APPENDIX B

Summary of Department of Water Resources Publication: Municipal Water Quality Investigations Program Summary and Findings from Data Collected August 1998 through September 2001

SUMMARY OF MWQI MONITORING DATA

The following is a summary of the information presented in the DWR publication *Municipal Water Quality Investigations (MWQI) Program Summary and Findings from Data Collected August 1998 through September 2001* with respect to the following constituents:

- Electrical Conductivity
- General Chemistry
- Nitrate

Electrical Conductivity

The data suggest that seawater influence was the primary source of salinity throughout the western Delta as indicated by the high median electrical conductivity (EC) and the wide EC range at Mallard Island (B-1).

EC in the Delta channel stations generally varied with their distance from the Mallard Island station where seawater influence was the greatest. An exception was the Delta-Mendota Canal where the San Joaquin River influence may play a major role (B-1).

EC of San Joaquin River water is significantly higher than waters from the American and Sacramento rivers, partially due to discharge of recirculated irrigation water from the Delta-Mendota Canal, which is seawater-influenced. Salinity was significantly lower at Delta channel and diversion stations than at the San Joaquin River due to the dilutional effects of water from the Sacramento and other Rivers that drain from the eastern Sierra Mountains.

In addition to seawater intrusion, salinity in Delta waters is affected by sources that include watershed runoff, urban discharges, and agricultural drainage. Salinity loads from the watersheds were significant during the wet months, especially after each of the first few significant rain events.

General Chemistry

Concentrations of the major anions (chloride and sulfate) and cations (sodium, magnesium, and calcium) can be roughly divided into 3 groups.

The group with the lowest concentrations is not affected by seawater influence. Stations of this group include the American River at E.A. Fairbairn WTP, the West Sacramento WTP Intake, and the Sacramento River at Hood. Within this group, chloride ranged from 1 to 12 mg/L, sulfate ranged from 1 to 15 mg/L, sodium ranged from 2 to 17 mg/L, and the combined calcium and magnesium from 5.0 to 28.9 mg/L (B-2 and B-3).

Seawater influences resulted in the detection of the highest concentrations at the Mallard Island station (B-2 and B-3).

The remaining stations belong to the third group, which is either directly or indirectly is affected by seawater (except for the Natomas East Main Drainage Canal station). The

concentrations of the major anions and cations in these stations were similar, with these concentrations being slightly higher in the San Joaquin River stations (B-2 and B-3).

Agricultural drainage waters, which often contain higher levels of salinity, affect the stations on the San Joaquin River and Old River. Nevertheless, agricultural return water is a relatively small fraction of the water in the San Joaquin River system and in the Old River; therefore, chloride and sulfate in these river stations remained relatively low despite the discharges from agricultural drainage sites. Average and median salinity levels were similar in the urban drainage Natomas East Main Drainage Canal and in Delta Channel/Old River stations. However, the ranges were narrower in the Natomas East Main Drainage Canal than in the Old River, suggesting that salinity was less variable in Natomas East Main Drainage Canal than in Old River. Sulfate concentrations were higher at Natomas East Main Drainage Canal than at the American River at E.A. Fairbairn WTP, the Sacramento River at Hood, and the West Sacramento WTP Intake, but lower than at all other stations.

Similar to the salinity levels, the lowest hardness was found in the American River water, and the greatest hardness was found at Mallard Island, which is heavily influenced by seawater. If the Mallard Island station is excluded, hardness for the river and Delta channel stations ranged from 14 to 245 mg/L as $CaCO_3$ (B-4). Hardness at the 2 San Joaquin River stations and the 2 agricultural drainage stations were similar and were approximately twice as high as hardness at the 2 upper Sacramento River stations. The 2 Delta channel stations, the Banks Pumping Plant, the Delta-Mendota Canal, and the Natomas East Main Drainage Canal had similar water hardness. However, hardness at the Contra Costa Pumping Plant was somewhat higher than at the Delta channel stations. This may be due to the Contra Costa Pumping Plant's proximity to Mallard Island and the impact from seawater.

5.1.1.3 Nitrate

During the reporting period, nitrate was also monitored at all stations. Nitrate concentrations were highest in the San Joaquin River and the Old River and were also high in the agricultural and urban drainage sites. Consequently, nitrate was moderately high at all of the diversion stations (B-5). These high nitrate levels indicated high total nitrogen reserves in Delta waters.

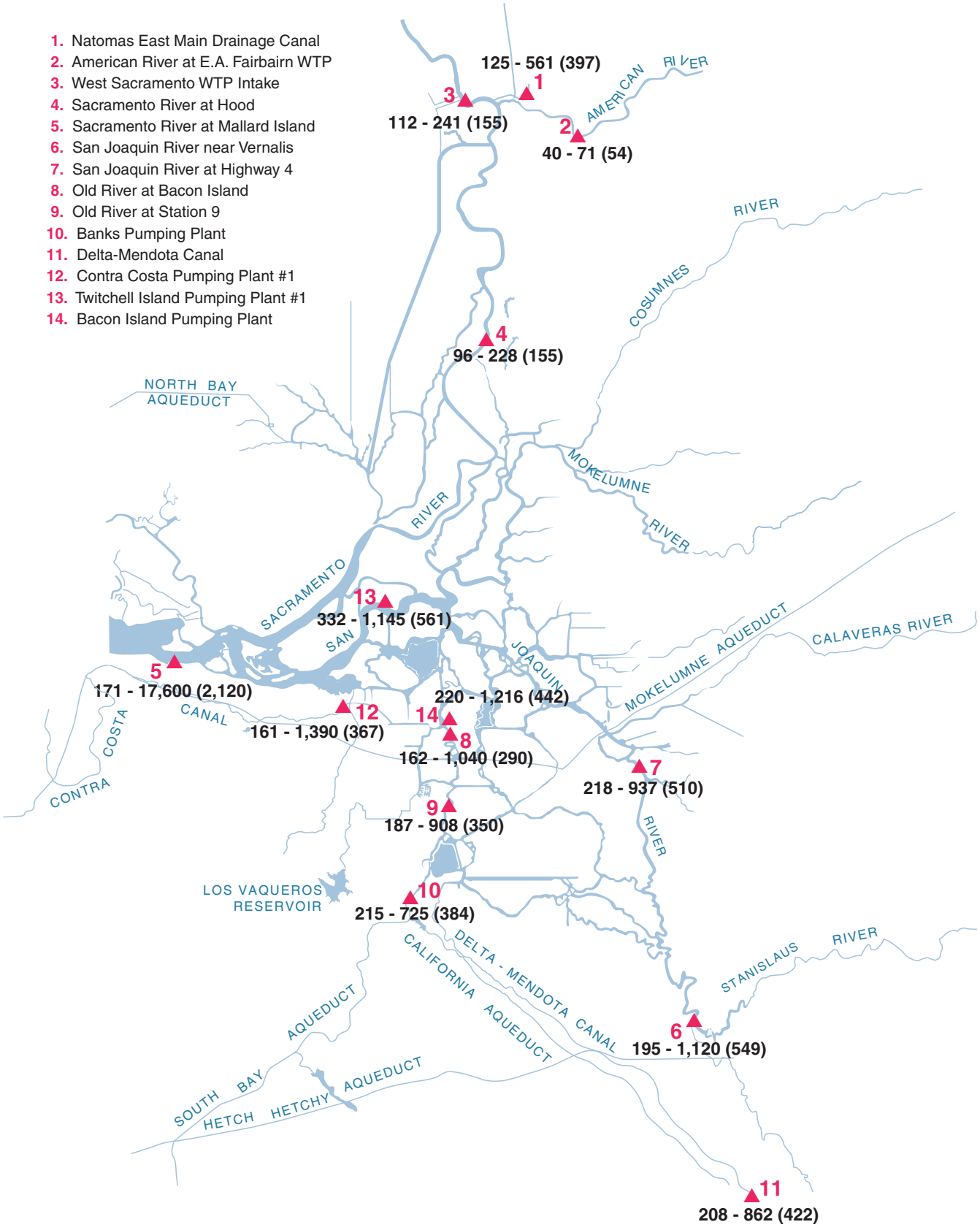
Despite some slight variations, nitrate at the diversion stations was generally higher in the wet months of each year and lower in the dry months (B-6). Lowered nitrate concentration during the dry months may be partly attributable to increased agal activities in the rivers and channels of the Delta.

Nitrate concentration in the San Joaquin River as measured at the Vernalis station is much higher than in the Sacramento River as measured at the Hood station (B-6). Although a wet month nitrogen buildup and an early dry month decline were also observed in both rivers, seasonal changes of nitrogen in the rivers were different from those at the diversion stations. Nitrogen levels in both rivers began to rise in June of each

year and reached the highest levels between July and October, which coincide with the agricultural drainage inflows to both rivers.

At the Banks Pumping Plant, ammonia, Kjeldahl nitrogen, and phosphorus were also monitored in addition to nitrate (B-5). Kjeldahl nitrogen, which includes organic forms of nitrogen, ranged from 0.3 to 0.8 mg/L with average and median concentrations of 0.5 and 0.4 mg N/L, respectively. The sum of nitrate as nitrogen (NO_3-N) and Kjeldahl nitrogen was from 0.13 to 1.20 mg/L. Ammonia was frequently detected at low levels at the Banks Pumping Plant.

Figure C Electrical conductivity: Range, median (µS/cm)



Appendix B-1

Table 6-4 Chloride and sulfate at 14 MWQI monitoring stations (mg/L)

Station	Chloride				Sulfate			
	Sample number	Range	Average	Median	Sample number	Range	Average	Median
American and Sacramento River stations								
American River at E.A. Fairbairn WTP	37	1–2	2	2	31/37[a]	1–6	2	2
West Sacramento WTP Intake	38	2–12	5	4	38	3–15	7	6
Sacramento River at Hood	158	2–11	6	5	159	2–15	7	7
Sacramento River at Mallard Island	30	10–4,660	964	458	31	11–637	138	58
San Joaquin River stations								
San Joaquin River near Vernalis	153	16–139	64	65	153	23–164	67	68
San Joaquin River at Highway 4	35	19–128	64	60	35	22–130	65	65
Delta channel stations								
Old River at Station 9	34	13–190	48	39	38	12–71	29	26
Old River at Bacon Island	34	10–246	45	30	38	8–42	23	22
Diversion stations								
Banks Pumping Plant	35	18–151	48	43	38	14–60	33	31
Delta-Mendota Canal	28	19–122	55	51	31	14–125	40	33
Contra Costa Pumping Plant	27	9–224	65	36	30	11–195	54	38
Agricultural drainage stations								
Bacon Island Pumping Plant	25	18–132	62	49	24	10–343	71	44
Twitchell Island Pumping Plant	31	45–191	100	90	33	11–127	39	28
Urban drainage station								
Natomas East Main Drainage Canal	41	6–71	41	44	41	6–34	21	21

a. Positive detects/total sample number

Appendix B-2

Table 6-5 Summary of sodium, calcium, and magnesium at 14 MWQI monitoring stations[a]

Station	Sample number	Sodium			Calcium+ magnesium			Sodium/(sodium + calcium + magnesium)		
		Range	Average	Median	Range	Average	Median	Range	Average	Median
American and Sacramento River stations										
American River at E.A. Fairbairn WTP	37	2–3	2	2	5.0–10.0	7.2	7.0	0.18–0.29	0.24	0.23
West Sacramento WTP Intake	38	5–16	10	9	13.8–28.9	19.5	19.0	0.26–0.39	0.33	0.33
Sacramento River at Hood	159	5–17	10	10	11.9–26.1	18.0	18.0	0.25–0.42	0.35	0.35
Sacramento River at Mallard Island	35	11–3,060	697	314	17.0–501.1	121.4	64.0	0.38–0.88	0.73	0.83
San Joaquin River stations										
San Joaquin River near Vernalis	159	18–135	59	60	16.0–80.0	37.9	39.0	0.51–0.64	0.59	0.58
San Joaquin River at Highway 4	37	20–104	59	56	18.0–63.0	40.1	41.0	0.51–0.66	0.58	0.58
Delta channel stations										
Old River at Station 9	38	16–112	42	35	17.0–42.0	27.6	27.5	0.45–0.75	0.57	0.55
Old River at Bacon Island	38	13–147	41	27	15.3–41.0	25.1	24.0	0.42–0.78	0.56	0.53
Diversion stations										
Banks Pumping Plant	37	18–91	41	36	20.0–40.0	27.6	26.0	0.46–0.72	0.57	0.56
Delta-Mendota Canal	31	18–102	47	42	20.0–60.0	31.5	30.0	0.47–0.70	0.58	0.57
Contra Costa Pumping Plant	30	12–188	59	37	16.4–82.0	34.8	30.0	0.41–0.73	0.58	0.56
Agricultural drainage stations										
Bacon Island Pumping Plant	25	20–88	48	46	21.0–133.0	45.0	39.0	0.40–0.61	0.53	0.53
Twitchell Island Pumping Plant	35	38–132	72	64	23.0–86.0	40.7	36.0	0.53–0.71	0.64	0.64
Urban drainage station										
Natomas East Main Drainage Canal	41	8–50	35	38	12.0–53.0	32.6	30.0	0.36–0.65	0.51	0.50

a. Data unit is mg/L except for the unitless sodium/(sodium + calcium + magnesium) ratio.

Appendix B-3

Table 7-3 Summary of hardness at 14 MWQI monitoring stations

Station	Sample number	Range	Majority data range	Data dispersion (IQR)	Average	Median
		mg/L as CaCO3				
American and Sacramento River stations						
American River at E.A. Fairbairn WTP	37	14–30	14–27	18–23	21	21
West Sacramento WTP Intake	38	42–90	47–78	52–67	60	59
Sacramento River at Hood	160	35–81	42–71	49–61	55	55
Sacramento River at Mallard Island	34	52–1,858	54–1,319	73–519	423	221
San Joaquin River Stations						
San Joaquin River near Vernalis	159	48–245	60–184	85–155	123	129
San Joaquin River at Highway 4	36	55–193	57–181	99–150	122	127
Delta channel stations						
Old River at Station 9	38	51–131	58–124	71–102	86	87
Old River at Bacon Island	38	46–138	52–122	62–93	79	74
Diversion stations						
Banks Pumping Plant	37	61–127	63–114	68–100	86	83
Delta-Mendota Canal	31	60–184	63–153	79–109	98	91
Contra Costa Pumping Plant	30	50–270	54–238	66–147	111	94
Agricultural drainage stations						
Bacon Island Pumping Plant	25	64–403	66–262	89–172	136	118
Twitchell Island Pumping Plant	35	72–261	79–258	89–133	126	113
Urban drainage station						
Natomas East Main Drainage Canal	41	36–165	57–145	80–120	97	86

Appendix B-4

Table 8-5 Summary of nitrate at 14 MWQI stations

Station	Positive detects/ sample number	Range	Average	Median
		----------mg NO_3 /L----------		
American and Sacramento River stations				
American River at E.A. Fairbairn WTP	9/25	0.1–0.8	0.3	0.2
West Sacramento WTP Intake	25/26	0.1–0.8	0.4	0.4
Sacramento River at Hood	112/113	0.1–12.4	0.8	0.5
Sacramento River at Mallard Island	23/23	0.9–8.2	1.7	1.4
San Joaquin River stations				
San Joaquin River near Vernalis	112/112	1.6–28.0	6.4	6.4
San Joaquin River at Highway 4	25/25	2.8–9.3	6.0	6.1
Delta channel stations				
Old River at Station 9	26/26	0.5–9.5	2.5	1.8
Old River at Bacon Island	25/25	0.1–6.4	1.8	1.4
Diversion stations				
Banks Pumping Plant	28/28	0.4–8.0	2.7	2.7
Delta–Mendota Canal	20/20	1.6–9.8	3.4	2.9
Contra Costa Pumping Plant	22/22	0.3–8.2	2.4	1.5
Agricultural drainage stations				
Bacon Island Pumping Plant	14/19	0.4–13	3.8	2.8
Twitchell Island Pumping Plant	23/23	0.1–12	2.8	1.1
Urban drainage station				
Natomas East Main Drainage Canal	36/36	1.8–21.0	10.0	9.4

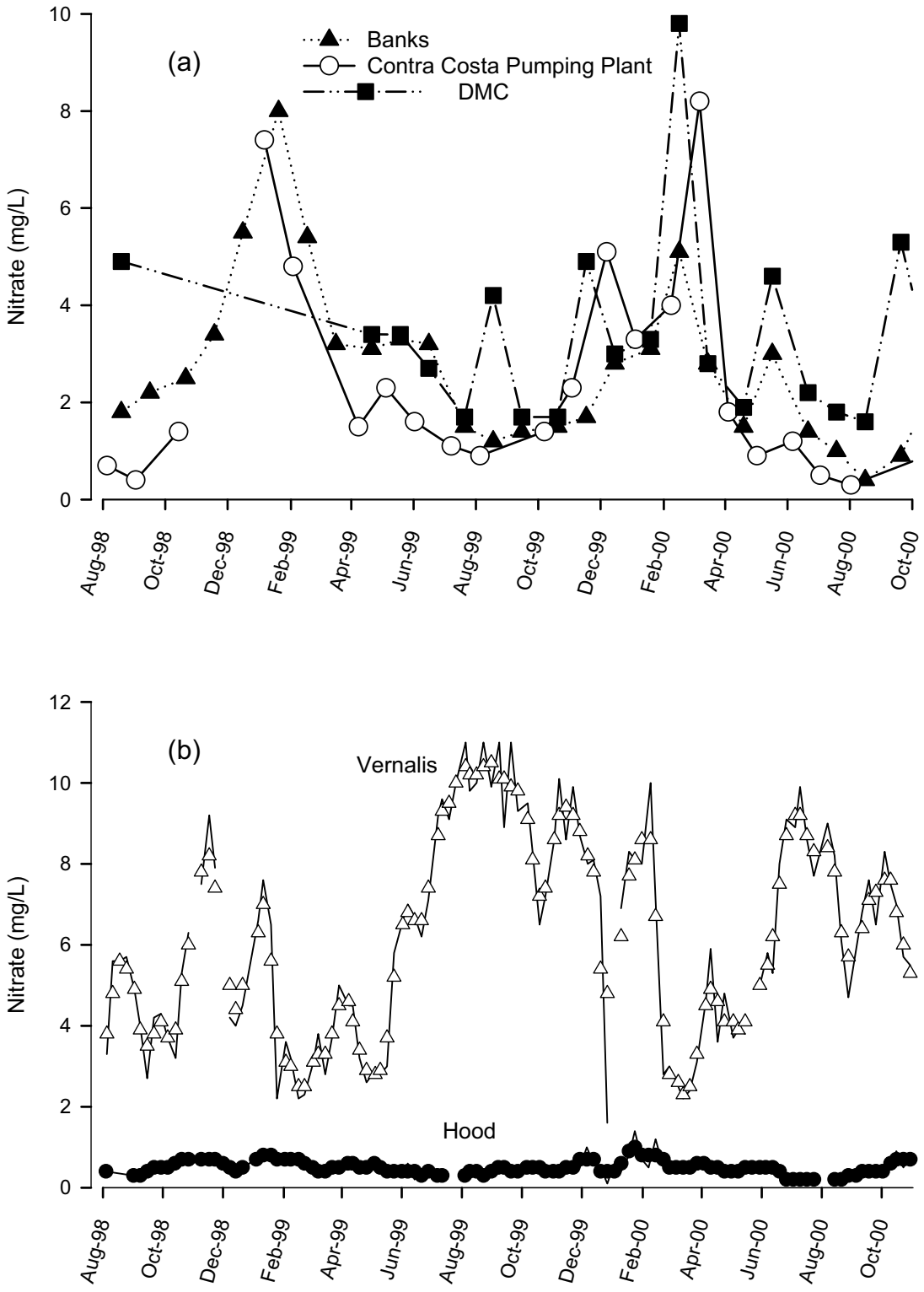
Note: Nitrate was determined by Standard Method 4500 except at NEMDC where EPA Method 300 was used.

Table 8-6 Summary of nutrient data at the Banks Pumping Plant

	Ammonia (mg N/L)	Nitrate + nitrite (mg N/L)	Kjeldahl nitrogen (mg N/L)	Orthophosphorus	Total P
				----------(mg P/L)----------	
Detects/sample number	29/29	29/29	29/29	29/29	29/29
Range	0.02–0.15	0.13–1.20	0.3–0.8	0.04–0.15	0.07–0.16
Average	0.06	0.57	0.5	0.07	0.11
Median	0.05	0.51	0.4	0.06	0.10

Appendix B-5

Figure 8-1 Nitrate at three diversion stations and two river stations



Appendix B-6