Alamitos Barrier Project

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Annual report on the control of seawater intrusion

2017 - 2018

Member Agencies:

Orange County Water District

Water Replenishment District of Southern California

Long Beach Water Department

Golden State Water Company

Los Angeles County Flood Control District

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Joint Management Committee

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INTRODUCTION

The Alamitos Barrier Project (ABP) was designed and constructed to protect the groundwater supplies of the Central/Orange County Basin of the Coastal Plain from the intrusion of seawater through the Alamitos Gap area. The project facilities are located near the Los Angeles-Orange County border about two miles inland from the terminus of the San Gabriel River. The original facilities included injection wells to form a freshwater pressure ridge and extraction wells to form a saltwater trough. The freshwater pressure ridge has proven to be historically effective, whereas the saltwater trough has not. As a result, the extraction wells are currently not in operation. A map showing the supply pipeline, injection wells, extraction wells, and observation wells is shown on page A-12.1.

Los Angeles County Public Works (Public Works) operates and maintains the ABP and its associated facilities under the direction and approval of the Joint Management Committee (JMC), acting on behalf of the Los Angeles County Flood Control District (LACFCD) and the Orange County Water District (OCWD).

This report summarizes design and construction issues, operation and maintenance activities, hydrogeologic effects, chloride concentrations, and project costs for Fiscal Year (FY) 2017-18 (i.e., July 1, 2017 through June 30, 2018).

SUMMARY

During FY 2017-18, a total of 4,414.1 acre-feet (AF) of water was injected into the ABP (an average rate of 6.1 cubic feet per second). Of that total, OCWD purchased 910.1 acre-feet (21 percent) and the Water Replenishment District of Southern California (WRD) purchased 3,504 acre-feet (79 percent). This total injected amount was 1,645.9 AF less than FY 2016-17, and was significantly lower than the average injection of 6,433 AF for the previous five fiscal years. However, even though a significant number of ABP injection wells were offline during this reporting period due to OCWD's ABP Unit 14 Injection and Observation Wells Project (ABP Unit 14 Project), injection rates at the remaining wells in service continued to be higher than average to counteract lower groundwater elevations, due to wells being offline. No major shutdowns have occurred since FY 2006-07. All minor shutdowns for FY 2017-18 are detailed in Appendix A-18.

The total costs associated with the ABP in FY 2017-18 are summarized below:

- Total Cost in FY 2017-18: $6,801,042
  - Injection Water costs: $4,583,182 (OCWD: $948,155; WRD: $3,635,027)
  - Total Operations and Maintenance Costs (not including liability): $2,139,958
    - Injection-related costs: $2,138,420 (OCWD: $440,515; LACFCD: $1,697,905)
      - Equivalent cost per AF of water injected: $484.45
    - Extraction-related costs: $1,538 (LACFCD only)
  - Liability Insurance cost: $77,902 (OCWD: $38,951; LACFCD: $38,951)

Overall, groundwater levels showed little change from the previous year with the exception of the portion along the Alamitos Channel, where localized decreases related to operational activities due to OCWD's ABP Unit 14 Project were observed. West of the San Gabriel River, chloride concentrations generally remained similar to the previous year. East of the San Gabriel River, chloride concentrations remained above 250 mg/L, with the exception of C-zone, which was slightly below 250 mg/L. This is most likely the result of a combination of factors, including higher groundwater levels in Fall and Winter

2017 related to OCWD's in-lieu program and the reduced injection along the eastern alignment between Phases I and II of OCWD's ABP Unit 14 Project. Detailed analyses of the reporting period's groundwater elevations and chloride concentrations are provided in the "Hydrogeologic Effects" and "Chlorides" sections of the report.

It is imperative that the barrier operate consistently and continuously to best prevent seawater intrusion. The JMC will continue to ensure that the ABP is operated and maintained efficiently, economically, and continuously protects the region's groundwater supplies. The inclusion of additional wells at the ABP Unit 14 Project will significantly aide in the protection of the region's groundwater resources.

PROJECTS AND STUDIES

Capital improvement projects and studies over this reporting period are briefly summarized below. The general location of each project is identified on the map in Appendix A-12.2 and further project details are included in Appendix A-17.

ABP Telemetry Upgrade

This project is funded by LACFCD, who hired Tetra Tech to prepare a design to upgrade the existing Geomation system with a state-of-the-art telemetry system that can be integrated with the existing Seawater Barrier Telemetry system. The ABP Telemetry Upgrade will also incorporate signals from injection well 33U3 which is not currently on telemetry. This project will help improve the overall efficiency of ABP operations by providing real-time data, including flow, pressure and vault flooded status. Construction began in March of 2017 and was completed in December 2017.

ABP Unit 14 Injection and Observation Wells

This project is jointly funded by OCWD and LACFCD and managed by OCWD. It consists of 17 new clustered injection wells, four nested observation wells and two shallow piezometers along the eastern alignment of the ABP. The new injection wells will provide additional capacity to maintain protective elevations along the eastern alignment of the ABP. The observation wells will fill data gaps in each of the aquifer zones and improve injection operations. Two injection wells and one nested observation well were installed between points B and C. OCWD re-advertised the project in August 2015 and awarded the contract for Phase 1, which includes the construction of injection and observation wells. Phase 1 construction concluded in June 2017. Phase 2, which involves equipping and connecting the injection wells to the ABP pipeline, construction of vaults, and installation of telemetry equipment, started in October 2017 and is scheduled to conclude in Fall of 2018.

ABP Unit 15 Injection and Observation Wells

During this reporting period, LACFCD prepared and submitted a concept proposal and application for grant funding available through State of California Proposition 1 Sustainable Groundwater Management funds for the following:

- Destroy injection well 33W and construct two replacement injection wells, 33W2(C,B) and 33W2(A,I) to provide additional operational flexibility.
- Destroy injection well 34F and construct replacement injection well 34F-A.
- Destroy nested injection wells 34H(A) and 34H(I) and construct two replacement wells 34H2-A and 34H2-I.
- Construct new internodal observation wells 34FG and 34GH2.

INJECTION OPERATIONS

The total amount of water injected into the ABP during FY 2017-18 was 4,414.1 AF. Of this total, approximately 9 percent (400.7 AF) was recycled water and 91 percent (4,013.4 AF) was imported water. The maximum monthly injection during this reporting period was 499.2 AF (100 percent imported) which occurred in August 2017. The minimum monthly injection of 263.4 AF (100 percent imported) occurred in February 2018 primarily due to seasonally high groundwater levels and decreased injection along the Los Alamitos Channel as part of OCWD's ABP Unit 14 Project.

The percentage of recycled water injection decreased considerably from the previous year primarily due to lack of source water to operate the Leo J. Vander Lans Advanced Water Treatment Facility (LVL AWTF). Since completion of the plant expansion in 2014, the LVL AWTF has operated intermittently between 3 and 4 million gallons per day (MGD). Further details regarding LVL operations can be found in the "Recycled Water Operations" section of this report.

The injection volumes and costs for FY 2016-17 and FY 2017-18 are shown in Table 1. The representative unit costs included in Table 1 for imported and reclaimed water were calculated by WRD. Table 1 shows that the volume of water injected at the ABP during FY 2017-18 decreased by 27.2 percent from the previous year, and is significantly lower than the average injection over the past thirty years (5,462 AF). This is primarily due to the impacts of decreased injection along the Los Alamitos Channel as part of OCWD's ABP Unit 14 Project.

All ABP shutdowns from FY 2017-18 are summarized in Appendix A-18. There were no major shutdowns during this reporting period.

TABLE 1. INJECTION OPERATIONS

	Imported Water Injections			Recycled Water Injections			Total Injections		
	FY16-17	FY17-18	Percent Change From Previous Year	FY16-17	FY17-18	Percent Change From Previous Year	FY16-17	FY17-18	Percent Change From Previous Year
	VOLUME OF WATER INJECTED IN ACRE-FEET								
OCWD[1]	781.3	850.3	8.8	383.8	59.8	-84.4	1,165.1	910.1	-21.9
WRD[2]	3,215.3	3,163.1	-1.6	1,679.6	340.9	-79.7	4,894.9	3,504.0	-28.4
TOTAL	3,996.6	4,013.4	0.4	2,063.4	400.7	-80.6	6,060.0	4,414.1	-27.2
	UNIT COST OF WATER PER ACRE-FOOT[3]								
JULY - DEC	$1,090.95	$1,132.19	3.8	$1,090.95	$1,132.19	3.8			
JAN - JUN	$1,128.32	$1,132.19	0.3	$1,128.32	$1,132.19	0.3			
	COST OF WATER PURCHASED								
OCWD[1]	$862,043	$886,967	2.9	$424,671	$61,188	-85.6	$1,286,714	$948,155	-26.3
WRD[2]	$3,560,508	$3,286,231	-7.7	$1,863,979	$348,796	-81.3	$5,424,488	$3,635,027	-33.0
TOTAL	$4,422,551	$4,173,199	-5.6	$2,288,650	$409,983	-82.1	$6,711,202	$4,583,182	-31.7
	AVERAGE INJECTION RATE IN CFS								
OCWD[1]	1.1	1.2	8.8	0.5	0.1	-84.4	1.6	1.3	-21.9
WRD[2]	4.4	4.4	-1.6	2.3	0.5	-79.7	6.8	4.8	-28.4
TOTAL	5.5	5.5	0.4	2.9	0.6	-80.6	8.4	6.1	-27.2

[1] Orange County Water District (OCWD)

[2] Water Replenishment District of Southern California (WRD)

[3] The Unit Cost of ***Imported Water*** Per Acre-Feet is the sum of the Metropolitan Water District's wholesale rate at LB-07A (managed by Long Beach Water Department) , the $5 Administrative Surcharge, Readiness-To-Serve (RTS) costs, and Capacity costs (using total volume plus penalties). This amount is greater than what is shown on monthly invoices because Capacity costs are not typically known or accounted for at the time of those invoices. Based on the agreement between the OCWD and the WRD, the representative Unit Cost of ***Recycled Water*** Per Acre-Foot is equal to that of the imported water and is shown in the calculations by the WRD.

FIGURE 1 - MONTHLY AMOUNT OF WATER INJECTED

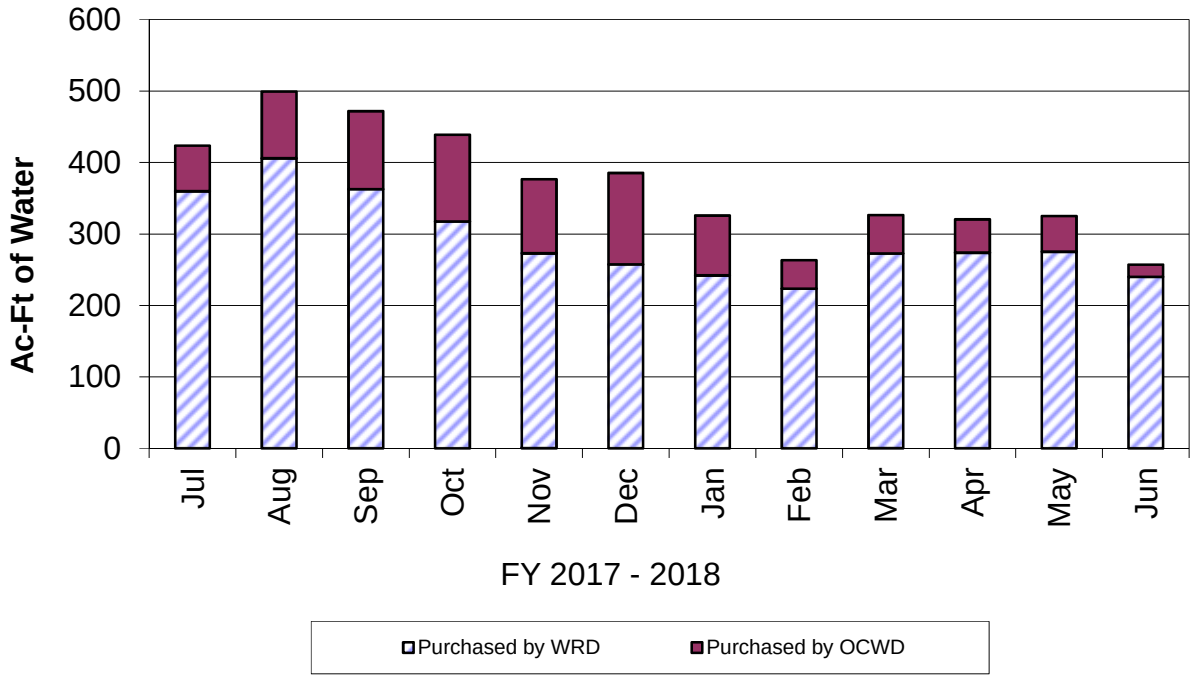
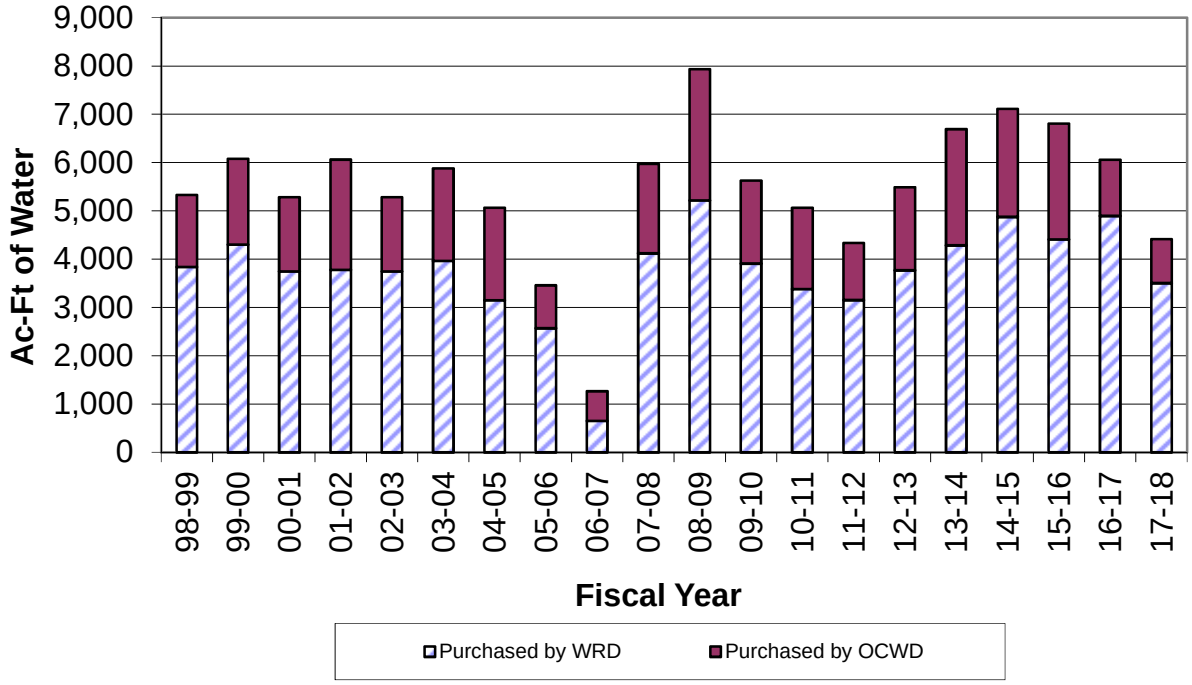


FIGURE 2 - ANNUAL AMOUNT OF WATER INJECTED



RECYCLED WATER OPERATIONS

The LVL AWTF was constructed in 2005 to provide up to 3 million gallons per day (MGD) of advanced treated recycled water to inject at the ABP. The LVL treatment train consists of Micro-Filtration (MF), Reverse Osmosis (RO), and Ultra-Violet light (UV) disinfection. An expansion project completed in 2014 increased the plant capacity to 8 MGD by adding a second treatment train and a third stage of RO. This third stage of treatment allows the LVL to treat the brine generated and thereby further reduce waste that would otherwise go to the regional sewage treatment plant. The Long Beach Water Reclamation Plant (LBWRD) owned by the Los Angeles County Sanitation Districts (LACSAN) provides recycled water to Long Beach Water Department (LBWD), who in turn provides recycled water to the LVL for advanced treatment.

The LVL was authorized to deliver up to 3 MGD for injection at the ABP under Regional Water Quality Control Board (RWQCB) Order No. R4-2005-0061 with the condition that the 10 year running average of recycled water contribution does not exceed 50 percent. In conjunction with completion of the plant expansion project, the LVL was authorized under RWQCB Order No. R4-2014-0111 to inject up to 8 MGD of advanced treated recycled water with no limitation on the percent recycled water contribution running average.

LACSAN planned maintenance activities at the LBWRD that will limit LBWD's ability to provide recycled water to LVL over three consecutive summers starting in Summer 2017. The first shutdown was delayed considerably, and as a result, LVL was placed on standby from mid-July 2017 to the beginning of March 2018, and then again starting in the beginning of May 2018. The LBWRP maintenance is scheduled to conclude in November 2018 and commence again in May 2019. Over this reporting period the LVL operated intermittently at approximately 3.0 MGD when sufficient source water was available for LVL to operate.

LVL PLANNING ACTIVITIES

WRD selected Woodard and Curren, Inc. consultants to conduct a water supply and alternatives analysis to study the availability of recycled water for advanced treatment at LVL and to identify improvements that would allow WRD to fully utilize the 8 MGD capacity of the expanded LVL facility. Stakeholder workshops were held in support of the development of concepts, which included the participation of WRD, LACPW, LBWD, LACSAN, and Metropolitan Water District. The efforts culminated in the following recommendations:

Injection Wells Project – Woodard and Curren, Inc. recommends construction of new injection wells either on-site at the LVL or within El Dorado Park in the City of Long Beach to offset the difference between LVL production and ABP demand.

Los Coyotes Pipeline Project - Woodard and Curren, Inc. explored the use of WRD's existing 10,000-AFY allocation of recycled water produced by LACSAN's Los Coyotes Water Reclamation Plant (LCWRP), which currently produces recycled water for distribution to customers via the City of Cerritos' recycled water system. WRD authorized Woodard and Curren to request preliminary data on their recycled water system and to provide 30% design plans for construction of a pipeline between the City of Cerritos' and LBWD's recycled water systems to wheel additional recycled water supplies for use at the LVL. These plans will be completed in Fall 2018.

LBWD Recycled Water System Upgrade - Woodard and Curren, Inc. met with LBWD to learn how the recycled water system is operated and conducted condition assessments of various storage and pump station facilities. Recommendations include using South Lake for storage, which entails rehabilitation of the South Lake Pump Station and reconfiguration of the pump station's discharge valves

MAINTENANCE

Typical well maintenance at the ABP includes observation well cleanouts and injection well redevelopments. The purpose of injection well redevelopments is to remove accumulated sediments and microbiological build-up within the well casings to restore each well's ability to operate at its maximum injection capacity. Each of the 41 injection well casings are routinely redeveloped once every two years. During FY 2017-18, Public Works completed redevelopment activities at the following 11 well casings[1]: 33T, 33U, 33U3, 33V, 34L, 34S(C/B), 34S(A), 34S(I), 35H1(A), 35H1(I), and 35H2(A).

Figure 3 depicts the operating status of each injection and extraction well during FY 2017-18 and demonstrates that the western portion of the ABP was in operation throughout the entire reporting period. There were multiple individual ABP well shutdowns as explained in Appendix A-18. The following is a brief summary of the shutdowns.

West of the San Gabriel River, injection well 33W suffered from surface leakage intermittently since being struck by an automobile in 2007. LACFCD installed a packer in June 2016, just above the perforations to isolate the injection zone, and the well operated at normal injection rates and pressures until November 2017, when the well started to exhibit surface leakage again. Well 33W has operated at a minimal flowrate since that time. Injection well 33S1, also located west of the San Gabriel River, continues to operate at a limited flow due to potential surface leakage.

East of the San Gabriel River, shutdowns were primarily the result of changes in ABP operation to accommodate the construction of OCWD's ABP Unit 14 Project along the Alamitos Channel. During redevelopment of injection well 34H(I) excessive fill was observed. Video inspection revealed a hole near the top of the perforations at 403 feet. Since this well has a 6-inch casing, a sleeve cannot be installed to cover the hole. The well was re-assembled and placed back in service. It should be noted that injection well

[1] The capital letters in parenthesis represent the aquifer(s) associated with that particular injection well casing. For example, (A) = A Zone aquifer, (A,I) = A and I Zone aquifers, and so forth.

34H(A) had already been offline since Spring 2015 because it also has a hole that is not repairable.

FIGURE 3 - ABP INJECTION AND EXTRACTION WELL STATUS

FY 2017-18

	2017																								2018																							
Well No.	**JUL**				**AUG**				**SEP**				**OCT**				**NOV**				**DEC**				**JAN**				**FEB**				**MAR**				**APR**				**MAY**				**JUN**			
33G (A,I)																																																
33J (A,I)																																																D
33L (A,I)																																																
33N (A,I)																																																
33Q (A,I)																																																
33Q1 (C,B)																																																
33S (A,I)																																																
33S1 (C,B)									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	S	S	S	S
33T (A,I)																																							D	R	R	D						
33U (A,I)																																									D	R	R	D	D	D		
33U3 (C,B)																																														D	R	R
33V (A,I)																																												D	R	R	D	
33W (C,B,A,I)																	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
33X (C,B,A,I)																								O	O																							
33Y (C,B,A,I)																								O	O																							
33Z (C,B,A,I)									D	D	D	D	D																															O				
33Z2 (A)																																																
33Z2 (I)																																																
34D (C,B,A,I)																											O	O																O				
34E (C,B)																											O	O	O	O														O	C	C		
34E (I)																											O	O																O				
34F (A)																											O	O																O				
34F (I)																											O	O																O				
34G (A)																											O	O																O				
34G2 (C,B)																										O	O	O	O	O														O				
34G2 (I)																										O	O	O																O				
34H (A)	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
34H (I)	O																										O	O																O				
34J (A)																										O	O	O	O	O	O	O	O	O	O	O								O				
34J (I)																										O	O	O	O	O	O													O				
34L (C,B,A,I)	D	R	R	R	D	D																				O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O		O				
34S (A)	O	O	O	O	D	R	D	D	D	D																O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
34S (I)	O	O	O	O	D	D	R	D	D	D																O	O	O	O	O	O													O	O	O	O	O
34S (C,B)	O	O	O	O	D	D	D	R	D	D							O									O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
34V (A)	O						O	O	O	O							O										O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
34V (I)	O						O	O	O	O							O										O	O	O	O	O													O	O	O	O	O
34V (C,B)	O						O	O	O	O																	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
34Z (I)																	O										O	O	O	O	O	O	O	O	O	O	O	O	O	O	O		O	O	O	O	O
35F (I)																	O										O	O	O	O	O	O	O	O	O	O	O	O	O	O	O		O	O	O	O	O
35G (A,I)																																												O	O	O	O	O
35H1 (A)																																					D	R	R	D				O	O	O	O	O
35H1 (I)																																					D	R	R	D				O	O	O	O	O
35H2 (A)																																	D	R	R	R	C							O	O	O	O	O
33V'15P	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	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	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	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	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	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	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

*Extraction Well

- **Well in Operation**
- **H - Header Repair**
- **P - Pressure Exceedance**
- **U - Under Construction**
- **C - Casing Repair**
- **M - Misc. Repair**
- **R - Redevelopment**
- **W - Water Quality Sampling**
- **D - Disassembled**
- **N - Not Needed**
- **S - Surface Leakage** (operating with reduced flowrate)
- **X - Waiting for Repair**
- **G - Grouted**
- **O - Other Circumstances**
- **I - Intermittent shutdown** (operated part of the week)
- **B - Barrier Shutdown**

HYDROGEOLOGIC EFFECTS

Figures 4 through 8 (pp. 15-19) show the average monthly groundwater elevation relative to the average groundwater elevation of the 10 preceding years (FY 2007-08 to FY 2016-17) in the vicinity of 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 two portions of the barrier alignment: wells west of the San Gabriel River and wells east of the San Gabriel River. It is important to note that the 10-year average does not represent a groundwater elevation goal nor does it specifically reflect barrier performance, but is simply included for comparison purposes. The graph includes all available semi-monthly, monthly, semi-annual, and annual data for wells within the barrier alignment and landward for approximately 2,000 feet from the barrier. As a result, semi-monthly values are "weighted" more heavily than the annuals in the calculation of the monthly average, and the months of September and March consistently have lower values than preceding and succeeding months due to the fact that semi-annual and annual water levels are measured during these months.

As shown in the graphs, during the first half of FY 2017-18, groundwater elevations were higher than historical averages both west of the San Gabriel River and east of the San Gabriel River. These groundwater elevation increases are most likely the result of OCWD's in-lieu program in Fall 2017. During the second half of FY 2017-18, groundwater levels dropped significantly both west of the San Gabriel River and east of the San Gabriel River, primarily due to reduced injection rates to aid in construction of OCWD's ABP Unit 14 Project. In general, all the figures show the expected seasonal trends of higher groundwater elevations in the winter months (decreased pumping) and much lower groundwater elevations in the summer months (increased pumping).

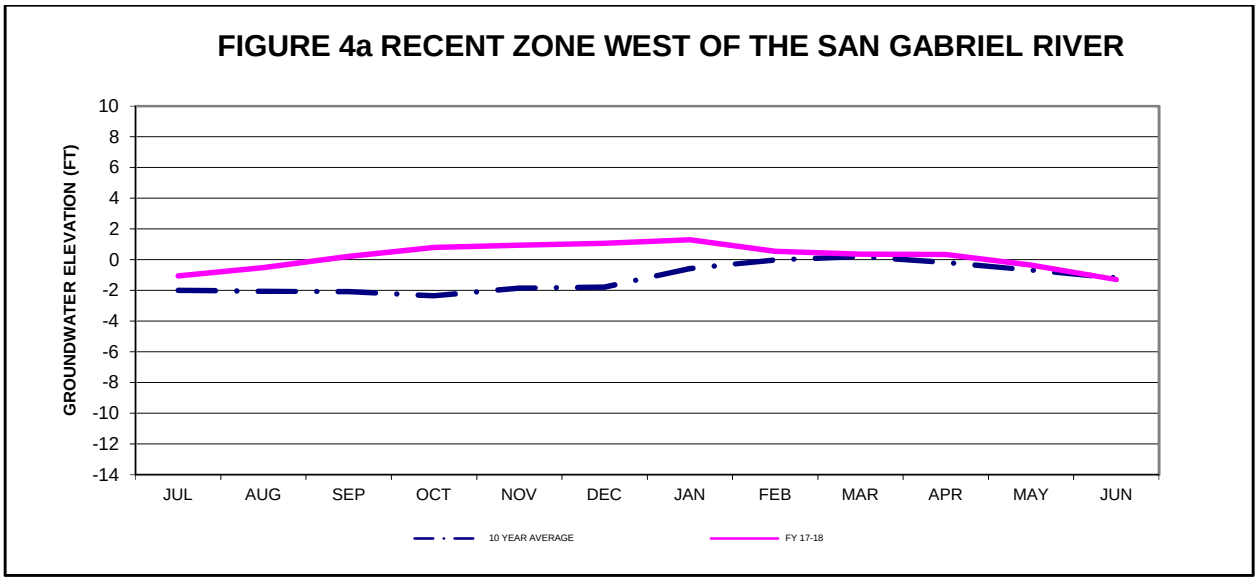


FIGURE 4a RECENT ZONE WEST OF THE SAN GABRIEL RIVER
GROUNDWATER ELEVATION (FT)
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
10 YEAR AVERAGE
FY 17-18

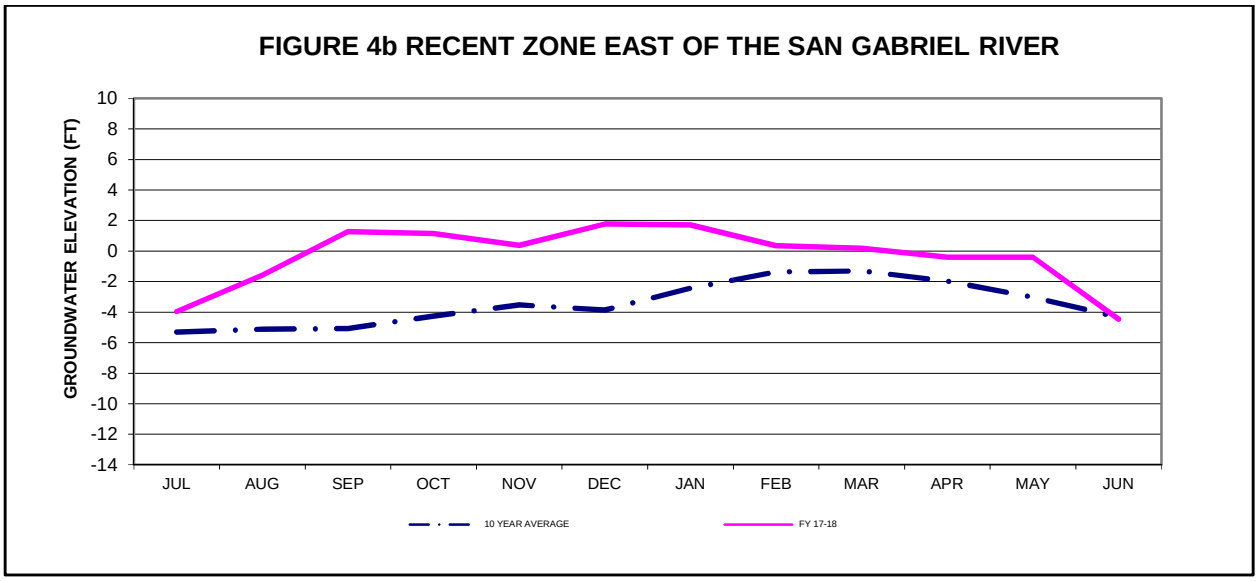


FIGURE 4b RECENT ZONE EAST OF THE SAN GABRIEL RIVER
GROUNDWATER ELEVATION (FT)
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
10 YEAR AVERAGE
FY 17-18

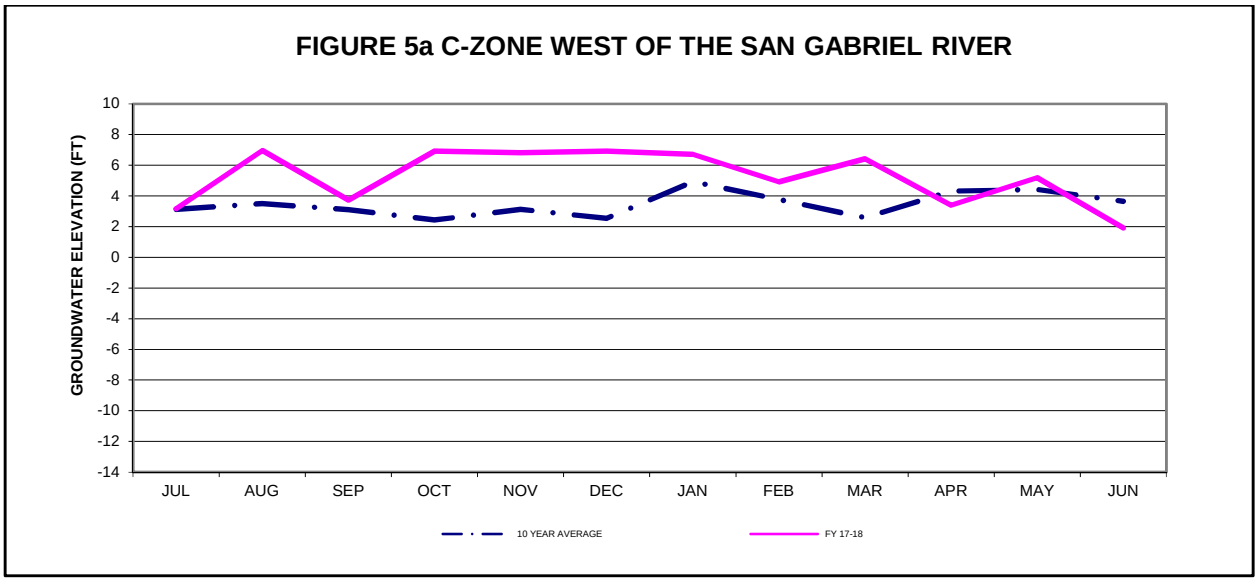


FIGURE 5a C-ZONE WEST OF THE SAN GABRIEL RIVER
GROUNDWATER ELEVATION (FT)
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
10 YEAR AVERAGE
FY 17-18

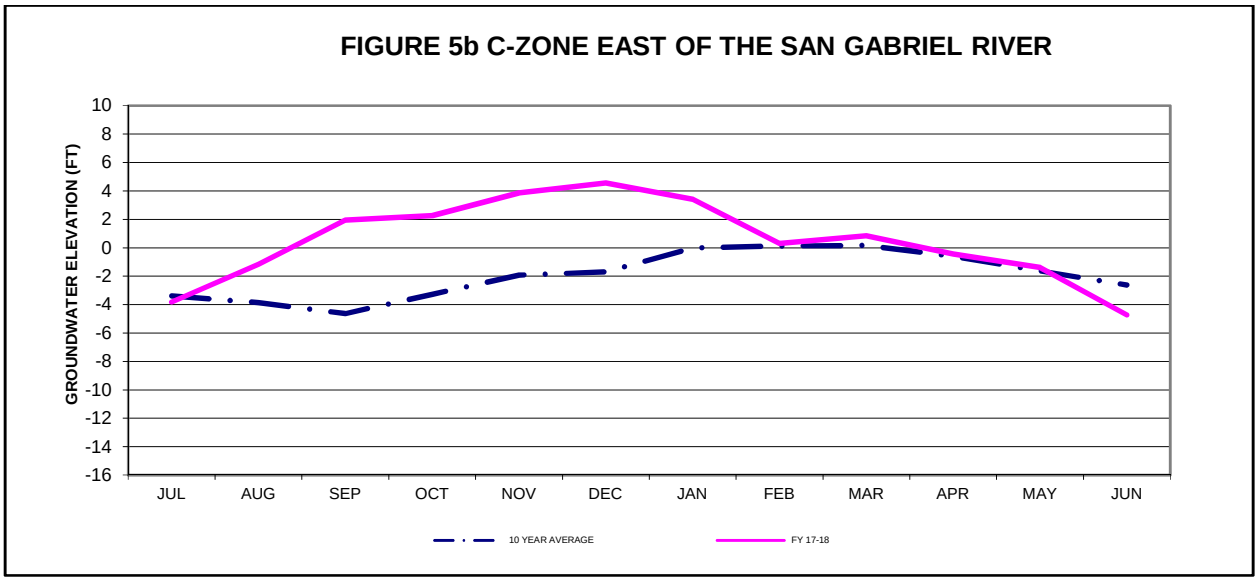


FIGURE 5b C-ZONE EAST OF THE SAN GABRIEL RIVER
GROUNDWATER ELEVATION (FT)
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
10 YEAR AVERAGE
FY 17-18

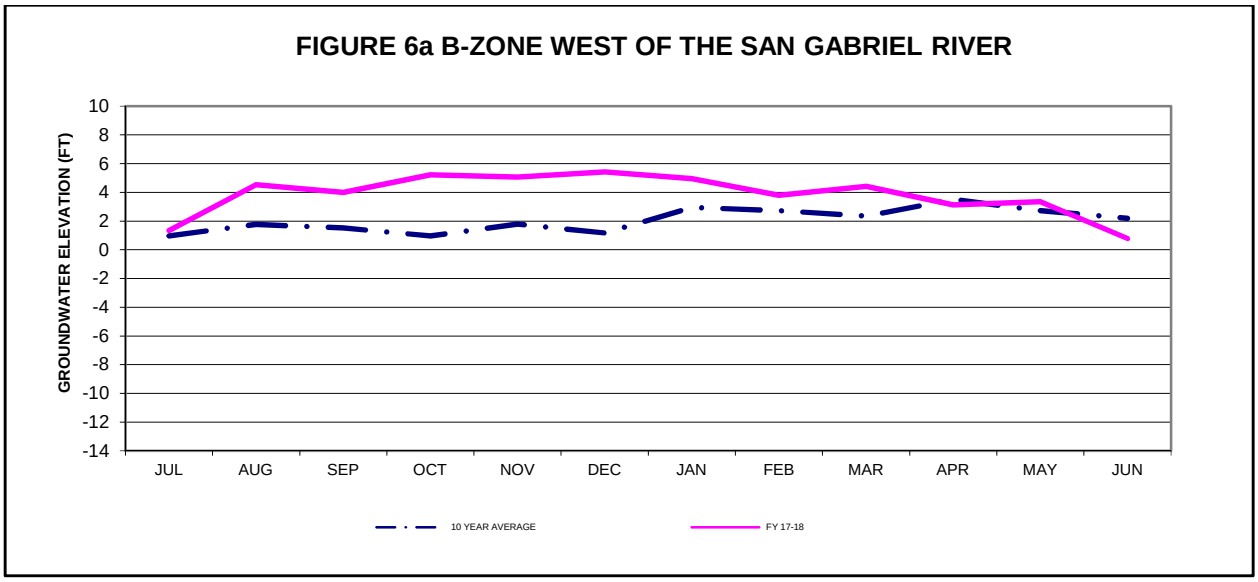


FIGURE 6a B-ZONE WEST OF THE SAN GABRIEL RIVER
GROUNDWATER ELEVATION (FT)
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
10 YEAR AVERAGE
FY 17-18

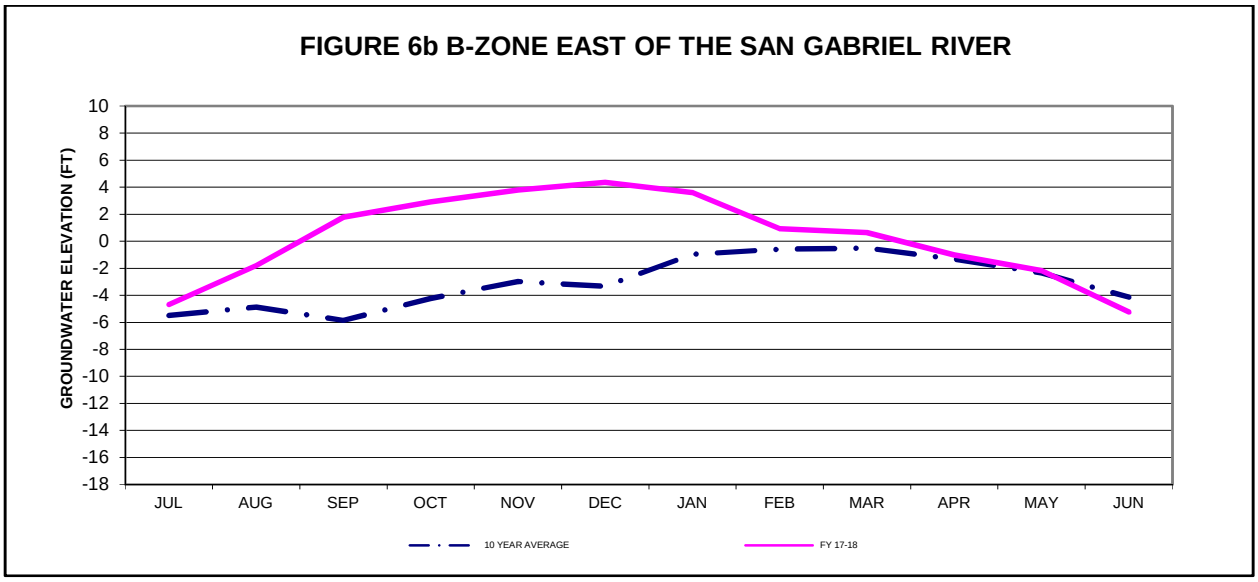


FIGURE 6b B-ZONE EAST OF THE SAN GABRIEL RIVER
GROUNDWATER ELEVATION (FT)
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
10 YEAR AVERAGE
FY 17-18

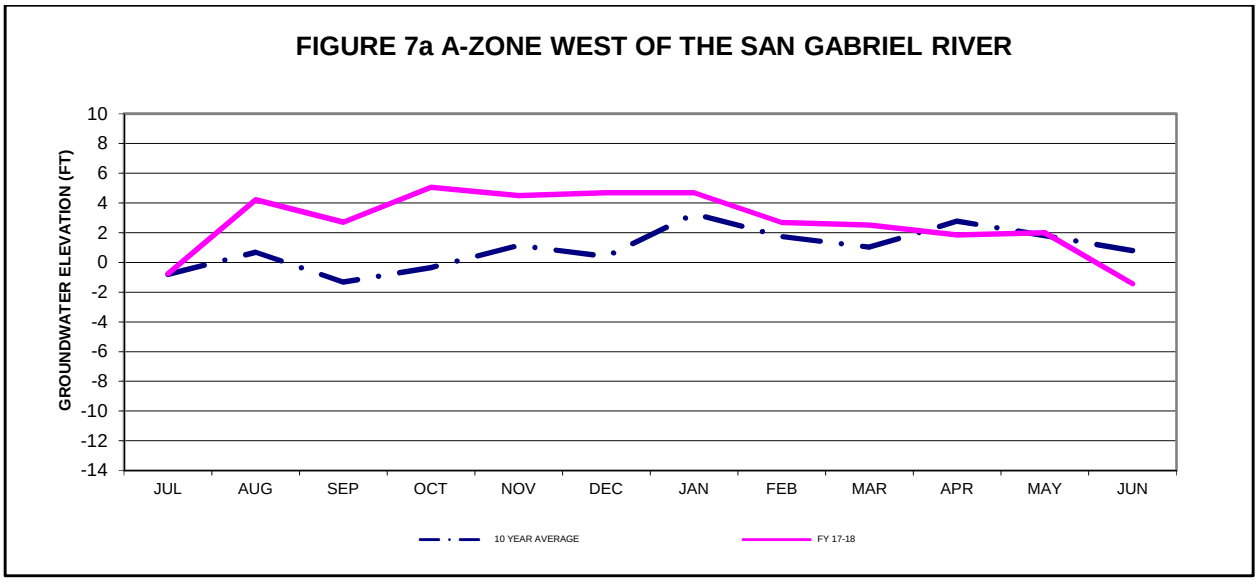


FIGURE 7a A-ZONE WEST OF THE SAN GABRIEL RIVER
GROUNDWATER ELEVATION (FT)
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
10 YEAR AVERAGE
FY 17-18

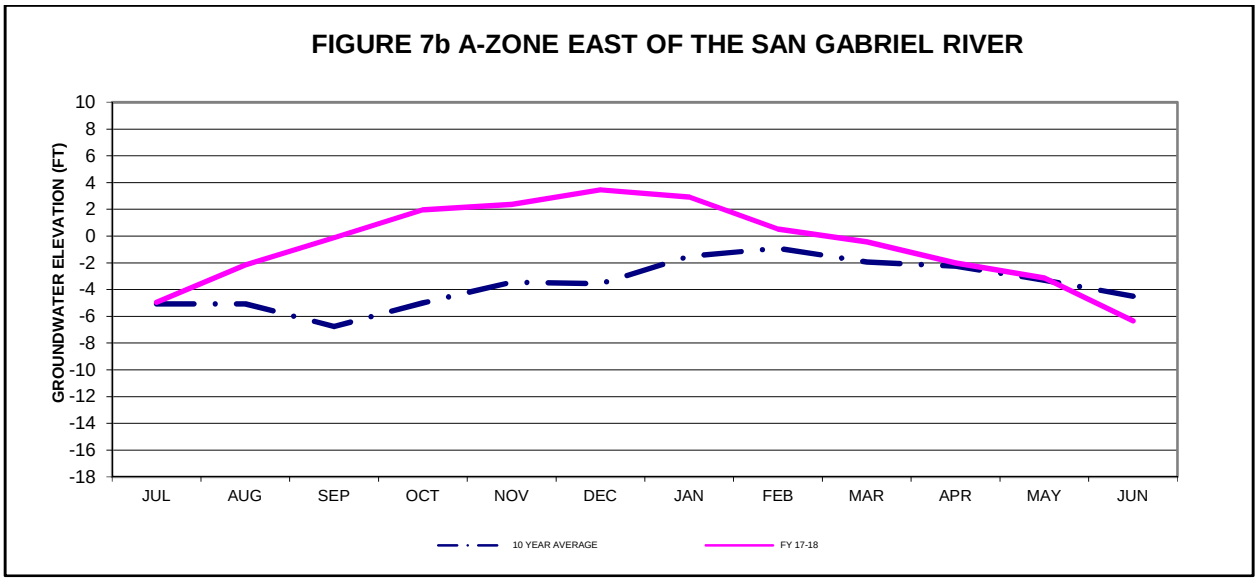


FIGURE 7b A-ZONE EAST OF THE SAN GABRIEL RIVER
GROUNDWATER ELEVATION (FT)
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
10 YEAR AVERAGE
FY 17-18

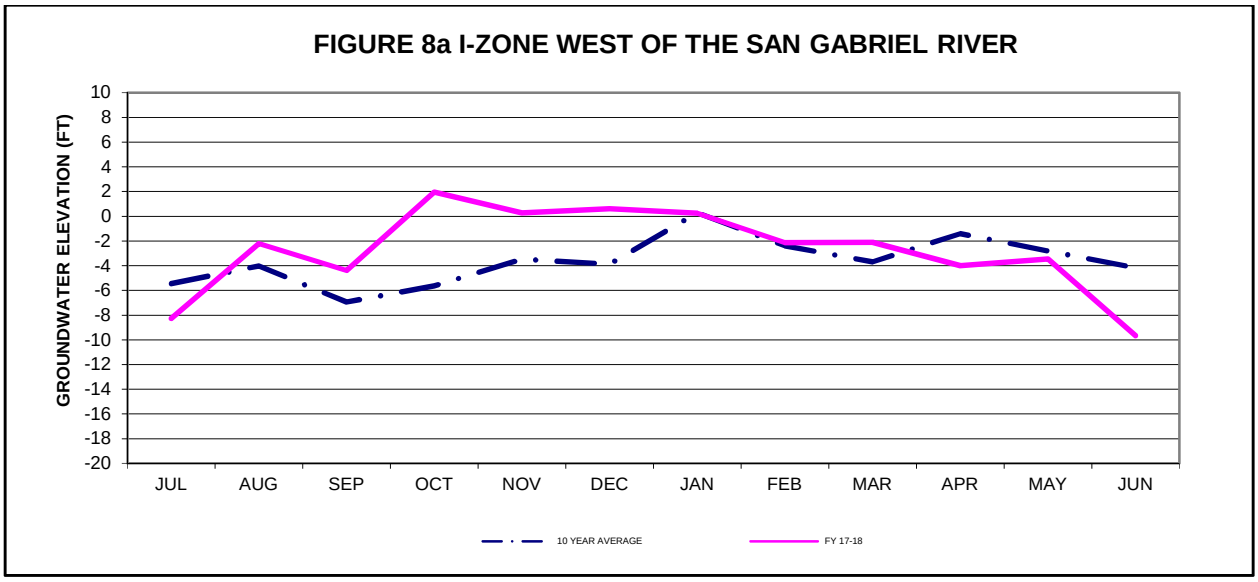


FIGURE 8a I-ZONE WEST OF THE SAN GABRIEL RIVER
GROUNDWATER ELEVATION (FT)
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
10 YEAR AVERAGE
FY 17-18

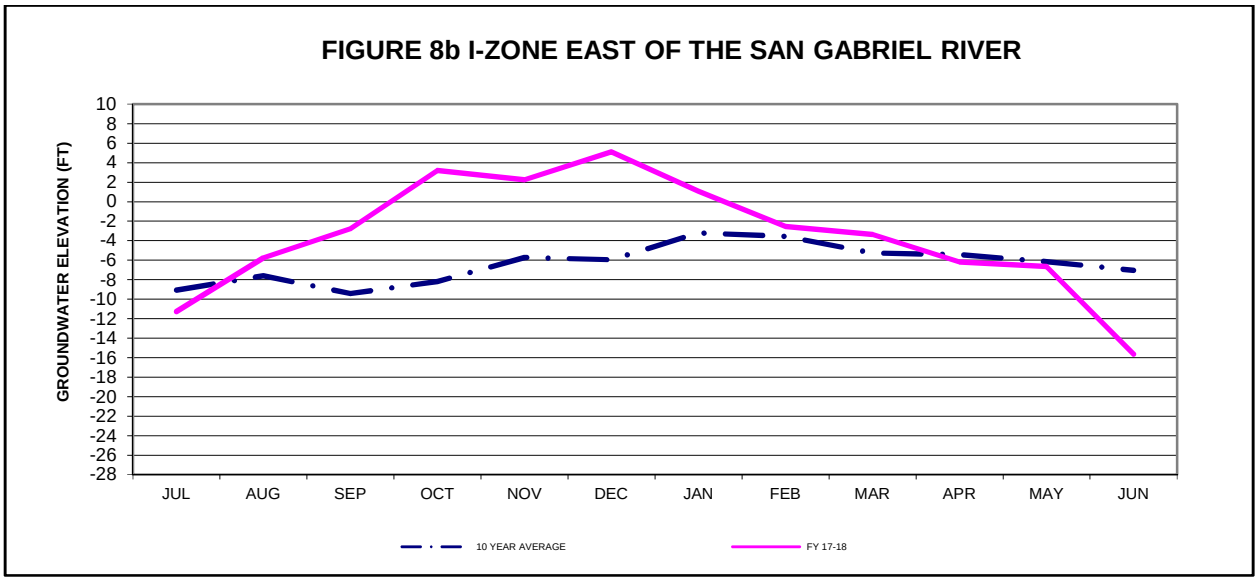


FIGURE 8b I-ZONE EAST OF THE SAN GABRIEL RIVER
GROUNDWATER ELEVATION (FT)
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
10 YEAR AVERAGE
FY 17-18

Groundwater elevation contours for the R, C, B, A, and I Zones have been prepared from data collected in Spring 2018 and are included in Appendix A-1.1, 2.1, 3.1, 4.1, and 5.1. In general, the contours show that the groundwater levels were the highest near the barrier alignment, and typically decrease moving landward. The general shapes of each contour are similar to the previous year and some similar groundwater mounds are seen around certain injection wells. Areas historically having higher groundwater elevations in the C and B zones, especially near where the barrier alignment bends at the San Gabriel River, continue to have higher groundwater elevations than their surroundings. The groundwater levels along the eastern alignment of the barrier showed large decreases due to reduced injection related to OCWD's ABP Unit 14 Project. Other areas of historically elevated groundwater levels (e.g., near 33XY and 33YZ) remained relatively constant when compared to the same time last year. This is likely due to the western portion of the barrier remaining in full operation during the entire reporting period. The injection wells in this portion of the barrier are screened across the four aquifers resulting in over injecting into aquifers C and B, while under injecting into aquifers A and I.

Contours of changes in groundwater elevations for the R, C, B, A, and I Zones between Spring 2017 and Spring 2018 are shown in A-1.2, 2.2, 3.2, 4.2, and 5.2. The data set is based on available data from Spring 2017, which was then subtracted from the corresponding and available data from Spring 2018 (shown in A-1.3, 2.3, 3.3, 4.3, and 5.3). These contours clearly identify increases and decreases in groundwater elevations from one reporting period to the next. In general, groundwater elevations remained relatively unchanged from the previous reporting period with the exception of localized decreases along the eastern alignment related to OCWD's Unit 14 Project. Below is a brief summary and discussion of each aquifer zone:

- <u>R Zone:</u>
    - Groundwater elevations decreased slightly overall compared to last year.
    - Groundwater elevations decreased about 1 foot along both the western and eastern alignments of the barrier.

- C Zone:
    - Groundwater elevations increased between 1 foot and 2 feet between Los Cerritos Channel and San Gabriel River and increased more than 2 feet just north of the western alignment.
    - Groundwater elevations decreased between 0.5 foot and 1 foot along the eastern alignment of the barrier, primarily due to injection wells being offline for OCWD's ABP Unit 14 Project.
- B Zone:
    - Groundwater elevations decreased between 1 foot and 2 feet along the barrier west of the Los Cerritos Channel and increased slightly along the barrier between Los Cerritos Channel and San Gabriel River.
    - Groundwater levels decreased up to 2 feet along the eastern alignment, due in part to injection wells being offline for OCWD's ABP Unit 14 Project.
- A Zone:
    - Groundwater elevations remained relatively constant in the vicinity of the barrier west of Los Cerritos Channel.
    - Groundwater elevations increased up to 4 feet between Los Cerritos Channel and the San Gabriel River.
    - Groundwater elevations decreased between 1 foot and 2 feet along the eastern alignment of the barrier, with localized decreases of almost 4 feet in the vicinity of well 34V.
- I Zone:
    - Groundwater elevations increased over 4 feet in the vicinity of 34GH and 34HJ.
    - Groundwater levels generally increased landward of the eastern alignment of the barrier, with the exception of decreases in the vicinity of 34LS and 35E0.1.

Graphs showing the average, maximum and minimum groundwater elevations at each internodal observation well throughout FY 2017-18 are included in Appendix A-13 through A-16. As shown in the graphs, the average groundwater elevation was below the

protective elevation at many wells along the barrier during FY 2017-18. A comparison of FY 2017-18 graphs with FY 2016-17 graphs indicate that average elevations increased slightly along the western alignment in all zones and decreased along the east alignment. This is most likely due to operational changes related to OCWD's ABP Unit 14 Project.

CHLORIDES

Figures 9 through 13 (pp. 24-28) show the historical chloride concentrations in each individual aquifer zone. The graphs plot the average of every maximum value measured at each observation well during each sampling event within the target area throughout FY 2017-18. The data includes all available information from the annual and semi-annual chloride sampling events for wells within the barrier alignment and landward for approximately 2,000 feet from the barrier. As a result, the semi-annual values are "weighted" more heavily than the annuals in the calculation of the annual average. Two graphs were created for each aquifer to account for changes in chloride concentration trends along two portions of the barrier alignment: wells west of the San Gabriel River and wells east of the San Gabriel River. In each figure, the average of the maximum chloride concentrations per well per event over the last 10 fiscal years (including FY 17-18) is shown with respect to the freshwater condition (250 mg/L).

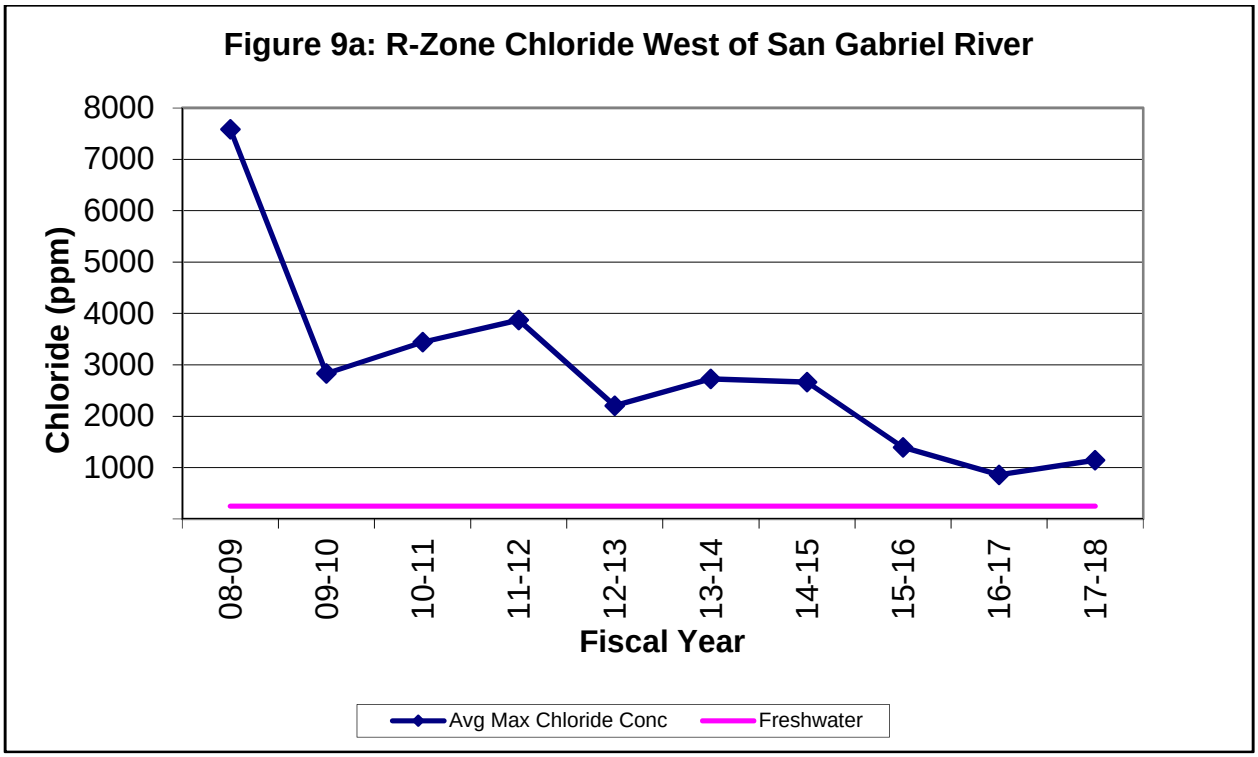


Figure 9a: R-Zone Chloride West of San Gabriel River
Chloride (ppm)
8000
7000
6000
5000
4000
3000
2000
1000
08-09
09-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
Fiscal Year
Avg Max Chloride Conc
Freshwater

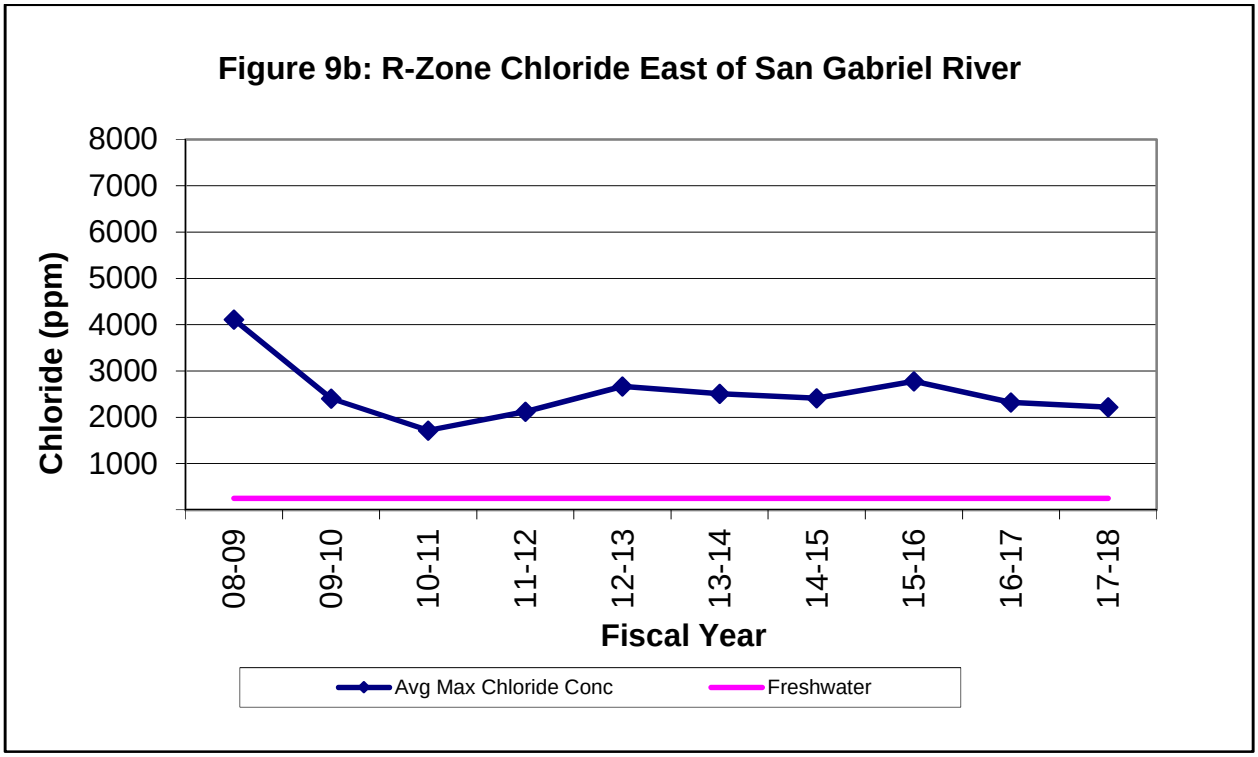


Figure 9b: R-Zone Chloride East of San Gabriel River
Chloride (ppm)
8000
7000
6000
5000
4000
3000
2000
1000
08-09
09-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
Fiscal Year
Avg Max Chloride Conc
Freshwater

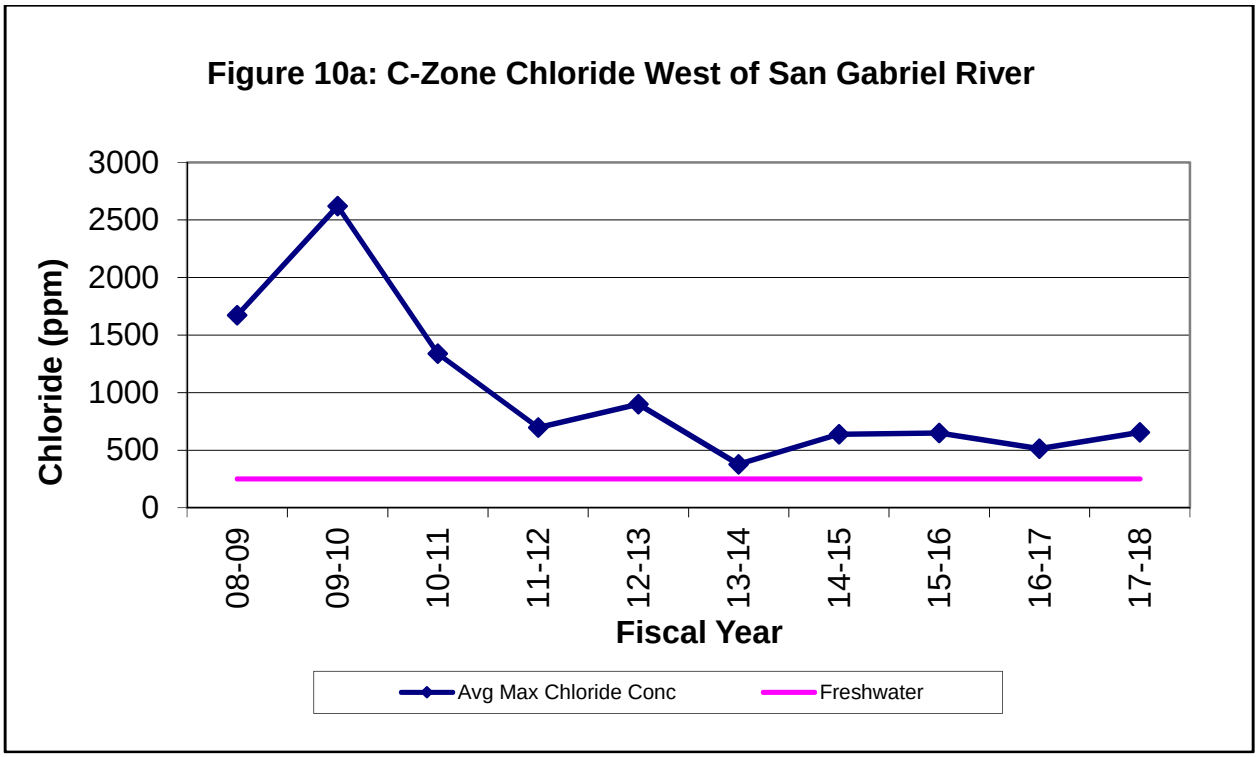


Figure 10a: C-Zone Chloride West of San Gabriel River
Chloride (ppm)
3000
2500
2000
1500
1000
500
0
08-09
09-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
Fiscal Year
Avg Max Chloride Conc
Freshwater

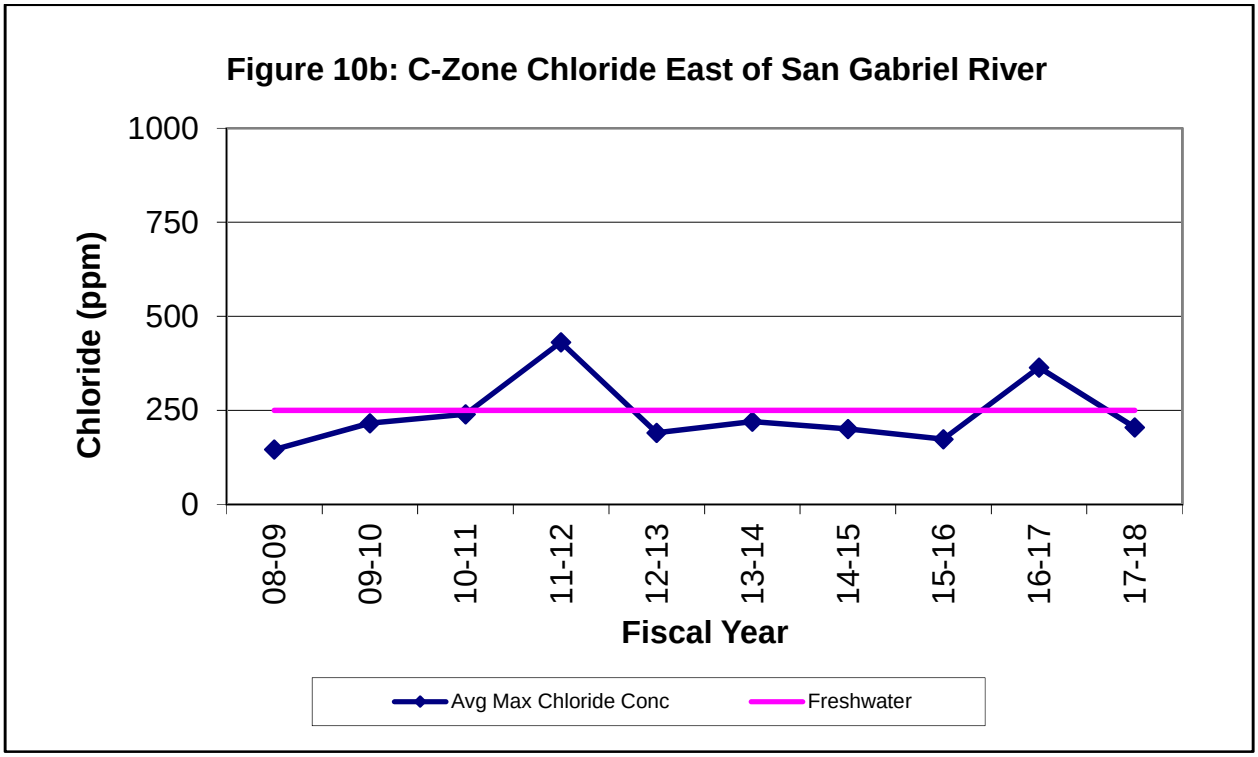


Figure 10b: C-Zone Chloride East of San Gabriel River
Chloride (ppm)
1000
750
500
250
0
08-09
09-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
Fiscal Year
Avg Max Chloride Conc
Freshwater

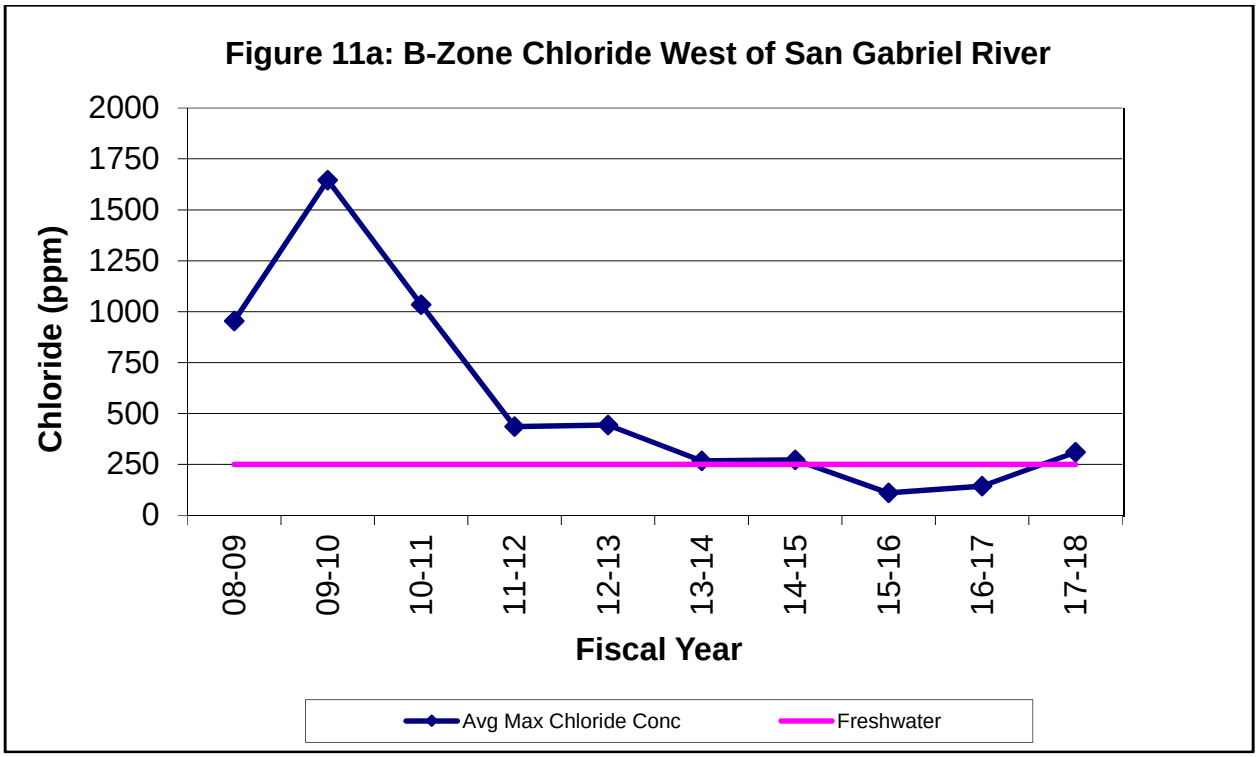


Figure 11a: B-Zone Chloride West of San Gabriel River
Chloride (ppm)
2000
1750
1500
1250
1000
750
500
250
0
08-09
09-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
Fiscal Year
Avg Max Chloride Conc
Freshwater

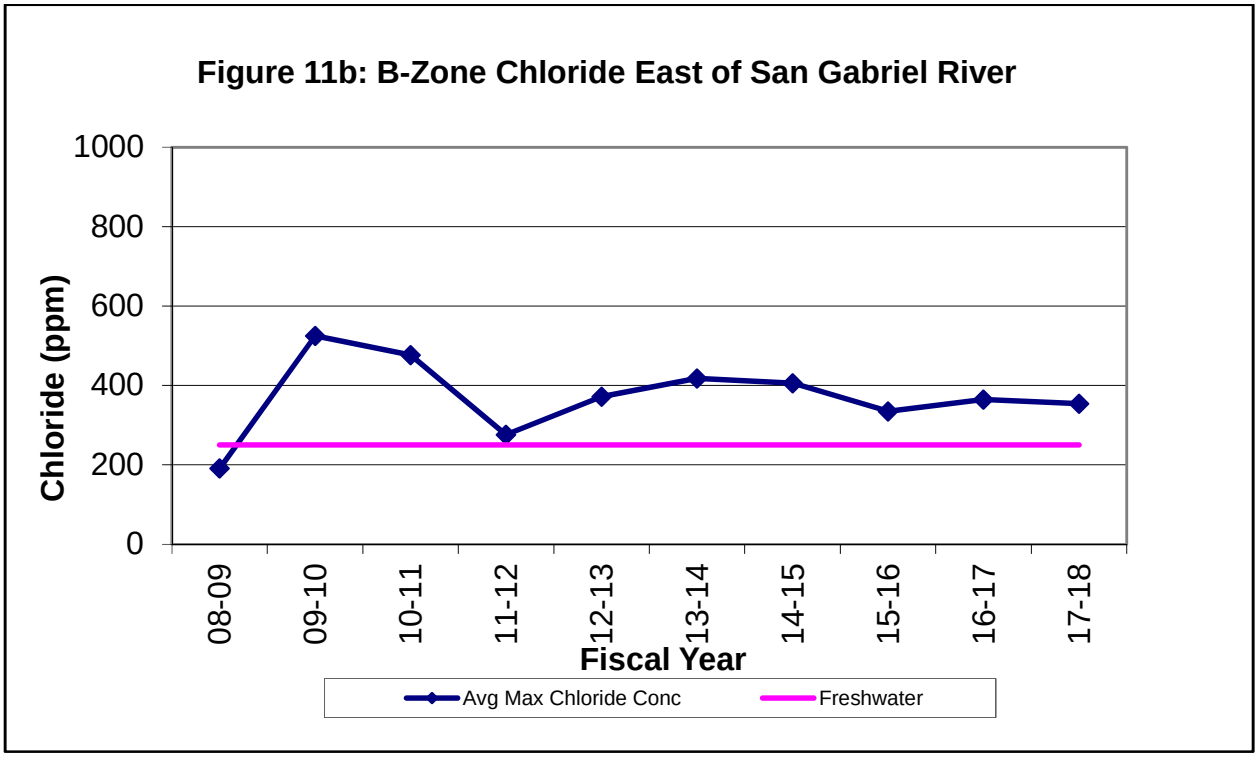


Figure 11b: B-Zone Chloride East of San Gabriel River
Chloride (ppm)
1000
800
600
400
200
0
08-09
09-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
Fiscal Year
Avg Max Chloride Conc
Freshwater

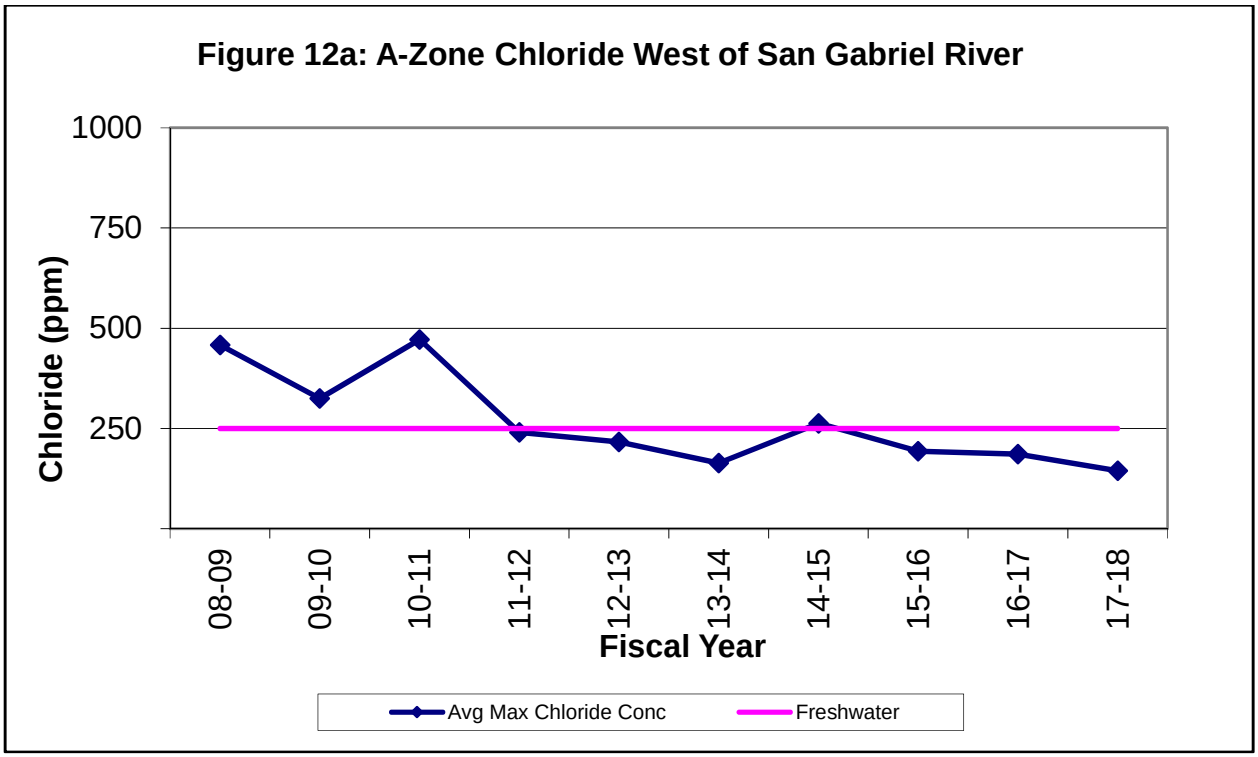


Figure 12a: A-Zone Chloride West of San Gabriel River
1000
750
500
250
Chloride (ppm)
08-09
09-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
Fiscal Year
Avg Max Chloride Conc
Freshwater

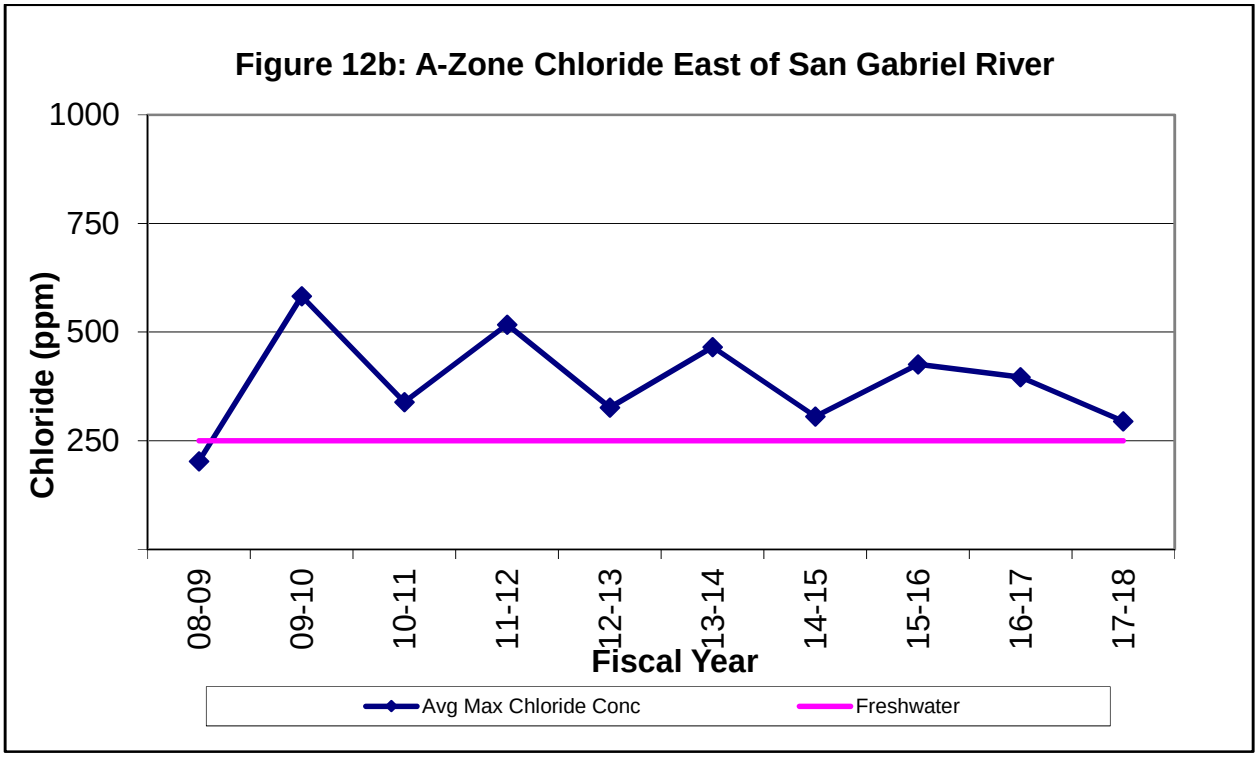


Figure 12b: A-Zone Chloride East of San Gabriel River
1000
750
500
250
Chloride (ppm)
08-09
09-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
Fiscal Year
Avg Max Chloride Conc
Freshwater

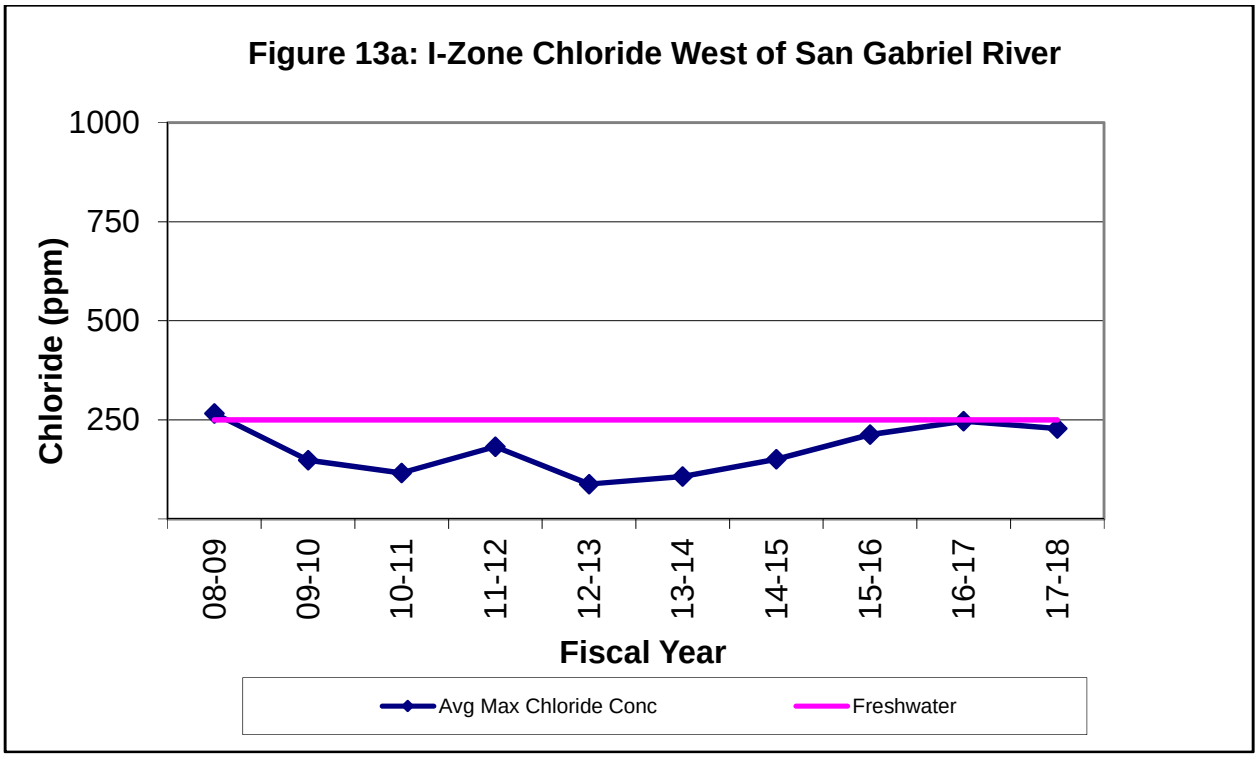


Figure 13a: I-Zone Chloride West of San Gabriel River
1000
750
500
250
Chloride (ppm)
08-09
09-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
Fiscal Year
Avg Max Chloride Conc
Freshwater

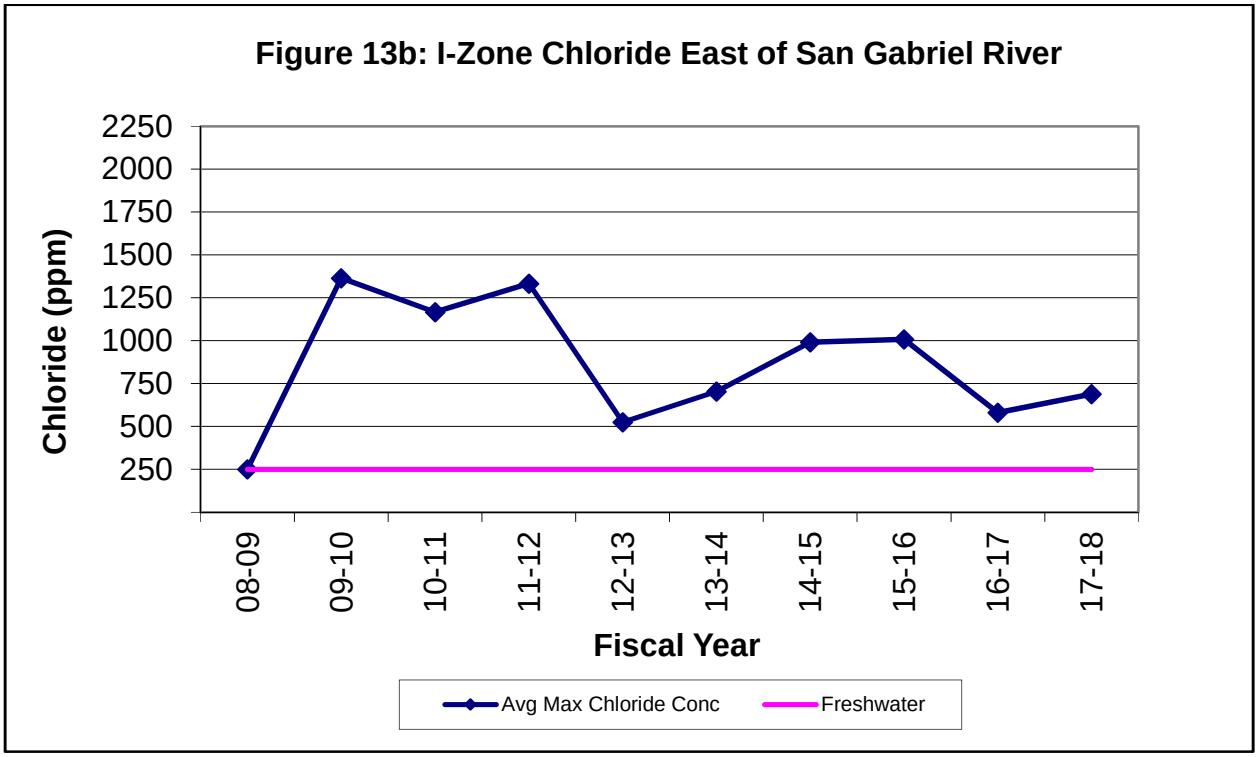


Figure 13b: I-Zone Chloride East of San Gabriel River
2250
2000
1750
1500
1250
1000
750
500
250
Chloride (ppm)
08-09
09-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
Fiscal Year
Avg Max Chloride Conc
Freshwater

West of the San Gabriel River, FY 2017-18 average maximum chloride concentrations increased in the R, C, and B Zones. R Zone chloride concentrations increased by more than 250 mg/L, while increasing only slightly in the Zones C and B. Average maximum chloride concentrations decreased slightly in the A and I Zones.

East of the San Gabriel River, FY 2017-18 average maximum chloride concentrations remained constant in the B Zone and decreased by at least 100 mg/L in Zones R, C, and A. Average chloride concentrations increased in the I zone east of the San Gabriel River by 100 mg/L. This was most likely the result of limited injection along the eastern alignment due to OCWD's ABP Unit 14 Project.

Chloride concentration contour maps for the R, C, B, A, and I Zones have been prepared and are included in Appendix A-6.1, A-7.1, A-8.1, A-9.1, and A-10.1, respectively. The chloride contour maps are based on the maximum chloride concentration (mg/L) measured at each observation well. Chloride data was gathered from observation wells located within the immediate vicinity of the barrier and does not represent basin-wide conditions for the groundwater basin protected by the barrier. Wells with chloride concentrations of 250 mg/L or less were considered fresh. The chloride measurements used in this report were taken during the semi-annual sampling event in March and April 2018 and the annual event in February and March 2018.

Contours of **changes** in chloride concentration for the R, C, B, A, and I Zones between Spring 2017 and Spring 2018 are shown in Appendices A-6.2, A-7.2, A-8.2, A-9.2, and A-10.2. The data set is based on available data for Spring 2018, which was then subtracted from the corresponding data for Spring 2017. These contours very clearly identify areas where chloride concentrations increased and decreased between these two reporting periods.

The chloride concentration contours for FY 2017-18 are similar in shape and pattern to those of the previous year. The current contours and the corresponding chloride concentration cross-section (A-11) for this reporting period indicate that intrusion of

seawater across the barrier continued to be controlled west of the San Gabriel River. East of the San Gabriel River, several areas recorded elevated chloride concentrations indicating seawater intrusion. Additional areas of high chloride concentrations and/or notable changes in concentration (since the FY 2016-17 report) are as follows:

- R Zone – Chloride concentrations remained elevated in the vicinity of the barrier with some exceptions. In the vicinity of 33Z' 1, chloride concentrations decreased over 3,000 mg/L. The northern portion of eastern alignment showed considerable decreases in concentrations as well. Chloride concentrations also remained elevated despite decreases at 34L'1.
- C Zone – West of the Los Cerritos Channel, chloride concentrations remain present north of the barrier, however, chloride concentrations have decreased in this area from the previous year. Chloride concentrations along the Alamitos Channel increased between 300 and 500 mg/L.
- B Zone – Elevated chloride concentrations continued to be present west of the barrier near well 32Z'5. Along the Alamitos Channel, chloride concentration levels at 34JL and 34V3 decreased significantly from last year but are still elevated. Chloride concentrations remained unchanged or increased slightly at 34DG and 34HJ2 and increased significantly at 32V' 10.
- A Zone – West of the barrier chloride concentrations decreased significantly at 33Z' 5 and 32X11. North of the barrier in the vicinity of Los Cerritos Channel and the San Gabriel River, chloride concentrations remained steady or decreased slightly. Chloride concentrations decreased significantly along the eastern alignment, with localized decreases at 34HJ and 35H11 of over 1,000 mg/L.
- I Zone – Chloride concentrations remained consistent along much of the barrier since the last reporting period, with concentrations mostly decreasing landward of the barrier. Chloride concentrations decreased significantly along the portion of the barrier near observation wells 34VZ, 34Y0.1 and 35E0.1.

There continues to be three possible causes of the high chloride concentrations in all zones north of and northwest of the barrier. These include the remaining seawater from previous intrusions, migration of seawater inland by the Los Cerritos Channel, and suspected intrusion around the west end of the barrier. Elevated chloride concentrations in the area immediately north of the western alignment and west of the barrier will continue to be monitored using the new observation wells constructed by LACPW in the 2012-13 reporting period. Along the barrier Alignment, areas of high chlorides are present where groundwater elevations are below the protective elevation.

BARRIER PROJECT COSTS

This section of the report is divided into four parts: Water Costs, Services and Supplies Costs (operation and maintenance), Fixed Assets Costs (capital outlay), and Budget. Under the terms of the 1964 Cooperative Agreement between LACFCD and OCWD, fixed assets are typically divided into facilities paid for by the LACFCD, facilities paid for by the OCWD, and joint facilities paid for by both agencies, depending on their location. Under the same agreement, water costs are divided between the LACFCD (whose portion is paid by the WRD per a separate agreement) and the OCWD. The total cost of the ABP in FY 2017-18 (not including liability insurance) was $6,723,140, which can be broken down as follows: water costs of $4,583,182, Operations and Maintenance costs of $2,139,958 and joint liability insurance for the ABP of $77,902.

WATER COSTS

During FY 2017-18, 4,414.1 AF of water were injected at an estimated total cost of $4,583,182. The monthly unit water cost (dollars per AF) from July 2017 to June 2018 varied periodically as shown earlier in Table 1. The monthly quantity of water injected and total water costs paid by each agency are shown below in Table 3.

TABLE 2. QUANTITY OF WATER INJECTED AND COSTS

MONTH	AMT BY WRD (AF)	AMT BY OCWD (AF)	TOTAL AMT (AF)
Jul-17	359.9	63.8	423.7
Aug-17	405.9	93.3	499.2
Sep-17	362.7	109.1	471.8
Oct-17	317.5	121.3	438.8
Nov-17	273.0	103.7	376.7
Dec-17	257.4	128.0	385.4
Jan-18	242.1	83.7	325.8
Feb-18	223.6	39.8	263.4
Mar-18	272.8	53.8	326.6
Apr-18	273.9	46.5	320.4
May-18	275.2	49.9	325.1
Jun-18	240.0	17.2	257.2
TOTAL INJECTED	**3,504.0**	**910.1**	**4,414.1**
TOTAL COST ($) [From Tbl. 1]	**$3,635,027**	**$948,155**	**$4,583,182**

OPERATIONS AND MAINTENANCE COSTS

A total of $2,139,958 was spent on Operations and Maintenance during FY 2017-18. Pursuant to the 1964 Cooperative Agreement, the OCWD pays a percentage of the applicable services and supplies costs for injection operations proportional to the percentage of the total amount of injection water paid for by the OCWD. The distribution of FY 2017-18 services and supplies costs is summarized in Table 3.

TABLE 3. DISTRIBUTION OF SERVICES AND SUPPLIES COSTS FOR INJECTION AND EXTRACTION ACTIVITIES

ITEM	LOS ANGELES COUNTY	ORANGE COUNTY	TOTAL
Service & Supplies of Injection Facilities (including Observation Wells)	$1,697,905	$440,515	$2,138,420[1]
Service & Supplies of Extraction Facilities	$1,538	$0	$1,538[2]
Right of Way Acquisition	$0	$0	$0
SUBTOTAL	**$1,699,443**	**$440,515**	**$2,139,958**
Liability Insurance	$38,951	$38,951	$77,902
TOTAL	**$1,738,394**	**$479,465**	**$2,217,859**

The values in Table 3 come from the ABP FY 2017-18 Costs (see A-19) as follows:

[1] The sum of Items 1, 2, 3, 7, 8, 9, 10, 11, 12, 13, and 14. OCWD is responsible for 20.6% of all costs for these items per the agreement.

[2] The sum of Items 4, 5, and 6. OCWD is not responsible for any portion of the cost for these items.

The yearly cost of the services and supplies (including special programs but excluding water and extraction costs) for the last 10 years of ABP operations are shown in Table 4.

TABLE 4. COSTS OF SERVICES AND SUPPLIES FOR INJECTION[1]

Fiscal Year	Volume of Water Injected (Ac-Ft)	Total Cost	Cost Per Ac-Ft Injected
2008-09	7,936.2	$1,875,902	$236.37
2009-10	5,629.2	$3,135,608	$557.03
2010-11	5,066.1	$2,830,801	$558.77
2011-12	4,334.7	$2,368,788	$546.47
2012-13	5,490.4	$2,477,565	$451.25
2013-14	6,692.3	$3,605,859	$538.81
2014-15	7,113.1	$1,678,123	$235.92
2015-16	6,807.7	$2,237,637	$328.69
2016-17	6,060.0	$1,650,686	$272.39
2017-18	4,414.1	$2,138,420	$484.45

[1]The costs reported in Table 4 prior to the FY14-15 period are higher because these years included costs for multiple repairs and/or capital improvement projects.

The costs of the services and supplies for extraction operations for the last 10 years, including electrical costs, are shown in Table 5.

TABLE 5. COSTS OF SERVICES AND SUPPLIES FOR EXTRACTION

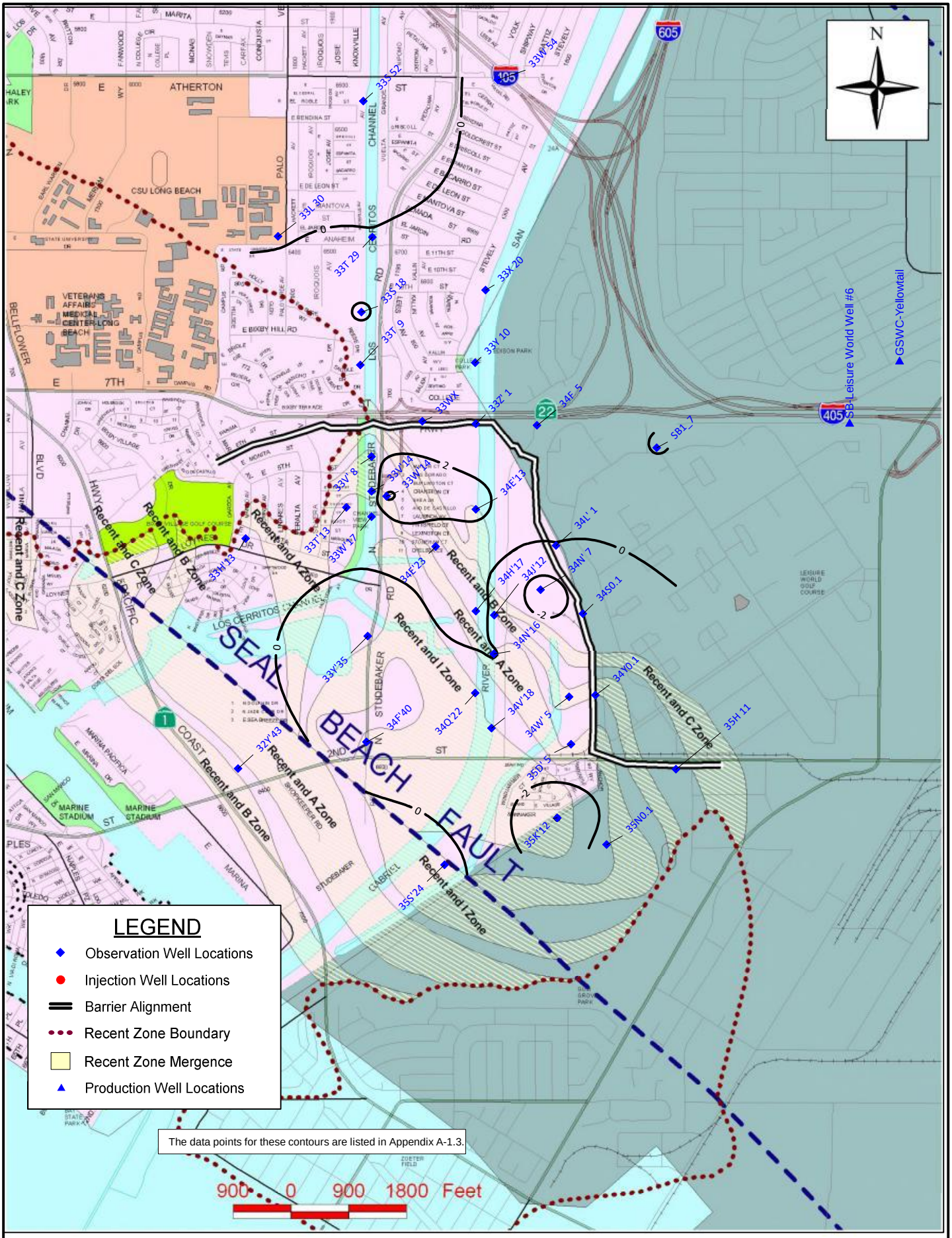
Fiscal Year	Volume of Water Extracted (Ac-Ft)	Total Cost	Cost Per Ac-Ft Extracted
2008-09	0.0	$14,742	N/A
2009-10	0.0	$20,223	N/A
2010-11	0.0	$4,552	N/A
2011-12	0.0	$6,219	N/A
2012-13	0.0	$70,408	N/A
2013-14	0.0	$6,768	N/A
2014-15	0.0	$13,714	N/A
2015-16	0.0	$6,961	N/A
2016-17	0.0	$1,510	N/A
2017-18	0.0	$1,538	N/A

FIXED ASSETS

During FY 2017-18 OCWD connected their newly constructed facilities to the existing ABP water supply pipeline in Phase 2 of the ABP Unit 14 Project. Injection wells 34J(C,B), 34K(C,B), 34N(C,B), 34N(A), 34N(I), 34Q(C,B), 34Q(A), 34Q(I), 34T(C,B), 34T(A), 34T(I), 34X(B), 34X(A), 34X(I), 34Z2(A), 34Z2(I), 35E(A,I), were connected to the ABP supply pipeline. In addition, each of the new injection and observation wells were integrated into LACFCD's existing Seawater Barrier Telemetry System. LACFCD entered into an agreement with OCWD to share the cost to design and construct injection wells 34J(C,B) and 34K(C,B) and monitoring well 34HJ2 which are located between Points B and C. The cost for the ABP Unit 14 Project Phase 1 (well construction) was approximately $10M, and Phase 2 (wellhead completion) was awarded for approximately $3.5M.

BUDGET

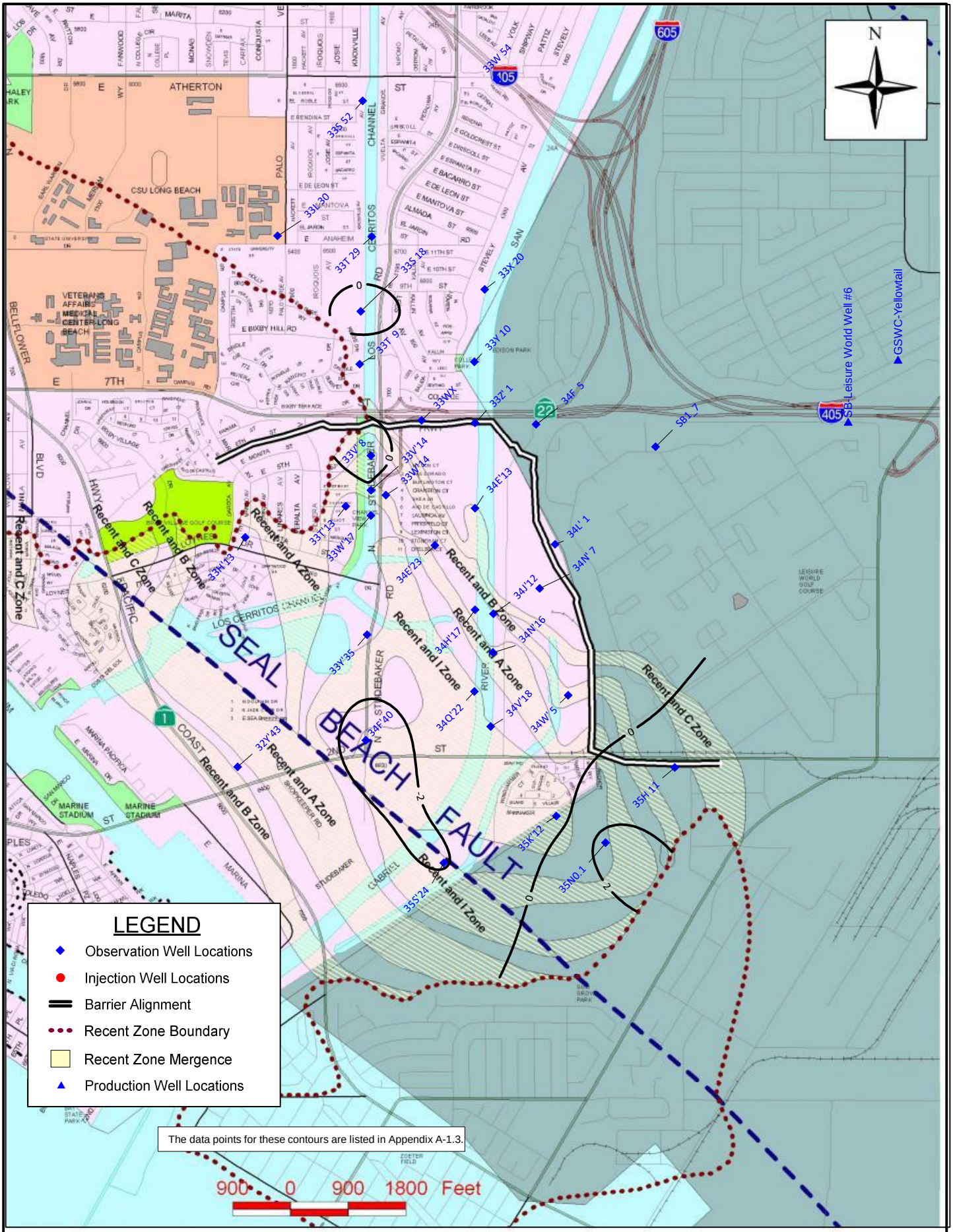
The FY 2019-20 budget for the cost of ABP Supplies and Services is $2,465,000. A breakdown of this amount, along with past expenditures per category, is shown in Appendix A-20.



Alamitos Barrier Project
R Zone Groundwater Elevation (ft) Contours Spring 2018

A-1.1

R zone GW.srf



Alamitos Barrier Project
R Zone: Change in Elevation (ft), Spring 2017 to Spring 2018

A-1.2

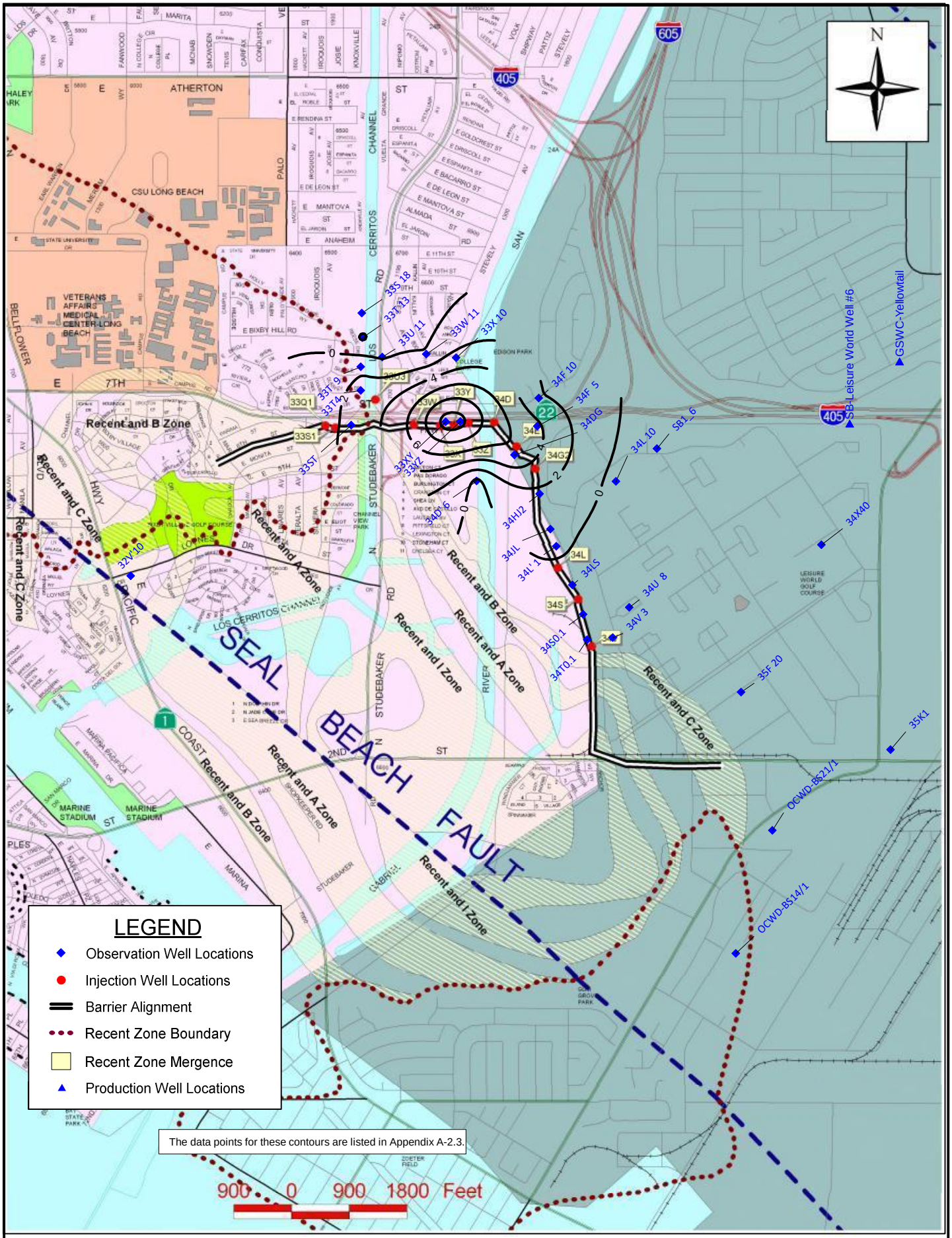
R zone GW.srf

ALAMITOS BARRIER PROJECT
R-Zone
Groundwater Elevation Data for Contours and Tables

POINT	PROJ	FCD	AQUIFER	DATE	FY 17-18 ELEV	P.E.[1]	Δ[2]	FY 16-17 ELEV	CHANGE IN ELEV
1	32Y'43	493WW	R	20180306	1.1			0.9	0.2
2	33H'13	493YY	R,A	20180228	1.0			1.6	-0.6
3	33L 30	491G	R	20180312	-0.2			0.7	-0.9
4	33S 18	492AH	R	20180214	2.3			1.8	0.5
5	33S 52	491J	R	20180305	-1.1			-0.9	-0.2
6	33T 9	492CV	R	20180405	0.5			1.1	-0.6
7	33T 29	491D	R	20180305	0.1			0.9	-0.8
8	33T'13	492AU	R	20180312	1.5			3.3	-1.8
9	33V' 8	492BY	R,A	20180307	1.7			0.8	0.9
10	33V'14	492JJ	R	20180307	0.3			0.4	-0.1
11	33W 54	501C	R	20180312	0.4			1.5	-1.1
12	33W'14	492AT	R	20180301	4.5			6.0	-1.5
13	33W'17	493PP	R	20180301	0.3			1.7	-1.4
14	33WX	502AZ	R	20180329	0.6			1.6	-1.0
15	33X 20	502L	R	20180405	0.4			0.8	-0.4
16	33Y 10	502BA	R	20180306	0.3			0.3	0.0
17	33Y'35	493AB	R	20180306	-1.4			0.2	-1.6
18	33Z' 1	502AU	R	20180308	0.5			1.2	-0.7
19	34E'13	503AU	R	20180312	2.5			4.4	-1.9
20	34E'23	503X	R	20180313	0.6			1.8	-1.2
21	34F 5	502BT	R	20180320	1.0			1.5	-0.5
22	34F'40	483J	R	20180305	-0.7			1.8	-2.5
23	34H'17	503Y	R	20180308	0.9			1.3	-0.4
24	34J'12	503U	R	20180305	-0.5			0.6	-1.1
25	34L' 1	503P	R	20180329	-0.1			0.4	-0.5
26	34N' 7	503AE	R	20180404	-3.0			-2.5	-0.5
27	34N'16	503W	R	20180403	0.1			0.2	-0.1
28	34S0.1	503BT	R	20180319	-0.8				n/a
29	34Q'22	503T	R	20180308	-1.2			0.1	-1.3
30	34V'18	503V	R	20180305	0.0			0.4	-0.4
31	34W' 5	503AH	R	20180301	-0.4			0.4	-0.8
32	34Y0.1	503CK	R	20180319	-1.3				n/a
33	35D' 5	503AL	R	20180301	0.0				n/a
34	35H 11	514F	R	20180319	-0.8			-1.3	0.5
35	35K'12	504R	R	20180228	-4.1			-3.4	-0.7
36	35N0.1	504M	R	20180228	-1.3			-4.0	2.7
37	35S'24	504K	R	20180308	0.7			2.8	-2.1
38	SB1_7		R	20180418	2.1			2.7	-0.6
				AVG=	0.2		AVG=	0.9	

[1] P.E. represents the protective elevations calcuated for internodal wells.
[2] Δ (+/-) represents how much groundwater level is above/below respective P.E.

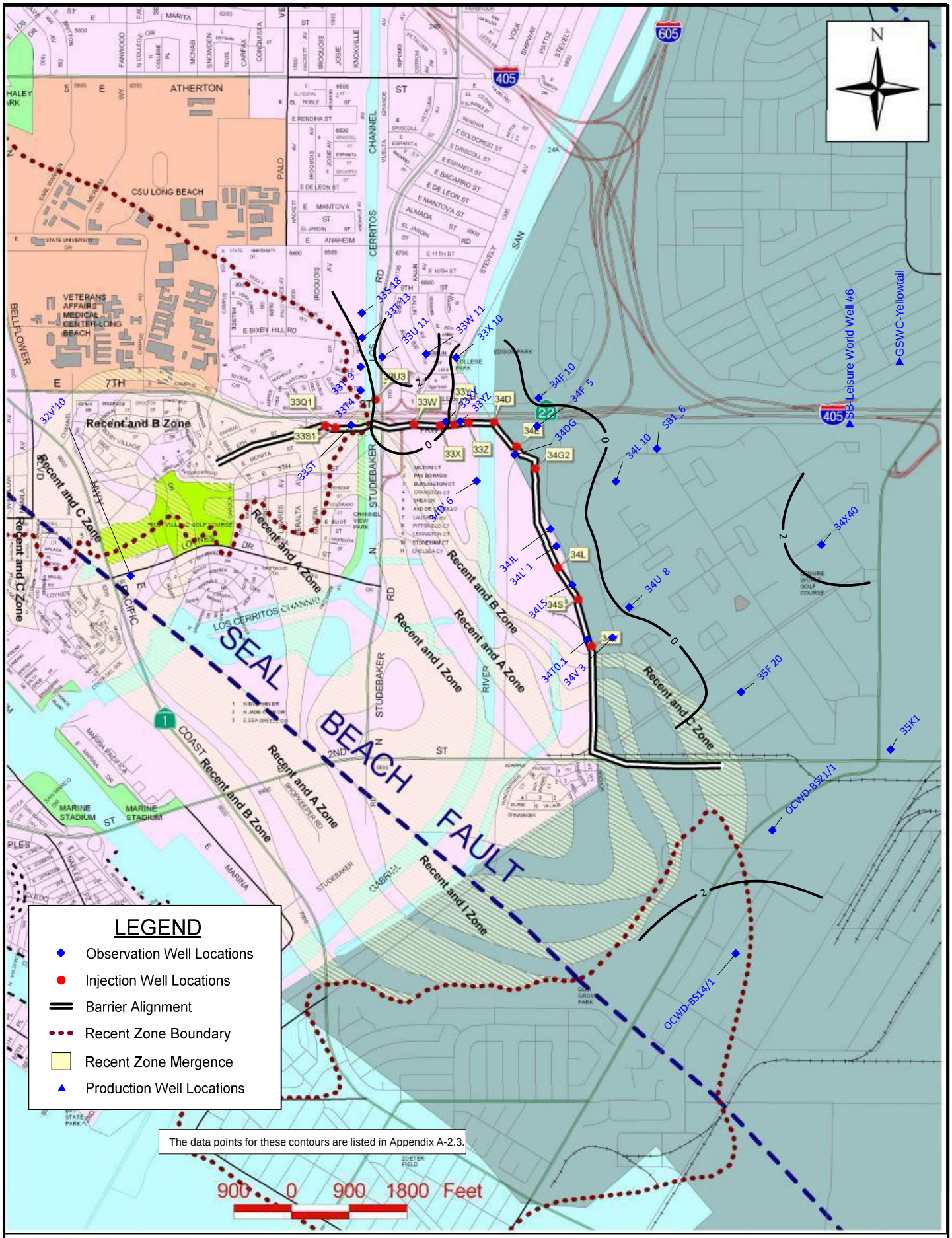
[ ] = A max. or min. elevation during that period.



Alamitos Barrier Project
C Zone Groundwater Elevation (ft) Contours Spring 2018

A-2.1

C zone GW.sif



Alamitos Barrier Project
C Zone: Change in Elevation (ft), Spring 2017 to Spring 2018

A-2.2

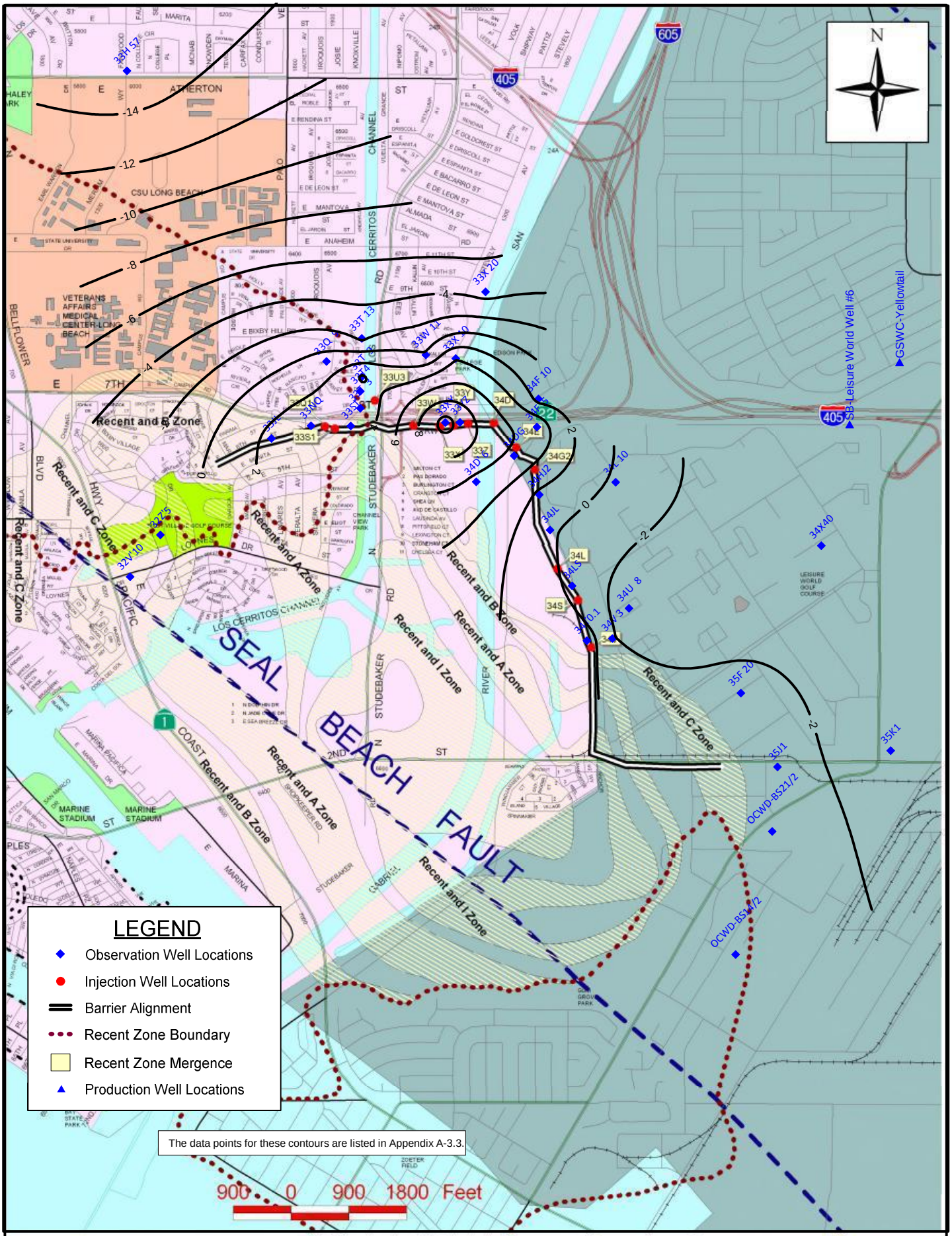
C zone GW.sif

ALAMITOS BARRIER PROJECT
C-Zone
Groundwater Elevation Data for Contours and Tables

POINT	PROJ	FCD	AQUIFER	DATE	FY 17-18 ELEV	P.E.[1]	Δ[2]	FY 16-17 ELEV	CHANGE IN ELEV
1	32V'10	483H	C	20180228	-1.2			-0.4	-0.8
2	33S 18	492AG	C	20180214	-0.4			-1.1	0.7
3	33ST	492BK	C,B	20180321	2.3	0.9	1.4	2.6	-0.3
4	33T 9	492CU	C	20180312	1.7			3.0	-1.3
5	33T 13	492AC	C	20180405	-2.3			-2.6	0.3
6	33T4	492CT	C	20180312	2.5			3.5	-1.0
7	33U 11	492AL	C	20180403	-0.2			-3.8	3.6
8	33W 11	502R	C	20180404	0.2			-3.7	3.9
9	33X 10	502BB	C	20180312	2.7			3.6	-0.9
10	33XY	502BL	C	20180315	10.9	5.4	5.5	10.6	0.3
11	33YZ	502AB	C	20180320	10.6	5.4	5.2	11.8	-1.2
12	34D' 6	502BF	C	20180308	-0.5			0.5	-1.0
13	34DG	502X	C	20180315	5.7	5.4	0.3	7.5	-1.8
14	34F 5	502BU	C	20180320	4.4			5.9	-1.5
15	34F 10	502AP	C	20180405	2.2			1.7	0.5
16	34HJ2	502BA	C	20180319	0.4	4.1	-3.7		n/a
17	34JL	503AR	C	20180319	0.2	4.2	-4.0	0.2	0.0
18	34L' 1	503N	C	20180319	0.4	4.8	-4.4	1.1	-0.7
19	34L 10	502AK	C	20180306	-0.5			-0.9	0.4
20	34LS	503BF	C	20180329	-0.9	4.5	-5.4	-0.6	-0.3
21	34S0.1	503BU	C	20180319	-0.9	3.7	-4.6		n/a
22	34T0.1	503AB	C	20180329	-0.2	3.6	-3.8	0.5	-0.7
23	34U 8	513D	C	20180308	-1.3			-1.6	0.3
24	34V3	503CB	C	20180308	-1.5			-0.3	-1.2
25	34X40	513R	C	20180412	-0.4			-3.0	2.6
26	35F 20	513L	C	20180308	-0.2			-0.3	0.1
27	35K1	523D	C	20180329	-1.6	4.3	-5.9	-1.9	0.3
28	SB1_6		C	20180301	-1.2			-1.3	0.1
29	OCWD-BS14/1		C	20180301	-1.2			-4.2	3.0
30	OCWD-BS21/1		C	20180301	-0.7			-2.1	1.4
				AVG=	1.0		AVG=	0.9	

[1] P.E. represents the protective elevations calcuated for internodal wells.
[2] Δ (+/-) represents how much groundwater level is above/below respective P.E.

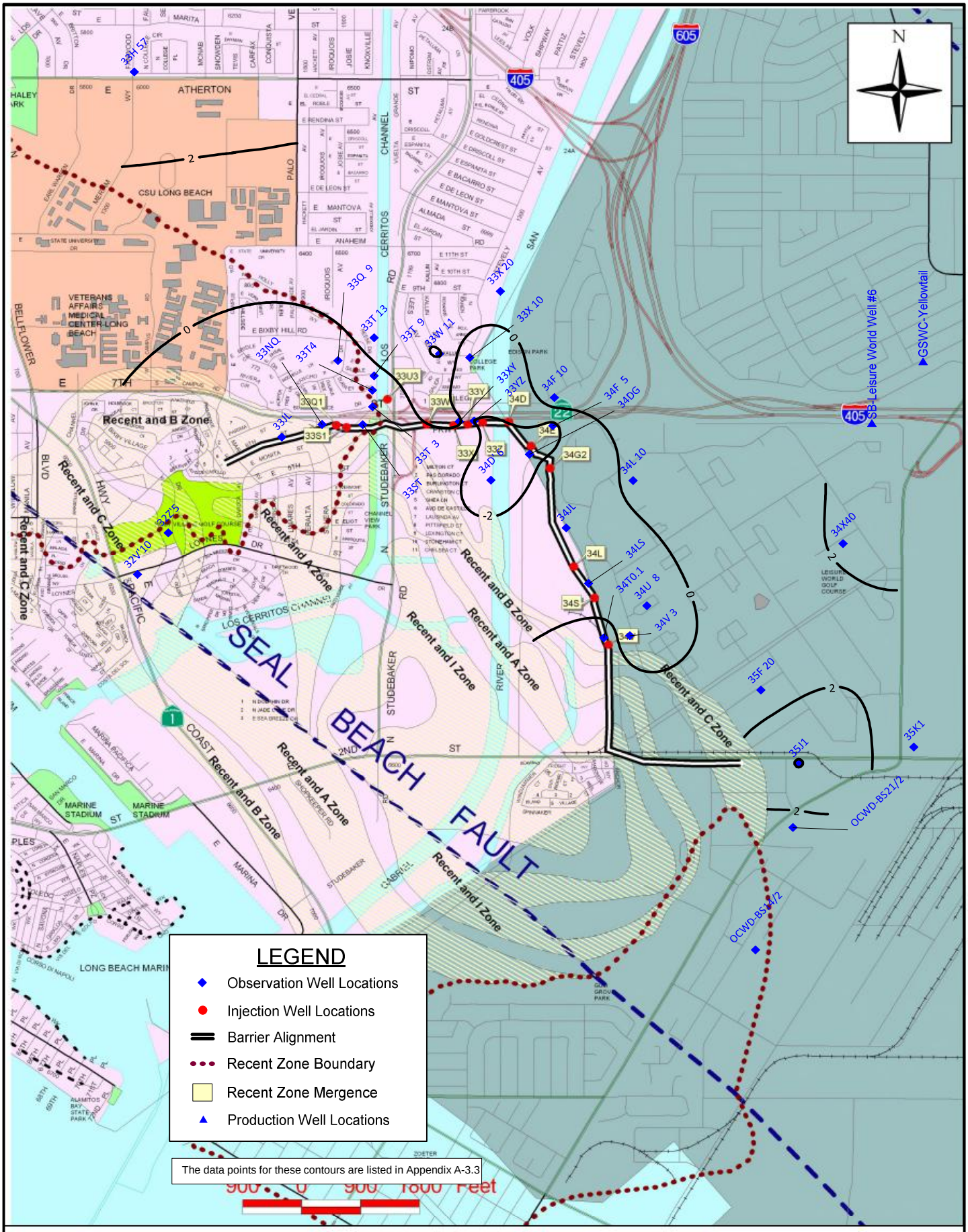
[ ] = A max. or min. elevation during that period.



Alamitos Barrier Project
B Zone Groundwater Elevation (ft) Contours Spring 2018

A-3.1

B zone GW.srf



Alamitos Barrier Project
B Zone: Change in Elevation (ft), Spring 2017 to Spring 2018

A-3.2

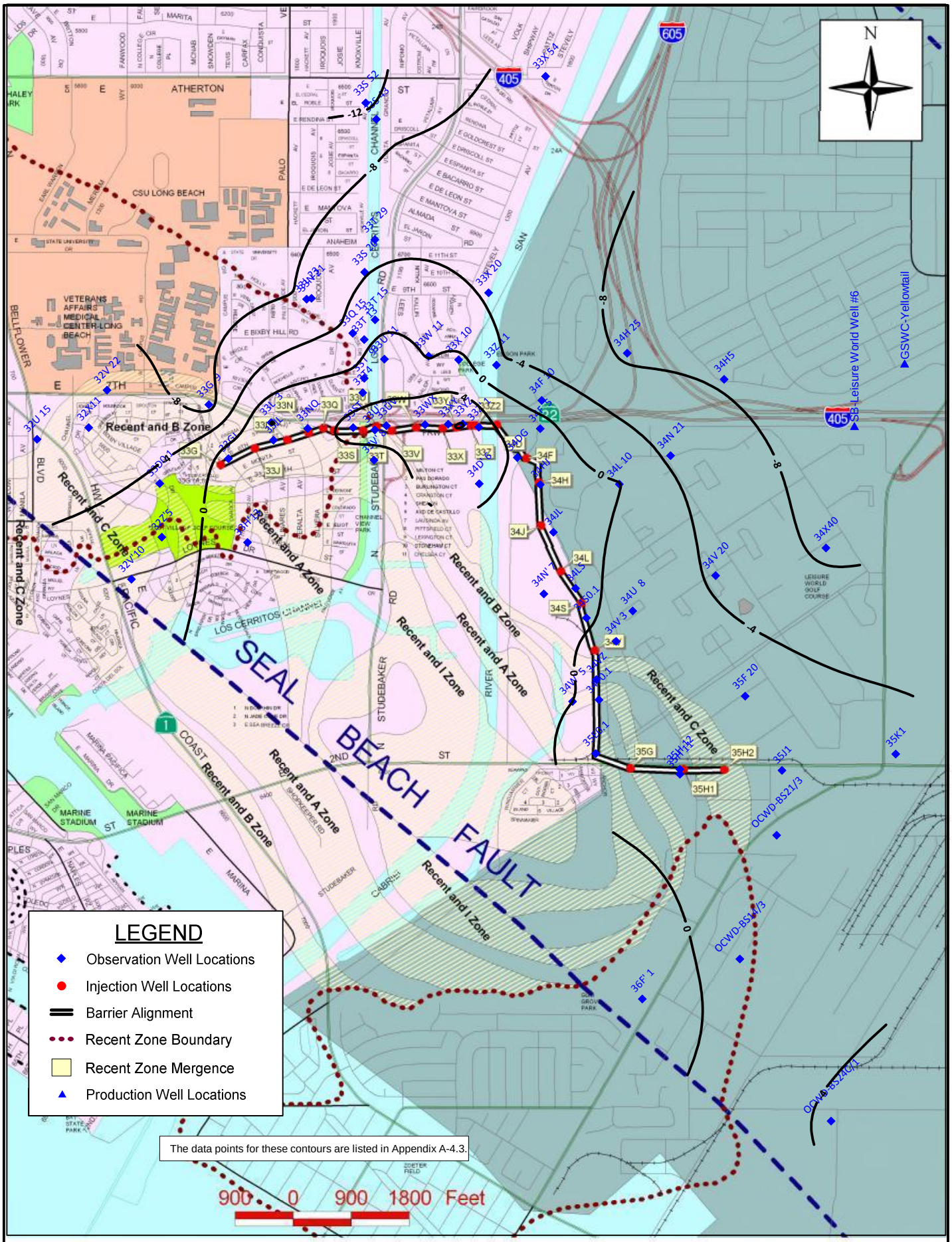
B zone GW.srf

ALAMITOS BARRIER PROJECT
B-Zone
Groundwater Elevation Data for Contours and Tables

POINT	PROJ	FCD	AQUIFER	DATE	FY 17-18 ELEV	P.E.[1]	Δ[2]	FY 16-17 ELEV	CHANGE IN ELEV
1	32V'10	483G	B	20180228	-1.5			-1.3	-0.2
2	32Z'5	482W	B,A	20180307	-1.2			-0.7	-0.5
3	33H 57	481	B	20180327	-15.6			-18.6	3.0
4	33JL	492BQ	B	20180329	2.5	0.8	1.7	3.7	-1.2
5	33NQ	492BN	B	20180329	3.0	0.7	2.3	4.3	-1.3
6	33Q 9	492CM	B	20180312	1.0			2.7	-1.7
7	33ST	492BK	C,B	20180321	2.3	0.9	1.4	2.6	-0.3
8	33T 3	492CL	B	20180307	2.4			3.4	-1.0
9	33T 9	492YY	B	20180417	4.3			4.9	-0.6
10	33T 13	492AB	B	20180405	-2.3			-3.5	1.2
11	33T4	492CS	B	20180312	3.3			5.2	-1.9
12	33U 11	492AK	B	20180403	4.0			-5.0	9.0
13	33W 11	502S	B	20180404	0.2			-2.0	2.2
14	33X 10	502BC	B	20180312	3.9			5.6	-1.7
15	33X 20	502K	B	20180312	-4.7			-5.5	0.8
16	33XY	502BM	B	20180315	10.9	6.3	4.6	10.6	0.3
17	33YZ	502AC	B	20180320	9.2	7.1	2.1	11.3	-2.1
18	34D' 6	502BG	B	20180308	5.4			8.3	-2.9
19	34DG	502Y	B	20180315	5.5	6.6	-1.1	7.6	-2.1
20	34F 5	502BS	B	20180320	5.5			8.0	-2.5
21	34F 10	502AQ	B	20180405	1.4			0.1	1.3
22	34HJ2	502BB	B	20180319	1.6	5.9	-4.3		n/a
23	34JL	503AQ	B	20180319	0.2	5.3	-5.1	0.5	-0.3
24	34L 10	502AL	B	20180306	-0.3			-0.6	0.3
25	34LS	503BE	B	20180319	-0.4	5.4	-5.8	1.2	-1.6
26	34T0.1	503AC	B	20180319	1.0	6.1	-5.1	-0.3	1.3
27	34U 8	513E	B	20180308	-3.3			-2.8	-0.5
28	34V3	503CC	B	20180308	-1.8			-0.6	-1.2
29	34X40	513Q	B	20180412	-2.8			-5.0	2.2
30	35F 20	513K	B	20180308	-1.5			-2.5	1.0
31	35J1	514M	B	20180329	-1.8	5.8	-7.6	-6.0	4.2
32	35K1	523A	B	20180329	-2.3	5.8	-8.1	-3.4	1.1
33	OCWD-BS14/2		B	20180301	-1.6			-3.2	1.6
34	OCWD-BS21/2		B,A	20180301	-1.6			-2.9	1.3
				AVG=	0.7		AVG=	0.5	

[1] P.E. represents the protective elevations calcuated for internodal wells.
[2] Δ (+/-) represents how much groundwater level is above/below respective P.E.

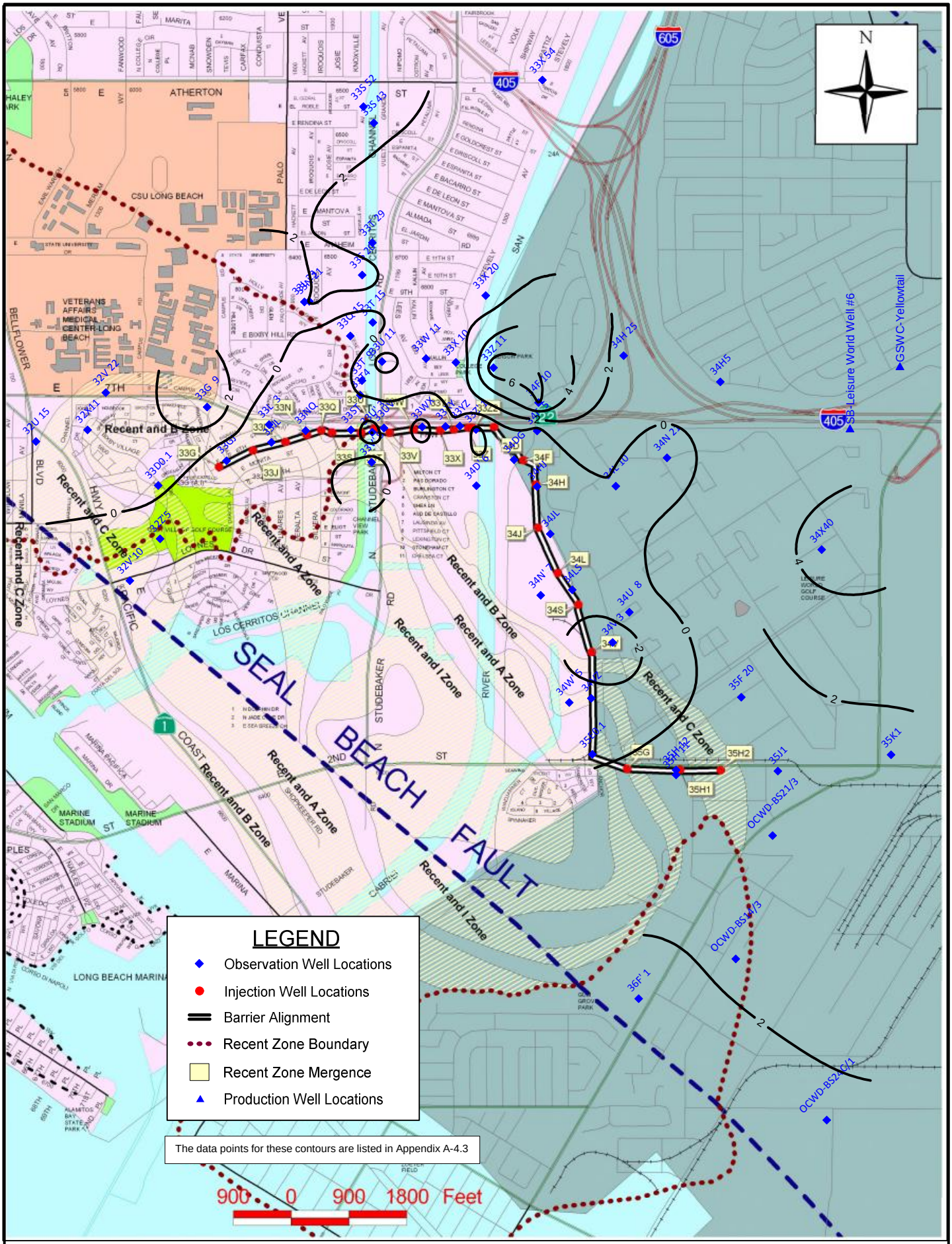
= A max. or min. elevation during that period.



Alamitos Barrier Project
A Zone Groundwater Elevation (ft) Contours Spring 2018

A-4.1

A zone GW.srf



Alamitos Barrier Project
A Zone: Change in Elevation (ft), Spring 2017 to Spring 2018

A-4.2

A zone GW.srf

ALAMITOS BARRIER PROJECT
A-Zone
Groundwater Elevation Data for Contours and Tables (Page 1 of 2)

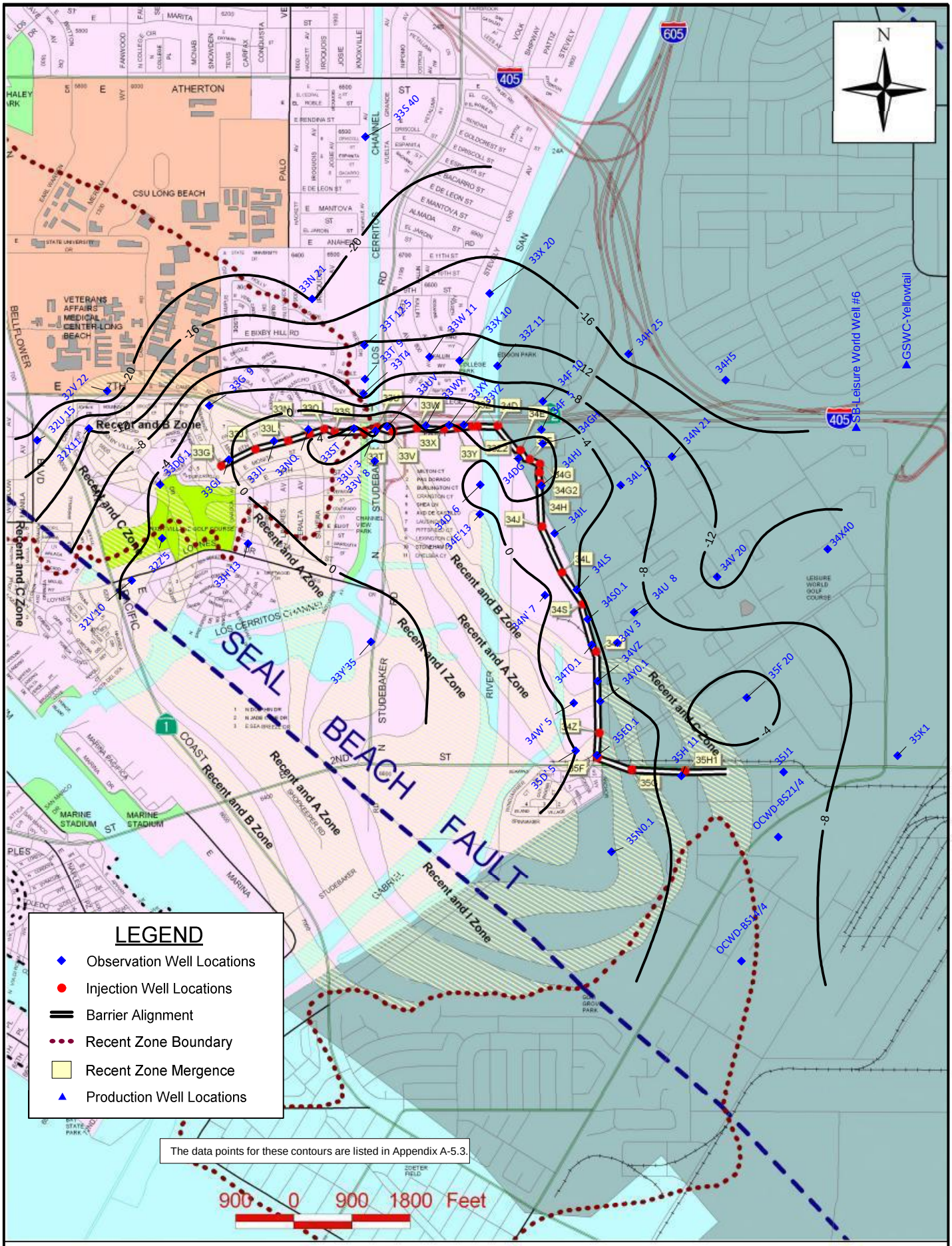
POINT	PROJ	FCD	AQUIFER	DATE	FY 17-18 ELEV	P.E.[1]	Δ[2]	FY 16-17 ELEV	CHANGE IN ELEV
1	32U 15	482M	A	20180307	-5.6			-6.4	0.8
2	32V 22	482P	A	20180307	-5.5			-5.6	0.1
3	32V'10	483F	A	20180228	-1.6			-0.1	-1.5
4	32X11	482S	A	20180315	-7.1			-8.7	1.6
5	32Z'5	482W	A,B	20180307	-1.2			-0.7	-0.5
6	33D0.1	482U	A,I	20180315	-3.1			-3.3	0.2
7	33G 9	482F	A	20180228	-9.2			-13.2	4.0
8	33GJ	482X	A	20180315	1.9	1.4	0.5	3.5	-1.6
9	33H'13	493YY	R,A	20180228	1.0				n/a
10	33JL	492BW	AI	20180319	2.3	3.1	-0.8	2.8	-0.5
11	33L 3	492	A	20180313	4.2			6.0	-1.8
12	33L 23	492RR	A	20180306	-7.7			-8.0	0.3
13	33N 21	492BU	A	20180305	-6.4			-8.8	2.4
14	33NQ	492BP	A,I	20180319	3.6	3.6	0.0	4.1	-0.5
15	33Q 15	492AM	A	20180307	-3.3			-1.4	-1.9
16	33S 20	492BR	A	20180227	-4.2			-7.5	3.3
17	33S 43	491E	A	20180305	-9.1			-11.6	2.5
18	33S 52	491H	A	20180305	-13.4			-17.0	3.6
19	33ST	492BL	A	20180321	4.8	2.8	2.0	5.5	-0.7
20	33T 9	492TT	A	20180417	0.9			0.5	0.4
21	33T 13	492ZZ	A	20180405	-0.9				n/a
22	33T 15	492SS	A	20180307	-0.9			0.0	-0.9
23	33T 29	491C	A	20180305	-5.2			-5.7	0.5
24	33T4	492CR	A	20180312	2.5			2.5	0.0
25	33U 11	492AJ	A	20180403	2.2			-0.7	2.9
26	33U' 3	492WW	A	20180307	6.0			10.2	-4.2
27	33UV	492BH	A	20180320	5.6	4.0	1.6	5.9	-0.3
28	33V' 8	492BY	R,A	20180307	1.7			0.8	0.9
29	33W 11	502T	A	20180404	-0.3			-1.5	1.2
30	33WX	502AF	A	20180327	4.8	7.6	-2.8	7.7	-2.9
31	33X 10	502BD	A	20180312	1.0			0.9	0.1
32	33X 20	502J	A	20180312	-4.4			-5.2	0.8
33	33X 54	501	A,I	20180328	-6.4			-6.7	0.3
34	33XY	502BN	A	20180320	7.9	8.0	-0.1	8.0	-0.1
35	33YZ	502AD	A	20180320	8.1	8.7	-0.6	8.4	-0.3
36	33Z' 1	502G	A	20180308	5.5			8.0	-2.5
37	33Z 11	502V	A	20180417	-3.6			-10.7	7.1
38	34D' 6	502BH	A	20180308	4.9			6.5	-1.6
39	34DG	502Z	A	20180315	3.5	8.5	-5.0	4.9	-1.4

ALAMITOS BARRIER PROJECT
A-Zone
Groundwater Elevation Data for Contours and Tables (Page 2 of 2)

POINT	PROJ	FCD	AQUIFER	DATE	FY 17-18 ELEV	P.E.[1]	Δ[2]	FY 16-17 ELEV	CHANGE IN ELEV
40	34F 5	502BR	A	20180320	1.6			2.3	-0.7
41	34F 10	502AR	A	20180405	-1.8			-7.9	6.1
42	34H 25	502AH	A	20180418	-8.7			-10.0	1.3
43	34H5	512E	A	20180416	-8.3			-9.6	1.3
44	34HJ	502BX	A	20180319	1.3	8.6	-7.3	1.8	-0.5
45	34JL	503AP	A	20180319	1.1	7.8	-6.7	1.4	-0.3
46	34L 10	502AM	A	20180306	0.1			0.1	0.0
47	34LS	503BD	A	20180329	0.5	7.7	-7.2	1.6	-1.1
48	34N 21	512B	A	20180306	-4.6			-3.6	-1.0
49	34N' 7	503AF	A	20180312	0.5			1.0	-0.5
50	34S0.1	503BV	A	20180319	0.4	6.7	-6.3		n/a
51	34U 8	513F	A	20180308	-0.9			-0.4	-0.5
52	34V 3	503CD	A	20180308	-1.2			3.6	-4.8
53	34VZ	503BH	A	20180329	-0.4	4.4	-4.8	0.9	-1.3
54	34Y0.1	503CL	A	20180319	-1.4	2.8	-4.2		n/a
55	34W' 5	503AJ	A	20180301	0.0			1.2	-1.2
56	34X40	513P	A	20180412	-8.7			-13.7	5.0
57	35E0.1	503BK	A	20180329	-1.1	2.4	-3.5	-0.9	-0.2
58	35F 20	513J	A	20180308	-1.6			-2.5	0.9
59	35H 11	514G	A	20180329	-1.3	3.8	-5.1	-2.0	0.7
60	35H 12	514D	A	20180329	-2.3	3.8	-6.1	-3.2	0.9
61	35J1	514L	A	20180329	-1.8			-3.4	1.6
62	35K1	523B	A	20180329	-2.2	6.2	-8.4	-3.4	1.2
63	36F' 1	505D	A	20180301	2.8			-0.1	2.9
64	OCWD-BS14/3		A	20180301	-1.9			-3.5	1.6
65	OCWD-BS21/3		A	20180301	-1.6			-2.8	1.2
66	OCWD-BS24C/1		A	20180301	-4.6			-6.7	2.1
				AVG=	-1.1		AVG=	-1.6	

[1] P.E. represents the protective elevations calcuated for internodal wells.
[2] Δ (+/-) represents how much groundwater level is above/below respective P.E.

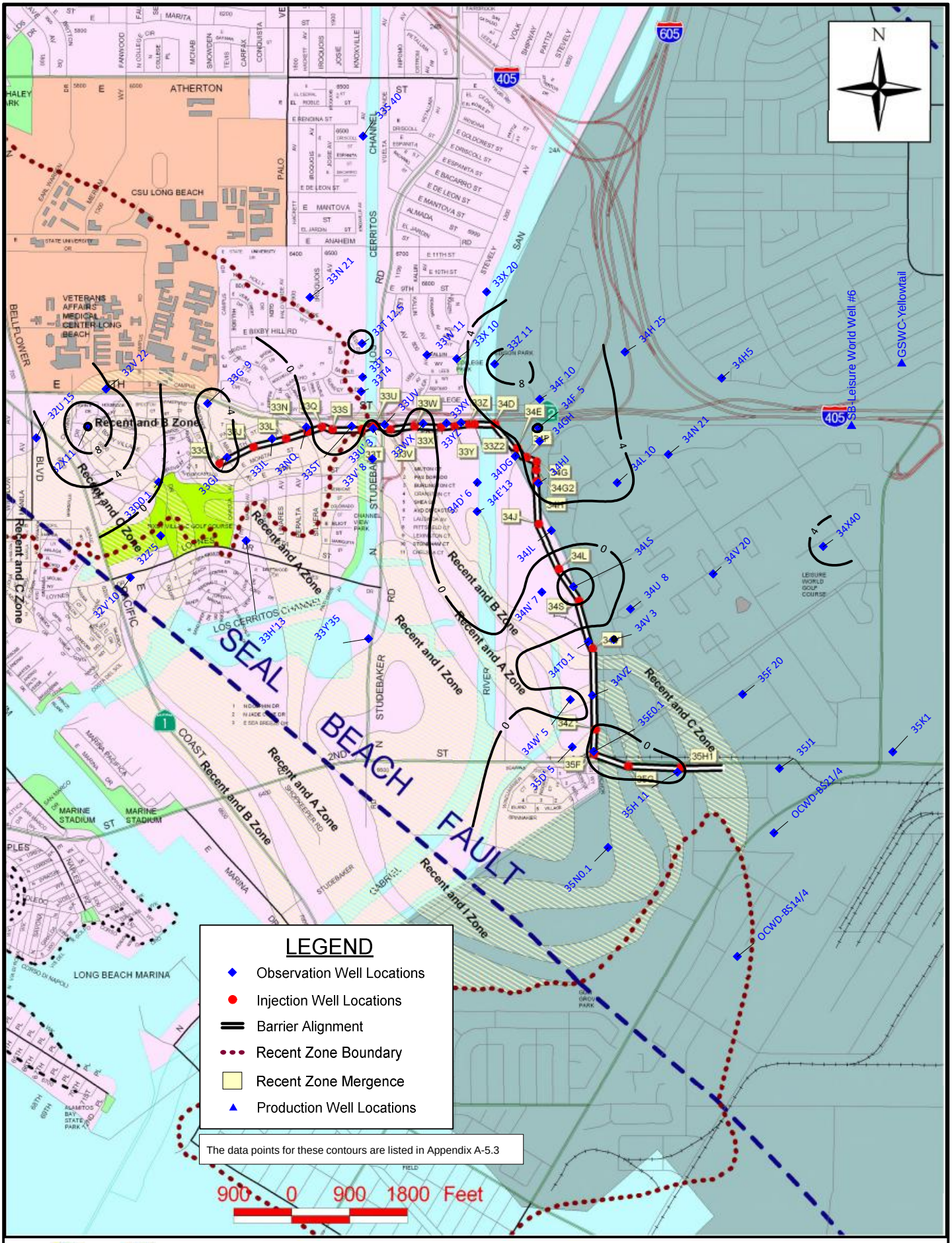
= A max. or min. elevation during that period.



Alamitos Barrier Project
I Zone Groundwater Elevation (ft) Contours Spring 2018

A-5.1

I zone GW.srf



Alamitos Barrier Project
I Zone: Change in Elevation (ft), Spring 2017 to Spring 2018

A-5.2

I zone GW.srf

ALAMITOS BARRIER PROJECT
I-Zone
Groundwater Elevation Data for Contours and Tables (Page 1 of 2)

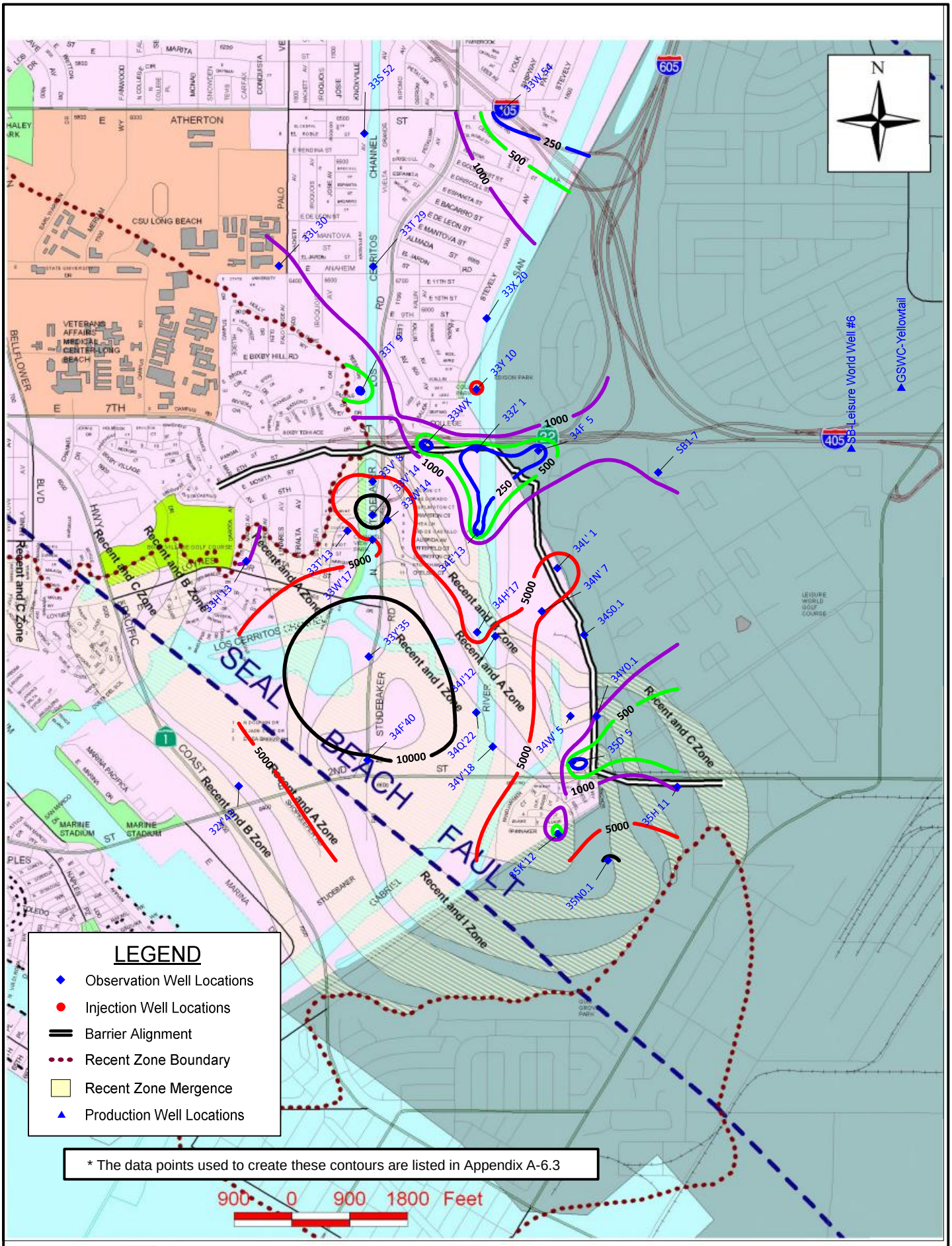
POINT	PROJ	FCD	AQUIFER	DATE	FY 17-18 ELEV	P.E.[1]	Δ[2]	FY 16-17 ELEV	CHANGE IN ELEV
1	32U 15	482L	I	20180307	-19.4			-21.6	2.2
2	32V 22	482N	I	20180307	-23.3			-27.6	4.3
3	32V'10	483E	I	20180228	-3.3			-0.5	-2.8
4	32X11	482R	I	20180315	-12.1			-24.9	12.8
5	32Z'5	482V	I	20180307	-3.7			-1.5	-2.2
6	33D0.1	482U	A,I	20180315	-3.1			-3.3	0.2
7	33G 9	482G	I	20180228	-2.3			3.0	-5.3
8	33GJ	482Y	I	20180329	-0.2	2.6	-2.8	4.7	-4.9
9	33H'13	493XX	I	20180228	-2.7			-1.2	-1.5
10	33JL	492BW	A,I	20180319	2.3	3.1	-0.8	2.8	-0.5
11	33N 21	492BV	I	20180305	-20.2			-23.4	3.2
12	33NQ	492BP	A,I	20180319	3.6	3.6	0.0	4.1	-0.5
13	33S 40	491F	I	20180305	-21.4			-24.8	3.4
14	33ST	492BM	I	20180321	4.7	4.2	0.5	1.1	3.7
15	33T 9	492XX	I	20180409	-9.4			-11.3	1.9
16	33T 12.5	492BT	I	20180307	-11.5			-10.7	-0.8
17	33T4	492CQ	I	20180312	-9.9			-11.5	1.6
18	33U' 3	492QQ	I	20180307	3.7			6.6	-2.9
19	33UV	492BJ	I	20180320	5.2	6.1	-0.9	2.5	2.7
20	33V' 8	492BX	I	20180307	2.0			4.1	-2.1
21	33W 11	502U	I	20180404	-10.5			-13.5	3.0
22	33WX	502AG	I	20180329	-0.6	10.4	-11.0	1.6	-2.2
23	33X 10	502BE	I	20180312	-9.5			-11.5	2.0
24	33X 20	502H	I	20180312	-13.5			-16.1	2.6
25	33XY	502BP	I	20180320	0.3	11.0	-10.7	-2.5	2.8
26	33Y'35	493ZZ	I	20180306	-1.5			-0.5	-1.0
27	33YZ	502AE	I	20180320	-0.4	11.1	-11.5	-2.3	1.9
28	33Z 11	502W	I	20180417	-10.9			-20.5	9.6
29	34D' 6	502BI	I	20180312	-1.0			-2.5	1.5
30	34DG	502AA	I	20180315	1.0	11.3	-10.3	-2.6	3.6
31	34E'13	503AT	I	20180308	0.2			-1.9	2.1
32	34F 5	502BQ	I	20180320	-1.1			-4.6	3.5
33	34F 10	502AS	I	20180405	-5.5			-13.1	7.6
34	34GH	502BV	I	20180315	0.9	10.5	-9.6	-4.3	5.2
35	34H 25	502AJ	I	20180418	-17.0			-19.9	2.9
36	34H5	512D	I	20180416	-19.1			-21.6	2.5
37	34HJ	502BW	I	20180319	0.6	11.0	-10.4	-3.7	4.3
38	34JL	503AN	I	20180319	-3.2	10.5	-13.7	-6.3	3.1

ALAMITOS BARRIER PROJECT
I-Zone
Groundwater Elevation Data for Contours and Tables (Page 2 of 2)

POINT	PROJ	FCD	AQUIFER	DATE	FY 17-18 ELEV	P.E.[1]	Δ[2]	FY 16-17 ELEV	CHANGE IN ELEV
39	34L 10	502AN	I	20180306	-4.4			-9.6	5.2
40	34LS	503BC	I	20180329	-3.9	9.5	-13.4	3.9	-7.8
41	34N 21	512C	I	20180306	-10.5			-11.7	1.2
42	34N' 7	503AG	I	20180312	0.8			1.5	-0.7
43	34S0.1	503BW	I	20180319	-4.0	8.1	-12.1		n/a
44	34T0.1	503AD	I	20180329	-3.4	8.4	-11.8	-5.7	2.3
45	34U 8	513G	I	20180308	-7.2			-9.3	2.1
46	34V3	503CE	I	20180308	-5.0			-4.9	-0.1
47	34V 20	513C	I	20180416	-13.1			-15.4	2.3
48	34VZ	503BG	I	20180329	-3.5	5.9	-9.4	-3.8	0.3
49	34Y0.1	503CM	I	20180319	-4.8	4.8	-9.6		n/a
50	34W' 5	503AK	I	20180301	-0.4			0.0	-0.4
51	34X40	513N	I	20180412	-9.6			-13.9	4.3
52	35D' 5	503AM	I	20180301	0.0			-0.7	0.7
53	35E0.1	503BJ	I	20180329	-1.0	3.0	-4.0	-0.7	-0.3
54	35F 20	513H	I	20180308	-1.5			-2.9	1.4
55	35H 11	514H	I	20180319	-5.4	5.5	-10.9	-5.3	-0.1
56	35J1	513M	I	20180319	-6.2			-6.6	0.4
57	35K1	523C	I	20180319	-10.6			-12.3	1.7
58	35N0.1	504N	I	20180228	-1.4			-2.2	0.8
59	OCWD-BS14/4		I	20180301	-6.8			-8.8	2.0
60	OCWD-BS21/4		I	20180301	-7.0			-8.5	1.5
				AVG=	-5.3		AVG=	-6.8	

[1] P.E. represents the protective elevations calcuated for internodal wells.
[2] Δ (+/-) represents how much groundwater level is above/below respective P.E.

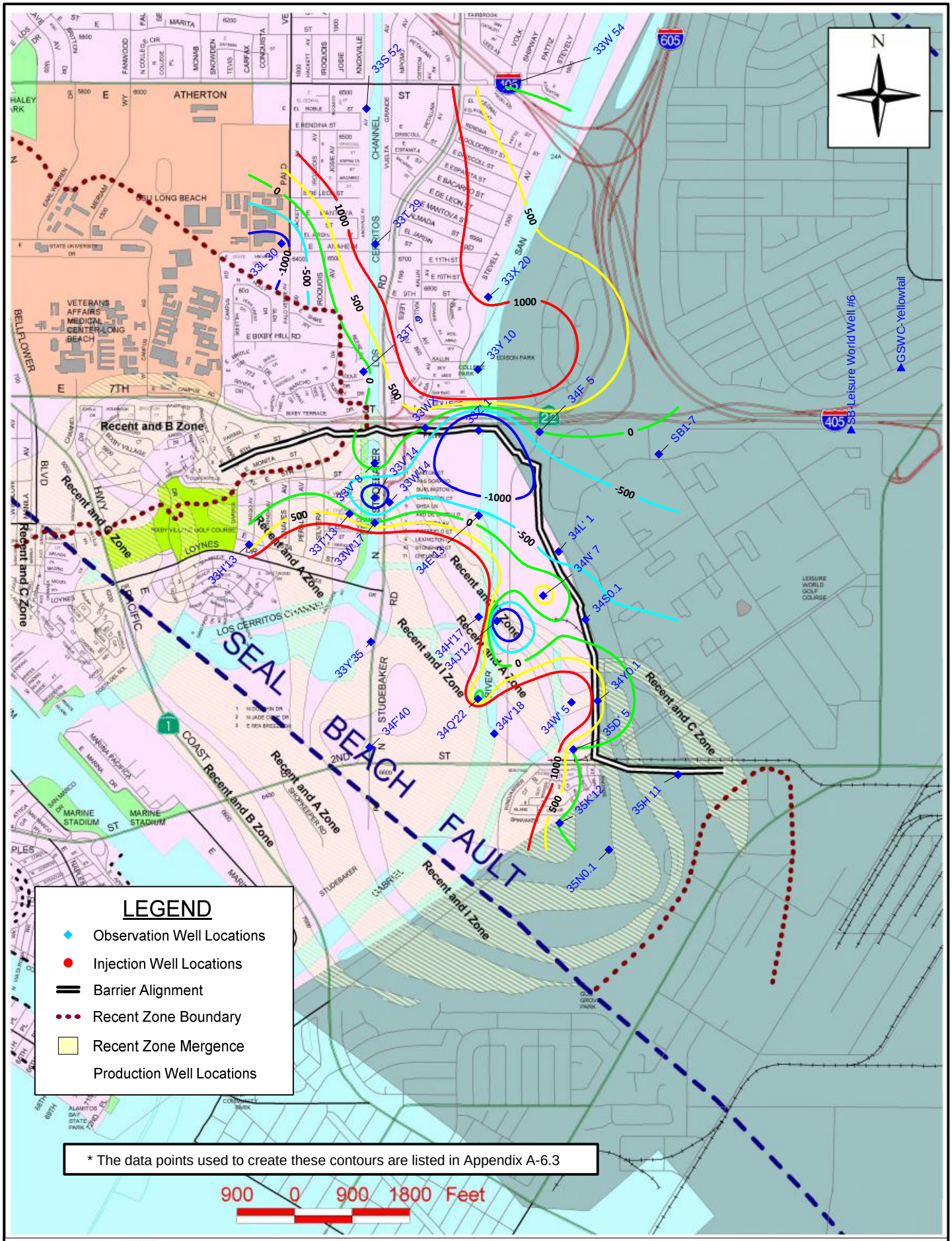
[ ] = A max. or min. elevation during that period.



Alamitos Barrier Project
R Zone Chloride Concentration (mg/L) Contours: Spring 2018

A-6.1

R zone CL.srf



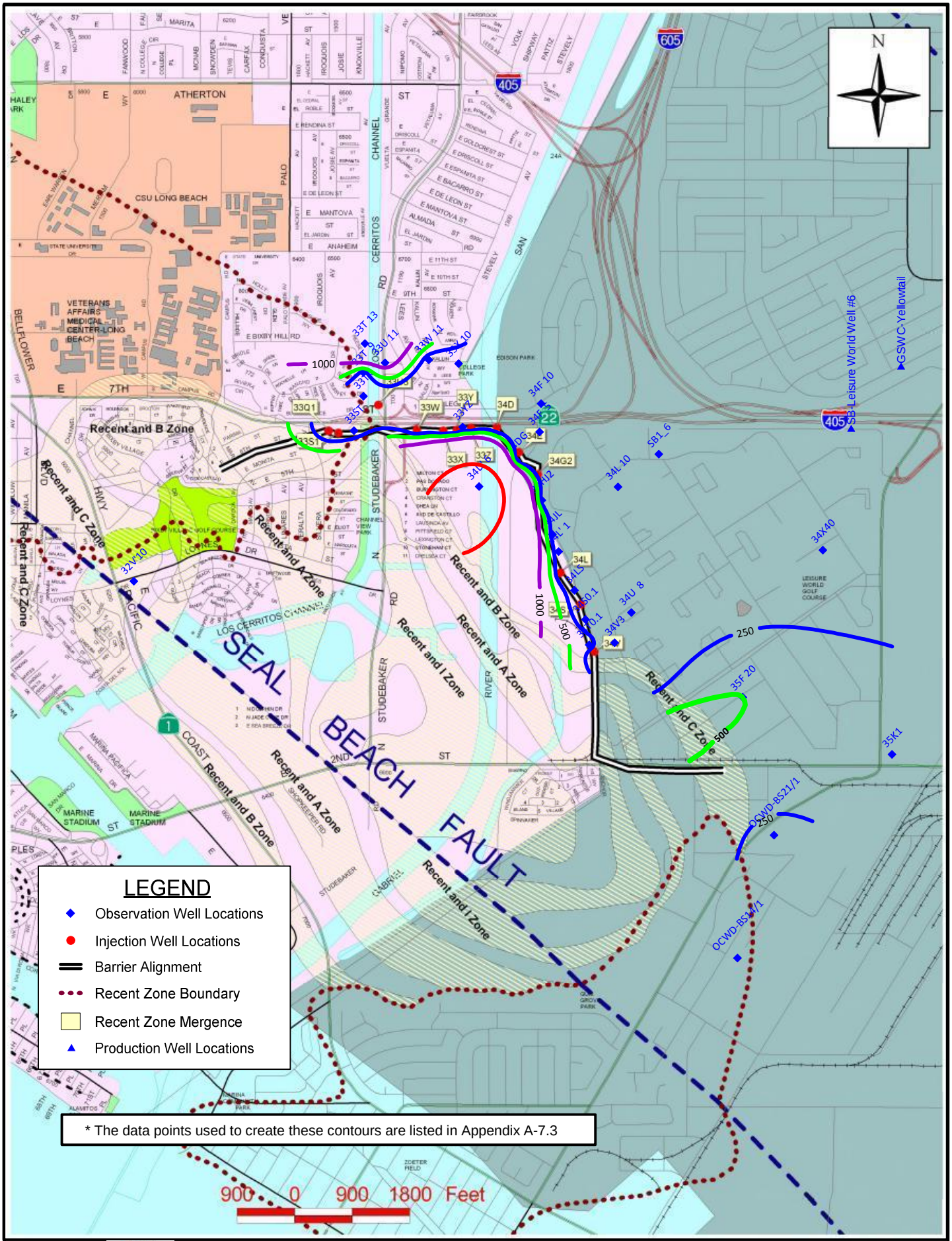
Alamitos Barrier Project
R Zone: Change in Chloride Concentration, Spring 2017 to Spring 2018

A-6.2

R zone CL.sif

ALAMITOS BARRIER PROJECT
R-ZONE CHLORIDE CONCENTRATIONS
Chloride Data Used for Contours and Cross-Section

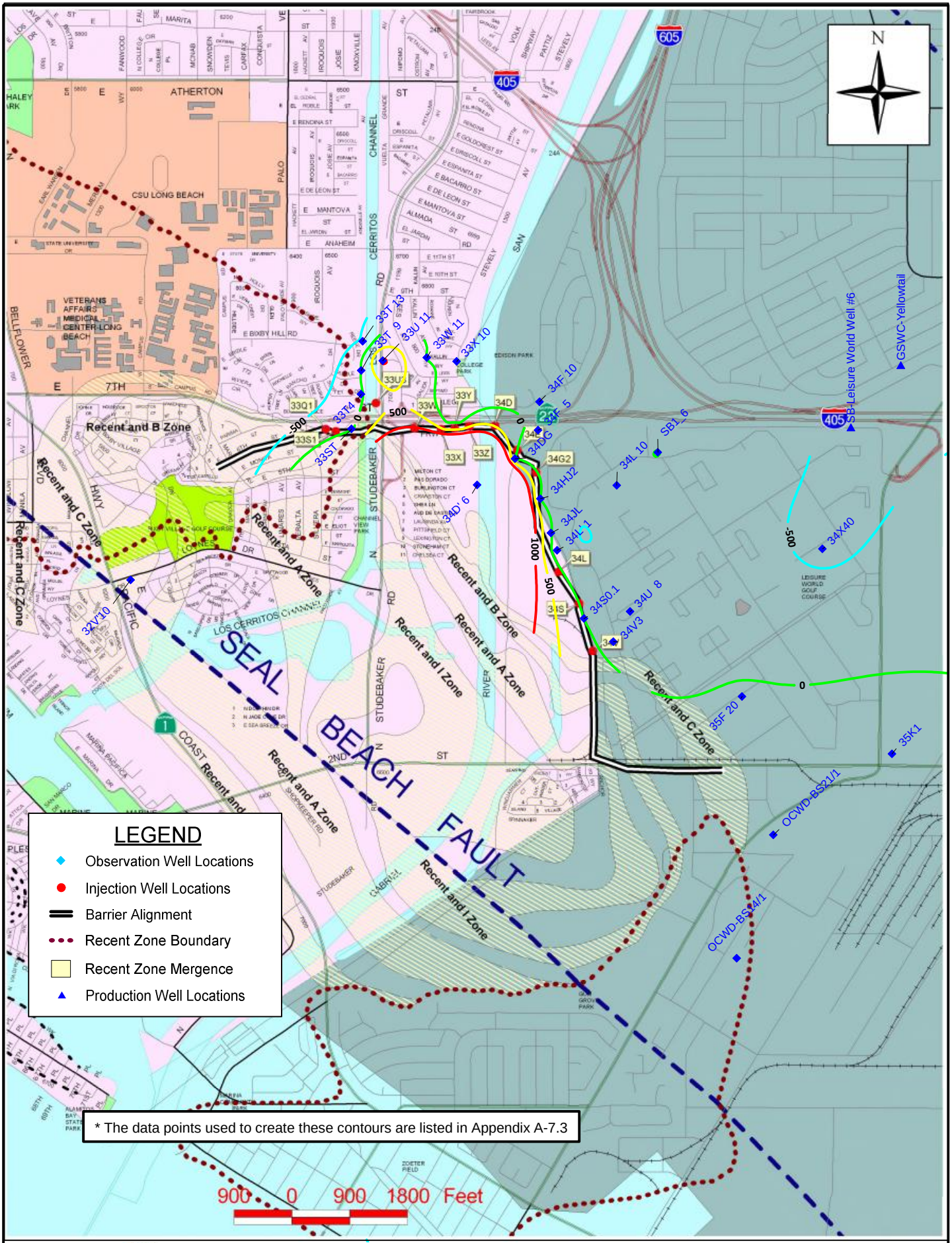
No.	PROJ	FCD	DATE	AQUIFER	For Cross-Section (Internodal Wells in **Bold**)						For Contours	MAX CHLORIDE 16-17	Change in Chloride (FY17-18 - FY16-17)
					ELEV 1 (ft)	CHL 1 (mg/L)	ELEV 2 (ft)	CHL 2 (mg/L)	ELEV 3 (ft)	CHL 3 (mg/L)	MAX CHL. 17-18		
1	32Y'43	493WW	20180306	RECENT	-42.9	1,840					1,840		n/a
2	33H'13	493YY	20180228	(R,A)	-18	339	-38	442	-58	876	876	620	256
3	33L 30	491G	20180312	RECENT	-50	750					750	2,000	-1,250
4	33S 52	491J	20180305	RECENT	-54	2,850					2,850	110	2,740
5	33T 9	492CV	20180405	RECENT	-21	198					198	399	-201
6	33T 29	491D	20180305	RECENT	-56	2,030					2,030	370	1,660
7	33T'13	492AU	20180312	RECENT	-41	2,300	-51	1,230			2,300	2,100	200
8	33V' 8	492BY	20180307	(R,A)	-24	5,490	-48	4,200			5,490	5,100	390
9	33V'14	492JJ	20180307	RECENT	-67	18,200					18,200	20,000	-1,800
10	33W 54	501C	20180312	RECENT	-33	111	-53	123			123	120	3
11	33W'14	492AT	20180301	RECENT	-46	6,680	-66	8,740			8,740	9,500	-760
12	33W'17	493PP	20180301	RECENT	-41	4,570	-51	4,450			4,570	4,500	70
13	**33WX**	**502AZ**	**20180327**	**RECENT**	**-45**	**48**					48	**50**	**-2**
14	33X 20	502L	20180405	RECENT	-68	1,660					1,660	1,110	550
15	33Y 10	502BA	20180306	RECENT	-58	772	-83	5,470			5,470	640	4,830
16	33Y'35	493AB	20180306	RECENT	-36	22,100					22,100	9,400	12,700
17	**33Z' 1**	**502AU**	**20180405**	**RECENT**	**-46**	**17**	**-56**	**30**			30	**3,260**	**-3,230**
18	34E'13	503AU	20180312	RECENT	-19	70	-52	75			75	380	-305
19	34F 5	502BT	20180327	RECENT	-136	67	-146	67	-156	67	67	79	-12
20	34F'40	483J	20180305	RECENT	-40	9,540					9,540	5,900	3,640
21	34H'17	503Y	20180305	RECENT	-46	3,380					3,380	400	2,980
22	34J'12	503U	20180305	RECENT	-28	5,700	-36	6,100			6,100	8,400	-2,300
23	**34L' 1**	**503P**	**20180329**	**RECENT**	**-57**	**6,270**					6,270	**7,120**	**-850**
24	34N' 7	503AE	20180312	RECENT	-51	4,490	-61	5,110	-70	4,770	5,110	4,200	910
25	34Q'22	503T	20180228	RECENT	-42	8,090	-57	8,360			8,360	8,700	-340
26	**34S0.1**	**503BT**	**20180424**	**RECENT**	**-59**	**2,360**	**-69**	**2,620**			**2,620**	**3,030**	**-410**
27	34V'18	503V	20180305	RECENT	-48	9,290					9,290	2,900	6,390
28	34W' 5	503AH	20180301	RECENT	-51	2,670					2,670	220	2,450
29	**34Y0.1**	**503CK**	**20180425**	**RECENT**	**-60**	**97**	**-70**	**876**			**876**	**250**	**626**
30	35D' 5	503AL	20180301	RECENT	-57	120					120	180	-60
31	**35H 11**	**514F**	**20180403**	**RECENT**	**-42**	**109**	**-65**	**745**			**745**	**760**	**-15**
32	35K'12	504R	20180228	RECENT	-44	125	-54	116			125	200	-75
33	35N0.1	504M	20180228	RECENT	-38	10,700	-62	10,900			10,900	11,000	-100
34	SB1-7		20180430	RECENT		825					825	1,000	-175



Alamitos Barrier Project
C Zone Chloride Concentration (mg/L) Contours: Spring 2018

A-7.1

C zone CL.sf



Alamitos Barrier Project
C Zone: Change in Chloride Concentration, Spring 2017 to Spring 2018

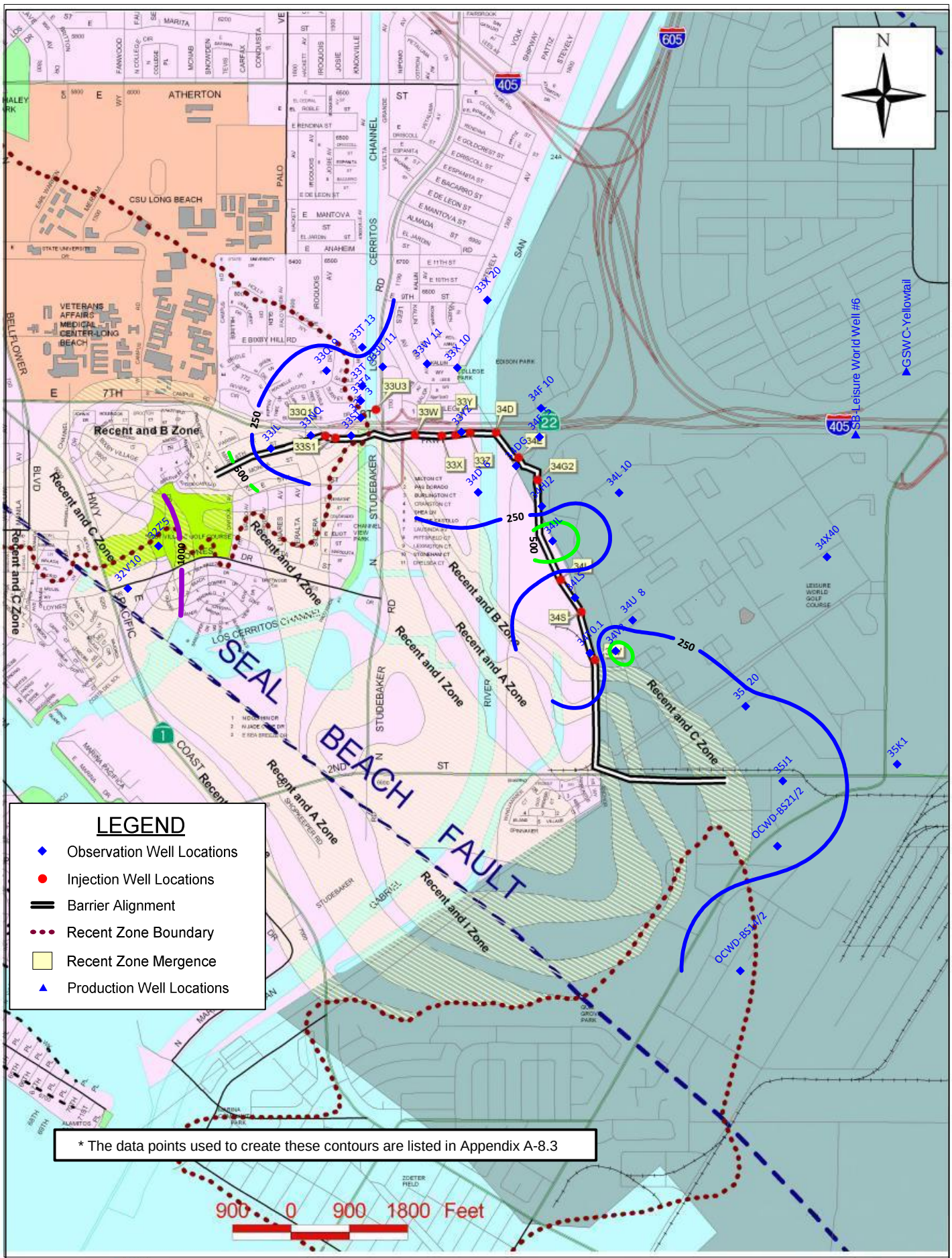
A-7.2

C zone CL.srf

ALAMITOS BARRIER PROJECT
C-ZONE CHLORIDE CONCENTRATIONS
Chloride Data Used for Contours and Cross-Section

No.	PROJ	FCD	DATE	AQUIFER	For Cross-Section (Internodal Wells in **Bold**)						For Contours	MAX CHLORIDE 16-17	Change in Chloride (FY17-18 - FY16-17)
					ELEV 1 (ft)	CHL 1 (mg/L)	ELEV 2 (ft)	CHL 2 (mg/L)	ELEV 3 (ft)	CHL 3 (mg/L)	MAX CHL. 17-18		
1	32V'10	483H	20180228	C ZONE	-37	941					941	3,200	-2,259
2	**33ST**	**492BK**	**20180321**	**C ZONE**	**-25**	**67**					**67**	**120**	**-53**
3	33T 9	492CU	20180409	(C,B)	-129	106	-144	108			108	116	-8
4	33T 13	492AC	20180405	C ZONE	-199	2,590					2,590	3,040	-450
5	33T4	492CT	20180409	C ZONE	-56	66					66	118	-52
6	33U 11	492AL	20180403	C ZONE	-188	1,310					1,310	196	1,114
7	33W 11	502R	20180404	C ZONE	-183	66	-216	79			79	100	-21
8	33X 10	502BB	20180312	C ZONE	-190	67	-215	74			74	64	10
9	**33YZ**	**502AB**	**20180320**	**C ZONE**	**-195**	**61**	**-210**	**61**			**61**		**n/a**
10	34D' 6	502BF	20180312	C ZONE	-125	9,710					9,710	330	9,380
11	**34DG**	**502X**	**20180402**	**C ZONE**	**-190**	**70**	**-205**	**81**			**81**	**85**	**-4**
12	34F 5	502BU	20180327	C ZONE	-191	78	-201	78	-211	78	78	83	-5
13	34F 10	502AP	20180405	C ZONE	-211	69					69	97	-28
14	**34HJ2**	**502BA**	**20180423**	**C ZONE**	**-148**	**64**	**-158**	**87**			**87**	**123**	**-36**
15	**34JL**	**503AR**	**20180411**	**C ZONE**	**-161**	**130**					**130**	**108**	**22**
16	**34L' 1**	**503N**	**20180329**	**C ZONE**	**-162**	**71**					**71**	**350**	**-279**
17	34L 10	502AK	20180306	C ZONE	-166	79					79	82	-3
18	**34LS**	**503BF**	**20180411**	**C ZONE**	**-133**	**109**	**-151**	**90**	**-163**	**89**	**109**		**n/a**
19	**34S0.1**	**503BU**	**20180424**	**C ZONE**	**-129**	**82**	**-139**	**85**			**85**	**93**	**-8**
20	**34T0.1**	**503AB**	**20180329**	**C ZONE**	**-134**	**359**					**359**		**n/a**
21	34U 8	513D	20180418	C ZONE	-150	91	-165	95			95	320	-225
22	34V3	503CB	20180423	C ZONE	-168	95					95	245	-150
23	34X40	513R	20180412	C ZONE	-85	54	-101	72			72	661	-589
24	35F 20	513L	20180418	C ZONE	-70	299	-78	428	-85	519	519	450	69
25	**35K1**	**523D**	**20180409**	**C ZONE**	**-88**	**300**	**-98**	**367**			**367**	**44**	**323**
26	SB1_6		20180430	C ZONE		83					83	73	10
27	OCWD-BS14/1		20180412	C ZONE		225					225	217	8
28	OCWD-BS21/1		20180412	C ZONE		198					198	175	23
29	33Q1	DP1									50	50	n/a
30	33S1	DP2									50	50	n/a
31	33U3	DP3									50	50	n/a
32	33W	DP4									50	50	n/a
33	33X	DP5									50	50	n/a
34	33Y	DP6									50	50	n/a
35	33Z	DP7									50	50	n/a
36	34D	DP8									50	50	n/a
37	34E	DP9									50	50	n/a
38	34L	DP10									50	50	n/a
39	34V	DP11									50	50	n/a

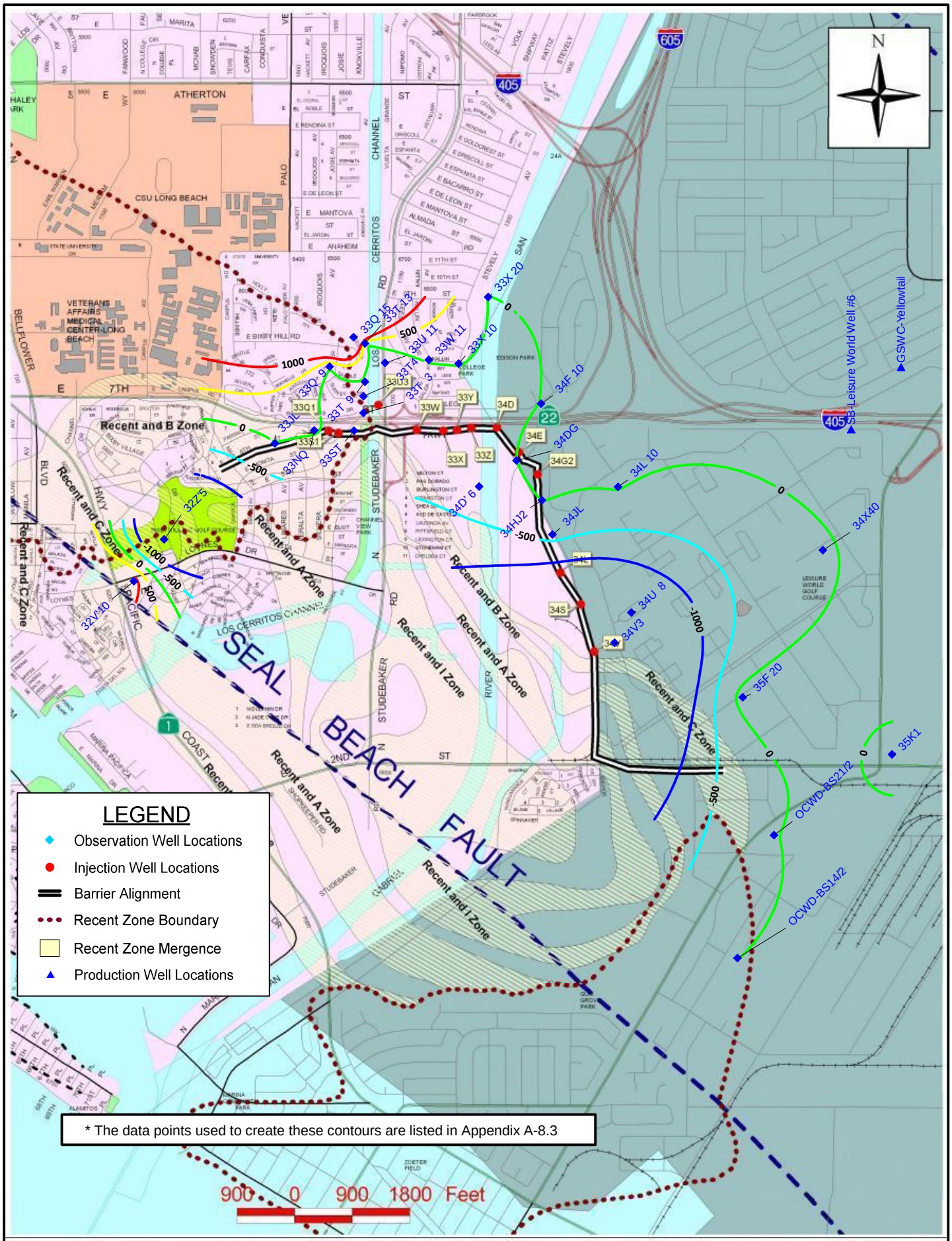
DP = Dummy Point with an assumed chloride concentration of 50 mg/L. Placed at wells that were injecting into this zone during this reporting period.



Alamitos Barrier Project
B Zone Chloride Concentration (mg/L) Contours: Spring 2018

A-8.1

B zone CL.srf



Alamitos Barrier Project
B Zone: Change in Chloride Concentration, Spring 2017 to Spring 2018

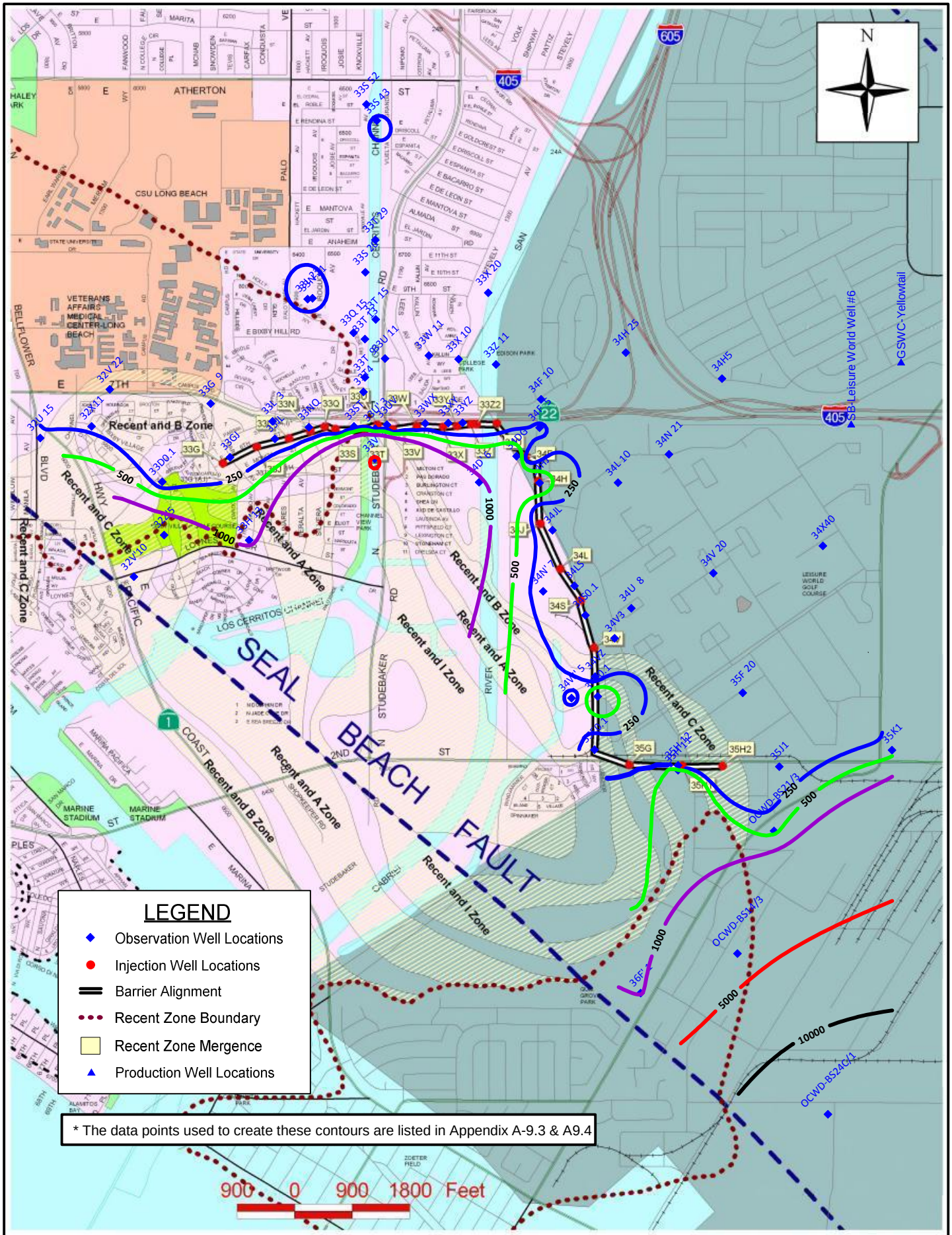
A-8.2

B zone CL.srf

ALAMITOS BARRIER PROJECT
B-ZONE CHLORIDE CONCENTRATIONS
Chloride Data Used for Contours and Cross-Section

No.	PROJ	FCD	DATE	AQUIFER	For Cross-Section (Internodal Wells in **Bold**)						For Contours	MAX CHLORIDE 16-17	Change in Chloride (FY17-18 - FY16-17)
					ELEV 1 (ft)	CHL 1 (mg/L)	ELEV 2 (ft)	CHL 2 (mg/L)	ELEV 3 (ft)	CHL 3 (mg/L)	MAX CHL. 17-18		
1	32V'10	483G	20180228	B ZONE	-62	3,620					3,620	2,400	1,220
2	32Z'5	482W	20180307	(B,A)	-20	755	-30	1,100	-40	1,680	1,680	4,000	-2,320
3	**33JL**	**492BQ**	**20180314**	**B ZONE**	**3**		**-7**	**80**			**80**	**87**	**-7**
4	**33NQ**	**492BN**	**20180319**	**B ZONE**	**-3**	**81**	**-14**	**82**			**82**	**52**	**30**
5	33Q 9	492CM	20180228	B ZONE	-85	115	-95	134	-105	98	134	110	24
6	33ST	492BK	20180321	(C,B)	-25	67					67	120	-53
7	33T 3	492CL	20180307	B ZONE	-40	67	-57	66	-75	67	67	230	-163
8	33T 9	492YY	20180417	B ZONE	-163	116					116	130	-14
9	33T 13	492AB	20180405	B ZONE	-254	320					320	268	52
10	33T4	492CS	20180409	B ZONE	-91	38					38	174	-136
11	33U 11	492AK	20180403	B ZONE	-260	81					81	309	-228
12	33W 11	502S	20180404	B ZONE	-241	113	-269	164			164	131	33
13	33X 10	502BC	20180312	B ZONE	-275	82					82	70	12
14	33X 20	502K	20180405	B ZONE	-266	65					65	75	-10
15	**33YZ**	**502AC**	**20180320**	**B ZONE**	**-214**	**60**	**-263**	**60**			**60**		**n/a**
16	34D' 6	502BG	20180312	B ZONE	-180	112	-194	101			112	320	-208
17	**34DG**	**502Y**	**20180402**	**B ZONE**	**-232**	**67**	**-257**	**80**			**80**	**80**	**0**
18	34F 5	502BS	20180327	B ZONE	-231	75	-260	74			75		n/a
19	34F 10	502AQ	20180405	B ZONE	-269	72					72	68	4
20	**34HJ2**	**502BB**	**20180423**	**B ZONE**	**-203**	**67**	**-215**	**72**	**-228**	**70**	**72**	**66**	**6**
21	**34JL**	**503AQ**	**20180411**	**B ZONE**	**-196**	**797**	**-211**	**934**			**934**	**1,290**	**-356**
22	34L 10	502AL	20180306	B ZONE	-224	78	-249	109			109	82	27
23	**34LS**	**503BE**	**20180411**	**B ZONE**	**-188**	**99**					**99**		**n/a**
24	**34T0.1**	**503AC**	**20180329**	**B ZONE**	**-174**	**84**	**-207**	**84**	**-239**	**86**	**86**		**n/a**
25	34U 8	513E	20180418	B ZONE	-225	85					85	2,000	-1,915
26	34V3	503CC	20180423	B ZONE	-280	680					680	4,400	-3,720
27	34X40	513Q	20180412	B ZONE	-137	18					18	59	-41
28	35F 20	513K	20180418	B ZONE	-115	272					272	110	162
29	**35J1**	**514M**	**20180424**	**B ZONE**	**-128**	**345**	**-143**	**425**	**-148**	**444**	**444**		**n/a**
30	**35K1**	**523A**	**20180409**	**B ZONE**	**-127**	**103**	**-142**	**123**	**-157**	**122**	**123**	**200**	**-77**
31	OCWD-BS14/2		20180412	B ZONE		36					36	41	-5
32	OCWD-BS21/2		20180412	B ZONE		317					317	331	-14
33	33Q1	DP1									50	50	n/a
34	33S1	DP2									50	50	n/a
35	33U3	DP3									50	50	n/a
36	33W	DP4									50	50	n/a
37	33X	DP5									50	50	n/a
38	33Y	DP6									50	50	n/a
39	33Z	DP7									50	50	n/a
40	34D	DP8									50	50	n/a
41	34E	DP9									50	50	n/a
42	34L	DP10									50	50	n/a
43	34V	DP11									50	50	n/a

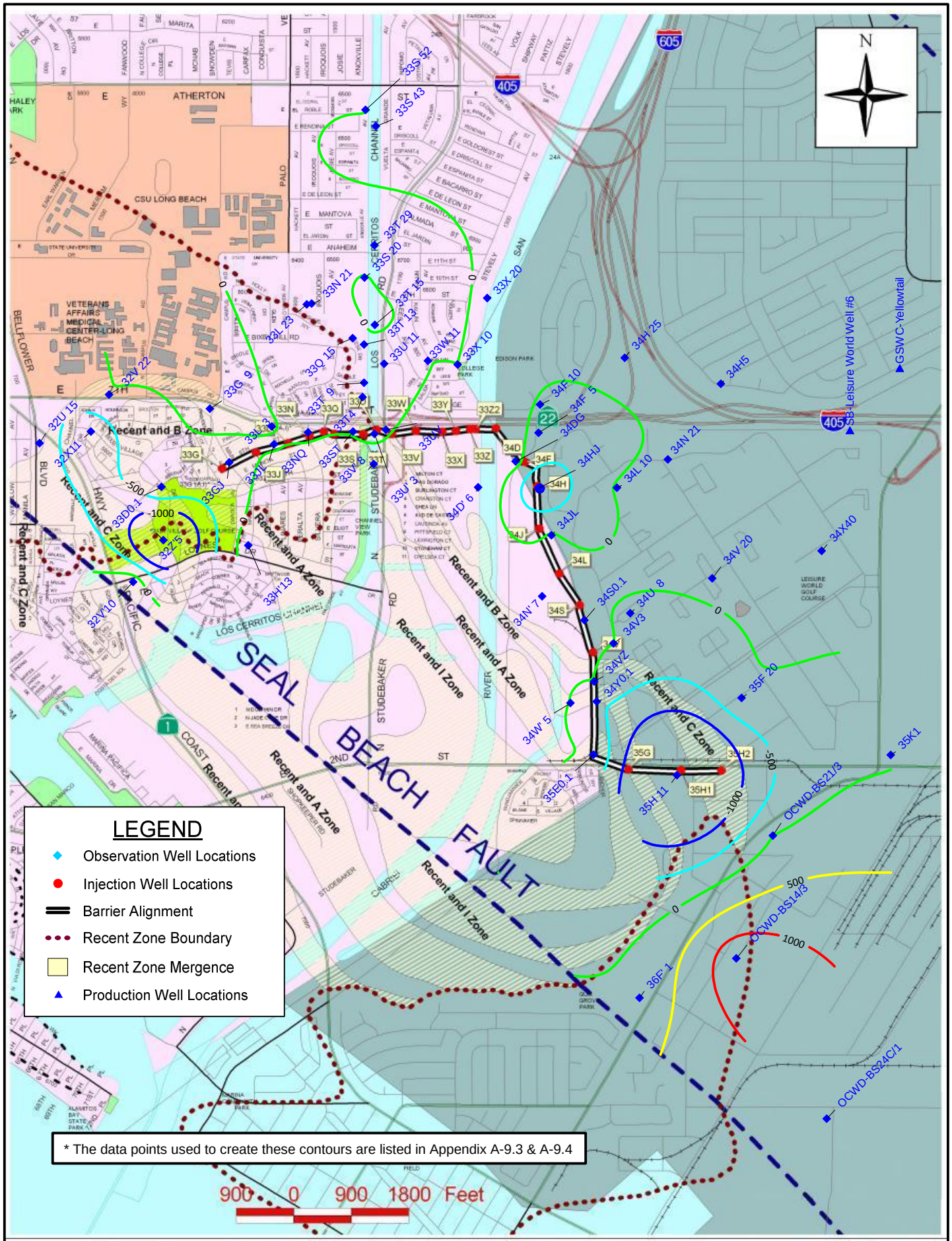
DP = Dummy Point with an assumed chloride concentration of 50 mg/L. Placed at wells that were injecting into this zone during this reporting period.



Alamitos Barrier Project
A Zone Chloride Concentration (mg/L) Contours: Spring 2018

A-9.1

A zone CL.srf



Alamitos Barrier Project

A Zone: Change in Chloride Concentration, Spring 2017 to Spring 2018

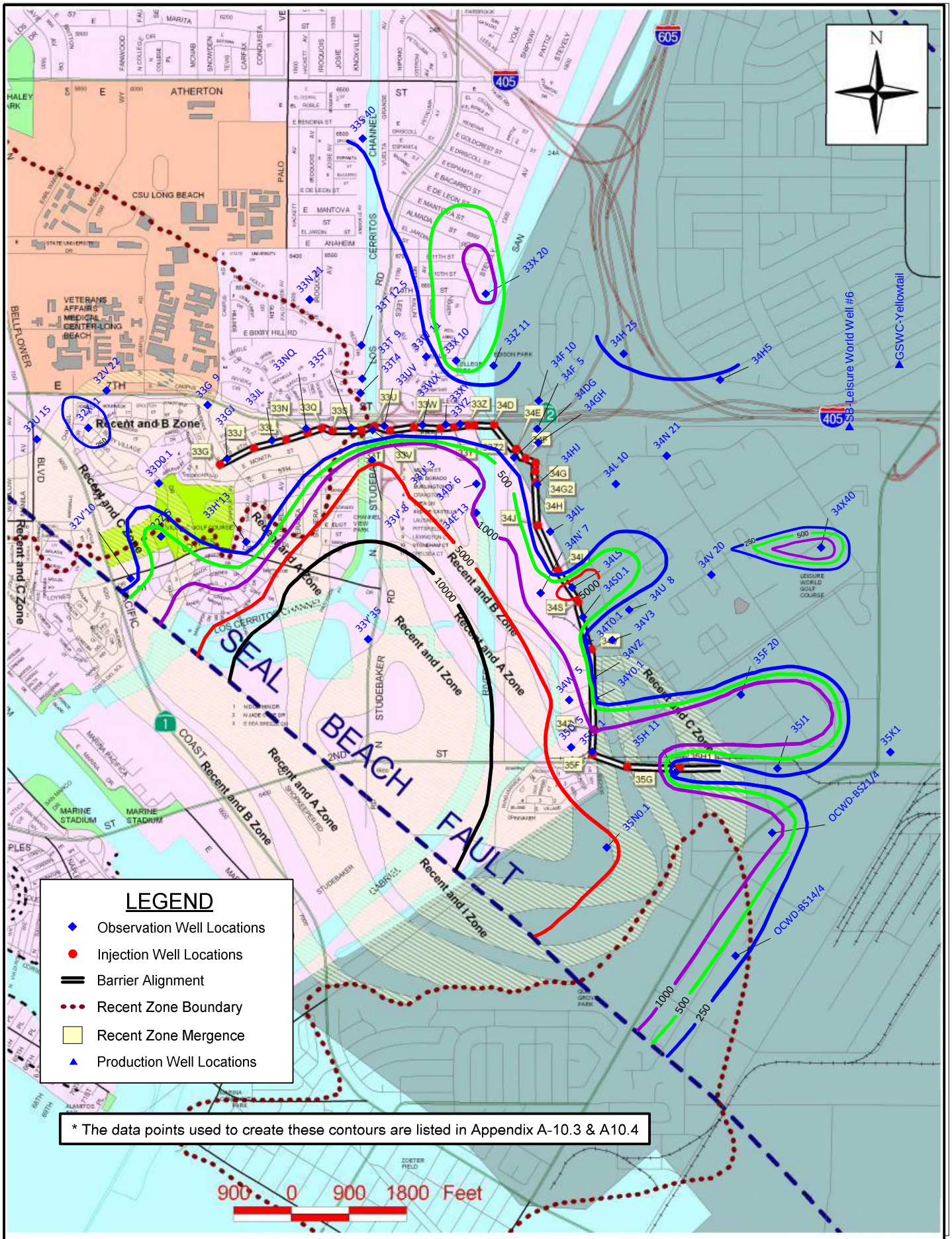
ALAMITOS BARRIER PROJECT
A-ZONE CHLORIDE CONCENTRATIONS
Chloride Data Used for Contours and Cross-Section

No.	PROJ	FCD	DATE	AQUIFER	For Cross-Section (Internodal Wells in **Bold**)						For Contours	MAX CHLORIDE 16-17	Change in Chloride (FY17-18 - FY16-17)
					ELEV 1 (ft)	CHL 1 (mg/L)	ELEV 2 (ft)	CHL 2 (mg/L)	ELEV 3 (ft)	CHL 3 (mg/L)	MAX CHL. 17-18		
1	32U 15	482M	20180307	A ZONE	-17	287					287	550	-263
2	32V 22	482P	20180307	A ZONE	-11	119					119	140	-21
3	32V'10	483F	20180228	A ZONE	-90	2,930	-105	3,200			3,200	2,900	300
4	32X11	482S	20180315	A ZONE	-9		-24	212			212	1,100	-888
5	32Z'5	482W	20180307	(A,I)	-20	755	-30	1,100	-40	1,680	1,680	4,000	-2,320
6	33D0.1	482U	20180315	A ZONE	-24	75	-49	75	-74	75	75	100	-25
7	33G 9	482F	20180228	A ZONE	-3		-23	123			123	79	44
8	**33GJ**	**482X**	**20180319**	**(R,A)**	**-35**	**54**					**54**	**120**	**-66**
9	33H'13	493YY	20180228	(A,I)	-18	339	-38	442	-58	876	876	620	256
10	**33JL**	**492BW**	**20180314**	**A ZONE**	**-41**	**62**	**-79**	**67**	**-116**	**78**	**78**	**94**	**-16**
11	33L 3	492	20180313	A ZONE	-60	94					94	82	12
12	33L 23	492RR	20180306	A ZONE	-344	321					321	380	-59
13	33N 21	492BU	20180305	(A,I)	-305	261	-330	305	-346	311	311	350	-39
14	**33NQ**	**492BP**	**20180319**	**A ZONE**	**-48**	**85**	**-92**	**59**	**-136**	**62**	**85**	**130**	**-45**
15	33Q 15	492AM	20180307	A ZONE	-337	101					101	150	-49
16	33S 20	492BR	20180227	A ZONE	-317	120	-336	120	-355	124	124	110	14
17	33S 43	491E	20180305	A ZONE	-333	267	-344	202			267	90	177
18	33S 52	491H	20180305	A ZONE	-284	195	-289	191			195	220	-25
19	**33ST**	**492BL**	**20180321**	**A ZONE**	**-65**	**75**	**-86**	**76**	**-100**	**77**	**77**	**100**	**-23**
20	33T 9	492TT	20180417	A ZONE	-262	70					70	92	-22
21	33T 13	492ZZ	20180405	A ZONE	-128	211					211	228	-17
22	33T 15	492SS	20180307	A ZONE	-334	148					148	130	18
23	33T 29	491C	20180305	A ZONE	-350	191					191	360	-169
24	33T4	492CR	20180417	A ZONE	-146	76	-166	73	-186	71	76	232	-156
25	33U 11	492AJ	20180403	A ZONE	-348	75					75	174	-99
26	33U' 3	492WW	20180307	A ZONE	-89	109					109	300	-191
27	**33UV**	**492BH**	**20180320**	**(R,A)**	**-106**	**70**	**-131**	**69**	**-155**	**65**	**70**	**124**	**-54**
28	33V' 8	492BY	20180307	A ZONE	-24	5,490	-48	4,200			5,490	5,100	390
29	33W 11	502T	20180404	A ZONE	-321	50	-349	49	-376	90	90	93	-3
30	**33WX**	**502AF**	**20180327**	**A ZONE**	**-258**	**65**	**-281**	**78**	**-297**	**78**	**78**		**n/a**
31	33X 10	502BD	20180312	A ZONE	-320	59	-340	71	-356	88	88	88	0
32	33X 20	502J	20180409	A ZONE	-353	121					121	110	11
33	**33XY**	**502BN**	**20180320**	**A ZONE**	**-279**	**54**	**-296**	**58**	**-311**	**60**	**60**		**n/a**
34	**33YZ**	**502AD**	**20180320**	**A ZONE**	**-296**	**76**	**-327**	**77**			**77**		**n/a**
35	33Z 11	502V	20180417	A ZONE	-321	61	-346	64			64		n/a
36	34D' 6	502BH	20180312	A ZONE	-270	261	-303	1,060	-335	1,040	1,060	630	430
37	**34DG**	**502Z**	**20180402**	**A ZONE**	**-292**	**534**	**-324**	**859**			**859**	**696**	**163**
38	34F 5	502BR	20180402	A ZONE	-297	62	-322	62	-347	293	293	399	-106
39	34F 10	502AR	20180405	A ZONE	-311	55	-326	55			55	75	-20
40	34H 25	502AH	20180418	A ZONE	-297	103	-312	183	-331	191	191	86	105

ALAMITOS BARRIER PROJECT
A-ZONE CHLORIDE CONCENTRATIONS
Chloride Data Used for Contours and Cross-Section

No.	PROJ	FCD	DATE	AQUIFER	For Cross-Section (Internodal Wells in **Bold**)						For Contours	MAX CHLORIDE 16-17	Change in Chloride (FY17-18 - FY16-17)
					ELEV 1 (ft)	CHL 1 (mg/L)	ELEV 2 (ft)	CHL 2 (mg/L)	ELEV 3 (ft)	CHL 3 (mg/L)	MAX CHL. 17-18		
41	34H5	512E	20180416	A ZONE	-298	70	-313	75	-328	75	75	74	1
42	**34HJ**	**502BX**	**20180410**	**A ZONE**	**-310**	**225**	**-321**	**576**	**-331**	**809**	**809**	**1,930**	**-1,121**
43	**34JL**	**503AP**	**20180411**	**A ZONE**	**-263**	**69**	**-288**	**156**	**-308**	**148**	**156**	**108**	**48**
44	34L 10	502AM	20180306	A ZONE	-310	133	-330	100	-354	97	133	94	39
45	**34LS**	**503BD**	**20180411**	**A ZONE**	**-238**	**80**	**-283**	**173**			**173**		**n/a**
46	34N 21	512B	20180306	A ZONE	-328	84	-354	86			86	61	25
47	34N' 7	503AF	20180312	A ZONE	-106	20	-144	100	-176	91	100	81	19
48	**34S0.1**	**503BV**	**20180424**	**A ZONE**	**-239**	**89**	**-249**	**91**	**-257**	**88**	**91**	**89**	**2**
49	34U 8	513F	20180418	A ZONE	-280	92	-310	95			95	120	-25
50	34V3	503CD	20180423	A ZONE		69					69	67	2
51	34V 20	513B	20180416	A ZONE	-234	143	-265	111	-292	110	143	94	49
52	**34VZ**	**503BH**	**20180410**	**A ZONE**	**-146**	**84**	**-156**	**82**			**84**	**95**	**-11**
53	34W' 5	503AJ	20180301	A ZONE	-81	106	-101	117	-119	97	117	130	-13
54	34X40	513P	20180412	A ZONE	-202	47	-232	149			149	144	5
55	**34Y0.1**	**503CL**	**20180425**	**A ZONE**	**-107**	**875**					**875**	**1,320**	**-445**
56	**35E0.1**	**503BK**	**20180410**	**A ZONE**	**-74**	**66**					**66**	**110**	**-44**
57	35F 20	513J	20180418	A ZONE	-129	98	-158	122			122	190	-68
58	**35H 11**	**514G**	**20180403**	**A ZONE**	**-123**	**124**	**-146**	**693**			**693**	**3,400**	**-2,707**
59	**35H 12**	**514D**	**20180424**	**A ZONE**	**-137**	**72**					**72**		**n/a**
60	**35J1**	**514L**	**20180424**	**A ZONE**	**-193**	**74**	**-208**	**73**	**-228**	**84**	**84**		**n/a**
61	**35K1**	**523B**	**20180409**	**A ZONE**	**-197**	**57**	**-212**	**152**	**-227**	**362**	**362**	**420**	**-58**
62	36F' 1	505D	20180301	A ZONE	-99	915					915	810	105
63	OCWD-BS14/3		20180412	A ZONE		3,550					3,550	2,190	1,360
64	OCWD-BS21/3		20180412	A ZONE		398					398	398	0
65	OCWD-BS24C/1		20180412	A ZONE		15,700					15,700	14,800	900
66	33G	DP1									50	50	n/a
67	33J	DP2									50	50	n/a
68	33L	DP3									50	50	n/a
69	33N	DP4									50	50	n/a
70	33Q	DP5									50	50	n/a
71	33S	DP6									50	50	n/a
72	33U	DP7									50	50	n/a
73	33V	DP8									50	50	n/a
74	33W	DP9									50	50	n/a
75	33X	DP10									50	50	n/a
76	33Y	DP11									50	50	n/a
77	33Z	DP12									50	50	n/a
78	33Z2	DP13									50	50	n/a
79	34D	DP14									50	50	n/a
80	34F	DP15									50	50	n/a
81	34L	DP16									50	50	n/a
82	34V	DP17									50	50	n/a
83	35G	DP18									50	50	n/a
84	35H1	DP19									50	50	n/a
85	35H2	DP20									50	50	n/a

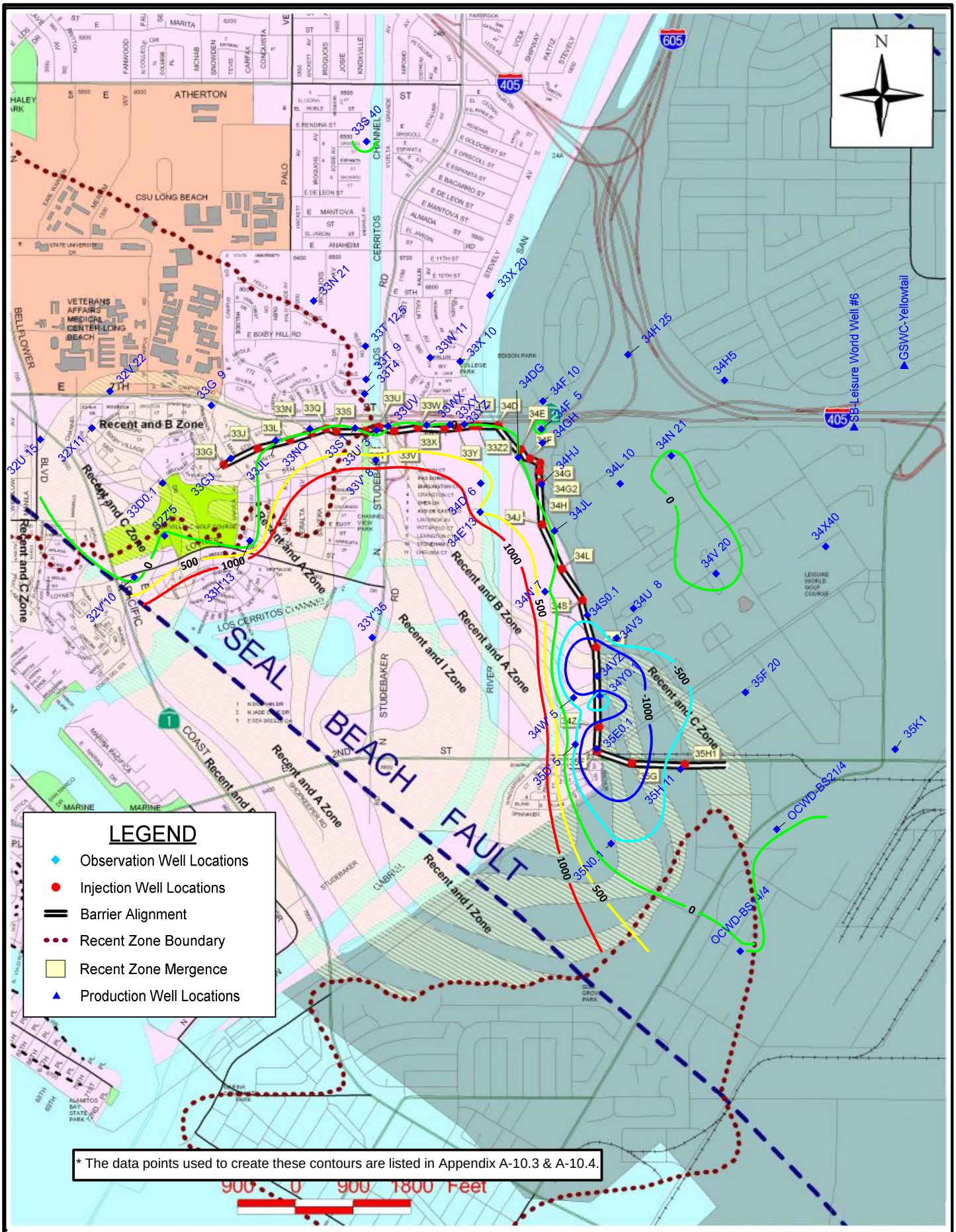
DP = Dummy Point with an assumed chloride concentration of 50 mg/L. Placed at wells that were injecting into this zone during this reporting period.



Alamitos Barrier Project
I Zone Chloride Concentration (mg/L) Contours: Spring 2018

A-10.1

I zone CL.srf



* The data points used to create these contours are listed in Appendix A-10.3 & A-10.4.

Alamitos Barrier Project
I Zone: Change in Chloride Concentration, Spring 2017 to Spring 2018

A-10.2

I zone CL.srf

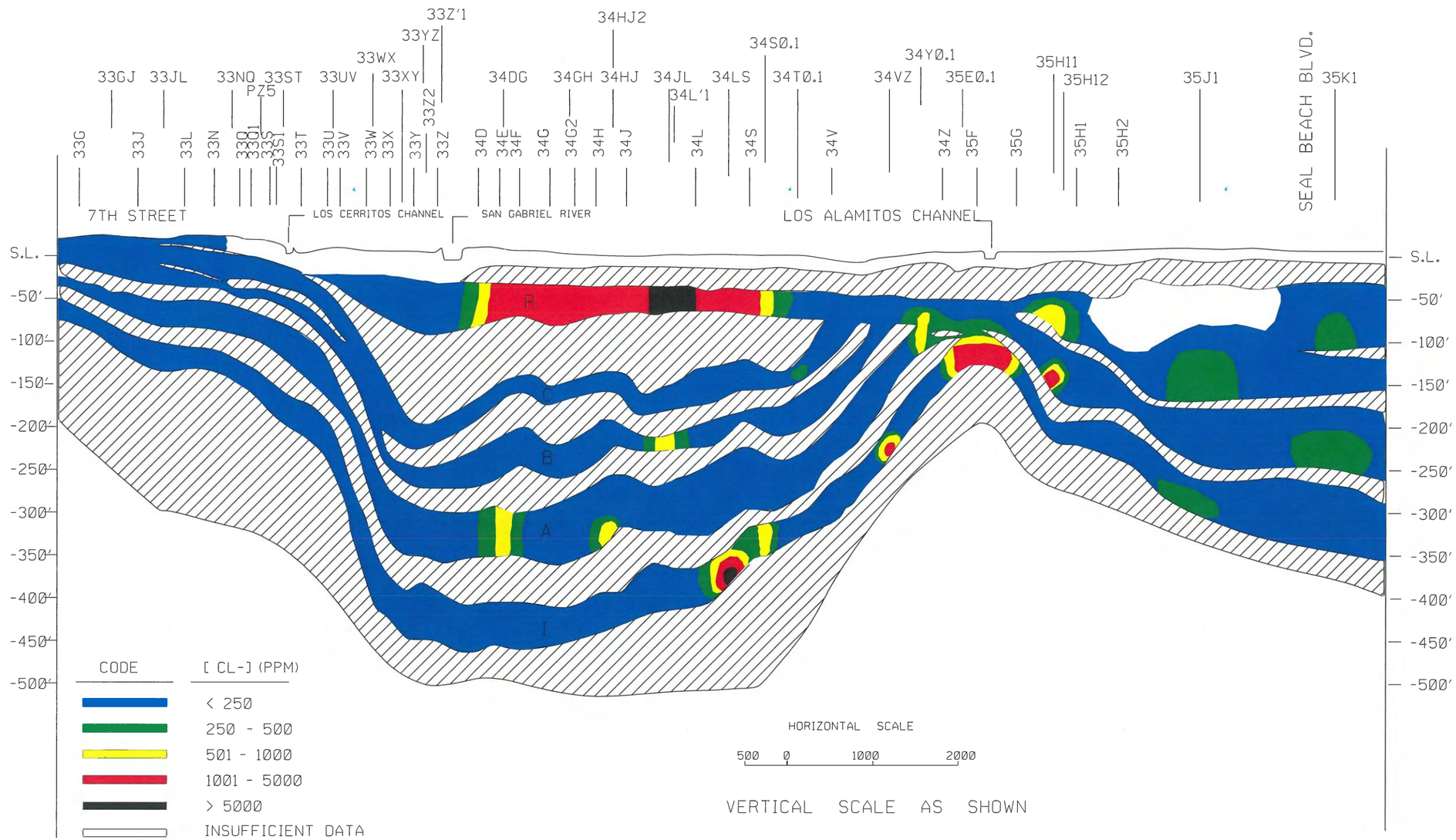
ALAMITOS BARRIER PROJECT
I-ZONE CHLORIDE CONCENTRATIONS
Chloride Data Used for Contours and Cross-Section

No.	PROJ	FCD	DATE	AQUIFER	For Cross-Section (Internodal Wells in **Bold**)						For Contours	MAX CHLORIDE FY16-17	Change in Chloride (FY17-18 - FY16-17)
					ELEV 1 (ft)	CHL 1 (mg/L)	ELEV 2 (ft)	CHL 2 (mg/L)	ELEV 3 (ft)	CHL 3 (mg/L)	MAX CHL. 17-18		
1	32U 15	482L	20180307	I ZONE	-74	140					140	160	-20
2	32V 22	482N	20180307	I ZONE	-51	123					123	140	-17
3	32V'10	483E	20180228	I ZONE	-140	223	-152	229	-165	232	232	390	-158
4	32X11	482R	20180315	I ZONE	-51	459	-61	481			481	540	-59
5	32Z'5	482V	20180307	I ZONE	-68	296	-83	422	-98	517	517	480	37
6	33D0.1	482U	20180315	(A,I)	-24	75	-49	75	-74	75	75	100	-25
7	33G 9	482G	20180228	I ZONE	-34	62	-68	57	-78	56	62	83	-21
8	**33GJ**	**482Y**	**20180319**	**I ZONE**	**-75**	**93**	**-95**	**86**			93	**100**	-7
9	33H'13	493XX	20180228	I ZONE	-89	165					165	620	-455
10	**33JL**	**492BW**	**20180314**	**(A,I)**	**-41**	**62**	**-79**	**67**	**-116**	**78**	78	**94**	-16
11	33N 21	492BV	20180305	I ZONE	-457	90	-468				90	360	-270
12	**33NQ**	**492BP**	**20180319**	**(A,I)**	**-48**	**85**	**-92**	**59**	**-136**	**62**	85	**130**	-45
13	33S 40	491F	20180305	I ZONE	-470	402					402	370	32
14	**33ST**	**492BM**	**20180321**	**I ZONE**	**-130**	**72**	**-148**	**62**	**-163**	**63**	72	**80**	-8
15	33T 9	492XX	20180409	I ZONE	-364	78					78	86	-8
16	33T 12.5	492BT	20180307	I ZONE	-423	99	-438	93	-443		99	110	-11
17	33T4	492CQ	20180417	I ZONE	-277	84	-292	77			84	119	-35
18	33U' 3	492QQ	20180307	I ZONE	-147	193					193	300	-107
19	**33UV**	**492BJ**	**20180320**	**I ZONE**	**-209**	**68**	**-228**	**74**	**-246**	**75**	75	**85**	-10
20	33V' 8	492BX	20180307	I ZONE	-109	4,140	-130	4,840			4,840	4,200	640
21	33W 11	502U	20180404	I ZONE	-423	78	-446	75	-468	76	78	111	-33
22	**33WX**	**502AG**	**20180321**	**I ZONE**	**-374**	**20**	**-391**	**66**	**-405**		66	**78**	-12
23	33X 10	502BE	20180312	I ZONE	-420	591	-440	305	-460	209	591	790	-199
24	33X 20	502H	20180409	I ZONE	-442	1,140					1,140	2,850	-1,710
25	**33XY**	**502BP**	**20180320**	**I ZONE**	**-404**	**53**	**-417**	**59**	**-431**	**80**	80	**78**	2
26	33Y'35	493ZZ	20180306	I ZONE	-67	25,900					25,900	8,800	17,100
27	**33YZ**	**502AE**	**20180320**	**I ZONE**	**-402**	**73**	**-433**	**60**			73	**83**	-10
28	33Z 11	502W	20180417	I ZONE	-417	434	-437	429	-457	442	442		n/a
29	34D' 6	502BI	20180312	I ZONE	-400	1,100	-410	1,110	-418		1,110	330	780
30	**34DG**	**502AA**	**20180402**	**I ZONE**	**-402**	**75**	**-432**	**71**			**75**	**80**	**-5**
31	34E'13	503AT	20180312	I ZONE	-289	595	-308	863			863	400	463
32	34F 5	502BQ	20180402	I ZONE	-411	69	-426	60	-441	61	69	58	11
33	34F 10	502AS	20180405	I ZONE	-416	58	-442	63			63	78	-15
34	**34GH**	**502BV**	**20180329**	**I ZONE**	**-412**	**64**	**-427**	**64**	**-437**	**65**	**65**	**88**	**-23**
35	34H 25	502AJ	20180418	I ZONE	-407	139	-427	309	-446		309	604	-295
36	**34H5**	**512D**	**20180416**	**I ZONE**	**-408**	**143**	**-423**	**226**	**-443**	**207**	226	**335**	-109
37	**34HJ**	**502BW**	**20180410**	**I ZONE**	**-407**	**64**	**-417**	**72**	**-427**	**78**	78	**141**	-63

ALAMITOS BARRIER PROJECT
I-ZONE CHLORIDE CONCENTRATIONS
Chloride Data Used for Contours and Cross-Section

No.	PROJ	FCD	DATE	AQUIFER	For Cross-Section (Internodal Wells in **Bold**)						For Contours	MAX CHLORIDE FY16-17	Change in Chloride (FY17-18 - FY16-17)
					ELEV 1 (ft)	CHL 1 (mg/L)	ELEV 2 (ft)	CHL 2 (mg/L)	ELEV 3 (ft)	CHL 3 (mg/L)	MAX CHL. 17-18		
38	**34JL**	**503AN**	**20180411**	**I ZONE**	**-383**	**84**	**-403**	**84**			**84**	**117**	**-33**
39	34L 10	502AN	20180306	I ZONE	-404	85	-426	83			85	91	-6
40	**34LS**	**503BC**	**20180411**	**I ZONE**	**-338**	**601**	**-368**	**7,970**			**7,970**		**n/a**
41	34N 21	512C	20180306	I ZONE	-423	69	-448	67			69	58	11
42	34N' 7	503AG	20180312	I ZONE	-221	88	-254	200	-274	777	777	690	87
43	**34S0.1**	**503BW**	**20180424**	**I ZONE**	**-306**	**651**	**-310**	**658**			**658**	**1,060**	**-402**
44	**34T0.1**	**503AD**	**20180329**	**I ZONE**	**-289**	**150**	**-312**	**117**	**-334**	**93**	**150**		**n/a**
45	34U 8	513G	20180418	I ZONE	-360	117	-375	122			122	140	-18
46	34V3	503CE	20180423	I ZONE	-328	96					96	89	7
47	34V 20	513C	20180416	I ZONE	-386	105					105	46	59
48	**34VZ**	**503BG**	**20180410**	**I ZONE**	**-214**	**106**	**-224**	**90**			**106**	**4,010**	**-3,904**
49	34W' 5	503AK	20180301	I ZONE	-156	4,150					4,150	4,900	-750
51	34X40	513N	20180412	I ZONE	-331	1,590	-346	1,690			1,690	1,860	-170
52	**34Y0.1**	**503CM**	**20180425**	**I ZONE**	**-175**	**132**	**-185**	**192**			**192**	**157**	**35**
53	35D' 5	503AM	20180301	I ZONE	-89	2,220					2,220	2,600	-380
54	**35E0.1**	**503BJ**	**20180410**	**I ZONE**	**-114**	**1,860**					**1,860**	**4,500**	**-2,640**
55	35F 20	513H	20180418	I ZONE	-235	1,430	-245	2,660	-255	3,370	3,370	3,600	-230
56	**35H 11**	**514H**	**20180403**	**I ZONE**	**-203**	**162**					**162**	**190**	**-28**
57	**35J1**	**513M**	**20180424**	**I ZONE**	**-261**	**263**	**-271**	**292**	**-281**	**385**	**385**		**n/a**
58	**35K1**	**523C**	**20180409**	**I ZONE**	**-363**	**31**	**-373**				**31**	**38**	**-7**
59	35N0.1	504N	20180228	I ZONE	-71	5,780					5,780	6,200	-420
60	OCWD-BS14/4		20180412	I ZONE		276					276	258	18
61	OCWD-BS21/4		20180412	I ZONE		1,270					1,270	1,270	0
62	33G	DP1									50	50	n/a
63	33J	DP2									50	50	n/a
64	33L	DP3									50	50	n/a
65	33N	DP4									50	50	n/a
66	33Q	DP5									50	50	n/a
67	33U	DP6									50	50	n/a
68	33V	DP7									50	50	n/a
69	33W	DP8									50	50	n/a
70	33X	DP9									50	50	n/a
71	33Y	DP10									50	50	n/a
72	33Z	DP11									50	50	n/a
73	33Z2	DP12									50	50	n/a
74	34D	DP13									50	50	n/a
75	34E	DP14									50	50	n/a
76	34F	DP15									50	50	n/a
77	34G2	DP16									50	50	n/a
78	34H	DP17									50	50	n/a
79	34L	DP18									50	50	n/a
80	34V	DP19									50	50	n/a

DP = Dummy Point with an assumed chloride concentration of 50 mg/L. Placed at wells that were injecting into this zone during this reporting period.



CHLORIDE SECTION ALONG THE BARRIER

Spring 2018

Note: The data points used to create this cross section are listed in the Appendix A-6.3, 7.3, 8.3, 9.3, 9.4, 10.3, & 10.4

ALAMITOS BARRIER PROJECT
Overview Map

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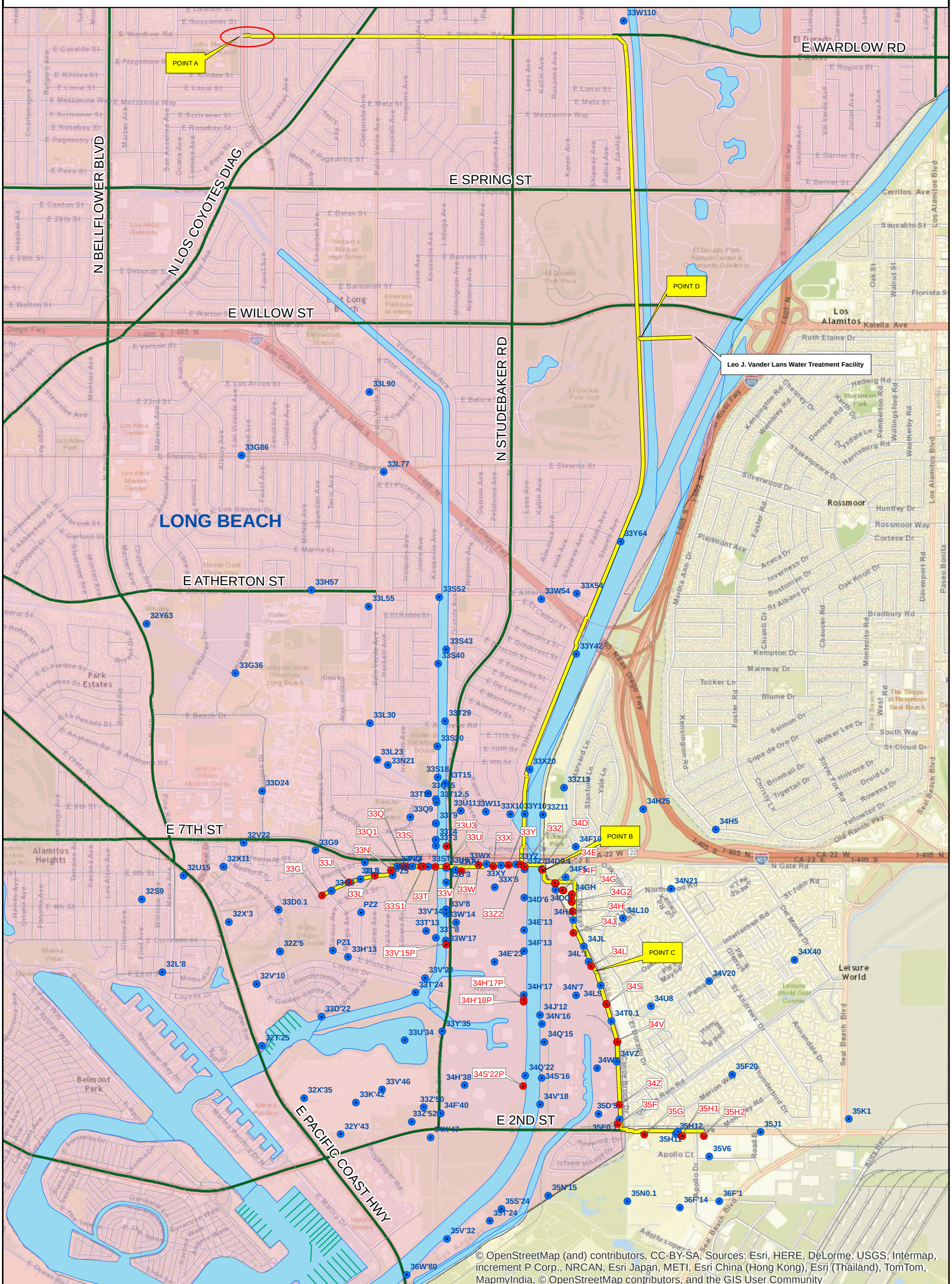


0 1,200 2,400 4,800 Feet

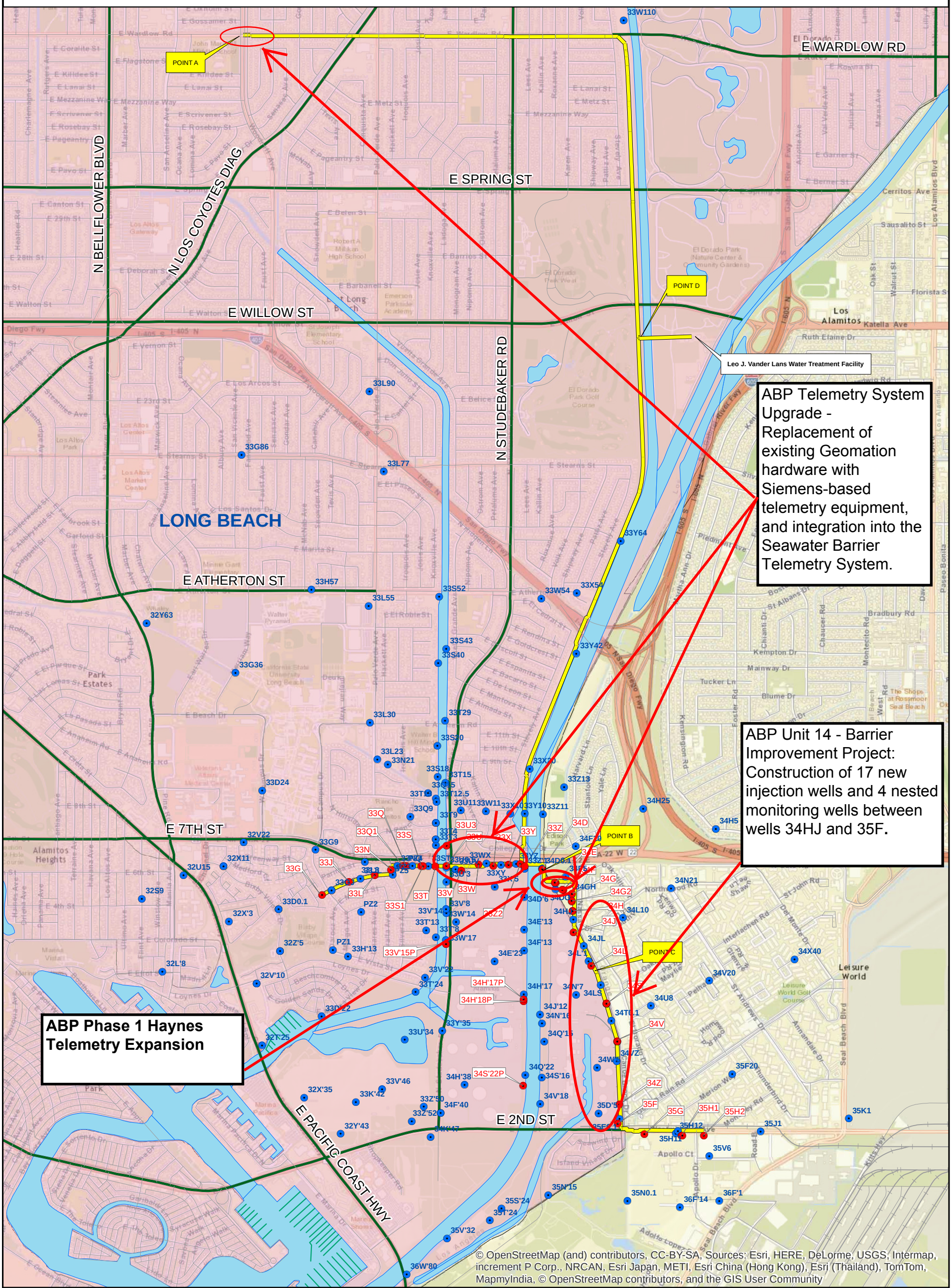
Legend

- Alamitos_Injection_Well
- Observation Well
- ABP Water Supply Line

A-12.1

ALAMITOS BARRIER PROJECT

Project Location Map



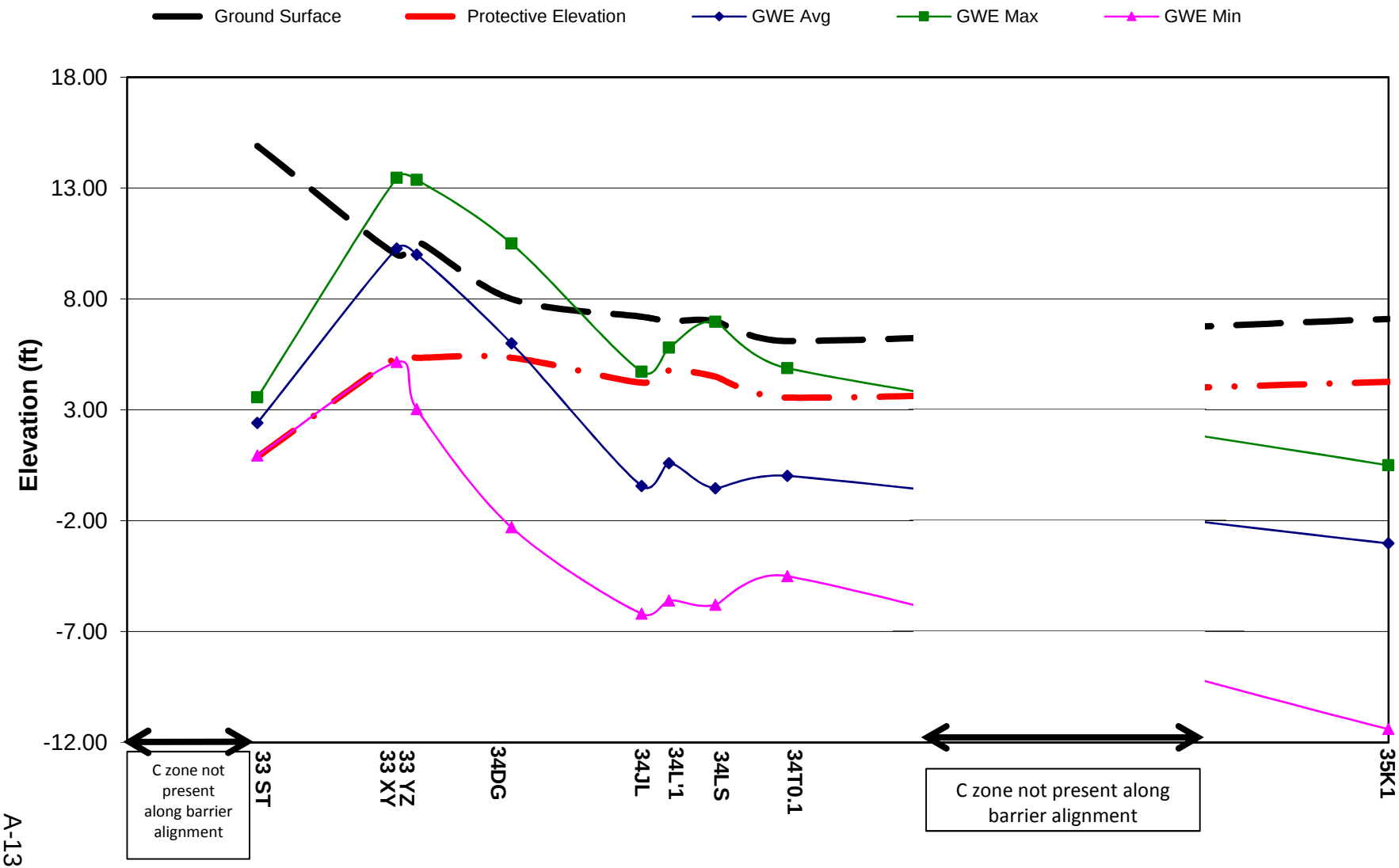
0 1,200 2,400 4,800 Feet

Legend

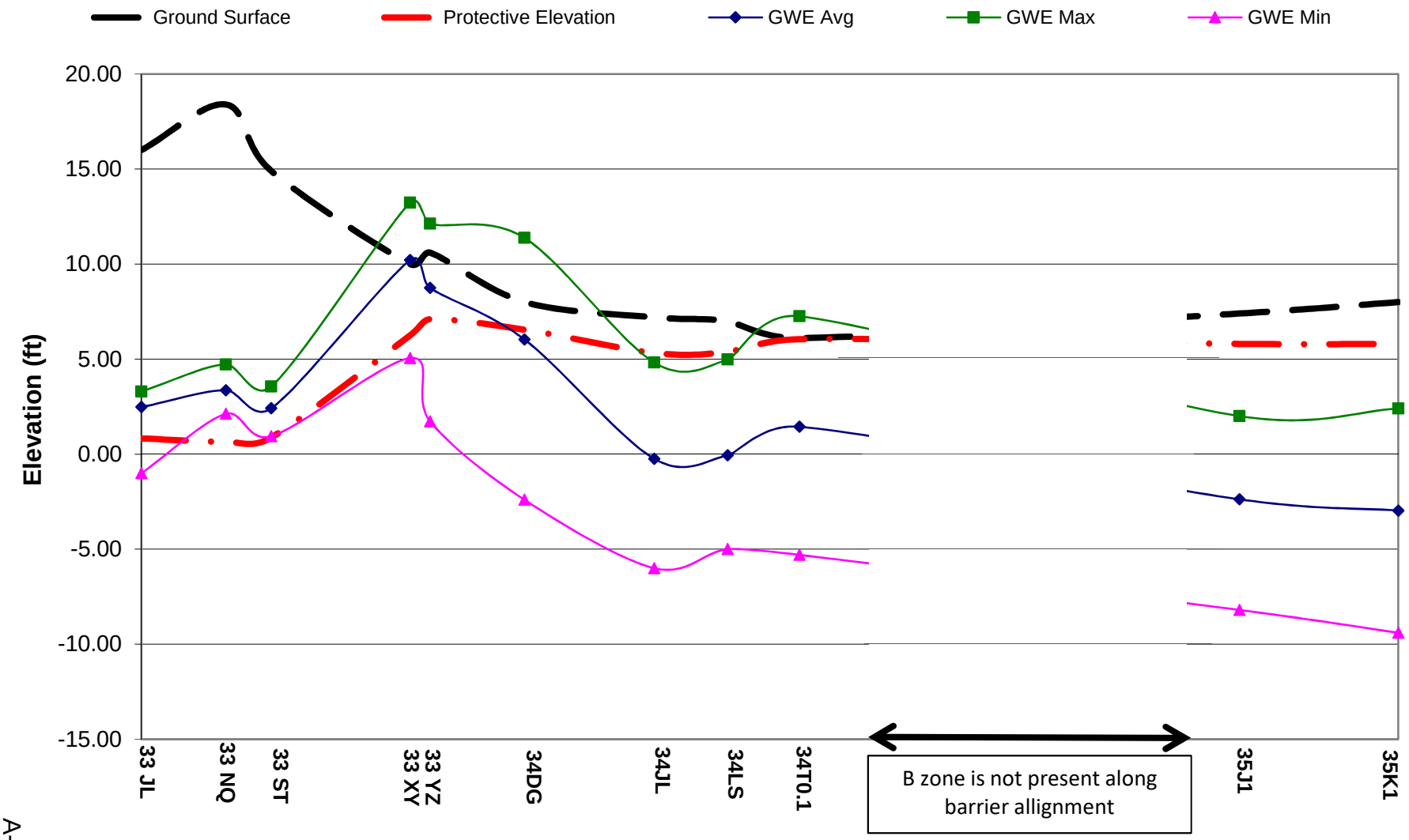
- Alamitos_Injection_Well
- Observation Well
- ABP Water Supply Line

A-12.2

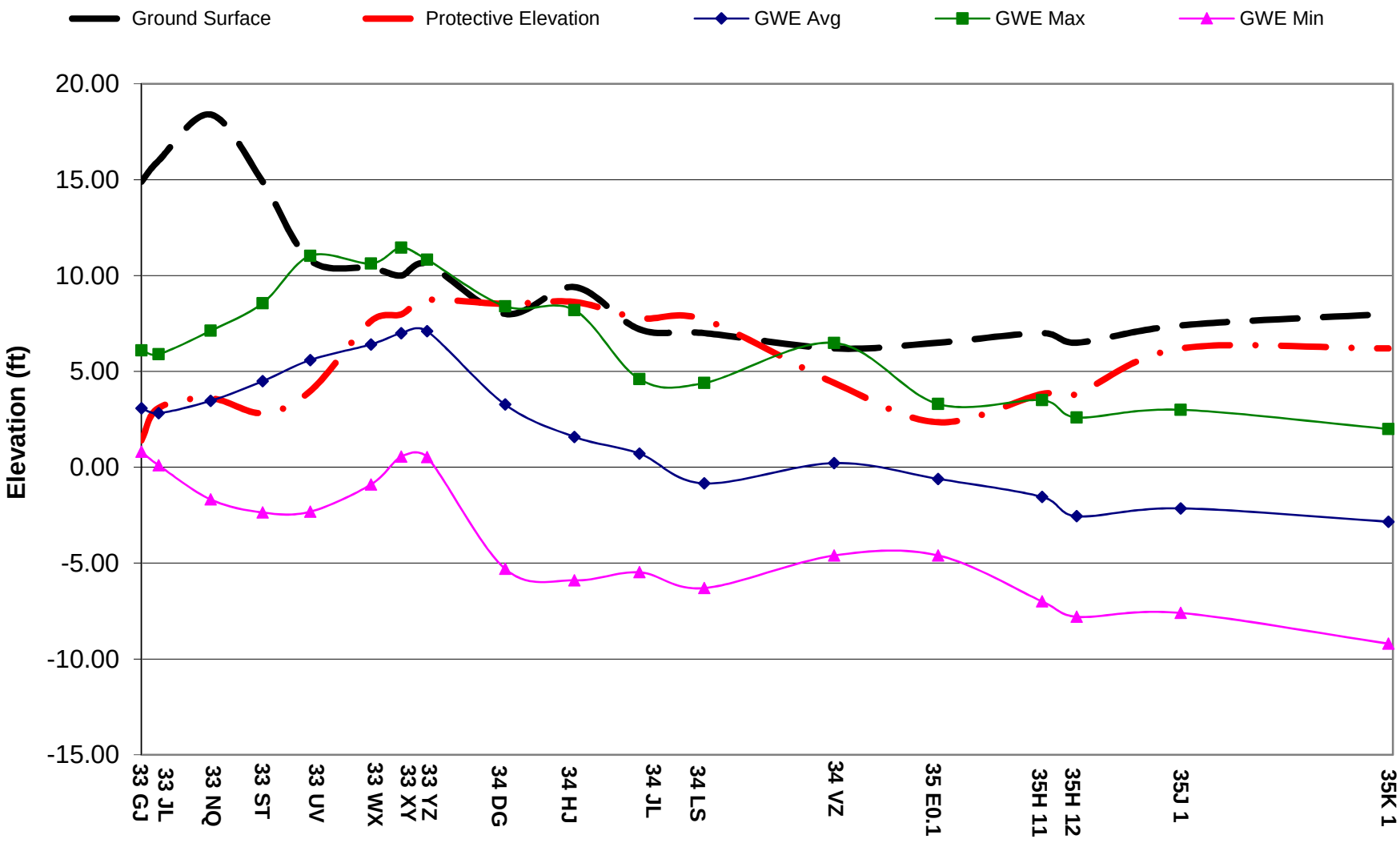
C Zone - Groundwater Elevation (GWE) Along the ABP FY17-18



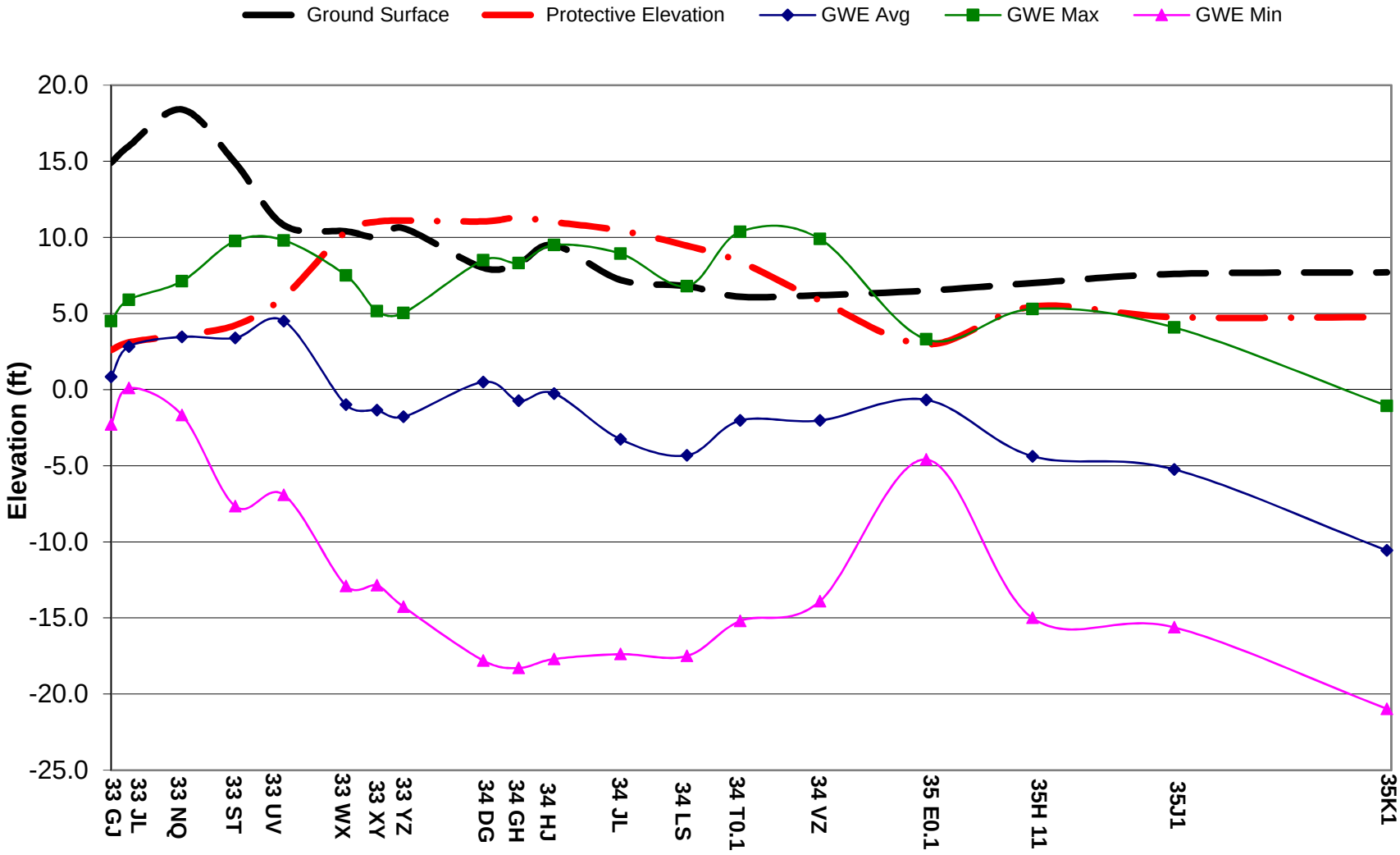
B Zone - Groundwater Elevation (GWE) Along the ABP FY17-18



A Zone - Groundwater Elevation (GWE) Along the ABP FY17-18



I Zone - Groundwater Elevation (GWE) Along the ABP FY17-18



Current Capital Improvement Projects and Contracts (July 2017 through June 2018)

Board Award Date	Project Title	Description	Contractor	Final Contract Amount	Field Acceptance
6/16/2017	ABP Telemetry	Replace existing Geomation system with Siemens based system, also incorporate signal from well 33U3	Leed Electric, Inc.	$388,308 Awarded	Spring 2019
10/15/2017	ABP Unit 14 - Phase 1 Drilling of injection and observation wells	Construction of 17 new clustered injection wells (8 locations), 4 nested observation wells, and 2 shallow piezometers	Jensen Drilling Co.	$9,984,335 Awarded	Jul-17
May-17	ABP Unit 14 - Phase 2 Wellhead improvement	Installation of injection well vaults, piping, and telemetry equipment	Kiewit	$3,550,000 Awarded	Fall 2018 [Estimated]
Jun-17	ABP - Phase 1 Haynes Plant Telemetry Extension	Install conduit, above ground intrument panels and run twisted shielded pair for wells 34E, 34J, and 34L. Replace old well vaults at 34HJ.	Tetra Tech	$77,250 Awarded	November 2018 [Estimated]

Note: For a full history of improvement projects and contracts on record, please contact LACPW.

Summary of the Alamitos Barrier Project Shutdowns (July 2017 through June 2018)

Shutdown	Startup	Duration (days)	Impacted Portion of ABP	Reason	Addressed By	Means of Repair/Remediation
5/15/2014	N/A	N/A	Well 34H(A)	Overpressure, will not take water.	LACPW	Well is filled with sediment due to hole near top of perforations. Well to be destroyed
9/5/2014	N/A	N/A	Well 33S1(C,B)	Surface leakage	LACPW	Will remain on at reduced flow rate
10/10/2016	9/26/2017	351	34S(C,B) 34S(A) 34S(I)	Requested shutdown to aide OCWD drilling project	LACPW	Well is in operation
4/7/2017	8/14/2017	129	34V(C,B) 34V(A) 34V(I)	Requested shutdown to aide OCWD drilling project	LACPW	Well is in operation
4/7/2017	8/14/2017	308	34V(C,B) 34V(A) 34V(I)	Requested shutdown to aide OCWD drilling project	LACPW	Well is in operation
10/10/2016	9/26/2017	351	34S(C,B) 34S(A) 34S(I)	Requested shutdown to aide OCWD drilling project	LACPW	Well is in operation
11/6/2017	N/A	N/A	33W(C,B,A,I)	Surface leakage	LACPW	Will remain on at reduced flow rate
Jan. 2018	Jun. 2018	21 - 35	34D(C,B,A,I), 34E(I), 34F(A), 34F(I), 34G(A), 34G2(I), 34H(I), 35G(A,I), 35H1(A),(I), 35H2(A)	Intermittent Shutdown, to aide OCWD's Well project. Reduce water levels.	LACPW	Wells are in operation
Jan. 2018	Jun. 2018	40 - 77	34E(C,B), 34G2(C,B), 34J(I), 34J(A), 34S(I), 34V(I)	Intermittent Shutdown, to aide OCWD's Well project. Reduce water levels.	LACPW	Wells are in operation
Jan. 2018	Jun. 2018	130 - 165	34L(C,B,A,I), 34S(A), 34S(C/B), 34V(A), 34V(C/B), 34Z(I), 35F(I)	Intermittent Shutdown, to aide OCWD's Well project. Reduce water levels.	LACPW	Wells are in operation

Notes:

* Routine and/or minor shutdowns of individual wells are not listed here but are included in Figure 3 of the Annual JMC Report and Table 2 for the Semi-Annual Meeting.

ABP EXPENDITURES
FY 17-18

ITEM NO.	DESCRIPTION	JOB NO.	DESCRIPTION	SERVICES AND SUPPLIES	FY 2017-18 BUDGET	% BUDGET FY 17-18	OCWD SHARE 20.6%	OCWD BUDGET FY 17-18	% OCWD BUDGET FY 17-18	LADPW SHARE	LADPW BUDGET FY 17-18	% LADPW BUDGET FY 17/18
1.	Analysis and direction of injection operations	H0321551	ABP ANALY&DIR OF INJECTION O	45,364.40								
		H0321550	BARRIER PROJECT OPERATION-GEN	62,480.45								
			Subtotal #1	**107,844.85**	100,000	107.8%	**22,216.04**	35,000	63.5%	85,628.81	65,000	131.7%
2.	Maintenance and repair of injection wells	F6004011	MAINT INJECTION WELLS - ABP	174,840.47								
		F5064011	INJECT. WELLS-MAINTAIN(ALAMITO	54,512.21								
		H0321911	Alamitos Barrier Proj-Telemetry Maint.	164,648.34								
		F6980080F	MAINT ENGR - BARRIER PROJ	17,672.89								
		HF01511000	DGBP Automated System	29,665.53								
		F5009760F	DRILL EQPT-MAINT&TEST - Eaton Yard	50,767.32								
			Subtotal #2	**492,106.76**	450,000	109.4%	**101,373.99**	157,500	64.4%	390,732.77	292,500	133.6%
3.	Operation of injection	F6004000	RECHARGE OPER U/S - ABP	68,235.95								
			Subtotal #3	**68,235.95**	50,000	136.5%	**14,056.61**	17,500	80.3%	54,179.34	32,500	166.7%
4.	Analysis and direction of extraction operations (No cost to OCWD)	H0321555	ABP ANALY&DIR OF EXTRACT OPE	0.00								
			Subtotal #4	**0.00**	0	N/A	**0.00**	0	0.0	0.00	-	-
5.	Maintenance, and repair of extraction wells											
			Subtotal #5	**0.00**	10,000	0.0%	**0.00**	0	0.0	0.00	10,000	0.0%
6.	Operation of extraction wells (No cost to OCWD)	F6000090	NON-LABOR EXP BARRIER (ALMT)	1,537.66								
			Subtotal #6	**1,537.66**	5,000	30.8%	**0.00**	0	0.0	1,537.66	5,000	30.8%
7.	Maintenance and repair of distribution system	H0321569	ALAMITOS BARRIER PROJECT	170,051.98								
		F6004010	MAINT AIR/VAC-BLWOFF U/S - ABP	17,985.58								
		F6004012	MAINT PRS - ABP	38,978.23								
		F6004014F	ABP Locate & Mark Barrier Proj. U/grd. Lines	17,060.64								
		H0321016	Seawater Barriers Administrative Support	36,945.98								
		F6001907	INSPECT CRANE PRES REDUCE - ABP	1,227.05								
		F6009118	Disassemble/Reassemble of Wells ABP	24,438.47								
			Subtotal #7	**306,687.93**	350,000	87.6%	**63,177.71**	122,500	51.6%	243,510.22	227,500	107.0%
8.	Maintenance of observation wells	F5064044	OBSERV. WELLS-CLEANOUT(ALAMITO	128,953.48								
			Subtotal #8	**128,953.48**	200,000	64.5%	**26,564.42**	70,000	37.9%	102,389.06	130,000	78.8%
9.	Collection of groundwater data	H0321552	ABP COLL OF GR WTR DATA FOR	171,405.09								
			OCPW Permit No. 2017-00433	771.00								
			OCPW Permit No. 2017-00434	771.00								
			Seal Beach Permit #DPW03451	420.66								
			Seal Beach Permit #DPW03451 refund	-150.00								
			Seal Beach Permit #DPW03548	420.66								
			Seal Beach Permit #DPW03548 refund	-75.00								
			Subtotal #9	**173,217.75**	200,000	86.6%	**35,682.86**	70,000	51.0%	137,534.89	130,000	105.8%
10.	Yard Maintenance	FFM34107	Facility Maintenance Alamitos Yd F107	44,031.08								
		FPM34107OS	Planned Maint. Alamitos Yd F107-OSD	227.56								
		F6001904	CONDUCT QUARTERLY INSPECTION	164.27								
		F6001920	CONDUCT QUARTERLY INSPECTION	76.90								
		F6003123	BUILDING MAINTENANCE NONRESI	2,058.62								
		F6003124	BUILDING MAITENANCE-NONRESI	1,933.89								
			Subtotal #10	**48,492.32**	80,000	60.6%	**9,989.42**	9,240	108.1%	38,502.91	70,760	54.4%
11.	Well redevelopment	F5064022	Redevelop injections wells - ABP	83,740.17								
		F55826970	REDEVELOP INJECTION WELL 34E, I ZONE - A.B.P.	2,581.94								
		F55834698	REDEVELOP INJECTION WELL 34L - A.B.P.	46,619.92								
		F55834706	REDEVELOP INJECTION WELL 34J - A.B.P.	40,001.13								
		F55852445	REDEVELOP INJECTION WELL 34S, CB -ZONE - A.B.P.	21,714.95								
		F55852447	REDEVELOP INJECTION WELL 34S, A -ZONE - A.B.P.	16,102.32								
		F55852450	REDEVELOP INJECTION WELL 34S, I-ZONE - A.B.P.	19,617.67								
		F55889340	REDEVELOP INJECTION WELL 33Z2 - A.B.P.	47,011.05								
		F55950196	REDEVELOP INJECTION WELL 35H2 - A.B.P.	32,969.55								
		F55950197	REDEVELOP INJECTION WELL 35H1, I-ZONE - A.B.P.	13,112.90								
		F55950198	REDEVELOP INJECTION WELL 35H, A-ZONE - A.B.P.	13,658.28								
		F55950201	REDEVELOP INJECTION WELL 33T- A.B.P.	40,353.47								
		F55950202	REDEVELOP INJECTION WELL 33Z- A.B.P.	30,396.49								
		H0321554	ABP WELL REDEVELOPMENT PROGRAM	83,329.14								
		H0321565	ABP NPDES MONI & REPORT INJ WE	33,715.44								
			OCPW Permit No. 2017-00019-1 - 34G	643.75								
			OCPW Permit No. 2017-00400 34G2	1,611.95								
			OCPW Permit No. 2017-00402 34H(I)	1,611.95								
			OCPW Permit No. 2017-00403 34J	1,611.95								
			OCPW Permit No. 2017-00404 34L	1,611.95								
			OCPW Permit No. 2017-00405 34S	1,611.95								
			OCPW Permit No. 2017-00408 34V	1,611.95								
			OCPW Permit No. 2017-00411 34Z	1,611.95								
			OCPW Permit No. 2017-00412 35F	1,611.95								
			OCWD Permit refund	-13,539.35								
			Subtotal #11	**524,924.42**	1,000,000	52.5%	**108,134.43**	350,000	30.9%	416,789.99	650,000	64.1%
12.	Processing of data and preparation of reports	H0321553	ABP DATA PRO & PRE OF REPORT	87,004.08								
			Subtotal #12	**87,004.08**	60,000	145.0%	**17,922.84**	21,000	85.3%	69,081.24	39,000	177.1%
13.	Reclaim Water Program	H0321556	ABP RECLAIMED WATER SUPPLY	42,826.85								
			Subtotal #14	**42,826.85**	45,000	95.2%	**8,822.33**	15,750	56.0%	34,004.52	29,250	116.3%
14.	Projects & Studies (Reimbursable amounts include labor expenses,	HF01515001	ALAMITOS BARRIER PROJECT TELEMETRY SYSTEM UPGRADE	158,125.54								
			Subtotal #15	**158,125.54**	10,000	1581.3%	**32,573.86**	3,500	930.7%	125,551.68	6,500	1931.6%
15.	ABP Liabilty Insurance Premiums paid separately by OCWD	N/A	ABP General Liability Coverage	59,924.11								
			ABP Excess Liability Coverage	17,977.44								
			Subtotal #16	**77,901.55**	76,000	102.5%	**38,950.78**	38,000	102.5%	38,950.78	38,000	102.5%
			TOTAL	**2,217,859.15**	**2,636,000.00**	84.1%	**479,465.28**	**909,990.00**	93.0	1,738,393.86	1,726,010	53.3

NOTES:

1 OCWD share represents 20.6% of the total costs in all Items except for 4, 5, and 6. The percentage is based on amount of overall barrier injection water provided to the Orange County portion of the ABP during this fiscal year.

2 Per Agreement No. 8458 between the LACFCD and the OCWD, all costs included in Items 4, 5, and 6 are not reimburseable with respect to OCWD.

3 Per Agreement No. 8458 between the LACFCD and the OCWD, the cost of liability insurance (item 15) shall be split equally among the Parties.

TOTAL OPERATION AND MAINTENANCE COST (not including insurance premium)	$	2,139,957.60
ORANGE COUNTY'S SHARE OF THE OPERATION AND MAINTENANCE COST (not including insurance premium)	$	440,514.51
Less: Los Angeles County's Share of the FY16-17 Liability Insurance	$	38,950.78
Less: Permit fees paid by OCWD	$	2,158.32
Less: Advance Deposit Paid by OCWD	$	200,000.00
BALANCE DUE FROM ORANGE COUNTY WATER DISTRICT	**$**	**199,405.41**

ABP FY19-20 Budget

JMC No.	Fiscal Year	LACFCD Budget	LACFCD Actual	OCWD Budget	OCWD Actual	WRD Budget	WRD Actual	TOTAL Budget	TOTAL Actual
1.	Analysis and direction of injection operation ($)								
	2015-16	48,750	74,291	26,250	40,355			75,000	114,646
	2016-17	55,250	67,944	29,750	16,145			85,000	84,089
	2017-18	65,000	85,629	35,000	22,216			100,000	107,845
	2018-19	65,000		35,000				100,000	
	2019-20	*65,000*		*35,000*				*100,000*	
2.	Maintenance and repair of injection wells ($)								
	2015-16	260,000	290,273	140,000	157,679			400,000	447,952
	2016-17	292,500	294,809	157,500	70,054			450,000	364,863
	2017-18	292,500	390,733	157,500	101,374			450,000	492,107
	2018-19	292,500		157,500				450,000	
	2019-20	*292,500*		*157,500*				*450,000*	
3.	Operations of Injection Well Facilities ($)								
	2015-16	19,500	34,922	10,500	18,970			30,000	53,892
	2016-17	26,000	38,379	14,000	9,120			40,000	47,499
	2017-18	32,500	54,179	17,500	14,057			50,000	68,236
	2018-19	32,500		17,500				50,000	
	2019-20	*45,500*		*24,500*				*70,000*	
4.	Analysis and direction of extraction operation ($)								
	2015-16	0	632	0	0			0	632
	2016-17	0	0	0	0			0	0
	2017-18	0	0	0	0			0	0
	2018-19	0		0				0	
	2019-20	*0*		*0*				*0*	
5.	Redevelopment, maintenance, and repair of extraction wells ($)								
	2015-16	15,000	3,683	0	0			15,000	3,683
	2016-17	10,000	0	0	0			10,000	0
	2017-18	10,000	0	0	0			10,000	0
	2018-19	10,000		0				10,000	
	2019-20	*10,000*		*0*				*10,000*	
6.	Operations of Extraction Wells ($)								
	2015-16	6,000	2,647	0	0			6,000	2,647
	2016-17	6,000	1,510	0	0			6,000	1,510
	2017-18	5,000	1,538	0	0			5,000	1,538
	2018-19	5,000		0				5,000	
	2019-20	*5,000*		*0*				*5,000*	
7.	Maintenance and repair of ABP ($)								
	2015-16	195,000	172,875	105,000	93,907			300,000	266,782
	2016-17	227,500	224,063	122,500	53,243			350,000	277,306
	2017-18	227,500	243,510	122,500	63,178			350,000	306,688
	2018-19	195,000		105,000				300,000	
	2019-20	*195,000*		*105,000*				*300,000*	
8.	Maintenance of Observation Wells ($)								
	2015-16	195,000	3,065	105,000	1,665			300,000	4,730
	2016-17	45,500	1,058	24,500	252			70,000	1,310
	2017-18	130,000	102,389	70,000	26,564			200,000	128,953
	2018-19	32,500		17,500				50,000	
	2019-20	*97,500*		*52,500*				*150,000*	
9.	Collection of groundwater data ($)								
	2015-16	110,500	103,842	59,500	56,408			170,000	160,250
	2016-17	130,000	143,655	70,000	34,136			200,000	177,791
	2017-18	130,000	137,535	70,000	35,683			200,000	173,218
	2018-19	130,000		70,000				200,000	
	2019-20	*130,000*		*61,250*				*175,000*	
10.	Yard Maintenance ($)								
	2015-16	75,380	61,078	4,620	8,027			80,000	69,105
	2016-17	75,380	68,518	4,620	4,635			80,000	73,153
	2017-18	70,760	38,503	9,240	9,989			80,000	48,492
	2018-19	66,250		8,750				75,000	
	2019-20	*57,417*		*7,583*				*65,000*	
11.	Injection Well Redevelopment ($)								
	2015-16	520,000	621,605	280,000	337,662			800,000	959,266
	2016-17	260,000	403,333	140,000	95,842			400,000	499,175
	2017-18	650,000	416,790	350,000	108,134			1,000,000	524,924
	2018-19	325,000		175,000				500,000	
	2019-20	*650,000*		*350,000*				*1,000,000*	
12.	Processing of data and preparation of reports ($)								
	2015-16	45,500	30,846	24,500	16,756			70,000	47,602
	2016-17	39,000	46,570	21,000	11,066			60,000	57,636
	2017-18	39,000	69,081	21,000	17,923			60,000	87,004
	2018-19	39,000		21,000				60,000	
	2019-20	*52,000*		*28,000*				*80,000*	
14.	Special Programs								
	2015-16	350,000	382,085	0	0			350,000	382,085
	2016-17	50,000	802,143	0	0			50,000	802,143
	2017-18	50,000	744,210	0	0			50,000	744,210
	2018-19	50,000		0	0			50,000	
	2019-20	*150,000*		*0*				*150,000*	
13.	Oversight of Reclaim Water Program ($)								
	2015-16	9,750	23,466	5,250	12,747			15,000	36,213
	2016-17	19,500	35,663	10,500	8,474			30,000	44,138
	2017-18	29,250	34,005	15,750	8,822			45,000	42,827
	2018-19	32,500		17,500				50,000	
	2019-20	*32,500*		*17,500*				*50,000*	
14.	Projects and Studies ($)								
	2015-16	45,500	50,025	24,500	27,174			70,000	77,199
	2016-17	6,500	19,171	3,500	4,556			10,000	23,727
	2017-18	6,500	125,552	3,500	32,574			10,000	158,126
	2018-19	6,500		3,500				10,000	
	2019-20	*6,500*		*3,500*				*10,000*	
15.	ABP Liability Insurance ($)								
	2015-16	37,500	37,794	37,500	37,794			75,000	75,589
	2016-17	37,500	37,794	37,500	37,794			75,000	75,588
	2017-18	38,000	38,951	38,000	38,951			76,000	77,902
	2018-19	38,000		38,000				76,000	
	2019-20	*40,000*		*40,000*				*80,000*	
16.	Total ABP Expenditure ($)								
	2015-16	1,583,380	1,511,042	822,620	809,145			2,406,000	2,320,187
	2016-17	1,230,630	1,382,469	635,370	345,315			1,866,000	1,727,784
	2017-18	1,726,010	1,738,394	909,990	479,465			2,636,000	2,217,859
	2018-19	1,269,750		666,250				1,936,000	
	2019-20	*1,678,917*		*882,333*				*2,545,000*	
TOTALS	Total ABP Operations and Maintenance ($) [Item 16-Item 15]								
	2015-16	1,376,500	1,181,055	588,200	510,783			2,002,200	1,691,838
	2016-17	1,545,880	1,473,248	785,120	771,350			2,331,000	2,244,599
	2017-18	1,193,130	1,699,443	597,870	440,515			1,791,000	2,139,958
	2018-19	1,688,010		871,990				2,560,000	
	2019-20	*1,638,917*		*842,333*				*2,465,000*	
	Volume of Water (ac-ft)								
	2015-16			2,275	2,399	4,225	4,409	6,500	6,808
	2016-17			2,450	1,165	4,550	4,895	7,000	6,060
	2017-18			2,450	910	4,550	3,504	7,000	4,414
	2018-19			2,960		4,440		7,400	
	2019-20			*2,800*		*4,200*		*7,000*	