



**ALLAMITOS
BARBER
PROJECT**

authors....

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Water Replenishment District of Southern California
Long Beach Water Department
Golden State Water Company
Los Angeles County Flood Control District**

**Secretary,
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Youn Sim

Annual report on the control of seawater intrusion



2004 - 2005

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INTRODUCTION

The Alamitos Barrier Project was designed and constructed to protect the groundwater supplies of the Central Basin of the County of Los Angeles and the southwest portion of the Coastal Plain area in Orange County from the intrusion of seawater through the Alamitos Gap area. The project facilities are located near the Los Angeles-Orange County line about two miles inland from the mouth of the San Gabriel River. Facilities include injection wells that form a freshwater pressure ridge and extraction wells that form a salt water trough. The fresh water ridge is intended to block the landward gradient of intruding seawater while the salt water trough is intended to reverse the landward gradient of intruding seawater. A map of the area around the barrier and the location of major facilities are presented in page A-1 of the Appendix. A map showing all injection and observation wells is shown on page A-13.

The County of Los Angeles Department of Public Works operates and maintains the project and its physical facilities under the direction and approval of the Joint Management Committee (JMC), acting on behalf of the Los Angeles County Flood Control District and the Orange County Water District.

This report summarizes operational activities, hydrologic effects, and project costs for Fiscal Year 2004-05, covering July 1, 2004, to June 30, 2005.

SUMMARY

During this report period, a total of 5,066 acre-feet of water were injected at an average rate of 7.0 cubic feet per second. A total water cost of \$2,182,157 was incurred. The Orange County Water District purchased 1,915 acre-feet at a cost of \$825,774. The Water Replenishment District of Southern California purchased 3,151 acre-feet at a cost of \$1,356,383.

The cost of services and supplies for injection, excluding the costs of water, was \$181.21/acre-feet this year. The previous year, this cost amounted to \$124.27/acre-feet, which was primarily due to less extensive redevelopment of injection wells.

A data comparison of spring 2004 and spring 2005 shows that groundwater levels have significantly increased in the R, A and I zones and slightly increased in the C and B Zones.

Intrusion of seawater across the barrier continues to be controlled along most of the alignment and the overall performance of the barrier has improved since the previous reporting period (Fiscal Year 2003-04). However, several areas continue to record high chloride concentrations. For all zones, the southeastern end of the barrier continues to be subject to seawater intrusion. Additionally, the R zone shows high chloride concentrations around the San Gabriel River, and the B zone shows high chloride concentrations landward of the barrier near Leisure World. In the area seaward of the barrier, most of the aquifer zones remain contaminated with high chloride concentrations, especially in areas where the Recent Aquifer is merged with underlying aquifers.

DESIGN AND CONSTRUCTION

The final design plans and specifications of the cathodic protection system for the water supply pipeline and appurtenances have been completed. Previously, it was anticipated that construction would begin in Fiscal Year 2005-06, but the project was postponed for budgetary reasons.

Design plans for the renovation of the pressure reduction vault have been finalized as anticipated and the project remains on schedule to begin construction in Fiscal Year 2005-06. The renovation includes replacement of the deficient pressure regulating valves and ball valves and removal of the hydroelectric generation plant.

No construction occurred during this period.

INJECTION OPERATIONS

The injection volumes and costs during Fiscal Years 2003-04 and 2004-05 are shown in Table 1.

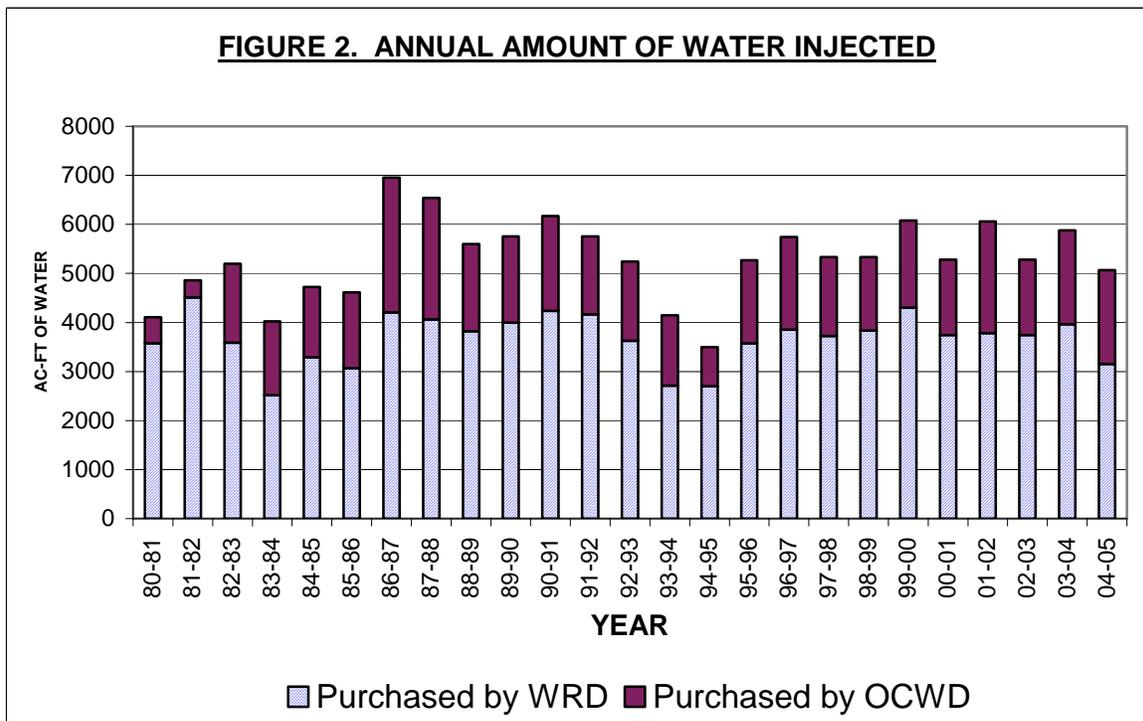
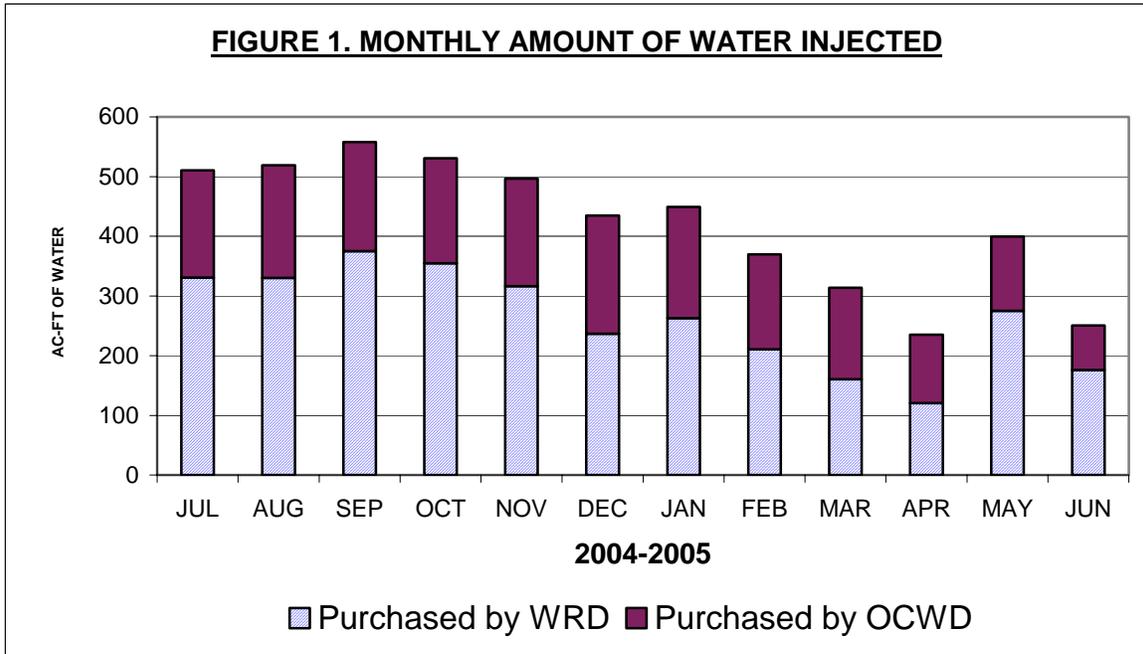
TABLE 1. INJECTION OPERATIONS

	Fiscal Year 2003-04	Fiscal Year 2004-05	Percent Change From Previous Year
	<u>VOLUME OF WATER INJECTED IN ACRE-FEET</u>		
OCWD ¹	1,915.6	1,915.3	-0.02
WRD ²	3,964.0	3,150.8	-20.51
TOTAL	5,879.6	5,066.1	-13.83
	<u>UNIT COST OF WATER PER ACRE-FEET</u>		
JULY-OCT	\$413	\$423	2.42
NOV	\$445	\$423	-4.94
DEC	\$494	\$423	-14.37
JAN	\$423	\$423	0.00
FEB-JUNE	\$423	\$448	5.91
	<u>COST OF WATER PURCHASED</u>		
OCWD ¹	\$820,116	\$825,774	0.69
WRD ²	\$1,692,885	\$1,356,383	-19.88
TOTAL	\$2,513,002	\$2,182,157	-13.17
	<u>AVERAGE INJECTION RATE IN CFS</u>		
OCWD ¹	2.6	2.6	-0.02
WRD ²	5.5	4.4	-20.51
TOTAL	8.1	7.0	-13.83

¹ Orange County Water District

² Water Replenishment District

Figure 1 presents the monthly amounts of water injected during the 2004-05 Fiscal Year. The maximum monthly injection of 557.7 acre-feet occurred in September 2004. The minimum monthly injection of 235.5 acre-ft occurred in April 2005. Figure 2 illustrates the annual amounts of water injected since 1980.



EXTRACTION OPERATIONS

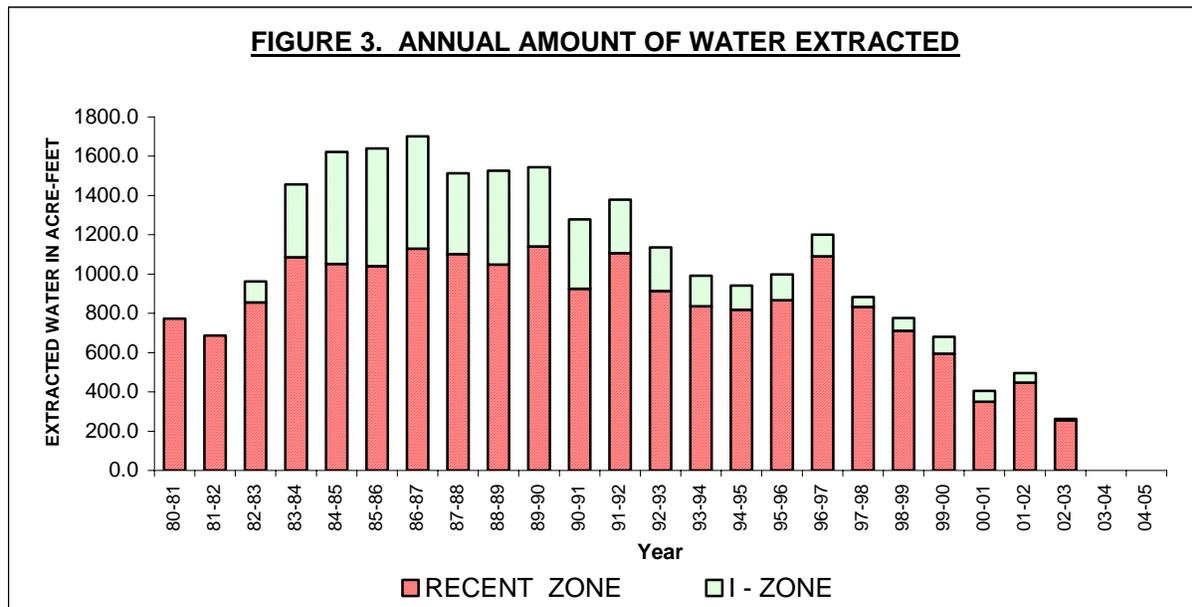
Table 2 presents the amount of water extracted during the last three fiscal years.

TABLE 2. EXTRACTION OPERATIONS

Zones	Fiscal Year 2004-05	Fiscal Year 2003-04	Fiscal Year 2002-03	Change in percent
<u>Volume of water extracted in acre-feet</u>				
R Zone	0	0	255.2	N/A
I Zone	0	0	7.5	N/A
TOTAL	0	0	262.7	N/A

No water was extracted during the Fiscal Year 2004-05. The extraction wells were turned off in Fiscal Year 2002-03 as part of the extraction well efficiency study. The study results demonstrated that the Chloride levels in the area decreased with all extraction wells turned off. The JMC subsequently recommended to temporarily keep the wells off and to continue to monitor the groundwater. If deemed advantageous in the future, these wells can be turned back on. Regardless of the operational status, minimal electrical system maintenance and redevelopment of the extraction wells will continue.

Figure 3 illustrates the amount of water extracted for each reporting period since 1980.



MAINTENANCE

No observation wells were cleaned out at the Alamitos Barrier during the Fiscal Year 2004-05. The purpose of cleaning is to remove accumulated sediment at the bottom of the well screens to facilitate chloride sampling of the wells.

During the 2004-05 Fiscal Year, the Los Angeles County Flood Control District completed the redevelopment of the following 13 injection well casings: 33J, 33Q, 33S1, 33U, 33U3, 33V, 33W, 33X, 33Y, 34D, 34E(C,B), 34E(A,I), and 34G2(B,C).

Figure 4 depicts the operating status of each injection and extraction well during Fiscal Year 2004-05. As indicated, most periods of nonoperation were due to either repairs or redevelopments and for a fairly short duration. Transition time before and after such repairs and redevelopments will continue to be reduced where possible.

Figure 4. INJECTION AND EXTRACTION WELL STATUS

Well No.	2004						2005					
	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
33Gai						D D D D	M M M M	M M M M	M M M M	M M M M	X X X X	X X D D
33Jai		M M M M						R R				
33Lai									M M M M	M M M M	M M M M	M M M M
33Nai									H H H H	H H H H	H H H H	H H H H
33Qai			R R									M
33Q1cb									M M M M	M M M M		
33Sai												
33S1		M	R R	S S S S	S S S S	S S S S	S S S S	S S S S	S S S S	S S S S	S S S S	S S S S
33Tai											S S S S	S S S S
33Uai				R R R R								
33U3cb					R R R							
33Vcbai					R R							
33Wcbai						R R R						
33Xcbai							R R R					
33Ycbai								D R R R	D D D D	D D D D	D D D D	
33Z2a												
33Z2i												
33Zcbai												
34Dcbai								D D D D	D D R R	S S S S		
34Ebc										R R		
34Eai										R R D	D D	
34Fa												
34Fai												
34Gi											S S S S	S S S S
34G2cb												R R
34G2ai												
34Ha									M M M M	M M M M		
34Hi												
34Ja												M
34Ji												
34Lcbai												
34Sa				M M M M	M M M M	M M M M	M M M M	M M M M	M M M M	M M M M	S S S S	S S S S
34Si				M M M M	M M M M	M M M M	M M M M	M M M M	M M M M	M M M M	S S S S	S S S S
34Scb				M M M M	M M M M	M M M M	M M M M	M M M M	M M M M	M M M M	S S S S	S S S S
34Va												M M
34Vi												M M
34Vcb												M M M M
34Zi												
35Fai												
35Gi												
35H1a												M M
35H1(ai)												
35H2a												
* 33V'15P	N	N	N	N	N	N	N	N	N	N	N	N
* 34H'17P	N	N	N	N	N	N	N	N	N	N	N	N
* 34H'18P	N	N	N	N	N	N	N	N	N	N	N	N
* 34S'22P	N	N	N	N	N	N	N	N	N	N	N	N

*Extraction Well

- Well in Operation
- R - Redevelopment
- S - Surface Leakage
- G - Grouted
- N - Not Needed
- H - Header Repair
- C - Casing Repair
- T - Tremie Repair
- U - Still Under Construction
- w - NPDES Water quality Sampling
- D - Disassembled
- M - Misc. Repair
- X - Waiting for Repair
- O - Other Special Circumstances

HYDROLOGIC EFFECTS

Groundwater Elevations

Table 3 summarizes average groundwater elevations taken during the spring months of the last 12 years. The comparison of groundwater levels taken during spring 2004 and 2005 presented in the last columns of Table 3 shows on average a significant increase in groundwater levels in the R, A, and I Zones. It is especially significant to note this improvement since all other recent years have shown minimal, if any, increases in groundwater levels in the A and I Zones. Additionally, the C and B zones on average showed slight increases from the previous year. This continues to demonstrate a solid recovery from spring 2003's low groundwater levels due to a temporary shutdown of the eastern half of the barrier for repair.

Figures 5 through 9 show the average monthly groundwater elevation along the barrier alignment in the R, C, B, A, and I Zones, respectively. Two graphs were created for each aquifer to account for changes in groundwater elevation trends along the barrier alignment: wells west of the San Gabriel River and wells east of the San Gabriel River.

In each graph, monthly average groundwater elevations during the Fiscal Year 2004-05 are compared with the averages of the previous 10 years (Fiscal Years 1993-94 to 2003-04). As evidenced in each graph, groundwater levels have generally maintained historical values on both the west and east side of the San Gabriel River. It is noted that significantly low groundwater levels observed in all graphs during the months of August and December are attributable to the reduced injection during extensive repair or redevelopment of injection wells 33J, 33G, 33S1, 33U3, 33V, and 33W.

Groundwater elevation contours for the R, C, B, A, and I Zones have been prepared from data taken in April of 2005 and are included in the Appendix (A-2 through A-6).

TABLE 3. GROUNDWATER ELEVATION SUMMARY FOR PREVIOUS YEARS

Zones	Description	Spring 1994	Spring 1995	Spring 1996	Spring 1997	Spring 1998	Spring 1999	Spring 2000	Spring 2001	Spring 2002	Spring 2003	Spring 2004	Spring 2005
R	Maximum	2.5	2.6	4.5	5.8	4.3	5.0	5.9	5.0	1.0	-0.9	4.2	4.9
	Minimum	-5.9	-4.7	-3.0	-5.1	-5.4	0.0	-1.6	-2.2	-3.0	-7.6	-8.8	2.6
	Average	-1.4	-1.3	-0.6	-0.3	0.4	1.9	1.4	0.4	-0.9	-1.8	-0.4	3.6
C & B	Maximum	4.8	10.1	9.4	11.1	11.1	11.1	4.1	6.7	10.9	2.1	9.9	8.3
	Minimum	0.5	1.4	2.4	1.6	1.7	2.7	2.5	2.0	0.5	-0.4	3.7	1.8
	Average	2.6	5.8	5.8	6.9	5.5	7.9	7.8	5.0	7.0	1.1	7.3	4.2
A	Maximum	2.0	4.8	0.8	-0.4	3.2	8.0	3.8	6.0	7.8	0.4	4.1	7.0
	Minimum	-2.2	-2.6	-2.2	-2.0	-2.9	2.4	-0.9	-1.1	-2.3	-6.4	3.1	2.6
	Average	-0.6	0.3	-0.9	-1.1	1.5	4.4	0.6	1.1	1.1	-4.2	3.5	4.8
I	Maximum	-2.1	-0.7	-2.0	4.1	6.9	9.3	-3.2	-3.0	-2.4	-7.7	2.4	4.1
	Minimum	-5.4	-5.4	-6.2	-2.5	-2.3	-2.3	-10.2	-8.0	-7.5	-13.2	-1.5	2.1
	Average	-3.9	-3.9	-4.4	0.6	2.9	2.3	-6.6	-5.0	-5.1	-11.8	0.2	3.2
MAIN	Maximum	2.5	6.4	6.2	11.1	11.1	8.8	5.4	3.9	6.0	2.6	2.5	7.5
	Minimum	-8.5	-8.1	-4.5	-3.3	-1.9	-0.3	-2.5	-2.7	3.1	-6.6	-11.0	1.4
	Average	-2.7	-0.3	2.7	4.1	4.2	6.0	3.1	1.8	3.5	-3.1	-3.9	4.0
I	Maximum	2.5	6.4	6.2	6.0	8.2	6.2	4.0	2.8	4.3	3.9	2.5	6.7
	Minimum	-2.7	-3.0	-7.2	-8.7	-5.0	-1.0	-8.3	-6.7	-6.6	-12.9	-13.0	-4.3
	Average	0.7	3.7	-1.4	-2.3	4.2	1.9	-3.0	-2.2	-3.5	-7.3	-6.3	1.9
MAIN	Maximum	2.7	5.4	2.6	5.7	6.9	*	-6.9	-2.5	-5.6	-7.4	1.6	-1.0
	Minimum	-32.6	-29.7	-33.4	-30.9	-33.0	*	-30.7	-35.2	-39.6	-60.6	-34.9	-39.7
	Average	-16.9	-18.3	-14.8	-17.9	-17.1	*	-19.8	-19.6	-23.9	-34.9	-17.8	-23.1

* NO DATA

DATA FOR MAIN ZONE, SPRING 2005 TAKEN OCT .2005
 DATA FOR MAIN ZONE, SPRING 2003 TAKEN JULY.2003

FIGURE 5a RECENT ZONE WEST OF THE SAN GABRIEL RIVER

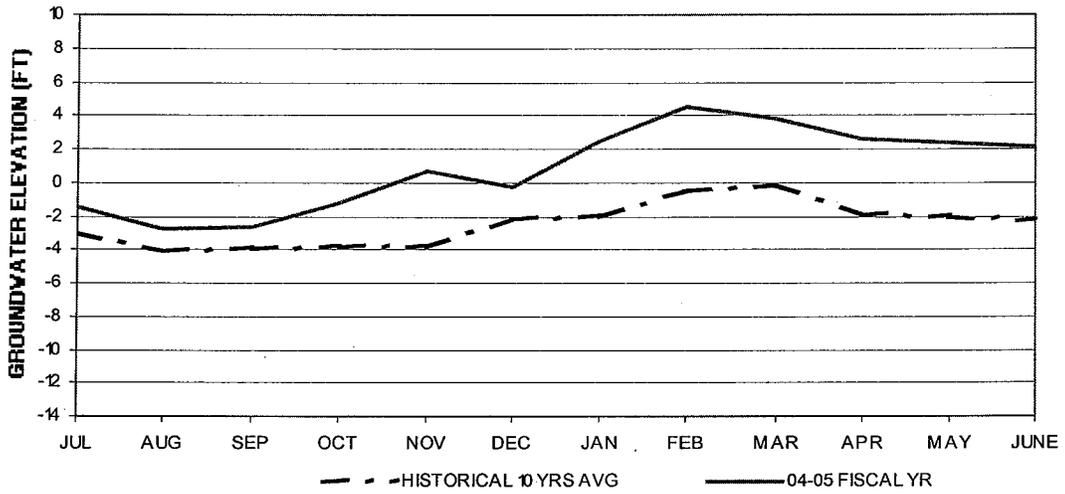
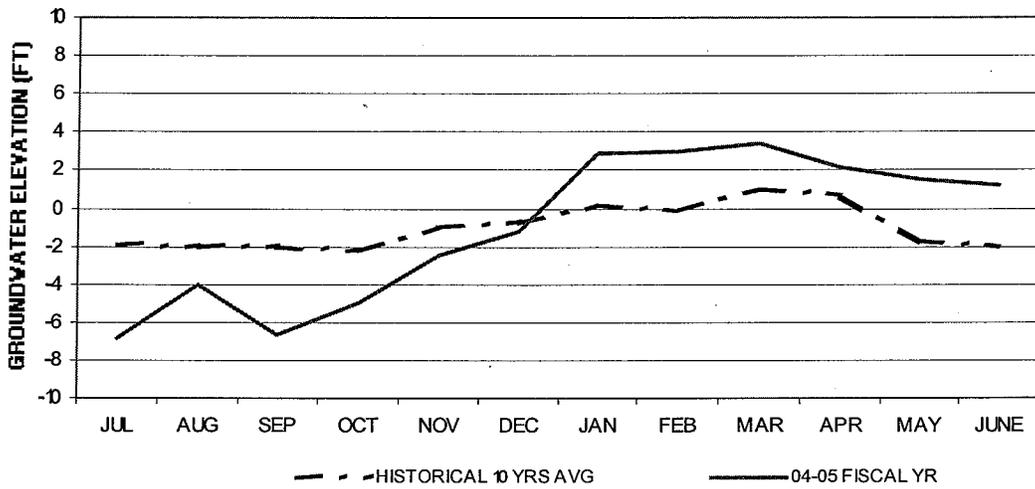
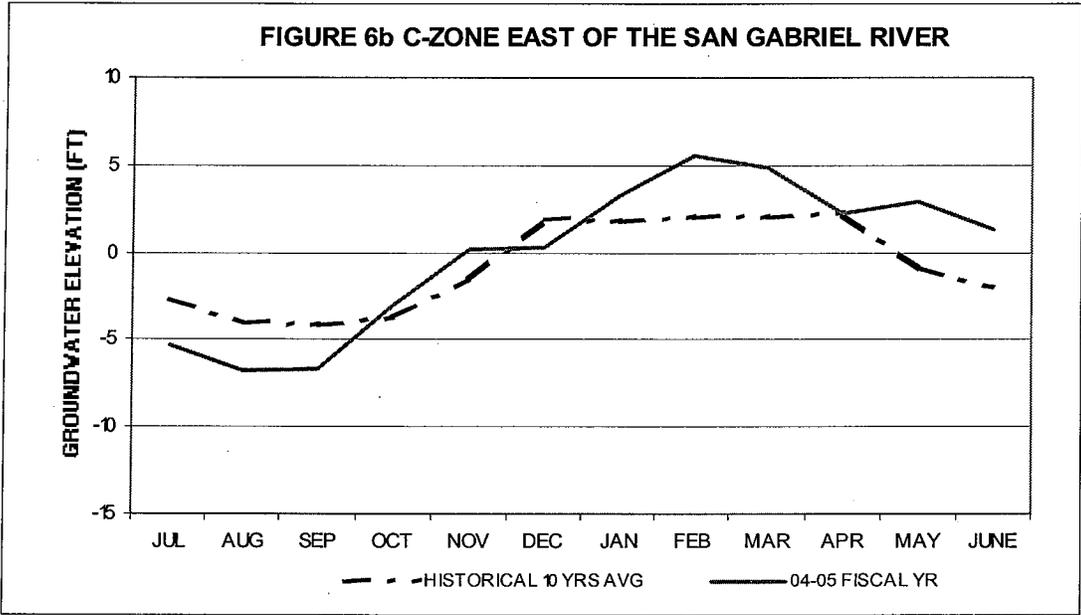
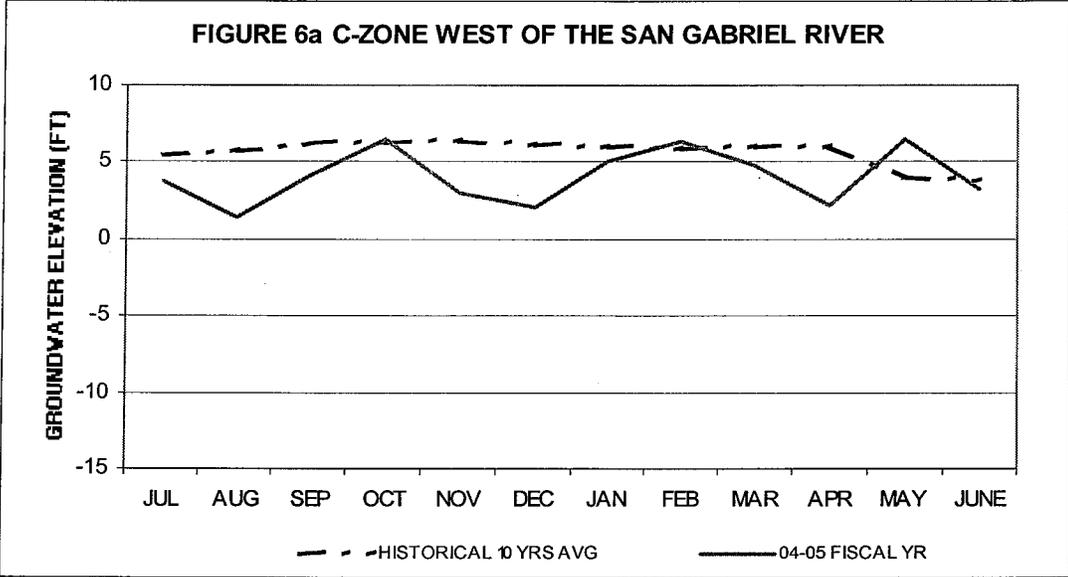
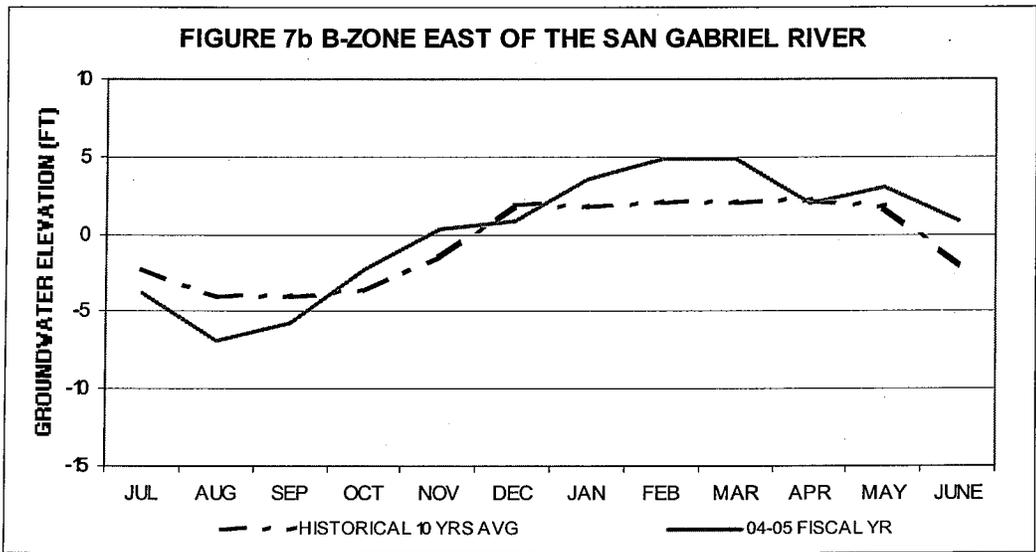
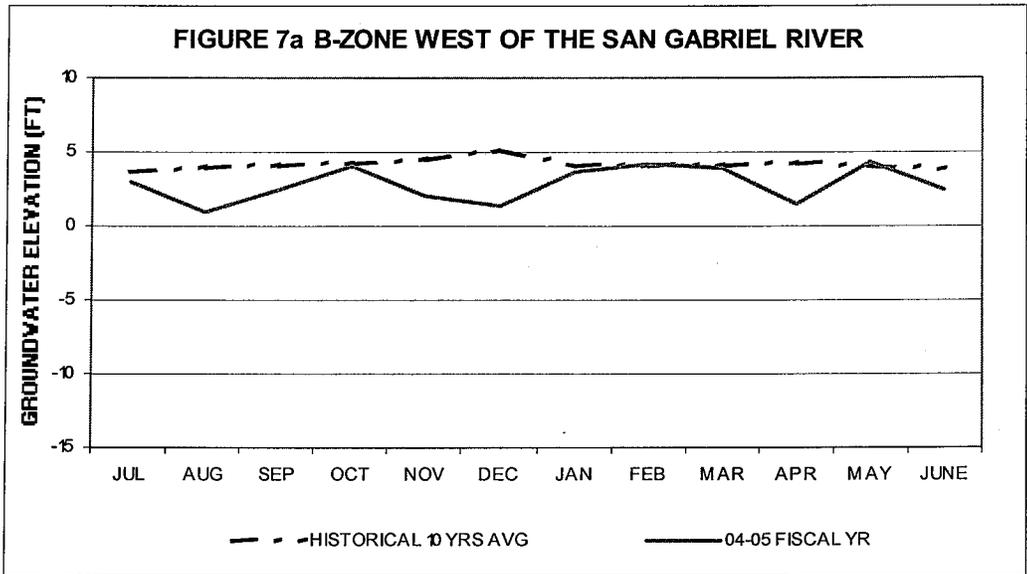


FIGURE 5b RECENT ZONE EAST OF THE SAN GABRIEL RIVER







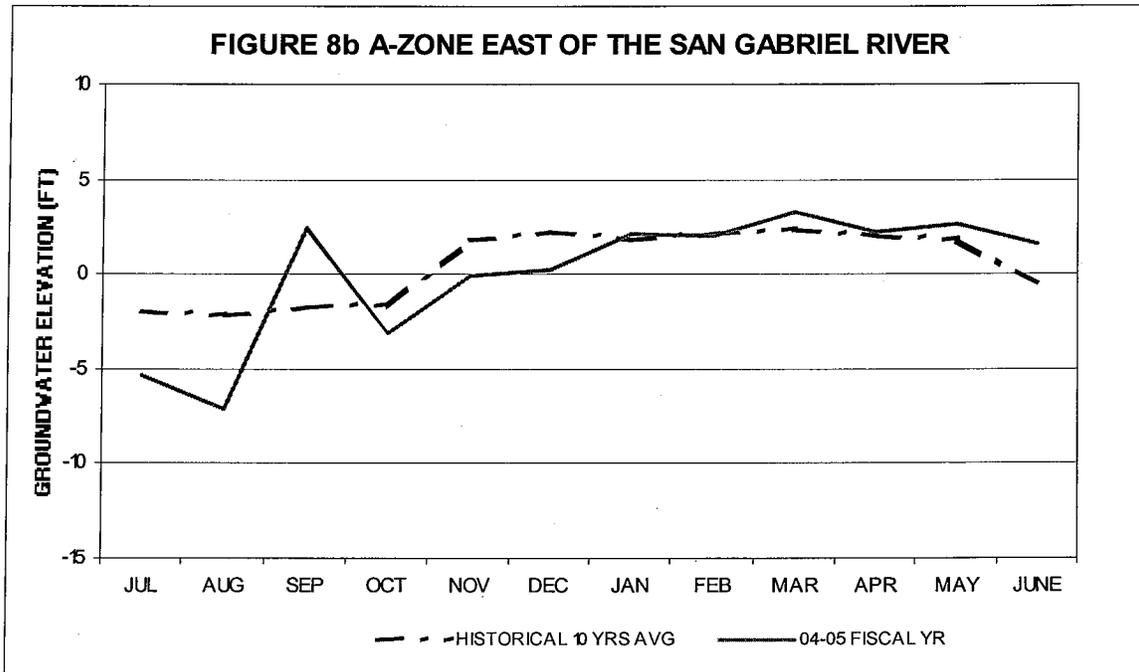
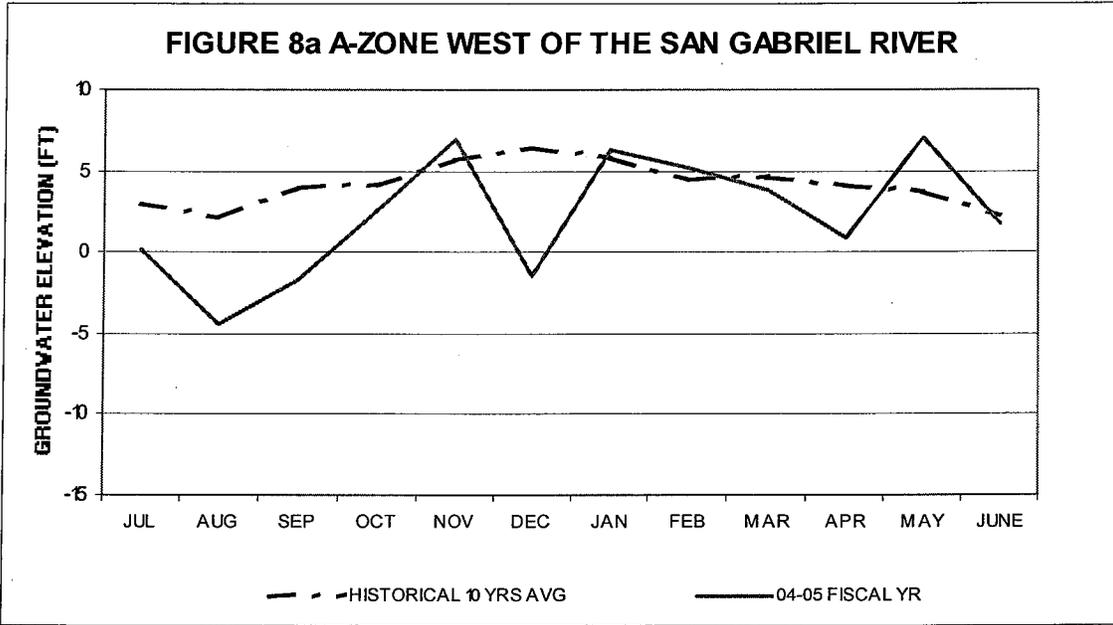


FIGURE 9a I-ZONE WEST OF THE SAN GABRIEL RIVER

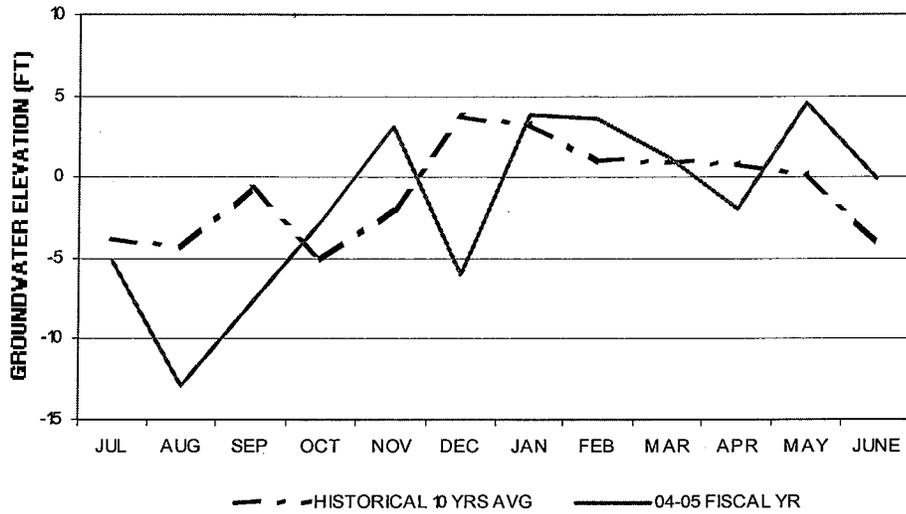
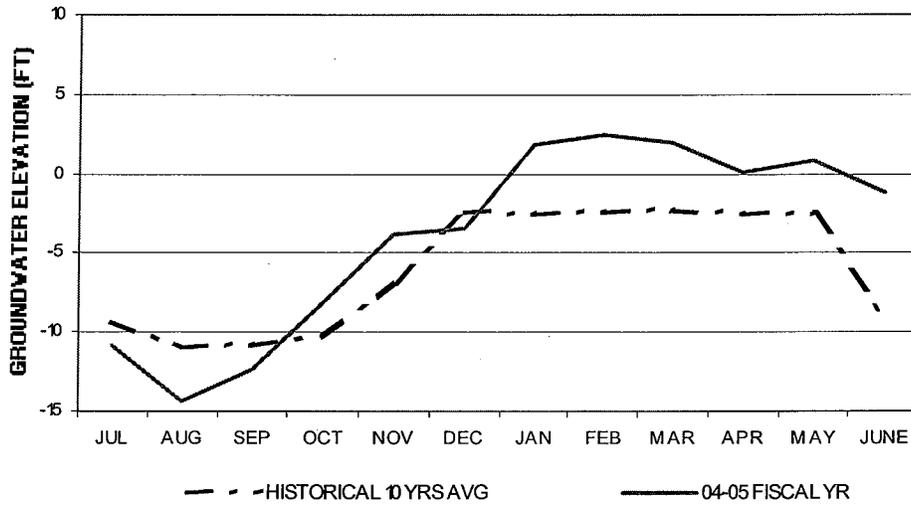


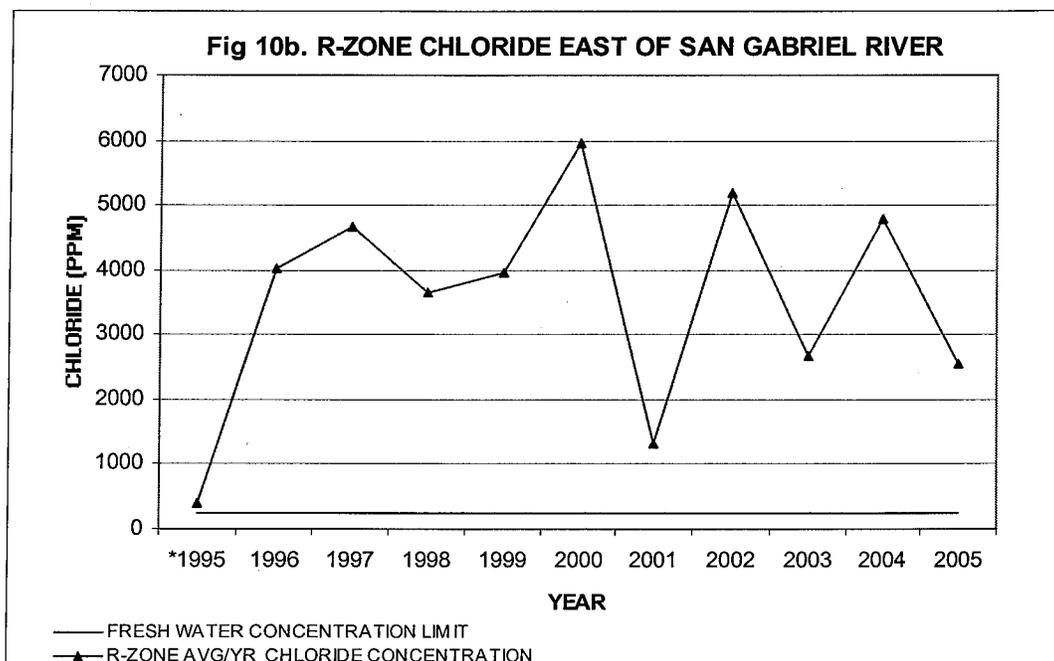
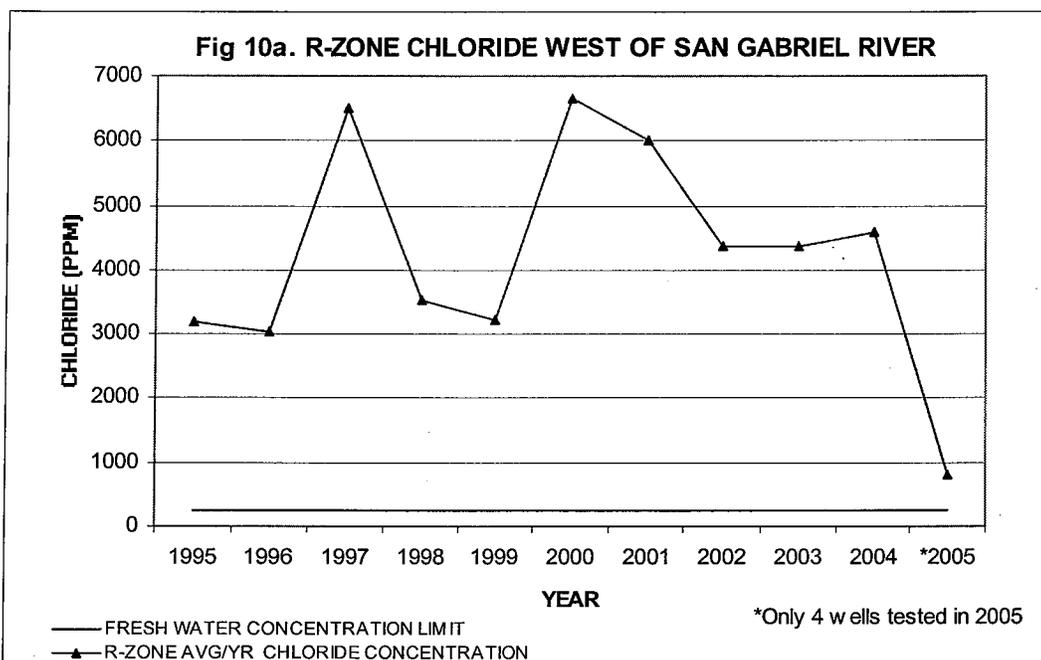
FIGURE 9b I-ZONE EAST OF THE SAN GABRIEL RIVER

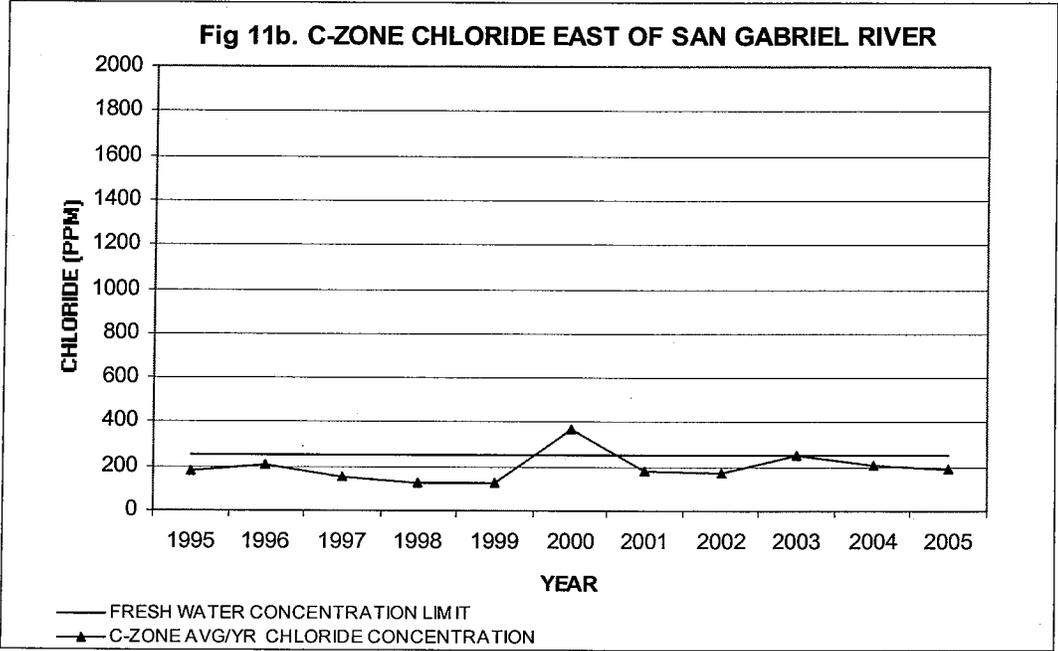
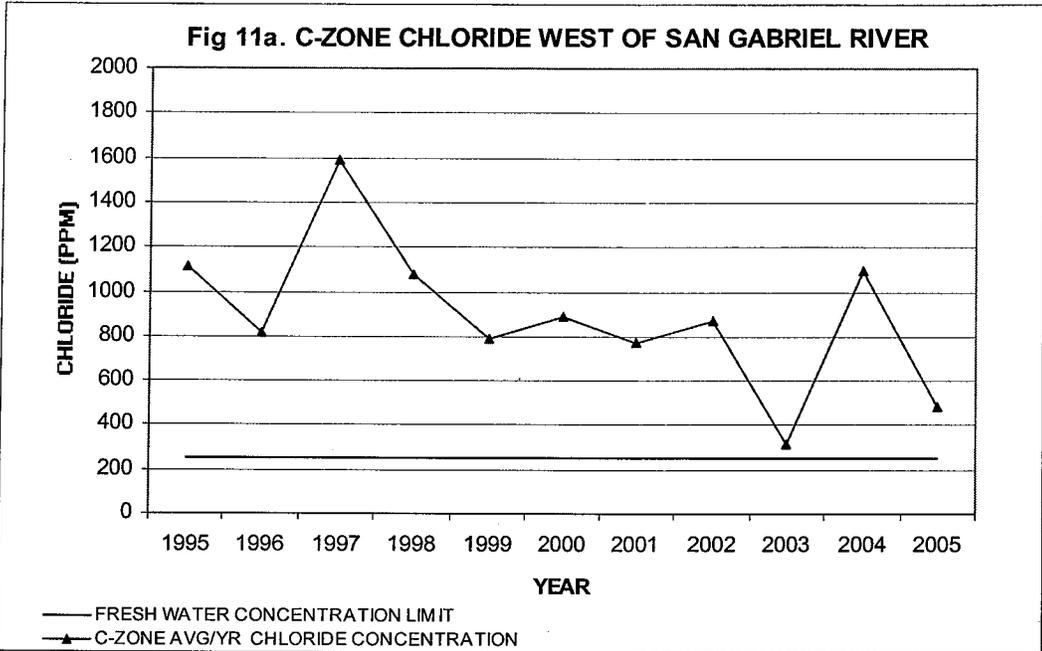


CHLORIDES

Using the data collected during June and July 2005, chloride contour maps for the R, C, B, A, and I Zones have been prepared as presented in the Appendix (Figures A-7, A-8, A-9, A-10, and A-11, respectively). The chloride contour maps for this reporting period are based on the highest chloride ion concentration (in mg/L) measured at each observation well. Chloride data were gathered within the immediate vicinity of the barrier and do not represent basin-wide conditions for the groundwater basin protected by the barrier. Wells with chloride concentrations of 250 mg/L or less are considered fresh. The majority of chloride measurements reported this period were taken in June 2005. However, a few data points from Fiscal Year 2005-06 (July 2005) were included. The incorporation of these points allowed for only a two-month data spread and more consistent data contours compared to the only available Fiscal Year 2004-05 data (July 2004) which would have created an 11-month spread. Additionally, some chloride data was not available for certain wells seaward and northward of the barrier. As a result, the most recent data available from 2003 and 2004 was substituted to complete the contours in those regions.

Historical seawater intrusion (based on average chloride concentrations) in the individual aquifer zones is summarized below in Figures 10a through 14b. Two sets of graphs were created for each aquifer to account for changes in chloride concentrations in the areas west and east of San Gabriel River, respectively.





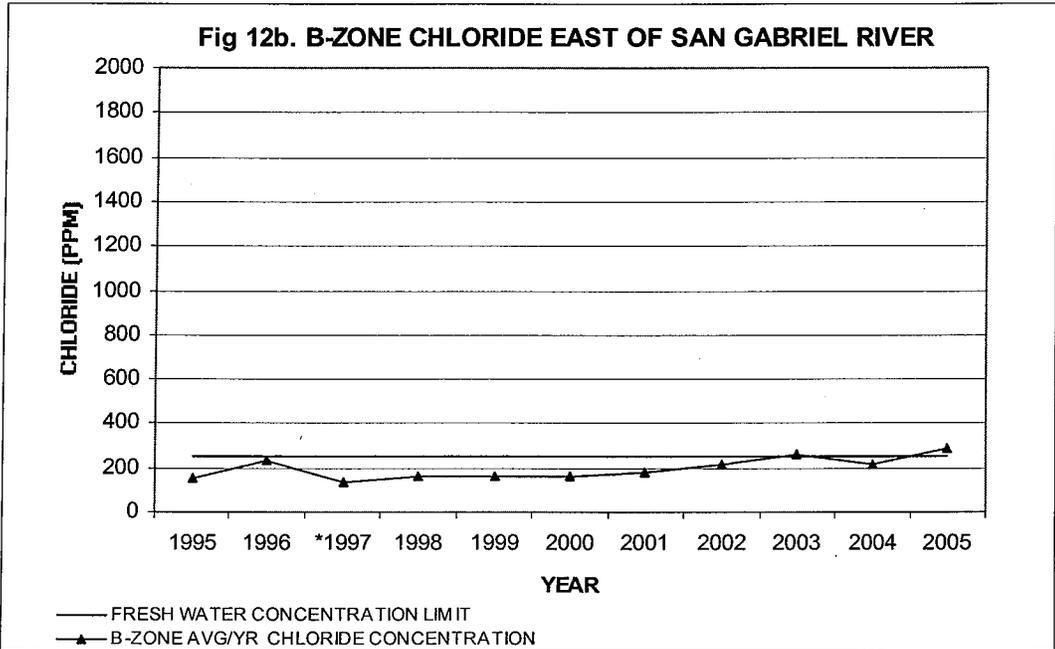
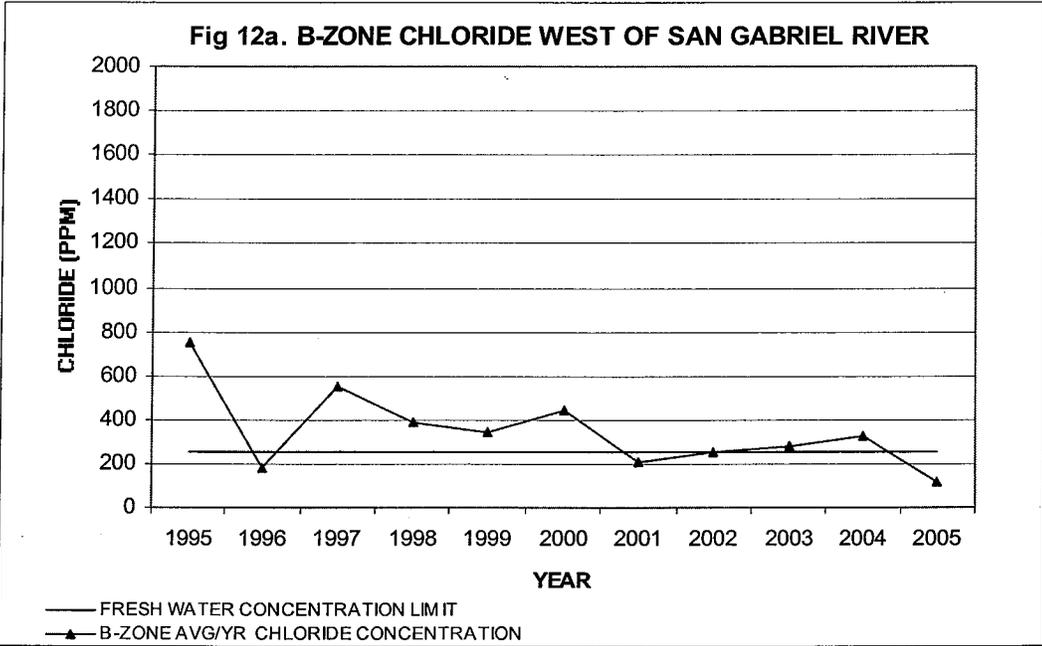


Fig 13a. A-ZONE CHLORIDE WEST OF SAN GABRIEL RIVER

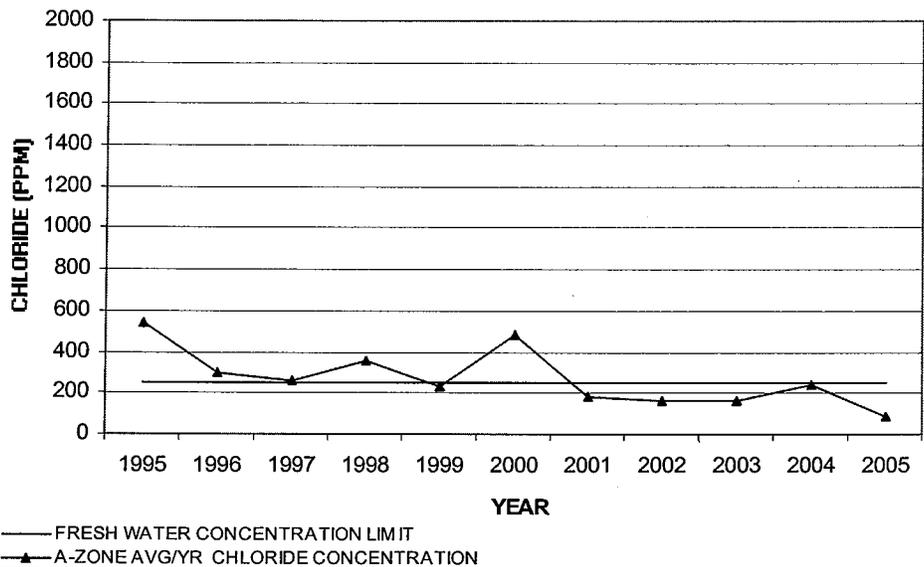
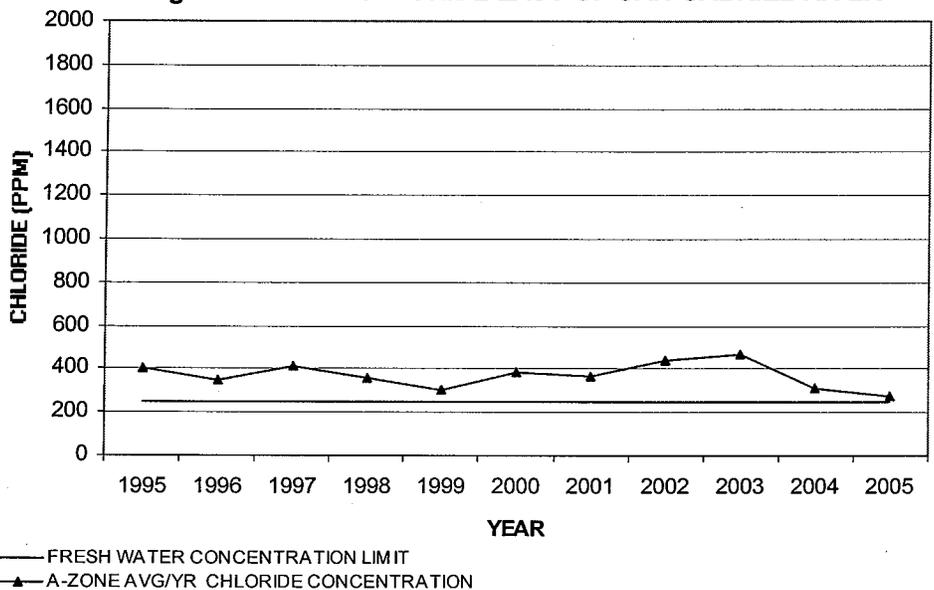
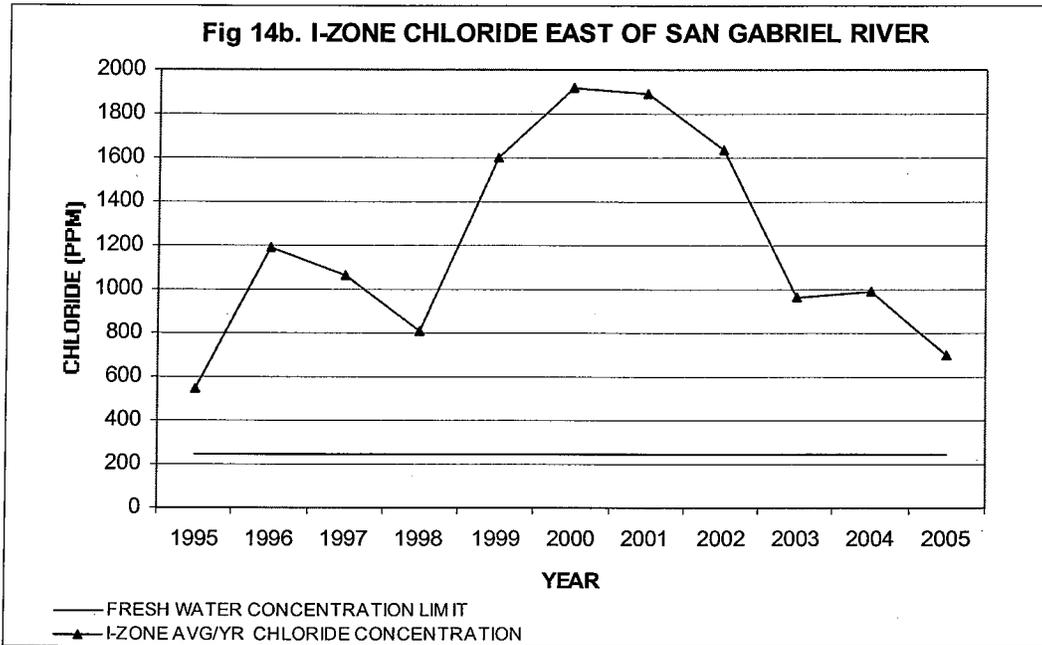
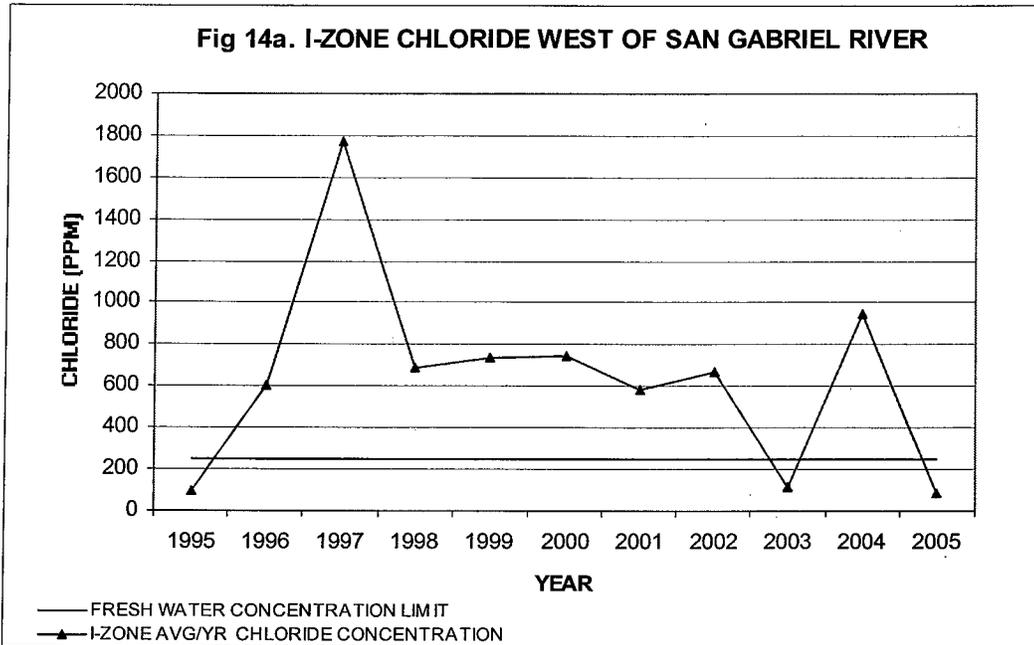


Fig 13b. A-ZONE CHLORIDE EAST OF SAN GABRIEL RIVER





FINANCING AND COSTS

This section of the report is divided into three parts: Water Costs, Services and Supplies Costs (operation and maintenance), and Fixed Assets Costs (capital outlay). Under the terms of the Cooperative Agreement, fixed assets are divided into facilities paid for by the Los Angeles County Flood Control District, facilities paid for by the Orange County Water District, and joint facilities paid for by both agencies.

WATER COSTS

During the 2004-05 fiscal year, 5,066 acre-feet of water were injected at a total cost of \$2,182,158. The water rates from July 2004 to June 2005 varied monthly depending on the periods which are shown in Table 1. The monthly quantity of water injected and the water costs paid by the respective agencies are shown in Table 4.

TABLE 4. QUANTITY OF WATER INJECTED AND COSTS

MONTH	WATER REPLENISHMENT DISTRICT (AF)	ORANGE COUNTY WATER DISTRICT (AF)	TOTAL (AF)
Jul-04	330.8	179.6	510.4
Aug-04	330.3	188.7	519.0
Sep-04	374.8	182.9	557.7
Oct-04	354.9	176.0	530.9
Nov-04	316.5	180.1	496.6
Dec-04	236.8	197.8	434.6
Jan-05	262.9	186.1	449.0
Feb-05	210.7	158.9	369.6
Mar-05	160.8	152.6	313.4
Apr-05	120.8	114.2	235.0
May-05	275.4	123.9	399.3
Jun-05	176.1	74.5	250.6
TOTAL	3150.8	1915.3	5066.1
COST	\$1,356,383.4	\$825,774.4	\$2,182,157.8

SERVICES AND SUPPLIES COSTS

A total of \$921,063 was expended on services and supplies during the 2004-05 fiscal year (not including liability insurance and water costs). Of this total, \$3,043 was charged to extraction well maintenance. Pursuant to the Cooperative Agreement, the Orange County Water District pays a percentage of the services and supplies costs for injection operations proportional to the percentage of the total amount of injection water paid for by the District. The distribution of 2004-05 services and supplies costs for injections are summarized in Table 5:

**TABLE 5. DISTRIBUTION OF SERVICES AND SUPPLIES COSTS FOR
INJECTION AND EXTRACTION ACTIVITIES**

ITEM	LOS ANGELES COUNTY	ORANGE COUNTY	TOTAL
Operation and Maintenance of Injection Facilities	\$518,937	\$302,158	\$821,095
Operation and Maintenance of Extraction Facilities	\$3,043	\$0	\$3,043
Special Programs	\$96,925	\$0	\$96,925
SUBTOTAL	\$618,905	\$302,158	\$921,063
Liability Insurance	\$6,015	\$6,015	\$12,029
TOTAL	<u>\$624,920</u>	<u>\$308,172</u>	<u>\$933,092</u>

The costs of the services and supplies for injection operations for past years, excluding water costs, are shown on the following page in Table 6.

TABLE 6. COSTS OF SERVICES AND SUPPLIES FOR INJECTION

Fiscal Year	Volume of Water Injected (Ac-Ft)	Total Cost	Cost Per Ac-Ft Injected
1965-66	4,076.30	\$171,888	\$42.17
1966-67	3,647.10	\$159,711	\$43.79
1967-68	4,530.90	\$210,115	\$46.37
1968-69	5,530.90	\$160,983	\$29.11
1969-70	4,605.90	\$131,929	\$28.64
1970-71	4,185.50	\$136,937	\$32.72
1971-72	4,820.60	\$138,043	\$28.64
1972-73	4,999.60	\$105,883	\$21.18
1973-74	6,893.90	\$181,518	\$26.33
1974-75	5,926.60	\$201,183	\$33.95
1975-76	4,744.50	\$213,504	\$45.00
1976-77	5,233.10	\$279,440	\$53.40
1977-78	5,017.50	\$225,982	\$45.04
1978-79	5,070.80	\$233,358	\$46.02
1979-80	4,842.30	\$252,359	\$52.12
1980-81	4,107.30	\$319,641	\$77.82
1981-82	4,858.90	\$436,558	\$89.85
1982-83	5,197.70	\$403,241	\$77.58
1983-84	4,024.00	\$489,302	\$121.60
1984-85	4,724.40	\$457,116	\$96.76
1985-86	4,609.90	\$427,278	\$92.69
1986-87	6,958.30	\$433,325	\$62.27
1987-88	6,537.80	\$441,706	\$67.56
1988-89	5,599.30	\$723,965	\$129.30
1989-90	5,755.80	\$515,964	\$89.64
1990-91	6,167.70	\$464,584	\$75.33
1991-92	5,757.50	\$865,016	\$150.24
1992-93	5,240.80	\$692,864	\$132.21
1993-94	4,144.80	\$584,975	\$141.13
1994-95	3,495.70	\$651,845	\$186.47
1995-96	5,269.00	\$509,377	\$96.67
1996-97	5,739.40	\$408,064	\$71.10
1997-98	5,335.80	\$923,342	\$173.05
1998-99	5,330.40	\$795,044	\$149.15
1999-00	6,077.90	\$589,168	\$96.94
2000-01	5,398.80	\$961,649	\$178.12
2001-02	6,061.70	\$713,299	\$117.67
2002-03	5,012.30	\$1,555,921	\$310.42
2003-04	5,879.70	\$730,652	\$124.27
2004-05	5,066.10	\$918,020	\$181.21

The costs of the services and supplies for extraction operations for past years, including electrical costs, are shown in Table 7.

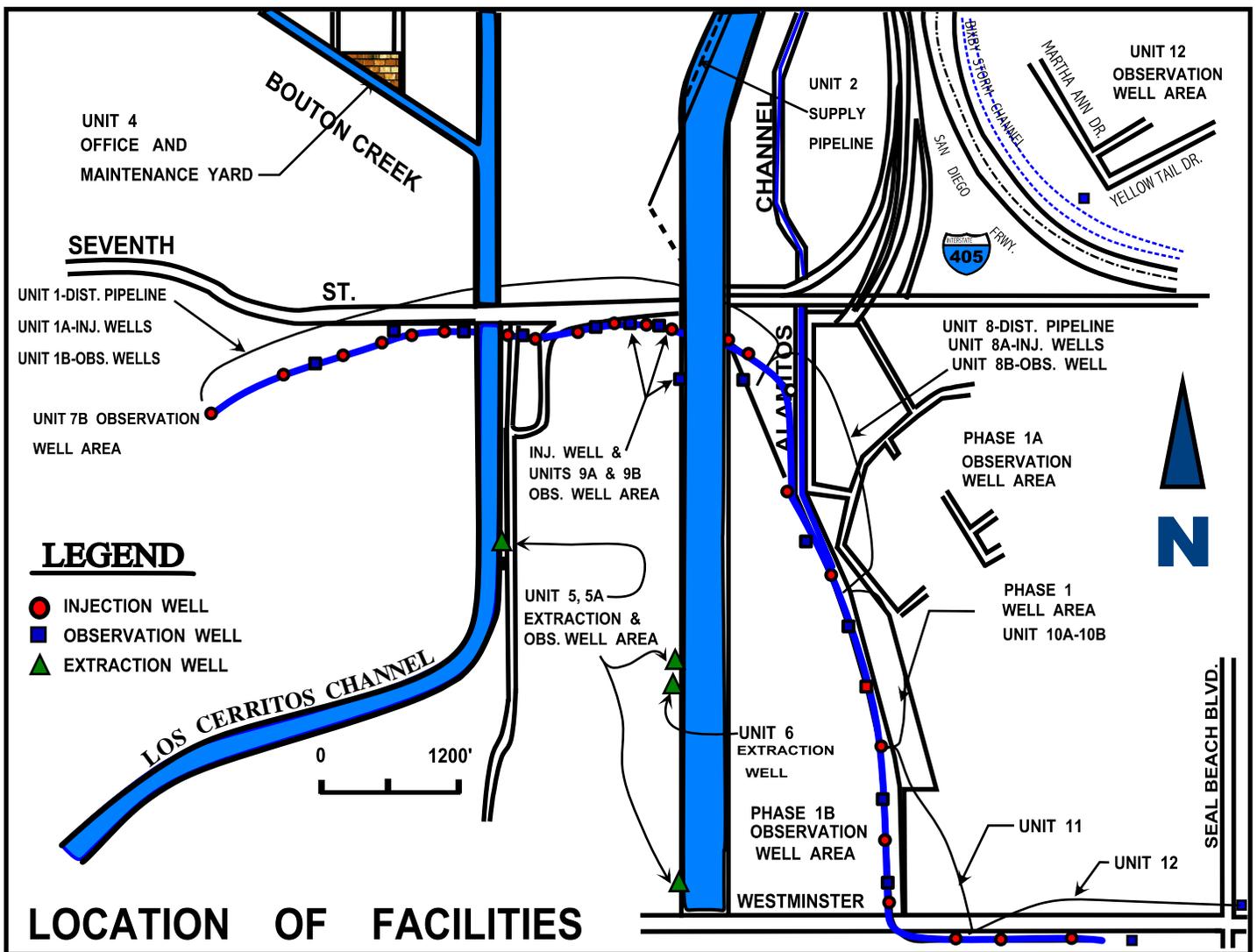
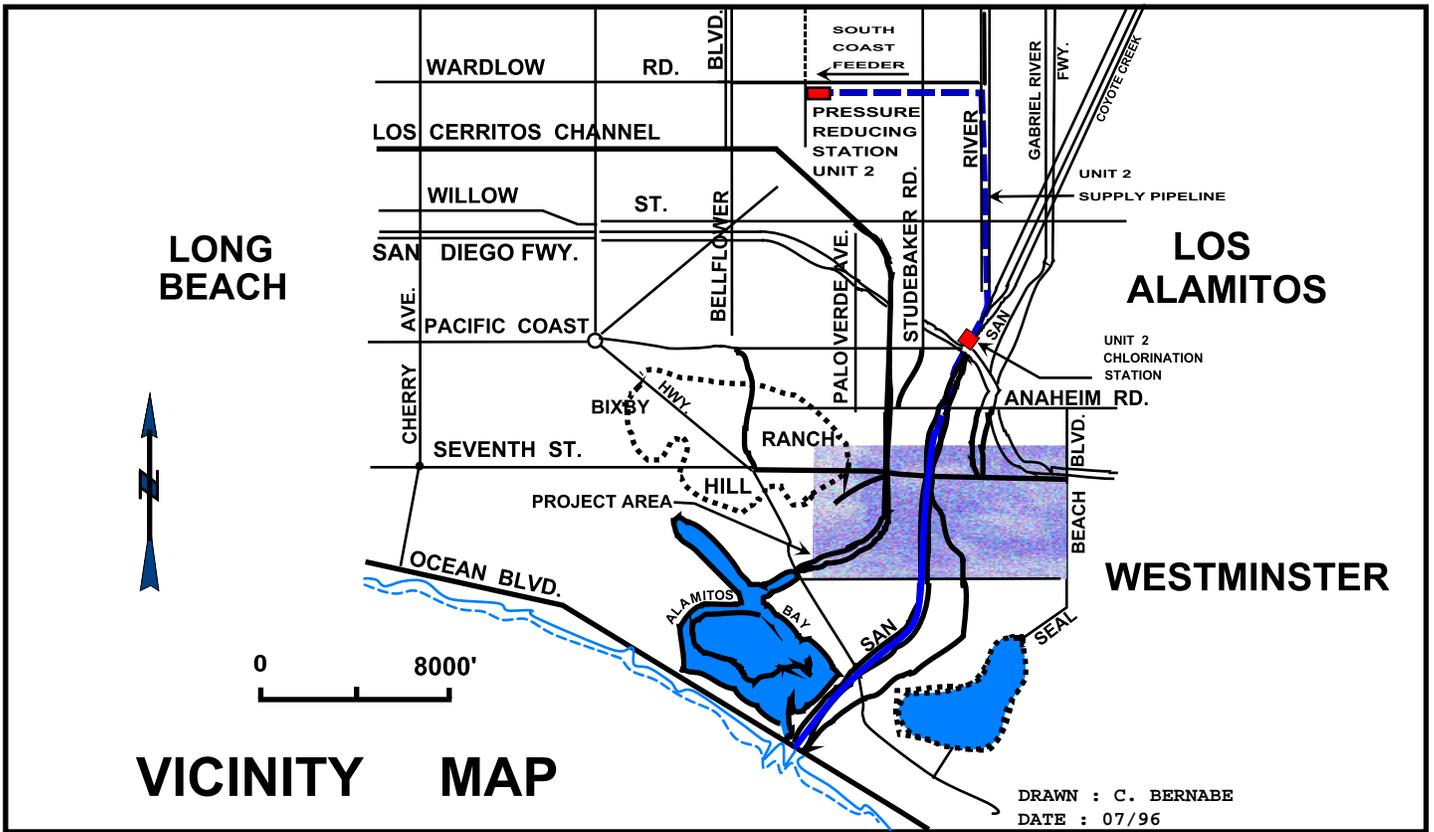
TABLE 7. COSTS OF SERVICES AND SUPPLIES FOR EXTRACTION

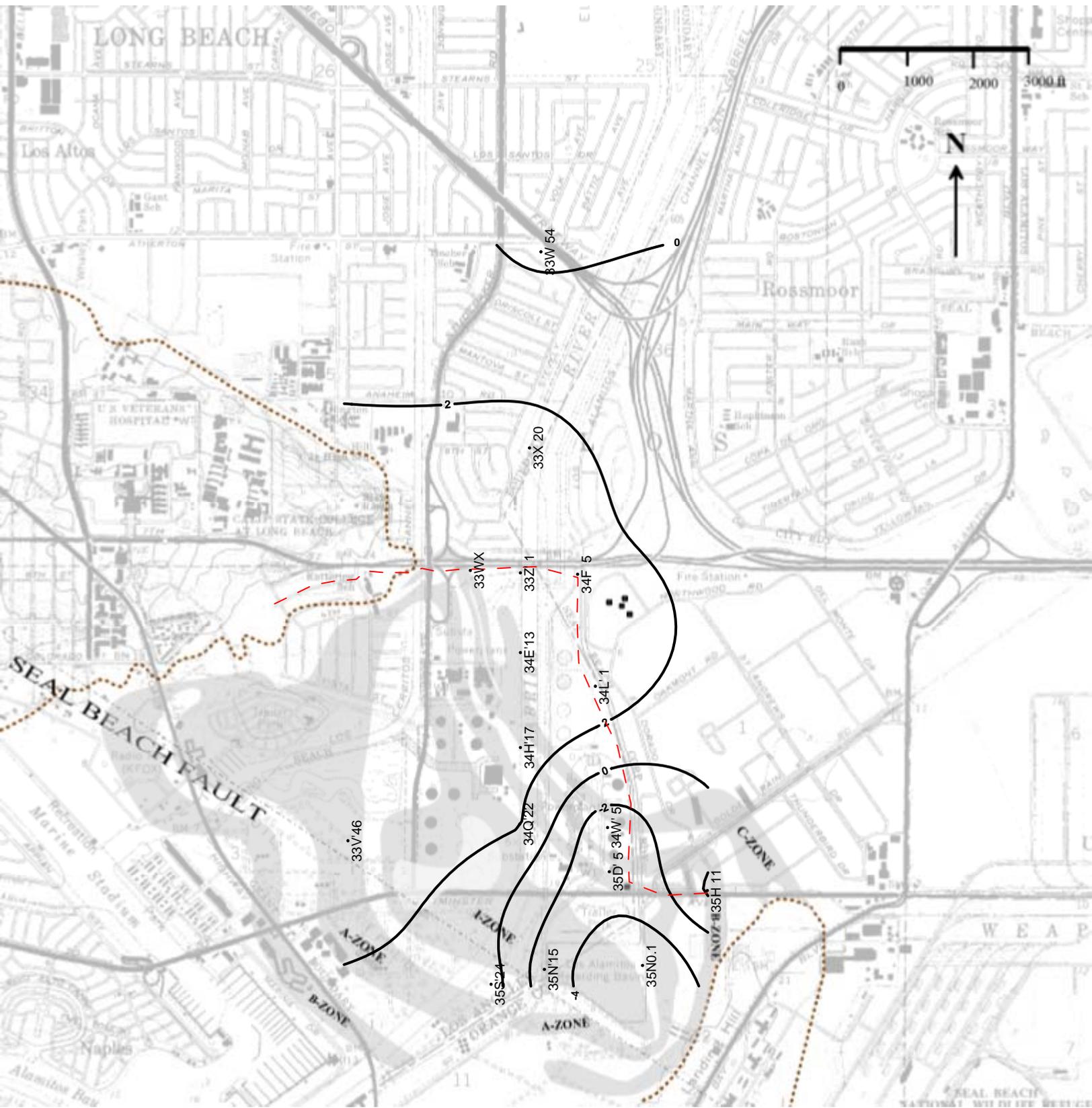
Fiscal Year	Volume of Water Extracted (Ac-Ft)	Total Cost	Cost Per Ac-Ft Extracted
1965-66	2,429.30	\$33,654	\$13.85
1966-67	2,215.40	\$48,594	\$21.93
1967-68	1,748.60	\$57,451	\$32.86
1968-69	1,832.80	\$50,658	\$27.64
1969-70	1,615.70	\$39,862	\$24.67
1970-71	1,420.50	\$32,963	\$23.21
1971-72	1,407.30	\$23,719	\$16.85
1972-73	1,078.60	\$14,189	\$13.16
1973-74	843.90	\$36,209	\$42.91
1974-75	133.50	\$93,303	\$698.90
1975-76	1,134.50	\$84,837	\$74.78
1976-77	1,283.40	\$85,199	\$66.39
1977-78	1,363.90	\$84,029	\$61.61
1978-79	1,326.60	\$53,744	\$40.51
1979-80	1,215.70	\$34,737	\$28.57
1980-81	722.60	\$79,540	\$110.07
1981-82	686.60	\$97,808	\$142.45
1982-83	962.30	\$90,630	\$94.18
1983-84	1,466.60	\$64,734	\$44.14
1984-85	1,621.30	\$105,058	\$64.80
1985-86	1,640.30	\$92,586	\$56.44
1986-87	1,700.70	\$84,447	\$49.65
1987-88	1,513.90	\$71,700	\$47.36
1988-89	1,522.40	\$99,315	\$65.24
1989-90	1,544.80	\$66,717	\$43.19
1990-91	1,278.00	\$172,230	\$134.77
1991-92	1,378.40	\$151,520	\$109.92
1992-93	1,136.10	\$99,099	\$87.23
1993-94	992.00	\$169,621	\$170.99
1994-95	940.70	\$148,122	\$157.46
1995-96	998.40	\$130,901	\$131.11
1996-97	1,200.90	\$51,077	\$42.53
1997-98	883.50	\$64,774	\$73.32
1998-99	775.60	\$52,043	\$67.10
1999-00	679.90	\$41,320	\$60.77
2000-01	404.80	\$49,769	\$122.95
2001-02	495.00	\$53,153	\$107.38
2002-03	262.70	\$63,165	\$240.45
2003-04	0.00	\$6,068	N/A
2004-05	0.00	\$3,043	N/A

HYDROELECTRIC REVENUES

No hydroelectric power was generated at the water supply pressure regulation station during the 2004-05 fiscal year.

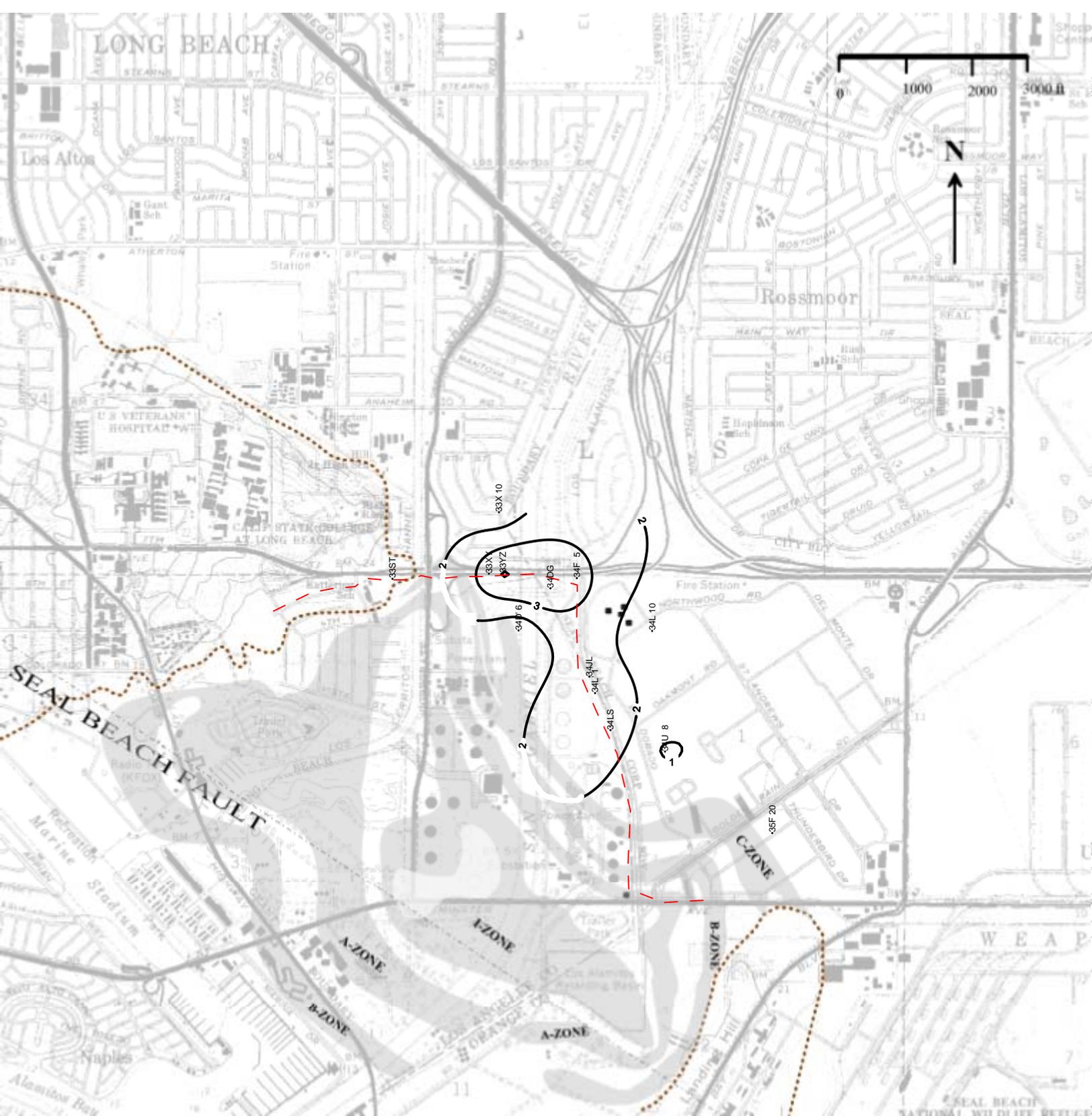
The hydroelectric plant has long been out of service and is currently being decommissioned as part of the pressure regulation vault renovation project.





Alamitos Barrier Project
 Groundwater Elevation (ft) Contours
 R-Zone
 April 2005

- Recent Zone Boundary
- Recent Zone Mergence
Barrier Alignment
- Extrapolated Groundwater Elevation
Groundwater Elevation



Alamitos Barrier Project

Groundwater Elevation (ft) Contours

C-Zone

April 2005

-  Recent Zone Boundary
-  Recent Zone Merge
-  Barrier Alignment
-  Extrapolated Groundwater Elevation
-  Groundwater Elevation



Alamitos Barrier Project
 Groundwater Elevation (ft) Contours
 B-Zone
 April 2005

- Recent Zone Boundary
- Recent Zone Mergence
- Barrier Alignment
- Extrapolated Groundwater Elevation
- Groundwater Elevation



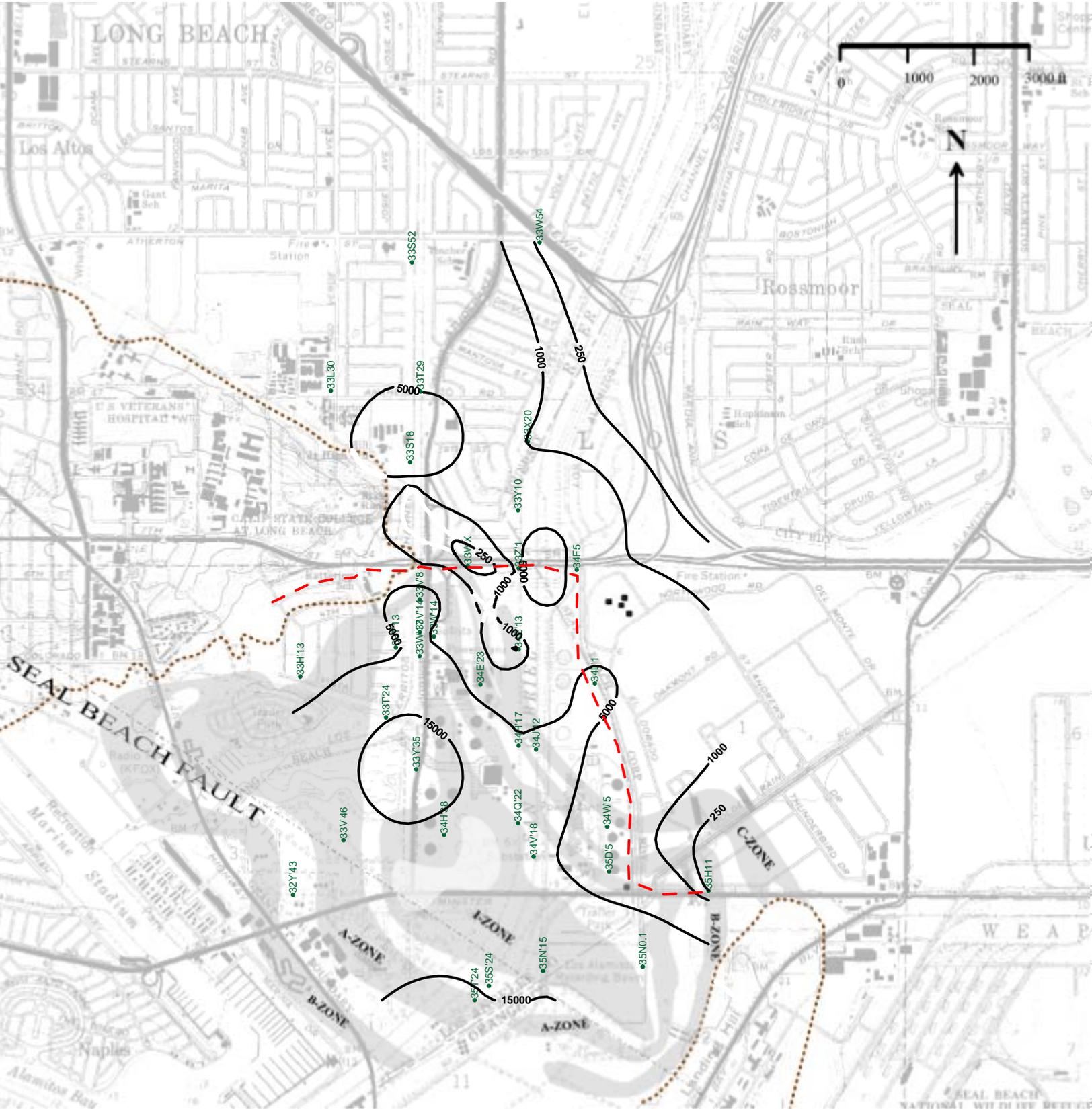
Alamitos Barrier Project
 Groundwater Elevation (ft) Contours
 A-Zone
 April 2005

-  Recent Zone Boundary
-  Recent Zone Mergence
-  Barrier Alignment
-  Extrapolated Groundwater Elevation
-  Groundwater Elevation



Alamitos Barrier Project
 Groundwater Elevation (ft) Contours
 I-Zone
 April 2005

-  Recent Zone Boundary
-  Recent Zone Mergence
-  Barrier Alignment
-  Extrapolated Groundwater Elevation
-  Groundwater Elevation



Alamitos Barrier Project

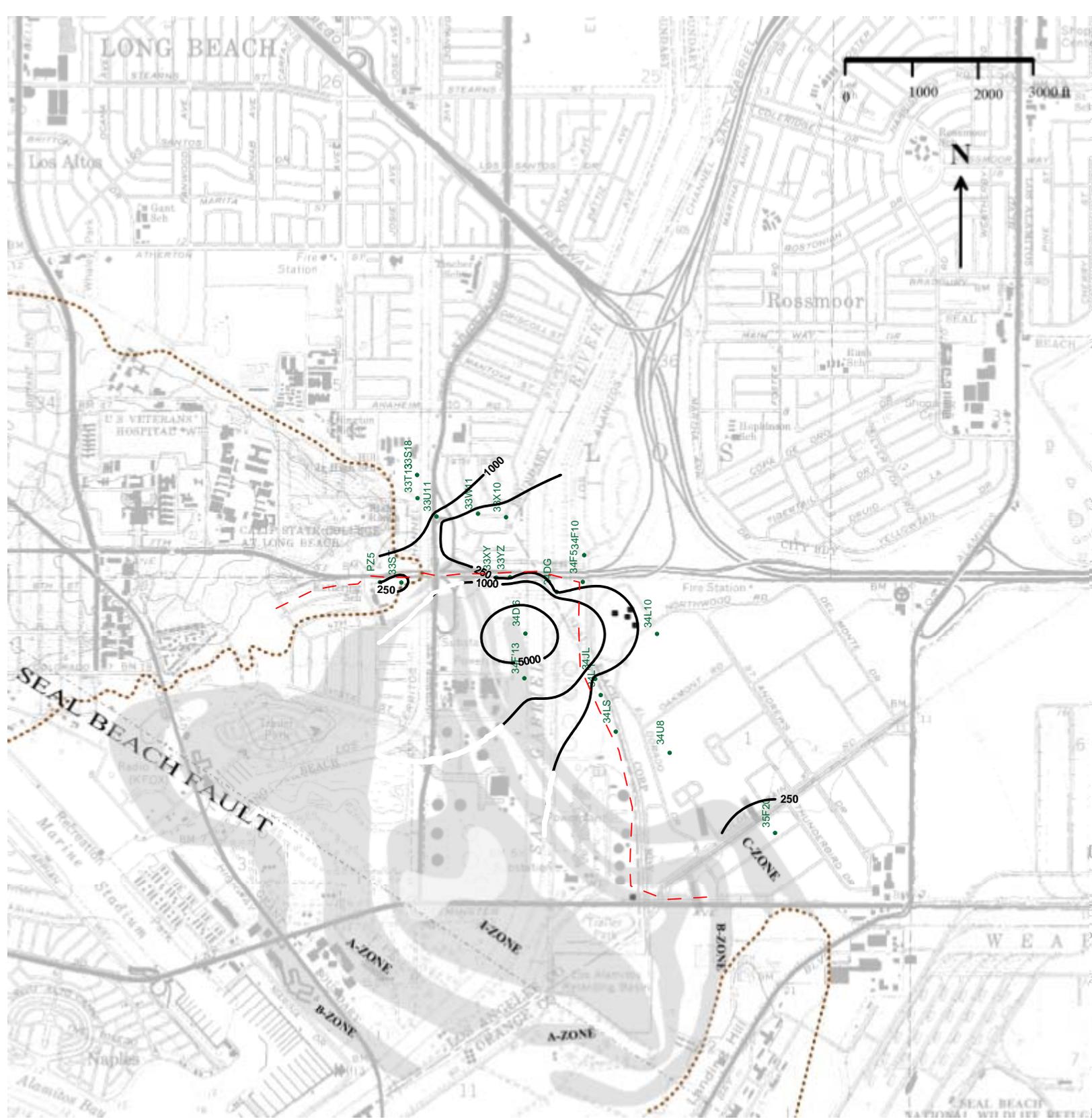
Chloride Concentration (mg/L) Contours

R-Zone

June and July 2005*

-  Recent Zone Boundary
-  Recent Zone Mergence
-  Barrier Alignment
-  Extrapolated Chloride Concentration
-  Chloride Concentration

* No FY04-05 data available for many wells seaward and north of barrier. Data from 2003 and 2004 substituted to complete contours.



Alamitos Barrier Project

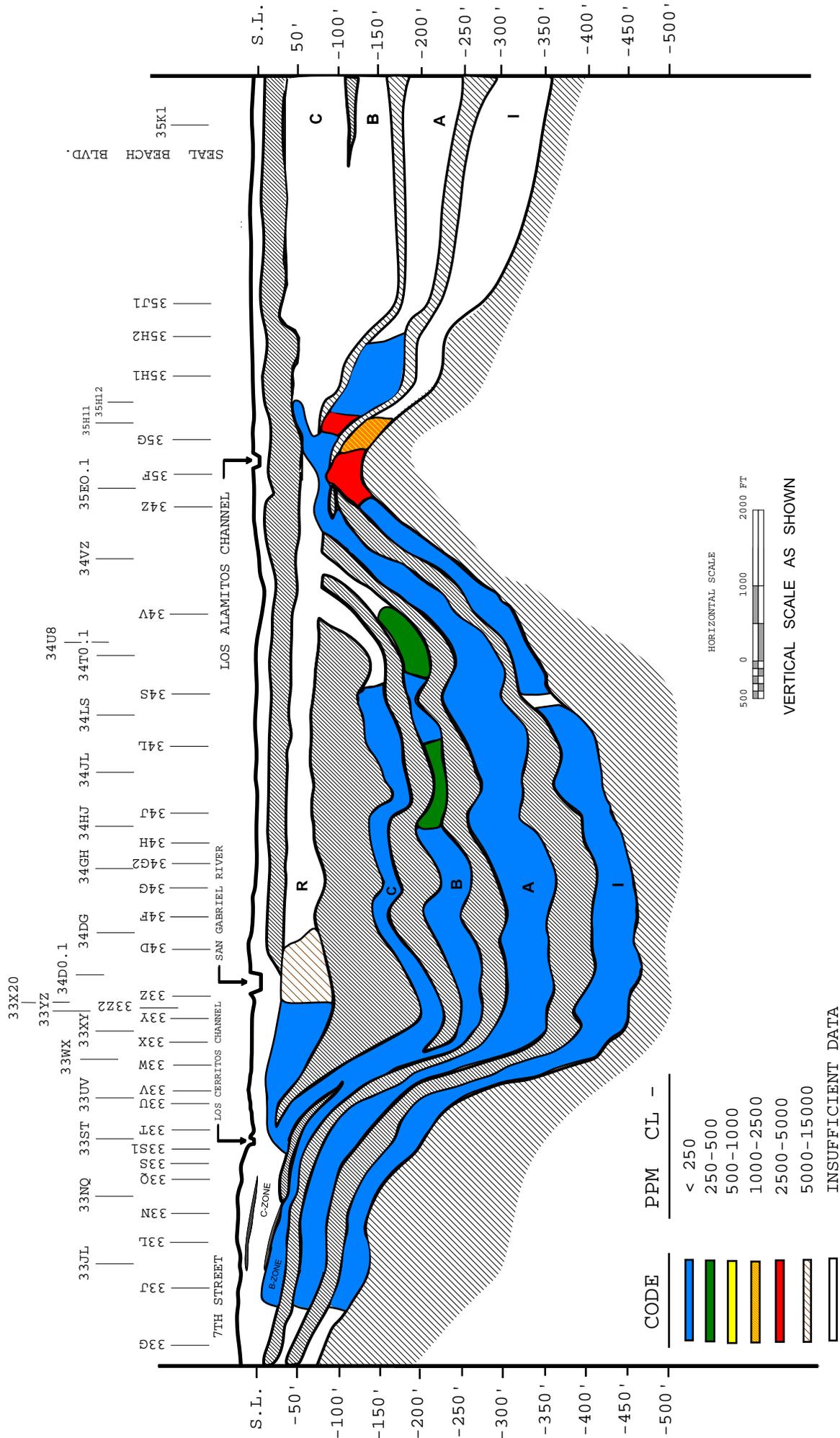
Chloride Concentration (mg/L) Contours

C-Zone

June and July 2005*

- Recent Zone Boundary
- Recent Zone Mergence
- Barrier Alignment
- Extrapolated Chloride Concentration
- Chloride Concentration

* No FY04-05 data available for many wells seaward and north of barrier. Data from 2003 and 2004 substituted to complete contours.



CHLORIDE SECTION ALONG THE BARRIER

June 2005

