5	<5		14	99	8	35	<5	5
F92	06/02/87		4190							232	1730				6.5			7	<1	<5	<0.2		81	<5	28		2
F93	04/03/86		6600	60						590	3400		250		14	6	<5	<5	7	<5		49	105		57	<5	11
F93	06/12/86	8.1	5800	65	5700	560	140	870	8.7	380	3000	270	270	1800	13	7	<5	6	5	<5		34	85	8	46	<5	11
F93	06/02/87		3730							252	1859				5.2			1	1	<5	<0.2		30	<5	17		7

APPENDIX B Table 6. (cont.)

RWQCB ID	DATE	pH	EC umhos/cm	TEMP F	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
					mg/L										ug/L												
F94	04/03/86	7.7	5000	60						460	1900		180		6.8	2	<5	10	<5	<5		11	53		194	<5	<5
F94	06/12/86	8.3	5300	62	4800	450	190	820	5.5	470	2400	170	170	1800	3.7	1	<5	19	<5	<5		5	48	<5	158	<5	5
F94	06/02/87		7300							629	1602				10.4			14	<1	<5	<0.2		67	<5	279		<1
F95	04/03/86	8.0	4800	60						330	2200		130		7.0	1	<5	<5	<5	<5		17	81		251	<5	<5
F95	06/12/86	8.2	6700	64	6000	390	200	1200	6.0	520	3400	130	146	1700	12	1	<5	9	<5	<5		<5	153	<5	225	<5	10
F95	06/02/87		3690							871	4805				19			6	<1	<5	0.6		207	<5	345		1
F96	04/03/86		3500	60						210	1600		210		4.9	2	<5	6	<5	<5		52	55		54	<5	<5
F96	06/12/86	8.3	3500	65	2900	320	110	390	5.5	220	1500	180	180	1200	4.6	2	<5	9	<5	<5		41	57	5	69	<5	<5
F96	06/02/87		10300							242	2336				5.3			5	<1	<5	<0.2		51	<5	76		1
F97	04/03/86		6800	60						600	3100		190		11	2	<5	12	<5	<5		12	80		329	<5	5
F97	06/12/86	8.3	2900	68	2400	300	81	320	4.4	170	1200	200	200	1100	2.7	1	<5	8	5	<5		94	51	<5	49	<5	1280
F97	06/02/87		4240							317	2226				5.5			1	<1	<5	<0.2		49	<5	110		220
F98	04/03/86		4600	61						490	1700		190		5.1	8	<5	11	<5	<5		<5	33		164	<5	<5
F98	06/12/86	8.0	4600	65	3800	380	140	670	5.2	430	1800	200	200	1500	5.5	8	<5	18	<5	<5		16	24	5	140	<5	<5
F98	06/02/87		4090							337	2232				4.7			5	<1	<5	<0.2		19	<5	108		<1
F99	04/03/86		6400	60						710	2300		240		11	2	<5	<5	5	<5		24	28		4	<5	6
F99	06/12/86	8.1	4900	66	4800	510	140	640	5.1	480	2200	140	140	1800	5.7	2	<5	16	6	<5		50	25	8	108	<5	11
F99	06/02/87		6110							624	3735				8.0			3	<1	<5	<0.2		31	<5	205		2
F100	04/03/86		5600	60						370	2300		270		7.8	1	<5	12	<5	<5		5	39		179	<5	<5
F100	06/12/86	7.9	3800	65	3400	320	110	570	4.8	210	1600	280	280	100	4.8	1	<5	8	<5	<5		26	25	7	65	<5	6
F100	06/02/87		4040							267	2202				4.9			6	<1	<5	<0.2		23	<5	93		<1
F101	04/03/86		6100	60						400	2500		210		5.0	1	<5	14	<5	<5		<5	48		155	<5	<5
F101	06/12/86	8.2	6500	66	6200	430	190	1200	6.8	410	3200	170	170	1900	9.1	2	<5	26	<5	<5		6	50	7	281	<5	81
F101	06/02/87		5350							322	3018				5.5			10	5	<5	<0.2		36	5	143		<1
F102	04/03/86	7.8	6600	60						440	3100		180		9.2	2	<5	10	<5	<5		<5	98		419	<5	33
F102	04/03/86														11	2	<5	12	<5	<5		5	45		375	<5	<5
F102	06/12/86	8.1	9400	65	8800	440	220	2000	9.5	690	4500	160	160	2000	17	2	<5	160	<5	<5		5	92	5	548	<5	7
F102	06/02/87		9550							760	5466				15			14	<1	<5	<0.2		83	<5	598		2
F103	04/03/86		4200	60						470	1700		200		5.6	2	<5	10	<5	<5		<5	34		88	<5	<5
F103	06/12/86	7.9	4600	66	3700	500	150	680	5.9	500	1500	180	180	150	5.4	2	<5	18	<5	<5		18	32	<5	131	<5	8
F103	06/02/87		5480							574	2983				6.6			10	<1	<5	<0.2		33	<5	194		1

APPENDIX B Table 6. (cont.)

RWQCB ID	DATE	pH	EC	TEMP	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
			umhos/cm	F	mg/L										ug/L												
F104	04/03/86		6000	60						530	2400		240		8.0		<5	24	<5	<5		23	36			<5	5
F104	06/12/86	8.2	4900	66	4400	380	150	760	7.8	310	2500	190	190	1500	6.3	1	<5	11	<5	5		<5	39	<5	97	<5	<5
F104	06/02/87		3560							287	1666				3.9			4	1	<5	<0.2		32	<5	56		2
F105	04/03/86		5200	60						410	2100		210		6.3	1	<5	9	<5	<5		22	43		175	<5	5
F105	06/12/86	8.3	5500	62	4900	380	140	890	6.5	370	2900	240	240	1600	7.9	2	<5	19	<5	<5		28	40	8	134	<5	<5
F105	06/02/87		4430							317	2389				5.6			9	1	<5	<0.2		32	8	106		3
F106	04/03/86		6000	60						380	2500		280		9.2	2	<5	30	<5	<5		<5	65		128	<5	<5
F106	06/12/86	8.1	5200	65	4600	260	130	820	5.9	260	2000	210	210	1300	8.9	2	<5	31	<5	<5		8	44	23	115	<5	<5
F106	06/02/87		6130							378	2780				9.4			21	<1	<5	<0.2		46	14	100		3
F107	04/03/86		7500	62						840	3000		200		13	2	<5	13	<5	<5		5	129		386	<5	<5
F107	06/12/86	8.3	8000	64	6800	420	200	1500	11	790	3100	180	180	2100	14	2	<5	29	<5	<5		6	35	11	476	<5	<5
F107	06/02/87		8240							846	4283				13			21	<1	<5	<0.2		32	8	279		2
F108	04/03/86		6400	60						520	2300		290		7.7	1	<5	22	<5	<5		9	28		122	<5	<5
F108	06/12/86	8.4	9400	64	8900	460	260	2000	11	860	2500	220	220	2000	18	2	<5	20	<5	<5		9	53	12	228	<5	<5
F108	06/02/87		8490							715	4633				13			15	<1	<5	<0.2		48	9	187		4
F109	04/03/86		4600	60						300	1900		250		7.1	2	<5	34	<5	<5		<5	54		94	<5	<5
F109	06/12/86	8.4	6600	66	5300	320	140	1100	7.2	650	2300	240	240	1600	12	2	<5	16	<5	<5		<5	51	13	246	<5	<5
F109	06/02/87		7530							574	3610				13			16	<1	<5	<0.2		56	<5	133		<1
F110	04/03/86		4800	60						340	1900		190		6.7	1	<5	10	<5	<5	<0.2	<5	49		136	<5	<5
F110	06/12/86	8.1	5200	65	4400	300	140	940	6.3	300	2000	180	180	890	8.7	2	<5	11	<5	<5		35	49	11	133	<5	<5
F110	06/02/87		4470							277	3094				6.4			4	11	<5			38	7	119		1
F111	04/03/86		5700	60						360	2200		220		10	1	<5	30	7	<5		54	62		246	<5	37
F111	06/12/86	8.3	5800	64	5100	420	160	1100	6.0	340	2100	190	190	1400	11	2	<5	28	6	<5		68	56	41	228	<5	34
F111	06/02/87		6630							473	4062				12			37	2	<5	<0.2		68	37	332		24
F112	04/03/86		4800	60						190	2000		140		6.6	1	<5	<5	<5	<5		<5	102		54	<5	<5
F112	06/12/86	8.0	3500	66	3100	340	100	470	4.5	160	1900	120	120	1100	5.7	2	<5	10	<5	<5		<5	85	<5	55	<5	<5
F112	06/02/87		4060							262	2779				6.1			8	2	<5	<0.2		69	<5	51		4
F113	04/03/86		7000	60						540	2600		140		14	2	<5	41	<5	<5		<5	70		358	<5	<5
F113	06/12/86	8.2	6800	64	6300	430	180	1100	6.2	350	2400	130	130	2000	14	2	<5	42	<5	<5		<5	102	<5	292	<5	<5
F113	06/02/87		7620							629	2990				14			48	<1	<5	<0.2		100	<5	342		1
F114	04/03/86		6400	60						570	2500		190		12	1	<5	25	<5	<5		<5	56		146	<5	<5

APPENDIX B Table 6. (cont.)

	RWQCB ID	DATE	pH	EC	TEMP	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
				umhos/cm	F	mg/L											ug/L											
	F114	06/12/86	8.2	6700	65	6100	490	180	1200	8.8	510	3500	160	160	1800	13	2	<5	26	<5	<5		<5	70	<5	190	<5	<5
	F114	06/02/87		4860							413	3147				5.6			12	<1	<5	<0.2		40	<5	72		1
	F115	04/03/86		6600	60						690	2300		150		12	2	<5	28	<5	<5		<5	76		334	<5	<5
	F115	06/12/86	8.2	7900	64	7200	460	190	1400	7.3	880	3400	140	140	2000	15	2	<5	40	<5	<5		<5	28	<5	475	<5	<5
	F115	06/02/87		11700							1450	4370				19			49	<1	<5	<0.2		79	<5	656		2
	F116	04/03/86		13500	60						2280	4750		150		35	2	<5	49	<5	<5		<5	97		570	<5	<5
	F116	06/12/86	8.0	15000	64	13000	580	290	3100	11	2400	5100	150	150	2700	44	2	<5	53	<5	<5		<5	103	<5	592	<5	<5
	F116	06/02/87		12100							2138	4015				29			130	<1	<5	2.3		56	<5	592		2
	F117	06/02/87		19400							3620	6220				48			82	<1	<5	<0.2		89	<5	1067		<1
	F118	06/02/87		7380							992	2110				16.2			100	<1	<5			18	<5	159		<1
*	F119	04/03/86		5900	62						490	3100		260		8.6	1	<5	15	<5	<5		19	28		184	<5	<5
*	F119	06/12/86	8.1	4400	67	3800	330	120	720	5.1	240	1800	200	200	1100	5.6	1	<5	12	<5	<5		25	28	7	107	<5	14
*	F119	06/02/87		4290							272	2307				4.8			6	<1	<5	<0.2		23	<5	102		<1
*	F120	04/03/86		4100	62						420	1700		230		5.4	2	<5	10	<5	<5		214	27		90	<5	15
*	F120	06/12/86	5.1	400	63	340	36	5	15	13	21	27			110	0.8	4	<5	19	10	<5		122	<5	13	<1	<5	17
*	F120	06/02/87		3470							715	1602				4.2			3	<1	<5	<0.2		34	<5	91		<1
*	F121	04/03/86		1250	68						68	500		120		2.0	5	<5	11	11	<5		55	15		6	<5	13
*	F121	06/02/87		1530							136	757				12			1	1	<5	<0.2		16	<5	5		1
	F122	06/02/87		3420							297	1520				4.1			3	<1	<5	0.5		31	<5	88		1
	F123	06/23/87	7.6	7800		5700	500	190	1000	3.3	1400	2200		280	2100	15			60	<3	8	2.1		6	<5	27		3
	F124	06/23/87	7.6	7600		5700	390	200	1100	3.4	1200	2500		240	1800	18			51	3	<5	1.9		15	<5	28		3
	F125	06/23/87	7.4	10000		7400	510	240	1500	4.6	1900	2500		210	2300	21			63	6	<5	4.0		13	<5	48		5
	F126	06/23/87	7.7	9800		7400	440	200	1400	2.9	1600	2800		190	2000	22			100	<1	<5	1.9		11	<5	41		4
	F127	06/23/87	7.5	5100		3800	340	120	620	2.6	760	1400		220	1300	10			45	<3	6	0.9		8	<5	20		<1
	F128	06/23/87	7.8	4800		3500	250	80	680	2.0	600	1400		160	900	11			65	<3	<5	<0.2		6	<5	14		1
	F129	06/23/87	7.7	4800		3500	380	86	470	2.8	720	1200		150	1500	6.6			28	<3	7	<0.2		2	<5	57		5
	F130	06/23/87	7.9	3600		2400	210	54	420	2.4	560	800		170	760	7.5			43	2	<5	<0.2		2	<5	10		2
	F131	06/23/87	8.0	3700		2500	180	51	520	2.7	560	900		170	670	7.4			46	<3	6	<0.2		5	<5	18		5
	F132	06/23/87	7.9	3600		2600	190	59	510	1.8	480	1100		160	740	7.7			68	<3	6	<0.2		6	<5	30		1
	F133	06/23/87	7.8	4700		3500	280	78	610	2.7	600	1300		140	1100	11			120	<3	<5	<0.2		11	<5	30		2
	F134	06/23/87	7.5	8000		6000	520	160	1100	3.7	1400	2300		160	2000	16			68	<3	<5	<0.2		10	<5	50		5

APPENDIX B Table 6. (cont.)

RWQCB ID	DATE	pH	EC umhos/cm	TEMP F	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
					mg/L											ug/L											
F135	06/23/87	7.7	3600		2400	220	54	410	2.5	600	860		140	790	8.7			39	<3	<5	<0.2		2	<5	13		1
F136	06/23/87	7.6	10000		8000	490	260	1500	4.2	1300	2500		230	2300	23			99	<3	<5	1.4		40	<5	406		2
F137	06/23/87	7.6	7600		5800	380	180	1100	4.6	790	2800		290	1700	11			27	<3	<5	<0.2		43	5	133		3
F138	06/23/87	7.8	7200		5900	470	200	950	3.4	640	3000		140	2000	10			19	<3	<5	<0.2		51	<5	233		4
F139	06/23/87	7.7	3900		3100	320	77	440	3.4	440	1300		160	1200	7.6			82	<3	<5	<0.2		2	<5	43		2
F140	06/23/87	7.5	8500		7100	450	200	1200	4.2	1000	2900		240	2100	14			120	<3	<5	<0.2		25	6	549		2
F141	06/23/87	7.7	8500		7100	480	210	1300	4.8	1000	3200		280	2000	13			34	6	<5	<0.2		34	7	736		3
F142	06/23/87	7.6	5700		4700	350	140	740	5.8	530	2200		270	1500	7.2			15	<3	<5	<0.2		29	6	81		8
F143	06/23/87	7.7	14000		12000	580	250	2500	6.4	2000	4600		220	2500	28			48	<3	<5	<0.2		51	<5	1332		5
F144	06/23/87	7.7	23000		18000	510	290	4000	8.2	3000	7000		310	2500	49			47	4	<5	<0.2		80	<5	2812		6
F145	06/23/87	8.1	3200		2200	160	64	400	5.9	480	840		110	650	3.9			19	9	<5	<0.2		3	11	190		25
F146	06/23/87	7.7	3600		2600	270	62	380	2.4	430	1000		150	990	7.8			69	<3	<5	<0.2		3	<5	24		1
F147	06/23/87	7.6	5600		4500	440	120	540	2.8	760	1700		140	1800	9.6			79	<3	7	<0.2		2	<5	59		3
F148	06/23/87	7.6	8300		6900	500	200	1200	4.5	900	3100		220	2000	12			79	12	8	<0.2		24	5	583		5
F149	06/23/87	7.6	6400		5400	420	160	930	4.4	560	2600		240	1700	9.2			20	1	<5			28	6	269		5
F150	06/23/87	7.8	6200		5100	390	150	820	3.8	640	2200		200	1600	7.4			10	<3	<5	<0.2		23	<5	314		2
F151	06/23/87	7.4	5100		4100	340	120	580	8.3	490	1800		160	1400	10			49	29	14	<0.2		2	45	66		80
F152	06/23/87	7.9	7200		6100	530	180	1000	4.9	800	2800		230	2100	8.0			15	<3	<5	<0.2		10	<5	242		3
F153	06/23/87	7.9	2300		1700	230	46	180	2.1	160	840		140	790	3.3			2	<3	<5	<0.2		5	<5	5		1
F154	06/23/87	7.8	6400		5400	440	180	820	4.6	680	2500		200	1900	12			12	<3	<5	<0.2		6	<5	121		2
F155	06/23/87	7.7	7800		6500	500	190	1000	7.8	800	2600		290	2100	11			10	<3	6	<0.2		11	7	368		3
F156	06/23/87	7.6	5500		4100	340	91	760	2.8	630	1700		180	1200	13			66	1	<5			8	<5	45		3
F157	06/23/87	8.0	6200		5300	470	160	760	3.6	560	2400		260	1900	6.5			16	<3	<5	<0.2		10	<5	237		3
F158	06/23/87	7.8	5100		3600	350	100	550	3.1	820	1400		180	1400	9.0			28	3	<5	<0.2		4	<5	41		4
F159	06/23/87	7.9	3600		2400	140	69	480	4.4	450	1000		150	630	9.2			11	6	<5	<0.2		18	12	12		12
F160	06/23/87	8.0	2900		1900	170	42	330	3.4	420	660		140	600	6.0			35	4	<5	<0.2		2	5	11		6
F161	06/23/87	7.4	1500		910	96	24	160	5.2	220	320		92	350	2.5			22	9	6	<0.2		1	17	7		21
F162	06/23/87	7.3	5000		3700	260	110	700	9.6	540	1500		220	1100	7.3			25	8	<5	<0.2		11	17	284		22
F163	06/23/87	7.4	2000		1300	120	45	220	9.4	200	550		140	500	1.9			12	9	<5	<0.2		6	12	54		19
F164	06/23/87	7.7	1100		660	60	24	130	7.6	140	200		100	230	1.6			35	21	6	<0.2		1	26	38		70
F165	06/23/87	7.8	1400		930	88	32	180	8.3	180	350		120	320	1.6			70	52	14	<0.2		1	69	38		150

APPENDIX B Table 6. (cont.)

RWQCB ID	DATE	pH	EC umhos/cm	TEMP F	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
					mg/L											ug/L											
F166	06/23/87	8.0	3900		2700	200	68	480	2.5	550	1000		190	810	7.8			30	3	<5	<0.2		5	<5	16		7
F167	06/23/87	7.8	3500		2500	220	69	420	5.5	490	1000		160	840	6.7			58	17	8	<0.2		3	30	47		45
F168	04/03/86		4400	71						500	1700				5.8		<10	18	<10	<10			5	<5	53		15
F168	06/12/86	8.0	4600	65	3900	530	85	510	4.4	470	1900	130	130	1900	6.1	1	<5	23	<5	<5		10	<5	<5	47	<5	<5
F168	06/02/87		4720							510	1520				7.2			15	<1	<5	<0.2		4	<5	51		<1
F169	04/03/86		4600	71						560	1500				5.6	<1	<10	27	<10	<10			4	<5	62		<10
F169	06/12/86	8.1	4200	65	3500	450	92	990	3.8	500	1600	110	110	1700	5.1	<1	<5	34	<5	<5		6	<5	<5	54	<5	<5
F169	06/02/87		4590							560	1400				5.9			24	<1	<5	<0.2		4	<5	58		3
F170	04/03/86		4800	65						810	1400				6.4		<10	22	<10	<10			5	<5	106		<10
F170	06/12/86	8.0	4700	65	3700	440	90	430	4.1	840	1200	120	120	1700	6.2	<1	<5	32	<5	<5		<5	<5	<5	97	<5	<5
F170	06/02/87		5140							910	1240				5.8			25	<1	<5	<0.2		5	<5	120		3
F171	04/03/86		5200	65						730	1600				4.9	2	<10	10	<10	<10			5	<5	126		14
F171	06/12/86	8.0	4700	65	4000	540	80	500	3.9	670	1700	120	120	1700	4.0									<5			
F171	06/02/87		4520							580	1380				4.4			5	<1	<5	<0.2		5	<5	89		1
F172	04/03/86		6800	64						950	2200				8.3	1	<10	8	<10	<10			5	<5	167		21
F172	06/12/86	8.0	7000	64	5900	620	140	1100	6.1	940	2700	100	100	2100	7.8	1	<5	12	<5	<5		<5	6	<5	199	<5	<5
F172	06/02/87		7300							940	2680				7.5			4	<1	<5	<0.2		5	<5	150		1
F173	04/03/86		4700	64						700	1600				7.9	<1	<10	29	<10	<10			10	<5	46		11
F173	06/12/86	8.3	4500	64	3700	440	87	480	3.5	700	1600	120	120	1600	7.1	<1	<5	34	<5	<5		<5	10	<5	40	<5	<5
F173	06/02/87		4860							720	1230				8.0			27	<1	<5	<0.2		9	<5	46		<1
F174	04/03/86		6200	64						1300	2400		130		4.7	<1	<10	37	<10	<10			8	<5	124		10
F174	06/12/86	8.5	6400	64	5200	730	99	650	5.4	1100	2100	100	140	2200	9.0	<1	<5	30	<5	<5		<5	6	<5	139	<5	<5
F174	06/02/87		7540							1184	2180				10			26	<1	<5	<0.2		6	<5	148		<1
F175	04/03/86		6600	63						1400	2600		160		3.5	1	<10	5	<10	<10			5	<5	307		20
F175	06/12/86	8.2	9200	64	7100	690	170	1400	7.6	1700	3000	180	180	1800	10	1	<5	6	<5	<5		<5	7	<5	281	<5	<5
F175	06/02/87		9170							1454	2980				8.1			5	<1	<5	<0.2		7	<5	267		1
F176	04/03/86		8200	64						1300	2400		170		3.3	<1	<10	9	<10	<10			4	<5	285		13
F176	06/12/86	7.9	7000	65	5700	790	130	960	5.7	1300	2300	170	170	2100	6.2	2	<5	12	<5	<5		<5	<5	<5	263	<5	<5
F176	06/02/87		7540							1434	2125				4.8			8	<1	<5	<0.2		4	<5	263		1
F177	04/03/86		6000	66						1100	2500		160		3.2	<1	<10	9	<10	<10			5	<5	204		11
F177	06/12/86	8.0	6400	64	4450	730	120	880	5.0	1200	2200	130	130	2400	5.8	1	<5	14	<5	<5		7	<5	<5	141	<5	<5

APPENDIX B Table 6. (cont.)

RWQCB ID	DATE	pH	EC	TEMP	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
			umhos/cm	F	mg/L											ug/L											
F177	06/02/87		4540							640	1270				2.8			5	<1	<5	<0.2		6	<5	111		1
F178	04/03/86		4700	63						750	2400		180		5.4	<1	<10	31	<10	<10			6	<5	36		10
F178	06/12/86	8.1	6000	64	4800	670	140	880	5.0	940	2300	150	150	1800	12	1	<5	41	<5	<5		5	6	<5	46	<5	<5
F179	04/03/86		3100	64						340	1900		170		5.4	<1	<10	19	<10	<10			7	<5	22		11
F179	06/12/86	8.0	3500	63	2600	460	87	410	3.7	410	1400	130	130	1100	5.8	<1	<5	27	<5	<5		<5	<5	<5	28	<5	<5
F179	06/02/87		3950							405	1375				5.9			15	<1	10	<0.2		6	<5	30		1
* F180	04/03/86		3800	70						640	2000		120		2.9	2	<10	20	<10	<10			4	6	65		12
* F180	06/02/87		3070							375	840				3.4			11	3	<5	<0.2		3	7	48		9
F181	06/02/87		5335							515	2210				7.2			<1	<1	<5	<0.2		114	6	2		2
F182	04/03/86															2	<10	3	<10	<10			62	<5	208		180

* Open Drain

APPENDIX B Table 7. Suburface Tile Drainage Physical Properties and Chemical Concentrations.
Zone G - Open Water Ways

San Joaquin River

RWQCB ID	DATE	pH	EC	TEMP	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
			umhos/cm	F	mg/L											ug/L											
G1	04/02/86		65							3	4		22		0.5										<1		
G1	06/16/86		230	77						20	16		60		<0.1			7	3	<5	<0.5		2	4	<1		5
G1	06/01/87		1000							146	75				0.2								8		1		
G2	04/02/86		165	58						16	48		38		0.2												
G2	06/01/87		764							110	102				0.4								2		3		
G3	04/02/86		185	58						20	58		38		0.3										<1		
G3	06/16/86		290	69						30	36		40		0.1			3	4	<5	<0.5		<1	5	1		6
G3	06/01/87		714							86	85				0.4								1		3		
G4	04/02/86		175	58						18	48		38		0.3										<1		
G4	06/16/86		330	70						42	44		70		0.2			8	4	<5	<0.5		<5	5	2		7
G4	06/01/87		961							136	125				0.6										4		
G5	04/02/86		225	61						24	61		44		0.2										<1		
G5	06/01/87		1260							151	210				0.9										5		
G6	04/02/86		150	60						23	64		40		0.3										<1		
G6	06/16/86		600	75						70	96		100		0.1			10	5	<5	<0.5		<5	7	2		10
G6	06/01/87		1290							181	210				0.9										5		
G7	04/02/86		190	60						21	48		40		0.5										<1		
G7	06/16/86		600	75						67	98		100		0.2										3		
G7	06/01/87		1210							166	180				0.9								5		6		
G8	04/02/86		55	59						60	160		70		0.7										2		
G8	06/16/86		890	76						100	160		116		0.6			16	10	<5	<0.5		4	9	4		15
G8	06/01/87																	12	6	<5			7	10	9		16
G9	04/02/86		740	60						5	5		36		2.6										<1		
G9	06/16/86		590	78						66	95		100		0.1			14	9	<5	<0.5		<5	7	2		12
G9	06/01/87		1590							206	315				1.5										10		

APPENDIX B Table 7. (cont.)

Grasslands

RWQCB ID	DATE	pH	EC umhos/cm	TEMP F	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
					mg/L											ug/L											
G10	04/02/86		3100	56						360	890		300		2.6										5		
G10	06/01/87		2140							237	530				2.1								2		5		
G11	04/02/86		360	59						2	5		24		0.0				45	19	8			36	<1		43
G12	04/03/86		5900	57						890	1700		150		7.5		<10	15	<10	<10			6	8	125		19
G12	06/16/86	7.9	2900	69	2100	200	52	280	5.8	350	840	120	120	850	2			13	15	5	<0.5		4	39	54		60
G12	06/01/87		3610							332	1170				3.5				50	22	15		2	37	65		76
G13	04/02/86		3200	57						380	1000		110		5.2										59		
G13	06/01/87		2690							297	790				3.8								8		40		
G14	04/03/86		3200	57						320	1200		120		4.9	5	<10	28	17	<10			13	27	66		41
G14	06/16/86	8.1	1900	68	1300	96	37	210	5.0	140	560	120	120	410	2.4			19	6	<5	<0.5		17	13	33		10
G14	06/01/87		2320							235	630				2.9			30	15	<5			9	28	40		35
G15	04/03/86		3800	56						590	1100		120		6.0	2	<10	17	<10	<10			4	6	65		13
G15	06/16/86	7.4	3200	66	2400	220	57	290	2.9	400	940	100	100	950	3.1			6	5	<5	<0.5		4	10	66		11
G15	06/01/87		3180							445	950				3.6			14	<3	<5			3	5	49		6
G16	04/02/86		6400	59						<4	540		20		0.0										<1		
G17	04/02/86		4000	58						660	1500		150		6.8										64		
G17	06/01/87		3210							420	900				5.6								6		38		
G18	04/03/86		4200	58						310	640		170		8.7	2	<10	45	<10	<10			4	45	63		23
G18	06/16/86	8.0	3100	66	1800	180	54	320	5.5	380	740	150	150	770	5.4			16	5	<5	<0.5		4	8	43		6
G18	06/01/87		3400							445	900				5.8								6		50		
G19	04/03/86		6400	59						550	1200		190		16.0	3	<10	8	<10	<10			34	11	22		14
G19	06/16/86	8.1	3300	68	1900	200	75	400	3.8	240	1200	190	190	760	7.4			21	7	<5	<0.5		6	14	16		11
G19	06/01/87		2700							295	790				5.1								16		6		
G20	04/02/86		2800	59						280	920		120		9.4										3		
G20	06/01/87		1910							195	510				3.7								10		3		
G22	04/02/86		2900	60						380	940		150		5.8										33		
G22	06/16/86	7.6	2300	70	1500	160	44	240	4.3	260	610	100	100	550	3.3			9	7	<5	<0.5		16	15	29		19
G23	04/02/86		1100	62						900	250		200		1.8										<1		
G23	06/16/86		1100	69						100	200		200		0.9										4		

APPENDIX B Table 7. (cont.)

Grasslands

RWQCB ID	DATE	pH	EC umhos/cm	TEMP F	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
					mg/L											ug/L											
G23	06/01/87		2640							295	650				3.9										4		
G24	04/02/86		2700	60						370	870		150		5.5										27		
G25	04/03/86		2600	62						320	820		140		4.7	4	<10	27	15	<10			5	22	31		36
G26	04/03/86		2400	64						500	510		160		1.2								6		12		
G26	06/01/87		1140							176	140				0.5								4		2		
G27	04/02/86		710	61						88	130		98		0.5										<1		
G27	06/16/86		640	77						61	110		110		0.1				8	<5	<0.5		<5	11	4		23
G27	06/01/87		838							121	105				0.3			31	7	<5			3	11	2		10
G28	04/03/86		1800	63						230	430		140		4.4	5	<10	10	<10	<10				9	12		23
G28	06/01/87		1560							196	340				1.6			5	5	<5			6	6	10		2
G29	04/02/86		2100	61						280	580		152		2.9										13		
G29	06/16/86		870	77						100	150		870		0.5			22	6	<5	<0.5		6	17	1		18
G29	06/01/87		1570							201	370				1.5								7		10		
G31	04/02/86		680	63						82	220		110		0.8										2		
G32	04/02/86		145	61						12	27		48		0.4										<1		
G33	04/02/86		165	60						11	42		48		0.5										<1		
G34	04/02/86		1650	64						220	600		290		2.5										1		
G35	04/02/86		1700	68						220	710		320		2.3										3		
G36	04/02/86		2600	62						330	1000		160		4.9										4		
G37	04/02/86		1450	62						220	760		200		2.4										<1		
G38	04/02/86		1650	66						400	980		210		3.0										10		
G39	04/03/86		1000	62						130	460		100		1.0	4	<10	5	<10	<10			4	6	5		14
G39	06/16/86		2300	78						270	630		2300		3.1			18	4	<5	<0.5		8	10	22		8
G39	06/01/87		2620							337	610				3.5								11		19		
G40	04/03/86		1690	64						260	600		290		3.3	8	<10	13	<10	<10			4	16	1		29
G40	06/01/87		1320							171	250				1.1										1		
G41	04/02/86		1000	64						140	230		130		4.0										3		
G41	06/01/87		2450							307	515				2.7										11		
G42	04/02/86		640	60						55	180		110		0.4										<1		
G43	04/02/86		4300	62						200	1600		520		7.8										6		

APPENDIX B Table 7. (cont.)

Westside Creeks

RWQCB ID	DATE	pH	EC	TEMP	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
			umhos/cm	F	mg/L											ug/L											
G44	04/02/86	8.1	9100	62	7000	482	458	602	18	120	3200	350	350	3000	2.6										51		
G44	06/11/86	8.3	8900	74	10500	430	1000	1100	20	170	6200	300	300	5100	5.9	5	<10	<2	<10	23			8	<5	31		21
G46	04/02/86	8.3	1600	53	1000	101	50	171	5.8	110	400	290	290	500	2.8										2		
G46	06/11/86	8.1	1800	67	1200	50	49	220	6.0	160	460	260	260	440	3.9	4	<10	<2	<10	<2			5	<5	1		<10
G47	04/02/86	8.2	4000	63	3400	228	100	446	8.3	140	1900	240	240	1200	1.8										14		
G47	06/11/86	8.2	4500	75	4300	310	220	530	4.5	110	2600	180	180	1800	2.6	3	<10	<2	<10	<2			5	<5	13		<10
G47	05/13/87																								7		
G48	04/02/86	7.9	4300	49	3800	355	197	524	3.2	370	2400	300	300	1840	1.0										13		
G49	04/02/86	8.1	980	59	620	39	95	53	2.1	19	160	340	340	500	0.5										1		
G49	06/11/86	8.8	1100	74	790	98	6	83	4.0	30	280	340	404	570	1.1								2		1		
G49	05/13/87																								1		
G51	04/02/86	8.3	1000	64	680	61	52	87	3.6	52	340	210	210	360	0.4										<1		
G52	04/02/86	8.2	860	62	600	63	32	76	4.1	39	190	210	210	260	0.9										<1		
G52	06/11/86	8.5	920	76	650	30	55	79	4.4	44	230	152	160	310	1.2	2	<10	<2	<10	<2			2	<5	1		<10
G53	04/02/86	8.4	1600	62	1100	69	65	197	5.7	93	400	270	314	440	4.5										3		
G53	06/11/86	8.6	2700	74	1900	76	120	400	10	170	990	210	320	630	7.0	2	<10	<2	<10	<2			4	<5	6		10
G54	04/02/86	8.2	1000	54	610	63	36	115	2.4	97	110	300	320	610	2.3										3		
G54	06/11/86	8.5	1500	68	910	24	43	240	2.6	210	170	290	290	280	4.9	1	<10	<2	<10	2			2	<5	4		11
G54	05/13/87	8.6	580	87	360	47	30	35	3.8	34	57	160	176	220											3		
G55	06/11/86														0.4	9	<10	<2	<10	<2			1	<5	<1		<10
G57	04/02/86	8.2	1700	58	1200	113	63	171	12	130	470	280	280	580	2.9										2		
G58	04/02/86	7.9	2100	47	1200	110	46	246	4.1	520	170	230	230	460	8.5										<1		
G58	06/11/86	8.3	1700	84	940	86	40	210	5.8	300	120	200	200	340	5.7	2	<10	<2	<10	2			4	<5	1		12
G58	05/13/87																								1		
G59	04/03/86		1800							350	200		230		6.6	3	<10	<2	<10	<10			2	<5	1		<10
G59	06/11/86	8.4	2900	76	1700	91	56	420	7.0	600	190	290	295	450	11.0	5	<5	<5	<5	<5		85	<5	(<5)	5	<5	<5
G59	05/13/87																								<1		
G60	04/02/86	8.3	980	52	590	65	42	81	2.7	62	140	260	272	360	1.6										<1		
G60	06/11/86	8.3	1200	67	780	30	45	130	4.4	110	200	250	250	340	3.2	<1	<10	<2	<10	<2			1	<5	1		<10

APPENDIX B Table 7. (cont.)

Westside Creeks

RWQCB ID	DATE	pH	EC	TEMP	TDS	Ca	Mg	Na	K	Cl	SO4	HCO3	Total Alk	Hard	B	As	Cd	Cr	Cu	Pb	Hg	Mn	Mo	Ni	Se	Ag	Zn
			umhos/cm	F	mg/L											ug/L											
G61	05/13/87																								15		
G62	04/02/86	8.4	940	63	640	66	49	62	3.6	31	300	220	232	330	0.3										<1		
G62	06/11/86	8.2	1100	76	790	100	61	73	9.3	31	360	180	180	400	0.3	<1	<10	<2	<10	<2			1	<5	1		<10
G63	04/03/86	8.3	5700	68	4300	190	280	800	4.5	1200	1600	410	410	1500	5.7	1	<10	<2	<10	<10			4	<5	6		<10
G63	06/11/86	8.2	6000	82	4500	180	260	940	7.6	1000	1600	380	380	1500	5.9	2	<10	<2	<10	<2			5	<5	6		<10
G63	05/13/87																								6		
G64	04/03/86		4400							140	2000		400		5.3	7	<10	39	26	<10			2	98	8		420
G65	04/03/86		1000							76	150		290		1.6		<10	<2	<10	<10			2	<5	2		<10
G66	04/03/86		860							90	74		230		1.6	1	<10	<2	<10	<10			2	<5	1		12
G66	06/11/86	8.4	1100	84	620	57	43	120	2.7	160	75	270	278	300	2.3	1	<10	<2	<10	<2			1	<5	<1		11
G67	04/02/86	8.2	1900	60	1400	97	99	180	4.3	53	600	270	270	630	0.8										5		
G67	06/11/86	8.2	2700	73	2100	140	140	280	7.0	62	1200	240	240	1900	1.3	2	<10	<2	<10	<2			4	<5	4		<10
G67	05/13/87																								2		
G68	04/02/86	8.2	3000	48	2200	192	107	332	7.4	250	1000	180	180	1040	5.0										4		
G69	04/03/86		3700							75	1700		390		4.0	2	<10	15	<10	<10			4	82	7		340

From: Dennis Westcot
To: Glenn Hoffman
CC: Mark Gowdy
Date: 10/9/2009 11:53 AM
Subject: Figure 3.18

Glenn:

Yesterday I mailed both you and Mark Gowdy a marked up copy of your Figure 3.18 which shows the additional sites that good drainage information is available from. I want to ask you to make one change.

After reviewing the field notes from the samplers (actually they are still available in the Regional Board files), please take out #22. It is found in the center of the figure. I think it should be taken out as it is influenced by an urban area and does not represent agricultural practices very well and I think there may be surface drainage that gets into the tile lines at times or they have septic tanks hooked up to it.

Any questions, please let me know.
Dennis W. Westcot
Project Administrator
San Joaquin River Group Authority

TK/MG

Figure 3.18. Location of subsurface tile drains sampled on the west side of the SDWA (Chilcott, et al., 1988).