2016 ANNUAL REPORT

OF SANTA ANA RIVER WATER QUALITY

Draft Report

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Prepared by:

SANTA ANA WATERSHED PROJECT AUTHORITY

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Acronym and Abbreviations List

AFY	acre-feet per year
CBWM	Chino Basin Watermaster
COD	chemical oxygen demand
EC	electrical conductivity
EPA	Environmental Protection Agency
HCMP	Hydraulic Control Monitoring Program
IEUA	Inland Empire Utilities Agency
mg/L	milligrams per liter
umho/cm	micromhos per centimeter
MWD	Metropolitan Water District of Southern California
NTU	nephelometric turbidity units
OCWD	Orange County Water District
RIX	Regional Tertiary Treatment Rapid Infiltration and Extraction Facility
RWQCB	Regional Water Quality Control Board, Santa Ana Region
SAR	Santa Ana River
SAWPA	Santa Ana Watershed Project Authority
TDS	total dissolved solids
TIN	total inorganic nitrogen
TN	total nitrog|en
USGS	United States Geological Survey

1 Introduction

In 1996, the Nitrogen and Total Dissolved Solids (N/TDS) Task Force was formed to conduct scientific investigations regarding the then existing nitrogen and TDS water quality objectives of the 1995 Water Quality Control Plan for the Santa Ana River (SAR) Basin (Region 8). This Task Force, administered by the Santa Ana Watershed Project Authority (SAWPA) was comprised of 22 water supply and wastewater agencies. The work performed by the Task Force was broken out into a number of phases. In 2003, the Final Technical Memorandum was completed, which reported the results of this scientific investigation, *The TIN/TDS Study – Phase 2B of the Santa Ana Watershed Wasteload Allocation Investigation*.

As a result of this work, the Regional Water Quality Control Board (Regional Board) staff amended the Santa Ana River Watershed Water Quality Control Plan (Basin Plan). The Basin Plan Amendment (hereafter the 2004 Basin Plan Amendment) was adopted by the Regional Board in January 2004, approved by the State Water Resources Control Board in September 2004, and approved by the Office of Administrative Law in December 2004.

Pursuant to the 2004 Basin Plan Amendment, certain participants in the N/TDS Task Force are required to conduct the following investigations:

- Re-computation of the triennial Ambient Water Quality over a 20 year period; and
- Preparation of an Annual Report of Santa Ana River Water Quality.

This report fulfills the second requirement listed above – *Preparation of an Annual Report of Santa Ana River Water Quality*. Contained within this report are water quality data required to implement the surface water monitoring program necessary to determine compliance with the nitrogen and TDS objectives of the SAR and, thereby, the effectiveness of the wasteload allocations.

In Chapter 4 of the Basin Plan, the baseflow TDS and total nitrogen objectives for Reach 3 of the River are specified. For Reach 2, a TDS objective based on a five-year, volume-weighted, moving average of the annual TDS concentration is also defined. The use of this moving average allows the effects of wet and dry years to be integrated over the five-year period and reflects the long-term quality of water recharged by Orange County Water District (OCWD) downstream of Prado Dam.

The Basin Plan specifies a monitoring program to determine compliance with the Reach 3 baseflow objectives at Prado Dam (see Chapter 4 of the Basin Plan), whereas baseflow is defined by the Basin Plan as composed of wastewater discharges, rising groundwater, and nonpoint source discharges. Regional Board staff conducts this program on an annual basis. The measurement of baseflow quality, rather than the quality of flows in Reach 2, has long been used to indicate the effects of recharge of SAR flows on Orange County groundwater. The efficacy of this approach was evaluated as part of the 2004 Basin Plan Amendment for the TDS/nitrogen management plan in the Basin Plan. As discussed in the 2004 Basin Plan Amendment, Reach 3 baseflow objectives are considered protective of the Orange County Groundwater Basin and the existing monitoring program designed to measure compliance is sufficient.

In addition to the baseflow sampling program and the surface water monitoring commitments associated with certain agencies' "maximum benefit" programs, the comprehensive monitoring program implemented by the Task Force members must include an evaluation of compliance with the TDS and nitrogen objectives for Reaches 2, 4, and 5 of the SAR. Compliance with the Reach 2 TDS objective can be determined by the evaluation of data collected by the Chino Basin Watermaster (CBWM), Inland Empire Utilities Agency (IEUA) OCWD, the United States Geological Survey (USGS), and others.

Compliance with Basin Plan objectives for Reach 4 and 5 of the SAR can be determined in the same manner.

A description of the data collected for this report is discussed in Section 2. Section 3 presents the analysis of the monitoring data collected. Results are presented by Reach of the SAR. Water quality and flow data were also collected from tributaries to the SAR and, where appropriate, were compared to Basin Plan objectives to determine compliance. Section 4 provides a summary of the report. The complete set of 2016 surface water quality data is included as Appendix C on the enclosed CD.

2 Data Collection

Water quality and discharge data used to prepare the 2016 Annual Report of Santa Ana River Water Quality, were collected from a number of regional efforts to monitor surface water quality along the SAR and its tributaries, including in-stream gauges employed by USGS, shown in Figure 2-1.

A detailed description of each of these monitoring efforts follows:

Regional Board staff typically conducts annual water quality monitoring of baseflow in the SAR exiting Reach 3, below Prado Dam. Monitoring typically extends over a five-week period during the months of August and September and is used to determine compliance with Reach 3 baseflow objectives. In 2016 baseflow monitoring consisted of five sampling events from August 12 through September 9, as shown in Table 3-3. The complete set of 2016 baseflow water quality data collected exiting Reach 3 below Prado Dam by the Regional Board is included in Appendix C on the enclosed CD.

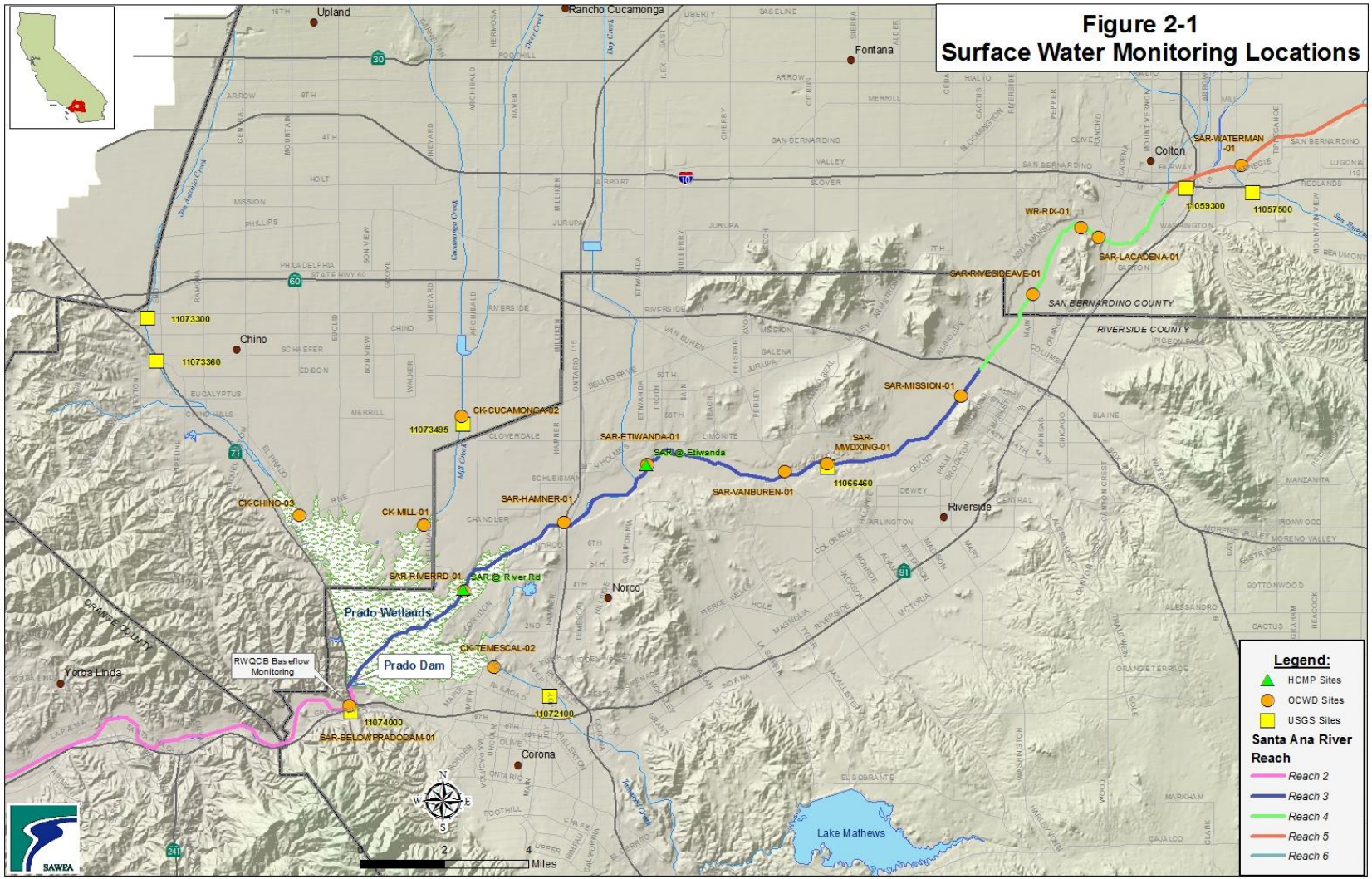
OCWD conducts a monitoring program for the SAR to assess the quality of the SAR water recharged into the Orange County Groundwater Basin. OCWD collects monthly and quarterly samples from the SAR at Imperial Highway in Anaheim and other locations along the SAR below Prado Dam and its tributaries. During the month of August, monitoring is performed with a greater sampling frequency to capture base flow conditions within the Watershed. Above Prado Dam, OCWD collects samples from a single monitoring event in August (event took place on 08/16/2016). These data are used in this report to evaluate water quality for Reaches 2, 3, 4, and 5 of the SAR and Reach 1B of Chino Creek during low flow conditions. OCWD monitoring locations used in this report are presented in Table 2-1. In later tables and figures, OCWD stations are referred to by their map location. The complete set of 2016 SAR water quality data collected by OCWD is included in Appendix C on the enclosed CD.

Table 2-1. OCWD's Santa Ana River Water Quality Monitoring Locations

Station ID	Station Name	Tributary
8105	SAR-BELOWDAM-01	Santa Ana River Reach 2
8096	SAR-RIVERRD-01	Santa Ana River Reach 3
8111	SAR-HAMNER-01	Santa Ana River Reach 3
9672	SAR-ETIWANDA-01	Santa Ana River Reach 3
8112	SAR-VANBUREN-01	Santa Ana River Reach 3
8113	SAR-MWDXING-01	Santa Ana River Reach 3
8094	CK-CHINO-03	Chino Creek
8090	CK-MILL-01	Cucamonga Creek
17576	CK-CUCAMONGA-02	Cucamonga Creek
8107	CK-TEMESCAL-02 *	Temescal Creek
8114	SAR-MISSION-01	Santa Ana River Reach 4
8115	SAR-RIVERSIDEAVE-01	Santa Ana River Reach 4
14655	WR-RIX-01	Santa Ana River Reach 4
8116	SAR-LACADENA-01 *	Santa Ana River Reach 4
8117	SAR-WATERMAN-01 *	Santa Ana River Reach 5

**No flow at these sites in 2016*

Figure 2-1. Surface Water Monitoring Locations



The USGS maintains eight active gauging stations to monitor flow and water quality along the SAR and several of its tributaries. Long-term stream flow and water quality data are available for gauging stations 11074000, *located at Below Prado Dam*, and 11066460, *located at MWD Crossing*. Data available from the other gauging stations, however, includes only stream flow and are used only to provide information on annual (calendar year) stream flow at various locations throughout the Watershed. The complete list of USGS gauging stations used in this report is presented in Table 2-2. The complete set of 2016 flow and water quality data available from the USGS is included in Appendix C on the enclosed CD.

Table 2-2. USGS Stream Gauge Stations

USGS ID	Station Name	2016 Flow (AFY)	Tributary
11074000	Santa Ana River Below Prado Dam	119,510	Santa Ana River Reach 2
11066460	Santa Ana River at MWD Crossing	33,842	Santa Ana River Reach 3
11073360	Chino Creek at Schaefer Avenue near Chino	15,411	Chino Creek
11073300	San Antonio Creek at Riverside Dr nr Chino	15,963	San Antonio Creek
11073495	Cucamonga Creek nr Mira Loma	18,850	Cucamonga Creek
11072100	Temescal Creek above Main St at Corona	5,006	Temescal Creek
11059300	Santa Ana River at E St near San Bernardino	12,749	Santa Ana River Reach 5
11057500	San Timoteo Creek near Loma Linda	6,665	San Timoteo Creek

The Chino Basin Hydraulic Control Monitoring Program (HCMP) is conducted jointly by the CBWM and IEUA as part of their Maximum Benefit monitoring commitment. Water quality data collected through this program is used in this report to evaluate compliance with Basin Plan objectives for Reaches 2 and 3 of the SAR. Through 2012, the HCMP program collected bi-monthly samples from locations along the SAR (both above and below Prado Dam) and its tributaries. In 2013, the HCMP requirements were reduced to quarterly monitoring at two locations, which are presented in Table 2-3. The complete set of 2016 water quality data collected through the HCMP is included in Appendix C on the enclosed CD.

Table 2-3. Chino Basin Hydraulic Control Monitoring Program (HCMP) Monitoring Sites

Station ID	Site Name	Tributary
1207120	Santa Ana River at River Road	Santa Ana River Reach 3
1207118	Santa Ana River at Etiwanda	Santa Ana River Reach 3

3 Analysis of Monitoring Data

3.1 Santa Ana River Reach 2

Water quality objectives specified for Reach 2 of the SAR by the Basin Plan include only a TDS objective of 650 mg/L. No other water quality objectives are specified for Reach 2. The determination of this TDS objective for Reach 2 is made by the SAR Watermaster in their annual report based upon their estimation of total flow quality, shown in Table 3-1. In years of normal rainfall, most of the total flow of the river is percolated in the Santa Ana Forebay, and directly affects the quality of the groundwater. For that reason, compliance with the TDS water quality objective for Reach 2 will be based on the five-year moving average of the annual TDS content of total flow, which is estimated by computing the arithmetic average of the five most recent annual estimates of flow-weighted TDS for total flow at Below Prado (from the SAR Watermaster Annual Reports). Use of this moving average allows the effects of wet and dry years to be smoothed out over the five-year period.

Table 3-1. Yearly Volume-Weighted Moving Average TDS at Below Prado Dam (SAR Watermaster Report)

Water Year Ending	Yearly Flow-weighted TDS (mg/L)
2012	598
2013	621
2014	582
2015	522
2016	541
5 Year Average	573

Alternative Method to Determine Compliance with TDS Objective for Reach 2

Additionally, an alternative methodology was employed using the data collected from OCWD, USGS, and for the HCMP. These data were plotted and a five-year, volume-weighted moving average was calculated to provide an alternative measure to estimate compliance with this objective.

During the 2016 calendar year, 59 samples were collected for TDS at *Below Prado Dam*. These included grab samples collected by the USGS, OCWD and the Regional Board. From the results of these samples, electrical conductivity (EC) and TDS were graphically plotted. A linear regression of TDS versus EC yielded the following equation:

$$TDS = (EC \times 0.6193) - 11.825$$

The coefficient of determination (R^2) of the linear regression was 0.96, which indicates a strong correlation between TDS and EC; that is, about 96 percent of the variability in TDS is explained by this equation. Using the above equation and daily EC data from a continuous monitoring device operated by USGS, daily TDS values were calculated for 2016 data. Daily stream flow values at *Below Prado Dam* were multiplied by the computed TDS values and summed for each month. This total was divided by the total monthly flow in order to yield a volume-weighted average for each month. These results are shown in Table 3-2. The 5-year volume-weighted TDS average for the period January 2012 through December 2016 was 569 mg/L. This represents an increase of 3.0 mg/L from last year's 5-year volume-weighted TDS average of 566 mg/L.

A five-year, volume-weighted, moving average was calculated using these values in addition to historic flow-weighted TDS averages calculated by the SAR Watermaster. Figure 3-1 shows the time history for TDS observations for 1996 to the present at *Below Prado Dam* as depicted as the five-year moving average TDS concentration, and the five-year, volume-weighted, moving average TDS concentration.

Through either method, the five-year, volume-weighted, moving average for TDS is the compliance metric for Reach 2. This statistic has never exceeded the Basin Plan objective of 650 mg/L for the period shown. The five-year, volume weighted moving average TDS concentration has decreased over time from the mid-1980s until about 2000 when TDS concentrations were observed to slightly increase. This upward trend continued until about 2004 when TDS concentrations dropped. Since 2008 there has been an increase in TDS concentrations.

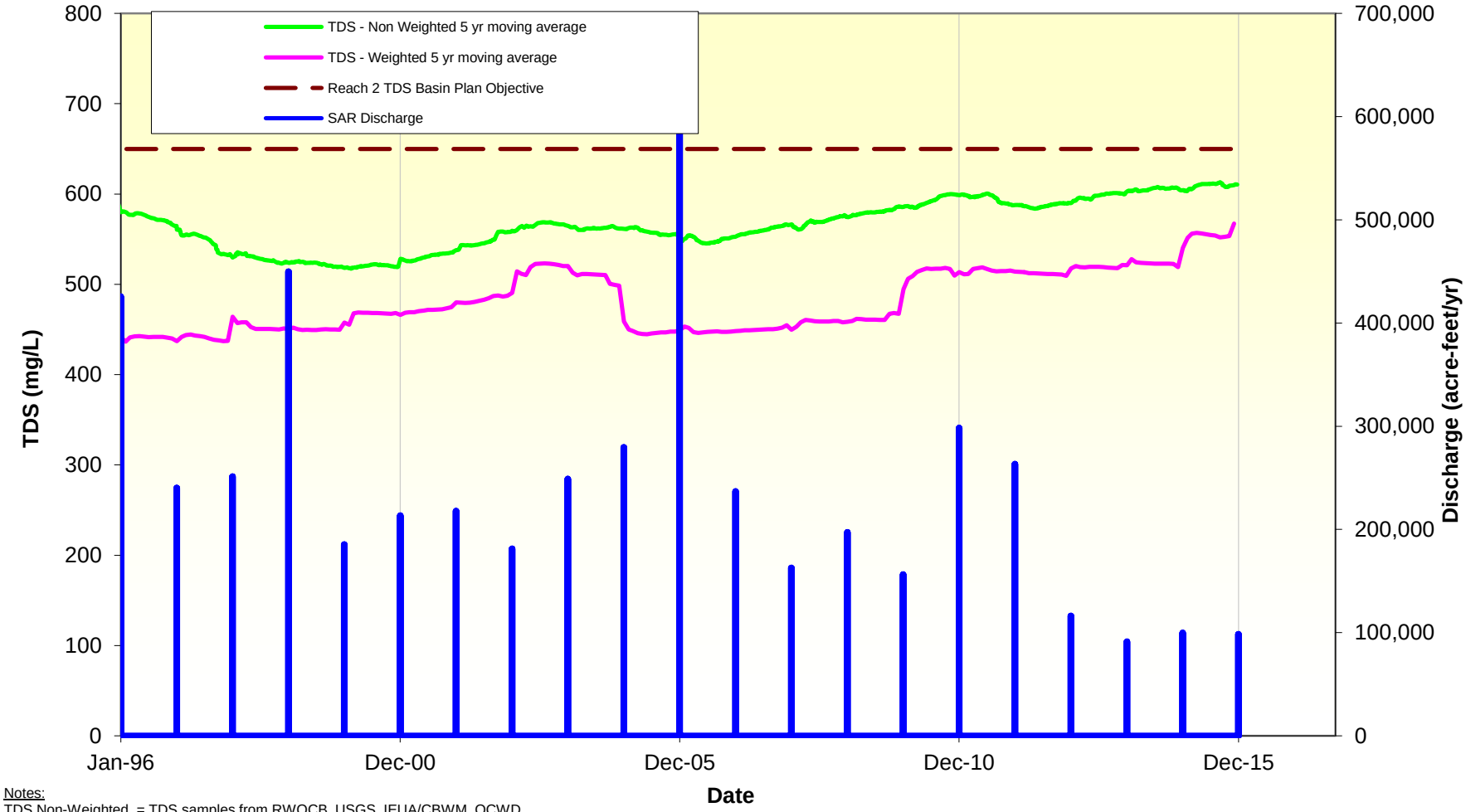
During wet periods, not all of the water flowing from Prado Dam is captured for recharge in Orange County. Therefore, a volume-weighted average may not be representative of the quality of water actually recharged. For comparison, the five-year moving average TDS, based on discrete samples collected by OCWD, Regional Board, USGS, and by CBWM/IEUA for the HCMP, is plotted on Figure 3-1. The volume-weighted and non-volume-weighted moving averages are quite similar. However, the five-year moving average exceeded 650 mg/L before 1976 and between 1984 and 1988. After the mid-1980s, TDS concentrations decrease monotonically until about 2000; wherein, a slight increase in TDS concentration is observed. The non-volume-weighted moving average also began to decrease around 2004, but not as significantly. Since mid-2006 the non-volume-weighted moving average has begun to increase.

Table 3-2. Monthly Volume-Weighted Moving Average TDS at Below Prado Dam (2016 OCWD, USGS and Regional Board at Below Prado Dam)

Month	Monthly Flow (cfs-days)	Monthly Volume Weighted TDS (mg/L)	Monthly Flow X TDS
Jan-12	5,693	602	3,424,405
Feb-12	6,369	603	3,837,482
Mar-12*	2,212	625	1,382,629
Apr-12*	4,717	519	2,447,907
May-12	6,523	622	4,055,712
Jun-12	2,704	696	1,883,185
Jul-12	2,386	687	1,640,271
Aug-12	2,273	677	1,539,422
Sep-12	2,914	651	1,896,607
Oct-12	3,492	639	2,230,792
Nov-12	4,703	635	2,984,371
Dec-12*	988	563	556,305
Jan-13*	1,023	543	555,871
Feb-13	6,276	598	3,754,901
Mar-13	5,297	607	3,217,293
Apr-13	3,468	677	2,346,238
May-13	3,484	655	2,280,414
Jun-13	2,333	693	1,616,724
Jul-13	2,183	671	1,465,135
Aug-13	2,000	661	1,322,963
Sep-13	1,970	637	1,254,888
Oct-13	2,721	658	1,791,512
Nov-13	4,207	578	2,433,502
Dec-13	4,446	653	2,903,676
Jan-14	3,312	681	2,255,040
Feb-14	3,627	659	2,390,989
Mar-14	10,811	429	4,635,755
Apr-14	4,329	616	2,664,778
May-14	2,160	698	1,507,815
Jun-14	1,857	702	1,304,490
Jul-14	1,698	711	1,206,771
Aug-14	2,452	635	1,557,234
Sep-14	2,043	672	1,373,065
Oct-14	2,057	572	1,175,631
Nov-14	3,541	575	2,171,523
Dec-14	12,331	612	4,029,366
Jan-15*	8,443	558	4,713,608
Feb-15*	4,181	548	2,292,593
Mar-15	5,971	611	3,647,810
Apr-15	3,055	705	2,153,348
May-15	3,917	649	2,540,633
Jun-15*	2,031	658	1,335,858
Jul-15*	3,114	553	1,722,216
Aug-15*	1,975	594	1,173,280
Sep-15*	3,766	451	1,699,702
Oct-15	4,935	631	3,115,713
Nov-15	3,795	659	2,502,562
Dec-15	4,420	586	2,590,772
Jan-16	11,015	355	3,913,599
Feb-16	6,529	610	3,979,901
Mar-16 **	2,454	493	1,209,018
Apr-16	3,753	629	2,362,198
May-16	3,421	614	2,102,066
Jun-16 **	3,792	570	2,162,097
Jul-16 **	903	520	469,962
Aug-16	3,830	499	1,910,346
Sep-16	2,064	683	1,408,987
Oct-16 **	2,907	637	1,851,646
Nov-16	4,082	574	2,344,955
Dec-16	8,304	337	2,795,675
Total	**237,257**		**135,093,209**
5 - Year Volume Weighted Average: 569 mg/L			

*Note: *Denotes monthly results with missing EC readings due to instrumentation issues with USGS equipment*
Monthly Flow weighted results with missing EC used for missing days
*** Denotes monthly results with missing EC readings due to instrumentation issues with USGS equipment only available EC data was used*

Figure 3-1. Total Dissolved Solids (TDS) Below Prado Dam



Notes:
TDS Non-Weighted = TDS samples from RWQCB, USGS, IEUA/CBWM, OCWD.
TDS Weighted = Monthly flow weighted TDS calculated from EC. Data prior to October 2003 from Watermaster; October 2003 to December 2004 from WeInc, 2005 to 2016 from SAWPA.

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3.2 Santa Ana River Reach 3

3.2.1 Below Prado Dam

In order to determine whether water quality and quantity objectives for base flow in Reach 3 are being met, the Regional Board collects a series of grab and composite samples at *Below Prado Dam* during August and September when the influence of storm flows and nontributary flows is at a minimum. In 2016, there were no non-tributary flows and at this time of year there is usually no water impounded behind Prado Dam, the volumes of storm flows, rising water, and nonpoint sources discharges tend to be low, and the major component of base flow is municipal wastewater. Water quality objectives specified for Reach 3 of the SAR by the Basin Plan include TDS, hardness, sodium, chloride, Total Nitrogen (TN), sulfate, Chemical Oxygen Demand (COD) and boron. In 2016, baseflow monitoring below Prado Dam consisted of five sampling events conducted during the months of August and September. The data collected through this program are presented in Table 3-3.

Table 3-3. Results for 2016 Annual Baseflow Monitoring Program for the Santa Ana River at Below Prado Dam

Parameter	Units	Basin Plan Objectives SAR Reach 3	8/12/2016	8/19/2016	8/26/2016	9/1/2016	9/9/2016
Ammonia-Nitrogen	mg/L		0.10	0.14	0.15	< 0.05	< 0.05
Bicarbonate (as CaCO3)	mg/L		-na-	-na-	-na-	-na-	-na-
Boron	mg/L	**0.75**	0.28	0.20	0.21	0.24	0.30
Calcium	mg/L		56	52	52	64	98
Carbonate (as CaCO3)	mg/L		-na-	-na-	-na-	-na-	-na-
Chemical Oxygen Demand	mg/L	**30**	23	14	< 5.0	< 5.0	< 5.0
Chloride	mg/L	**140**	88	85	86	92	132
Electrical Conductivity	umhos/cm		802	764	622	789	1130
Hydroxide (as CaCO3)	mg/L		-na-	-na-	-na-	-na-	-na-
Magnesium	mg/L		17	16	16	17	23
Nitrate-Nitrogen	mg/L		1.3	1.3	1.7	1.6	4.3
Nitrite-Nitrogen	mg/L		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Organic Nitrogen	mg/L		< 0.01	0.24	0.04	< 0.01	< 0.01
pH	units		7.6	7.6	7.3	7.2	7.5
Potassium	mg/L		8.86	8.24	8.53	13.3	19.2
Sodium	mg/L	**110**	87	81	82	96	138
Sulfate	mg/L	**150**	66	64	65	71	109
Total Alkalinity (as CaCO3)	mg/L		-na-	-na-	-na-	-na-	-na-
Total Dissolved Solids	mg/L	**700**	542	510	416	532	750
Total Hardness (as CaCO3)	mg/L	**350**	204	188	180	188	288
Total Inorganic Nitrogen	mg/L		1.4	1.5	1.8	1.6	4.3
Total Kjeldahl Nitrogen	mg/L		< 0.05	0.38	0.19	< 0.05	< 0.05
Total Nitrogen	mg/L	**10**	1.8	1.7	1.9	1.6	4.3
Total Organic Carbon	mg/L		4	3	4	5	4.9
Turbidity	NTU		-na-	-na-	-na-	-na-	-na-

Notes: Table includes a standard list of water quality constituents and does not reflect the actual constituents sampled

- na entered where there was no data available for the constituent

A summary of all monitoring data collected by the USGS, OCWD and the Regional Board at *Below Prado Dam* during 2016 along with Basin Plan objectives for baseflow conditions for SAR Reach 3 water quality are presented in Table 3-4. This includes five monitoring events conducted by the Regional Board for their annual water quality monitoring of baseflow in the SAR during August and September of 2016.

OCWD conducted seventeen near monthly monitoring events at Below Prado Dam, including seven monitoring events conducted in August and September 2016. The USGS conducted seventeen sampling events at Below Prado Dam including two monitoring events in August and September 2016. A review of this data showed no exceedences to water quality objectives specified in the Basin Plan. Table 3-4 presents the results of this monitoring.

Table 3-4. Summary of Annual and Baseflow Water Quality Observations for the Santa Ana River at Below Prado Dam

Constituent	Units	Basin Plan Objectives Santa Ana River Reach 3	Annual Average	# of Samples	Baseflow Average	# of Samples
Ammonia-Nitrogen	mg/L		< 0.1	39	< 0.1	14
Bicarbonate (as CaCO3)	mg/L		199	34	182	9
Boron	mg/L	**0.75**	0.24	24	0.25	11
Calcium	mg/L		67	32	64	12
Carbonate (as CaCO3)	mg/L		1.3	34	1.2	9
Chemical Oxygen Demand	mg/L	**30**	11	15	11	15
Chloride	mg/L	**140**	115	37	115	14
Dissolved Oxygen	mg/L		9.9	17	9.4	2
Electrical Conductivity	umhos/cm		943	380	966	80
Fluoride	mg/L		0.33	19	0.37	3
Hydroxide (as CaCO3)	mg/L		< 1	17	< 1	7
Magnesium	mg/L		17	32	17	12
Nitrate-Nitrogen	mg/L		2.9	39	2.3	14
Nitrite-Nitrogen	mg/L		0.042	39	0.048	14
Organic Nitrogen	mg/L		0.6	39	0.4	14
pH	UNITS		7.9	39	7.8	14
Potassium	mg/L		11.9	32	11.0	12
Sodium	mg/L	**110**	94	32	94	12
Sulfate	mg/L	**150**	89	37	86	14
Total Alkalinity (as CaCO3)	mg/L		182	49	177	11
Total Dissolved Solids	mg/L	**700**	553	61	554	18
Total Hardness (as CaCO3)	mg/L	**350**	234	32	221	12
Total Inorganic Nitrogen	mg/L	**10**	3.0	39	2.4	14
Total Kjeldahl Nitrogen	mg/L		0.7	39	0.5	14
Total Nitrogen	mg/L		3.6	39	2.8	14
Total Organic Carbon	mg/L		5.2	38	4.5	14
Turbidity	NTU		40.4	34	17.3	9

Note: Table summarizes monitoring data collected by USGS, OCWD, CBWM/IEUA and the Regional Board at Below Prado Dam during 2016
- Table includes a standard list of water quality constituents and does not reflect the actual constituents sampled.
- Baseflow Average results reflect a combination of stormflow and baseflow, due to rainfall and associated runoff that occurred.
- Exceedances are shown in red lettering.

The USGS also maintains a gauging station, 11074000, located on the SAR below Prado Dam, shown in Figure 2-1. In 2016, this station recorded flows totaling 119,510 AFY.

A long time-history of water quality data has been collected by USGS along with data collected by OCWD, Regional Board baseflow monitoring program, and by CBWM/IEUA at *Below Prado Dam* and *MWD Crossing*. These data were plotted for each constituent that has a Basin Plan objective for January

1996 through to current (note: Basin Plan objectives for water quality are based on discrete samples) and are included in Appendix B, to show the longer-term trends in baseflow data, and non-baseflow water quality samples, as well as non-volume-weighted five-year moving averages.

3.2.2 Santa Ana River Mainstem between Riverside Narrows and Prado Wetlands

Monitoring of Reach 3, above Prado Dam is performed by CBWM/IEUA for the HCMP, OCWD for their SAR Water Quality Monitoring Program and the USGS at MWD Crossing. This included monitoring of the following locations: *MWD Crossing, Van Buren Blvd., Etiwanda Avenue, Hamner Road, and River Road*, as shown in Figure 2-1. In 2016, CBWM/IEUA through the HCMP, monitored the *Etiwanda Avenue, and River Road* locations on a quarterly basis. OCWD conducted a single monitoring event for each of the locations in August 2016. Additionally, the USGS collects electrical conductivity and TDS at their gauge located *Santa Ana River at MWD Xing*. Table 3-5 presents a summary of the results of these monitoring efforts, as compared to Basin Plan objectives identified specifically for Reach 3 base flow conditions. Therefore, the data shown in Table 3-5 are reported for informational purposes only.

Baseflow conditions, presented in Table 3-6 are represented by water quality data collected in August and September. In 2016, this consisted of a single sample collected in August for each location.

This data reported water quality concentrations similar to average annual water quality and for the most part met water quality objectives specified in the Basin Plan. One exception was chloride, which exceeded its water quality objective at *Hamner Road.*

The USGS maintains a gauging station, 11066460, located along Reach 3 of the SAR at the MWD Crossing, shown in Figure 2-1. In 2016, this station recorded flows totaling 33,842 AFY.

Table 3-5. Summary of Water Quality Observations for the Santa Ana River Between Riverside Narrows and Prado Wetlands

Constituent	Units	Basin Plan Objectives Santa Ana River Reach 3	SAR River Road	# of Samples	SAR Hamner	# of Samples	SAR Etiwanda	# of Samples	SAR Van Buren	# of Samples	SAR MWD Crossing	# of Samples
Ammonia-Nitrogen	mg/L		< 0.1	5	< 0.1	1	< 0.1	5	0	1	< 0.1	1
Bicarbonate (as CaCO3)	mg/L		259	5	274	1	246	5	245	1	244	1
Boron (total)	mg/L		0.26	4	-na-	-na-	0.27	4	-na-	-na-	-na-	-na-
Calcium	mg/L		82	4	-na-	-na-	80	4	-na-	-na-	-na-	-na-
Carbonate (as CaCO3)	mg/L		5.3	5	< 1	1	4.8	5	< 1	1	< 1	1
Chemical Oxygen Demand	mg/L	**30**	7	2	10	2	12	2	1.5	2	7	2
Chloride	mg/L	**140**	124	5	143	1	122	5	111	1	109	1
Electrical Conductivity	umhos/cm		1056	5	1180	1	1050	5	1060	1	960	28
Hydroxide (as CaCO3)	mg/L		< 2	5	< 1	1	< 2	5	< 1	1	< 1	1
Magnesium	mg/L		17	4	-na-	-na-	16	4	-na-	-na-	-na-	-na-
Nitrate-Nitrogen	mg/L		5.2	5	3.6	1	5.7	5	9.3	1	9.4	1
Nitrite-Nitrogen	mg/L		< 0.05	5	0.013	1	< 0.05	5	0.016	1	0.018	1
Organic Nitrogen	mg/L		0.6	5	0	1	0.7	5	0	1	0	1
pH	units		8.3	5	8.1	1	8.3	5	8.2	1	8.1	1
Potassium	mg/L		18.0	4	-na-	-na-	19.0	4	-na-	-na-	-na-	-na-
Sodium	mg/L	**110**	105	4	-na-	-na-	104	4	-na-	-na-	-na-	-na-
Sulfate	mg/L	**150**	100	5	121	1	102	5	112	1	111	1
Total Alkalinity (as CaCO3)	mg/L		223	5	274	1	210	5	245	1	244	1
Total Dissolved Solids	mg/L	**700**	642	5	646	1	631	5	672	1	595	26
Total Hardness (as CaCO3)	mg/L	**350**	273	4	-na-	-na-	263	4	-na-	-na-	-na-	-na-
Total Inorganic Nitrogen	mg/L	**10**	5.2	5	3.6	1	5.8	5	9.5	1	9.4	1
Total Kjeldahl Nitrogen	mg/L		0.6	5	0	1	0.7	5	1	1	0	1
Total Nitrogen	mg/L		5.8	5	3.8	1	6.4	5	9.8	1	9.7	1
Total Organic Carbon	mg/L		3.5	5	3.7	1	4.0	5	1.8	1	1.8	1
Turbidity	NTU		2	5	0.9	1	1.5	5	1.5	1	2.1	1

Note: Table presents average concentration data
- Table includes a standard list of water quality constituents and does not reflect the actual constituents sampled
- na entered where there was no data available for the constituent
- Exceedances are shown in red lettering
- Site SAR River Road includes data collected by CBWM/IEUA at "Santa Ana River at River Road" and OCWD at "SAR-RIVERRD-01"
- Site SAR Hamner includes only data collected by OCWD at "SAR-HAMNER-01"
- Site SAR Etiwanda includes data collected by CBWM/IEUA at "Santa Ana River at Etiwanda" and OCWD at "SAR-ETIWANDA-01"
- Site SAR Van Buren includes only data collected by OCWD at "SAR-VANBUREN-01"
- Site SAR MWD includes data collected by USGS at "Santa Ana River at MWD Xing" and OCWD at "SAR-MWDXING-01"
- na entered where there was no data collected for the constituent
- Where appropriate, data results reflect Annual Average estimates

Table 3-6. Average Baseflow Water Quality Observations for the SAR between Riverside Narrows and Prado Wetlands (August – September 2016)

Constituent	Units	Basin Plan Objectives Santa Ana River Reach 3	SAR River Road	# of Samples	SAR Hamner	# of Samples	SAR Etiwanda	# of Samples	SAR Van Buren	# of Samples	SAR MWD Crossing	# of Samples
Ammonia-Nitrogen	mg/L		< 0.1	1	< 0.1	1	< 0.1	1	0.20	1	< 0.1	1
Bicarbonate (as CaCO3)	mg/L		243	1	274	1	221	1	245	1	244	1
Boron	mg/L	**0.75**	-na-	-na-	-na-	-na-	-na-	-na-	-na-	-na-	-na-	-na-
Calcium	mg/L		-na-	-na-	-na-	-na-	-na-	-na-	-na-	-na-	-na-	-na-
Carbonate (as CaCO3)	mg/L		< 1	1	< 1	1	< 1	1	< 1	1	< 1	1
Chemical Oxygen Demand	mg/L	**30**	7	2	10	2	12	2	1.00	2	7	2
Chloride	mg/L	**140**	129	1	143	1	130	1	111	1	109	1
Electrical Conductivity	umhos/cm		1100	1	1180	1	1070	1	1060	1	1040	5
Hydroxide (as CaCO3)	mg/L		< 1	1	< 1	1	< 1	1	< 1	1	< 1	1
Magnesium	mg/L		-na-	-na-	-na-	-na-	-na-	-na-	-na-	-na-	-na-	-na-
Nitrate-Nitrogen	mg/L		5.3	1	3.6	1	6.6	1	9.3	1	9.4	1
Nitrite-Nitrogen	mg/L		0.014	1	0.013	1	0.014	1	0.016	1	0.018	1
Organic Nitrogen	mg/L		0.40	1	0.20	1	0.40	1	0.30	1	0.20	1
pH	units		8.2	1	8.1	1	8.1	1	8.2	1	8.1	1
Potassium	mg/L		-na-	-na-	-na-	-na-	-na-	-na-	-na-	-na-	-na-	-na-
Sodium	mg/L	**110**	-na-	-na-	-na-	-na-	-na-	-na-	-na-	-na-	-na-	-na-
Sulfate	mg/L	**150**	103	1	121	1	109	1	112	1	111	1
Total Alkalinity (as CaCO3)	mg/L		243	1	274	1	221	1	245	1	244	1
Total Dissolved Solids	mg/L	**700**	648	1	646	1	646	1	672	1	635	5
Total Hardness (as CaCO3)	mg/L	**350**	-na-	-na-	-na-	-na-	-na-	-na-	-na-	-na-	-na-	-na-
Total Inorganic Nitrogen	mg/L	**10**	5.3	1	3.6	1	6.6	1	9.5	1	9.4	1
Total Kjeldahl Nitrogen	mg/L		0.4	1	0.2	1	0.4	1	0.5	1	0.3	1
Total Nitrogen	mg/L		5.7	1	3.8	1	7.0	1	9.8	1	9.7	1
Total Organic Carbon	mg/L		3.5	1	3.7	1	4.2	1	1.8	1	1.8	1
Turbidity	NTU		1.3	1	0.9	1	1.4	1	1.5	1	2.1	1

Note: Table presents average concentration data
- Exceedances are shown in red lettering
- Table includes a standard list of water quality constituents and does not reflect the actual constituents sampled
- na entered where there was no data available for the constituent
- Average baseflow sample results reflect a combination of stormflow and baseflow, due to rainfall and associated runoff that occurred.
- Site SAR River Road includes data collected by CBWM/IEUA at "Santa Ana River at River Road" and OCWD at "SAR-RIVERRD-01"
- Site SAR Hamner includes only data collected by OCWD at "SAR-HAMNER-01"
- Site SAR Etiwanda includes data collected by CBWM/IEUA at "Santa Ana River at Etiwanda" and OCWD at "SAR-ETIWANDA-01"
- Site SAR Van Buren includes only data collected by OCWD at "SAR-VANBUREN-01"
- Site SAR MWD includes data collected by USGS at "Santa Ana River at MWD Xing" and OCWD at "SAR-MWDXING-01"
- na entered where there was no data collected for the constituent
- Where appropriate, data results reflect Annual Average estimates

3.2.3 Tributaries to Reach 3 of the Santa Ana River

The three tributaries to Reach 3 of the SAR that are regularly monitored for water quality and discharge by OCWD, USGS, and by CBWM/IEUA for the HCMP are Chino Creek, Cucamonga Creek (which becomes Mill Creek in the Prado reservoir area), and Temescal Creek.

3.2.3.1 Chino Creek

Chino Creek extends from its confluence with the SAR (directly behind Prado Dam) along the eastern base of City of Chino Hills and into southern Pomona. Chino Creek is divided into two reaches. Reach 1 is that portion of the creek that extends from the confluence with the SAR upstream to the beginning of the concrete-lined channel south of Los Serranos Road. In 2004, Reach 1 of Chino Creek was further subdivided into two reaches, 1A and 1B. Reach 1A extends from the SAR confluence to downstream of the confluence with Mill Creek. Reach 1B extends from the confluence of Mill Creek to the beginning of the concrete-lined channel south of Los Serranos Road.

Chino Creek Reach 2 extends from Los Serranos Road to the boundary of Region 8 with that of the Los Angeles Regional Water Quality Control Board (Region 4) at the Los Angeles/San Bernardino County line. Reach 2 of Chino Creek is concrete-lined along the bottom and banks throughout its length. San Antonio Creek, an important drainage feature in western Chino Basin, is tributary to Reach 2 of Chino Creek at a location just north of Chino Avenue.

Chino Creek Reach 1A

The Basin Plan has specified water quality objectives for Chino Creek Reaches 1A for TDS, hardness, sodium, chloride, TIN, sulfate and COD. However, there are no data collected along Chino Creek Reach 1A for it encompasses an area upstream of Prado Dam which is difficult to access, and in the winter months, is commonly inundated.

Chino Creek Reach 1B

The Basin Plan has specified water quality objectives for Chino Creek Reaches 1B for TDS, hardness, sodium, chloride, TIN, sulfate and COD. Water quality monitoring in Chino Creek Reach 1B is performed by OCWD for their SAR Water Quality Monitoring Program, as shown in Figure 2-1. In 2016, OCWD monitored station *CK-CHINO-03,* located north of Pine Avenue Bridge and just west of El Prado Road, once in August of 2016. A review of this data showed no exceedances of water quality objectives specified in the Basin Plan. Table 3-7 presents the results of this monitoring.

The USGS maintains gauging station, 11073360, located along Chino Creek at Schaefer Avenue below the confluence with San Antonio Creek, and 11073300, located along San Antonio Creek at Riverside Drive near Chino, shown in Figure 2-1. In 2016, these stations recorded flows totaling 15,411 and 15,963 AFY, respectively.

Table 3-7. Summary of Water Quality and Flow Observations for Chino Creek, Reach 1B

Constituent	Units	Basin Plan Objective Chino Creek Reach 1B	Chino Creek Reach 1B	# of Samples
Ammonia-Nitrogen	mg/L		< 0.1	1
Bicarbonate (as CaCO3)	mg/L		80	1
Boron (dissolved)	ug/L		-na-	-na-
Calcium	mg/L		-na-	-na-
Carbonate (as CaCO3)	mg/L		< 1	1
Chemical Oxygen Demand	mg/L	**15**	9	2
Chloride	mg/L	**75**	72	1
Electrical Conductivity	umhos/cm		488	1
Hydroxide (as CaCO3)	mg/L		< 1	1
Magnesium	mg/L		-na-	-na-
Nitrate-Nitrogen	mg/L		0.3	1
Nitrite-Nitrogen	mg/L		0.008	1
Organic Nitrogen	mg/L		0.10	1
pH	units		7.8	1
Potassium	mg/L		-na-	-na-
Sodium	mg/L	**75**	-na-	-na-
Sulfate	mg/L	**60**	42	1
Total Alkalinity (as CaCO3)	mg/L		80	1
Total Dissolved Solids	mg/L	**550**	268	1
Total Hardness (as CaCO3)	mg/L	**240**	-na-	-na-
Total Inorganic Nitrogen	mg/L	**8**	0.3	1
Total Kjeldahl Nitrogen	mg/L		< 0.2	1
Total Nitrogen	mg/L		0.3	1
Total Organic Carbon	mg/L		5.4	1
Turbidity	NTU		5.4	1

Note: Table presents average concentration data
- Table includes a standard list of water quality constituents and does not reflect the actual constituents sampled
- na entered where there was no data available for the constituent
-Exceedances are shown in red lettering
- Site Chino Creek Reach 1B includes data collected by OCWD at "CK-CHINO-03"
- Where appropriate, data results reflect Annual Average estimates

Chino Creek Reach 2

No in-stream monitoring is currently performed in Reach 2 of Chino Creek.

3.2.3.2 Cucamonga Creek

As identified in Figure 2.1, Cucamonga Creek is located just upstream of Chino-Corona Road and is designated as a natural channel with unlined bottom and banks. Cucamonga Creek, Reach 1, extends from this "confluence" to the point where 23rd Street crosses the channel in the City of Upland. The segment of Cucamonga Creek upstream of this location is designated as Reach 2.

Cucamonga Creek becomes Mill Creek just north of Chino-Corona Road and travels a couple of miles before flowing into Prado Flood Control Basin. Mill Creek extends from its confluence with Chino Creek to a location just upstream of Chino-Corona Road near the San Bernardino/Riverside County border.

Water quality monitoring in Cucamonga Creek is performed by OCWD for their SAR Water Quality Monitoring Program. This included monitoring of the following locations: *Cucamonga Creek near Mira Loma, and Mill Creek*, as shown in Figure 2-1. In 2016, OCWD monitored the *Cucamonga Creek near Mira Loma (CK-CUCAMONGA_02) and Mill Creek* (CK-MILL-01) sites once in August of 2016. The Basin Plan specifies no water quality objectives for Reach 1 of Cucamonga Creek, therefore, summary results presented in Table 3-8 are reported for informational purposes only.

The USGS maintains a gauging station, 11073495, located along Cucamonga Creek near Mira Loma, shown in Figure 2-1. In 2016, this station recorded flows totaling 18,850 AFY.

Table 3-8. Summary of Water Quality and Flow Observations for Cucamonga Creek

Constituent	Units	Cucamonga Creek Near Mira Loma	# of Samples	Mill Creek	# of Samples
Ammonia-Nitrogen	mg/L	< 0.1	1	0.7	1
Bicarbonate (as CaCO3)	mg/L	31	1	153	1
Carbonate (as CaCO3)	mg/L	57	1	< 1	1
Chemical Oxygen Demand	mg/L	32	2	30	2
Chloride	mg/L	98	1	129	1
Electrical Conductivity	umhos/cm	660	1	879	1
Hydroxide (as CaCO3)	mg/L	< 1	1	< 1	1
Magnesium	mg/L	-na-	-na-	-na-	-na-
Nitrate-Nitrogen	mg/L	5.0	1	3.7	1
Nitrite-Nitrogen	mg/L	0.168	1	0.296	1
Organic Nitrogen	mg/L	1.6	1	1.9	1
pH	units	9.5	1	8.1	1
Potassium	mg/L	-na-	-na-	-na-	-na-
Sodium	mg/L	-na-	-na-	-na-	-na-
Sulfate	mg/L	67	1	74	1
Total Alkalinity (as CaCO3)	mg/L	88	1	153	1
Total Dissolved Solids	mg/L	400	1	516	1
Total Hardness (as CaCO3)	mg/L	-na-	-na-	-na-	-na-
Total Inorganic Nitrogen	mg/L	5.1	1	4.7	1
Total Kjeldahl Nitrogen	mg/L	1.7	1	2.6	1
Total Nitrogen	mg/L	6.8	1	6.6	1
Total Organic Carbon	mg/L	11.9	1	10.7	1
Turbidity	NTU	3.3	1	2.7	1

Note: Table presents average concentration data
- Site "Cucamonga Creek near Mira Loma" includes data collected by OCWD at "CK-CUCAMONGA-02"
- Site "Mill Creek" includes data collected by OCWD at "CK-MILL-01"
- Table includes a standard list of water quality constituents and does not reflect the actual constituents sampled.
- "na" entered where there was no data available for the constituent
- Where appropriate, data results reflect Annual Average estimates

3.2.3.3 Temescal Creek

Temescal Creek begins at the outfall of Lake Elsinore extending down to its confluence with the SAR in the Prado Basin. The Basin Plan specifies no water quality objectives for Temescal Creek.

Water quality monitoring in Temescal Creek is performed by OCWD at *Temescal Creek (SAR-TEMESCAL-02)* for their SAR Water Quality Monitoring Program, as shown in Figure 2-1. In 2016, OCWD did not monitor the *Temescal Creek (SAR-TEMESCAL-02)*, as during the time scheduled for sampling there was no stream flow, and therefore no data was collected for this site.

The USGS maintains a gauging station, 11072100, located along Temescal Creek above Main Street at Corona, shown in Figure 2-1. In 2016, this station recorded flows totaling 5,006 AFY.

3.3 Santa Ana River Reach 4

The Basin Plan has specified water quality objectives for SAR Reach 4 for TDS, TIN, and COD. Along SAR Reach 4, OCWD monitors sites, *SAR-MISSION-01*, *SAR-RIVERSIDEAVE-01, and SAR-LACADENA-01*, shown in Figure 2-1. The site designated WR-RIX-01 is located directly in the RIX Outfall pool and is not considered representative of the mainstem of the Santa Ana River.

In 2016, the *SAR-MISSION* and *SAR-RIVERSIDEAVE* sites were monitored once by OCWD in August, but no data was collected at *SAR-LACADENA-01*.

A review of this data showed TIN to exceed its water quality objective specified in the Basin Plan. Table 3-9 presents a summary of the results of this monitoring.

Table 3-9. Summary of Water Quality and Flow Observations for Santa Ana River Reach 4

Constituent	Units	Basin Plan Objective SAR Reach 4	SAR at Mission Ave	# of Samples	SAR at Riverside Avenue	# of Samples
Ammonia-Nitrogen	mg/L		< 0.1	1	< 0.1	1
Bicarbonate (as CaCO3)	mg/L		175	1	171	1
Boron	mg/L		-na-	-na-	-na-	-na-
Calcium	mg/L		-na-	-na-	-na-	-na-
Carbonate (as CaCO3)	mg/L		< 1	1	< 1	1
Chemical Oxygen Demand	mg/L	**30**	3	2	< 1	2
Chloride	mg/L		88	1	89	1
Electrical Conductivity	umhos/cm		858	1	857	1
Hydroxide (as CaCO3)	mg/L		< 1	1	< 1	1
Magnesium	mg/L		-na-	-na-	-na-	-na-
Nitrate-Nitrogen	mg/L		10.6	1	11.0	1
Nitrite-Nitrogen	mg/L		0.032	1	0.087	1
Organic Nitrogen	mg/L		0.20	1	0.10	1
pH	units		8.1	1	7.8	1
Potassium	mg/L		-na-	-na-	-na-	-na-
Sodium	mg/L		-na-	-na-	-na-	-na-
Sulfate	mg/L		79	1	79	1
Total Alkalinity (as CaCO3)	mg/L		175	1	171	1
Total Dissolved Solids	mg/L	**550**	538	1	524	1
Total Hardness (as CaCO3)	mg/L		-na-	-na-	-na-	-na-
Total Inorganic Nitrogen	mg/L	**10**	10.6	1	11.1	1
Total Kjeldahl Nitrogen	mg/L		0.20	1	< 0.2	1
Total Nitrogen	mg/L		10.8	1	11.1	1
Total Organic Carbon	mg/L		2.5	1	2.8	1
Turbidity	NTU		1.8	1	0.8	1

Note: Table includes a standard list of water quality constituents and does not reflect the actual constituents sampled.
- "na" entered where there was no data collected for the constituent
- Exceedances are shown in red lettering
- Where appropriate, data results reflect Annual Average estimates

3.4 Santa Ana River Reach 5

The Basin Plan has specified water quality objectives for the SAR Reach 5 for TDS, hardness, sodium, chloride, TIN, sulfate, and COD. Along the SAR Reach 5, OCWD monitors a single site, *SAR-WATERMAN-01*, shown in Figure 2-1. In 2016, no data was collected at *SAR- WATERMAN -01*, as during the time scheduled for sampling there was no stream flow.

The USGS maintains two gauging stations for this segment of the SAR – station 11059300 located along the SAR at E Street near San Bernardino and station 11057500 located along San Timoteo Creek near Loma Linda, shown in Figure 2-1. In 2016, these stations recorded flows totaling 12,749 and 6,665 AFY, respectively.

4 Summary

This 2016 Annual Report of Santa Ana River Water Quality presents water quality data required to implement the surface water monitoring program used to determine compliance with the nitrogen and TDS objectives of the SAR and, thereby, the effectiveness of the wasteload allocations established by the Regional Board. Water quality and discharge data used to prepare the 2016 Annual Report of Santa Ana River Water Quality were collected from various sources. These sources include a number of regional efforts to monitor surface water quality along the SAR and its tributaries and in-stream flow rate monitoring gauges employed by the USGS.

The evaluation of this data showed the SAR to be in compliance with water quality objectives specified in the Regional Board's Basin Plan. Analysis showed the most downstream stream segment, Reach 2 of the SAR, to have complied with its Basin Plan objective for TDS.

Overall in 2016, water quality measured at Below Prado Dam during baseflow conditions met water quality objectives specified in the Basin Plan as compared to the Reach 3 water quality objectives. Water quality objectives specified for Reach 3 of the SAR by the Basin Plan include total dissolved solids, hardness, sodium, chloride, total nitrogen, sulfate, chemical oxygen demand, and boron. Analysis of annual baseflow data for Reach 3 of the SAR showed chloride to exceed water quality objectives specified in the Basin Plan.

As for the three tributaries to Reach 3 of the SAR that are regularly monitored for water quality, only Reach 1 of Chino Creek has established numeric objectives for water quality. In 2016, analysis of surface water quality monitoring data showed Reach 1B of Chino Creek to have complied with the water quality objectives specified in the Basin Plan.

Water quality objectives specified for Reach 4 of the SAR by the Basin Plan include TDS, TIN, and COD. In 2016, analysis of available surface monitoring data for Reach 4 of the SAR showed TIN to exceed water quality objectives specified in the Basin Plan.

Water quality objectives specified for Reach 5 of the SAR by the Basin Plan include TDS, TIN, hardness, sodium, chloride, sulfate and COD. In 2016, no surface monitoring data was available for Reach 5 of the SAR, because during the time scheduled for sampling there was no stream flow.

Appendix A
Comments and Responses to 2016 Draft Annual Report of Santa Ana River Water Quality - May 2017

Appendix B
Water Quality Trends
at Below Prado Dam and MWD Crossing
1996 to Current

Figure 3-2. Total Nitrogen (TN) Below Prado Dam

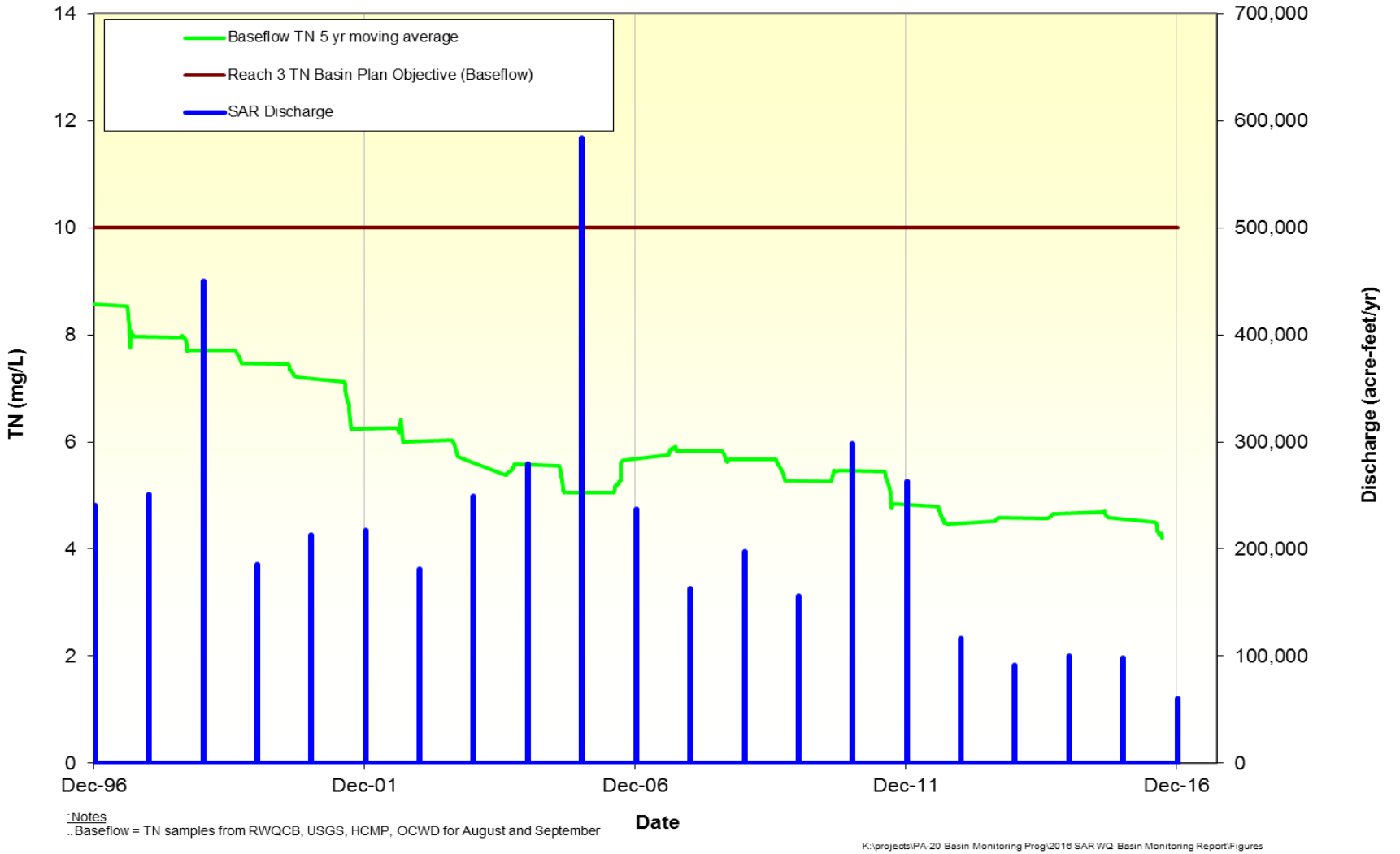
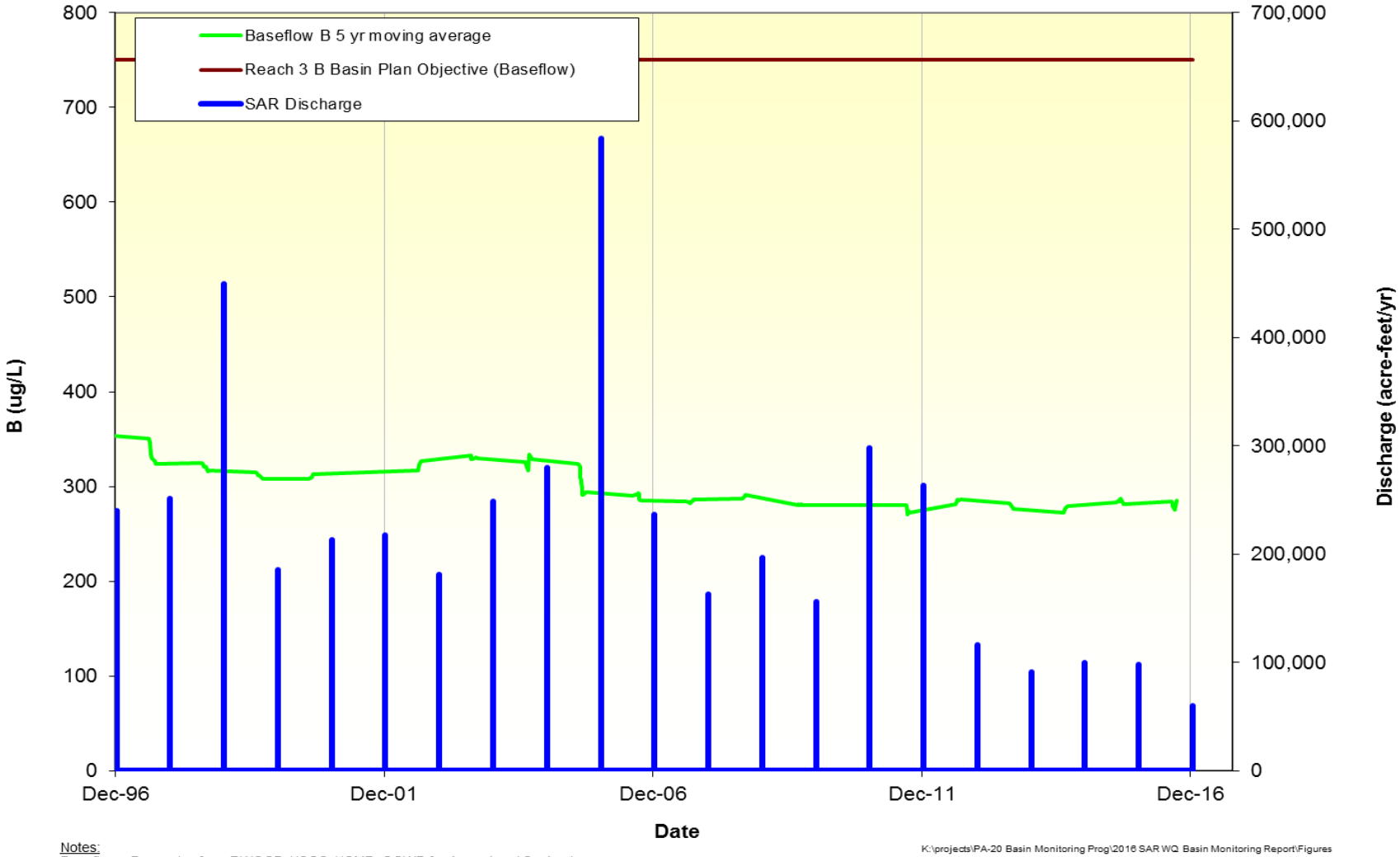


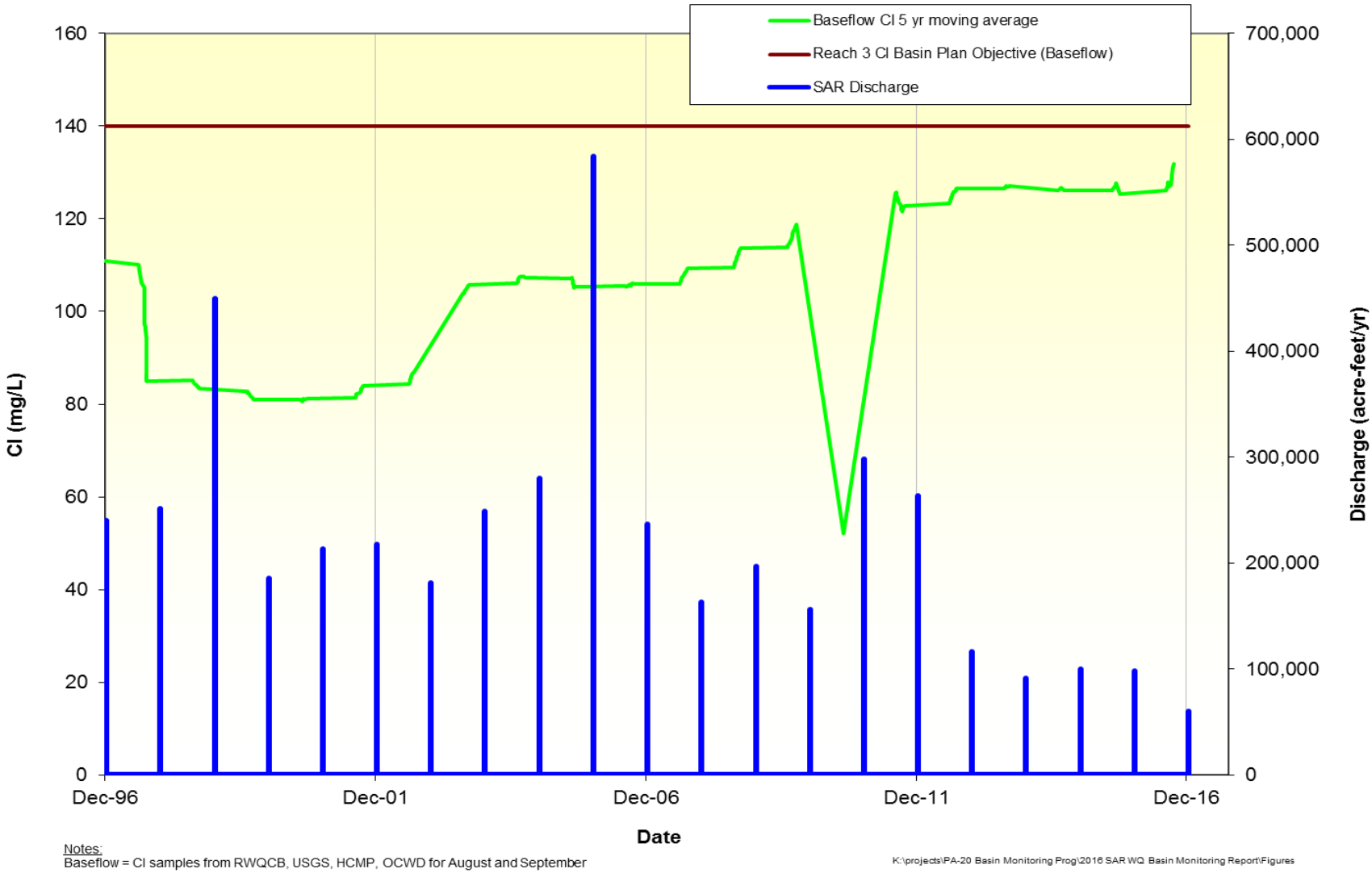
Figure 3-3. Boron (B) Below Prado Dam



Notes:
Baseflow = B samples from RWQCB, USGS, HCMP, OCWD for August and September.

K:\projects\PA-20 Basin Monitoring Prog\2016 SAR WQ Basin Monitoring Report\Figures

Figure 3-4. Chloride (Cl) Below Prado Dam



Notes:
Baseflow = Cl samples from RWQCB, USGS, HCMP, OCWD for August and September

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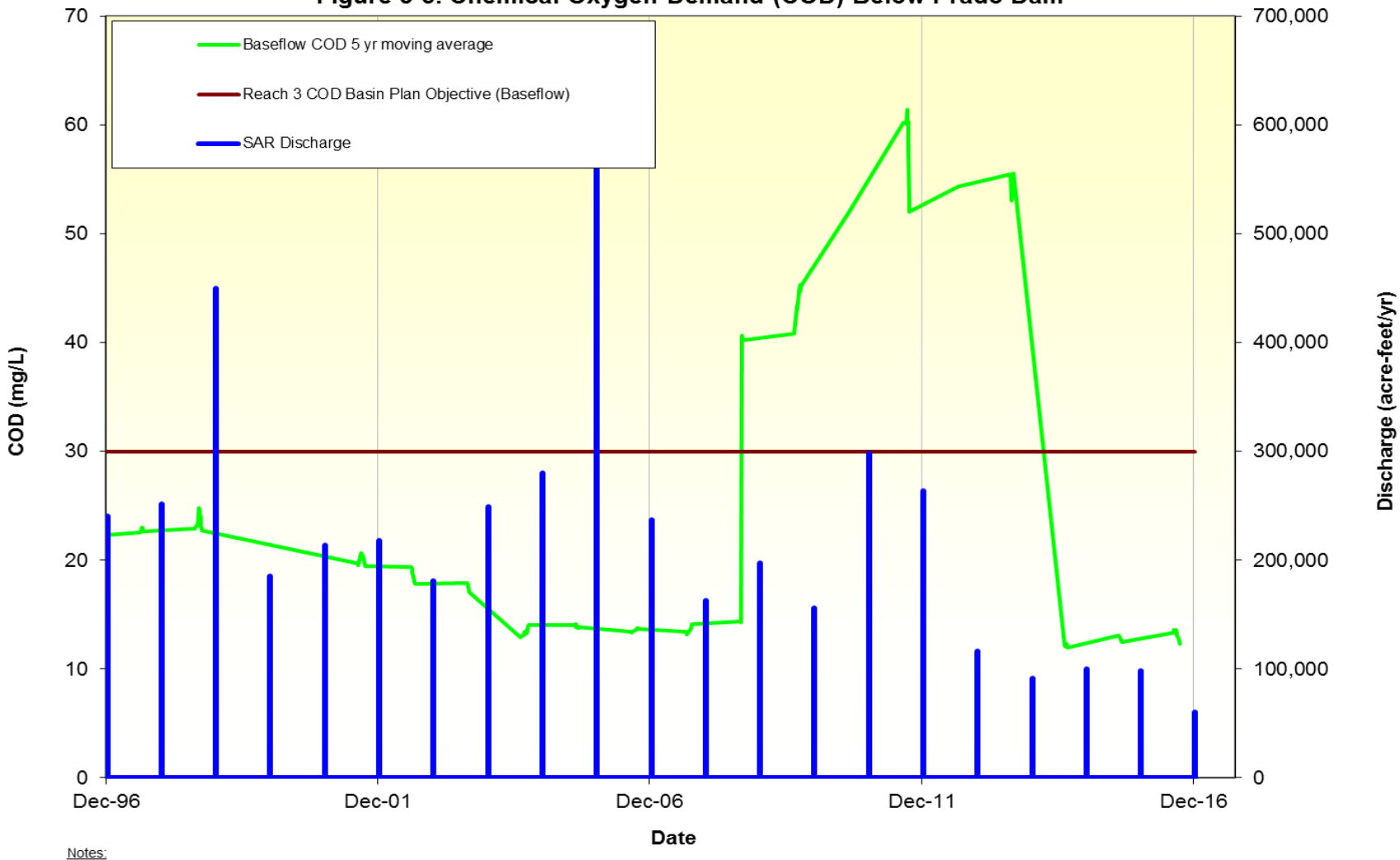
Figure 3-5. Chemical Oxygen Demand (COD) Below Prado Dam



Notes:
Baseflow = COD samples from RWQCB, USGS, HCMP, OCWD for August and September

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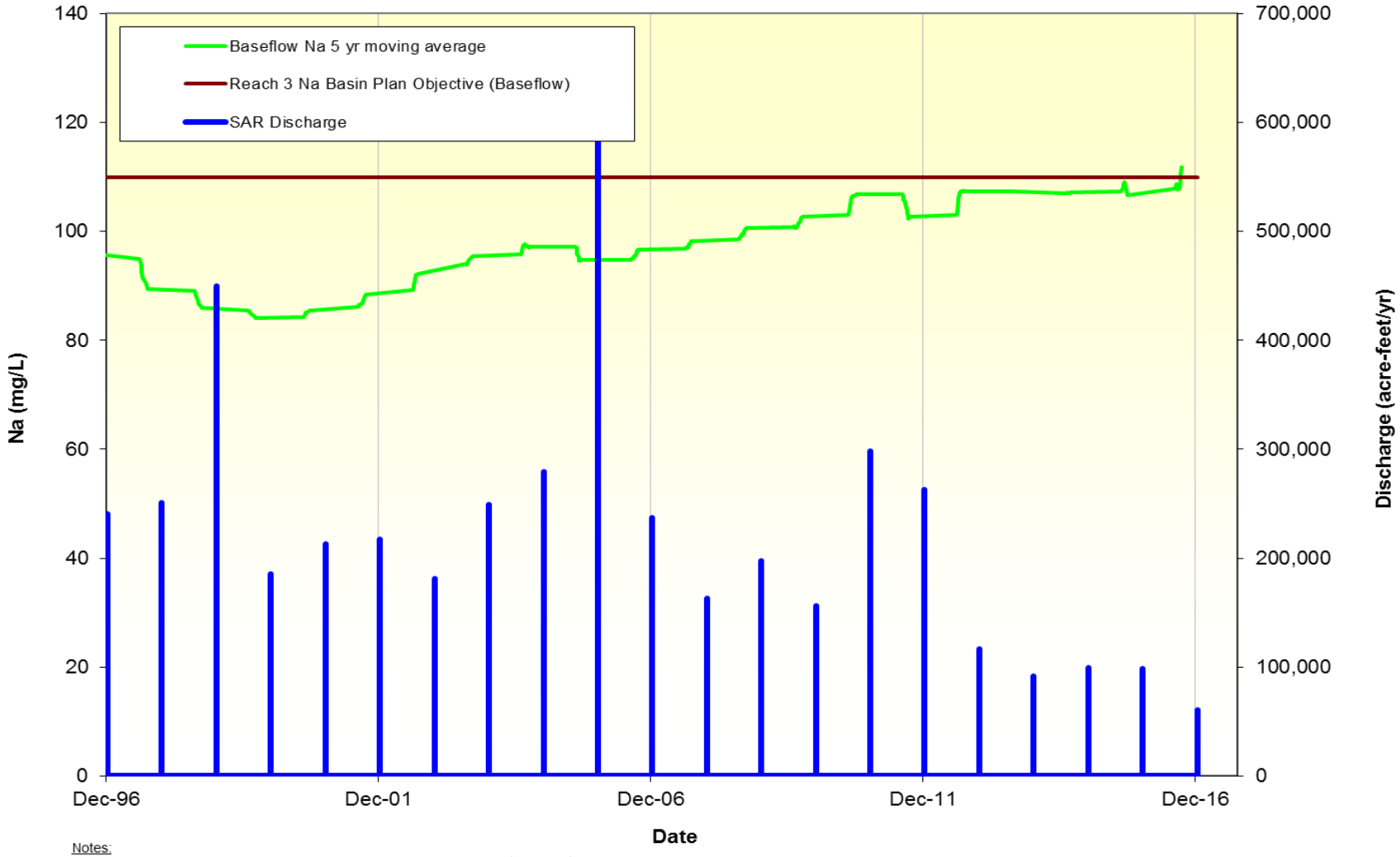
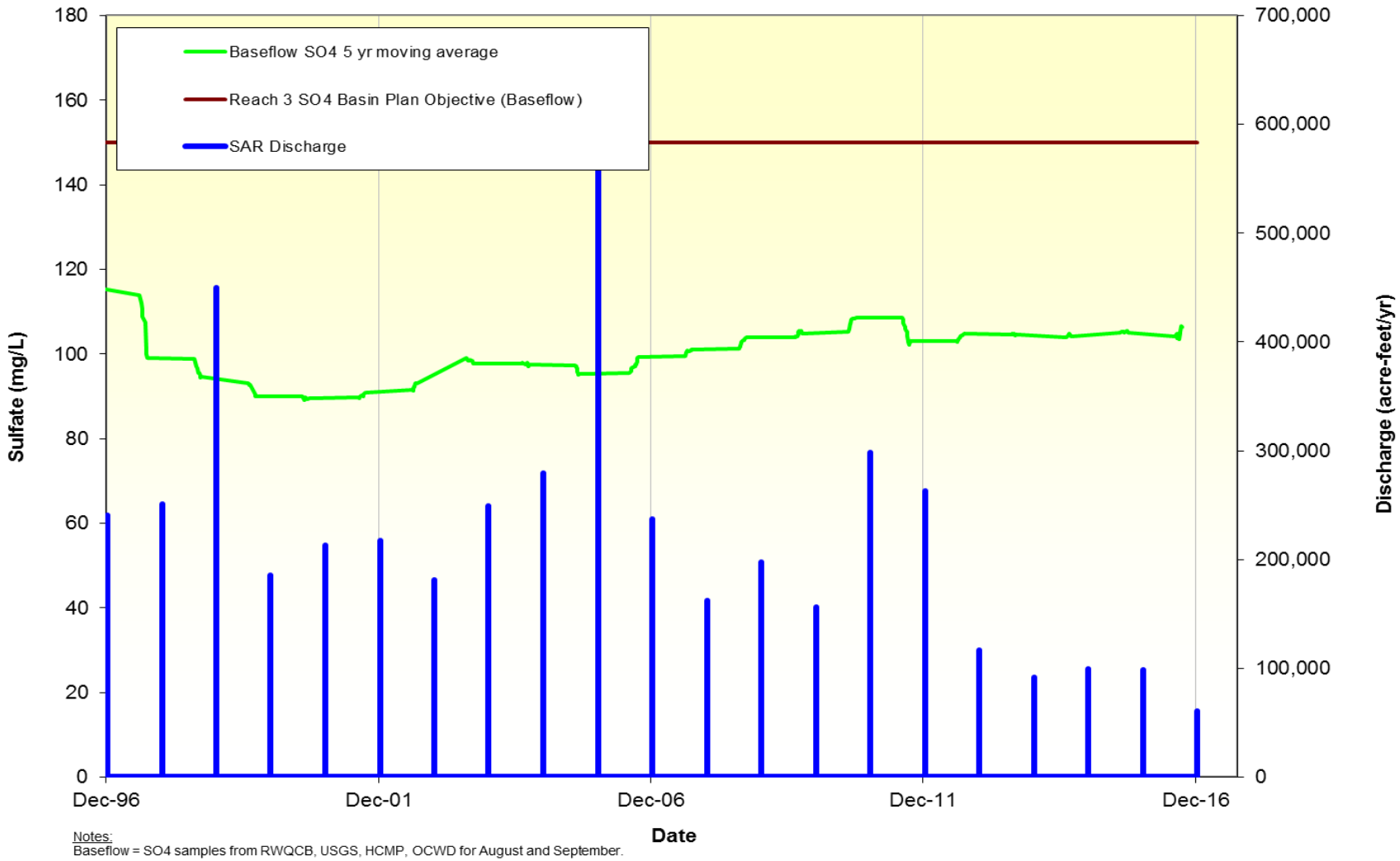
Figure 3-6. Sodium (Na) Below Prado Dam



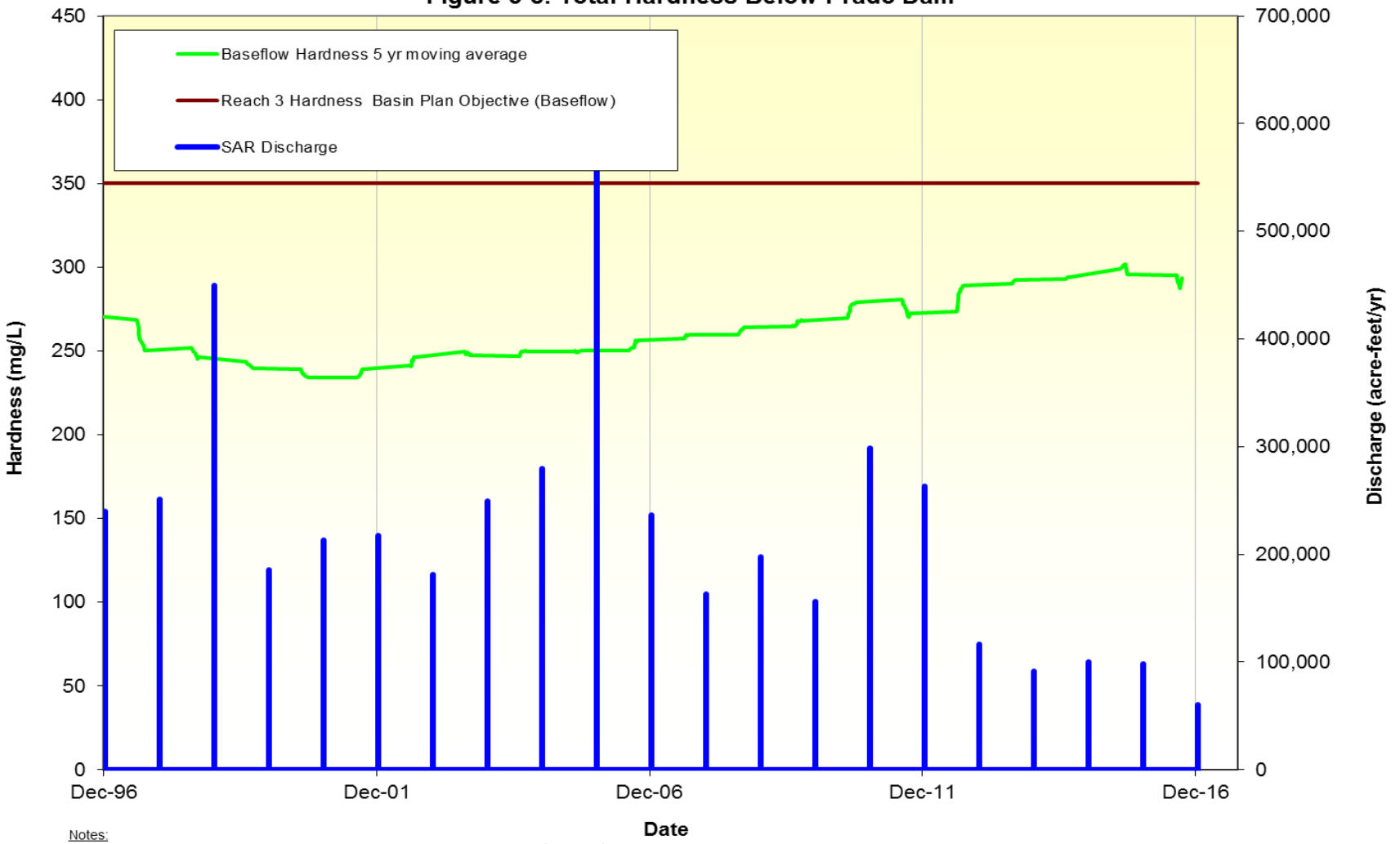
Notes:
Baseflow = Na samples from RWQCB, USGS, HCMP, OCWD for August and September.

Figure 3-7. Sulfate (SO4) Below Prado Dam



Notes:
Baseflow = SO4 samples from RWQCB, USGS, HCMP, OCWD for August and September.

Figure 3-8. Total Hardness Below Prado Dam



Notes:
Baseflow = Hardness samples from RWQCB, USGS, HCMP, OCWD for August and September.

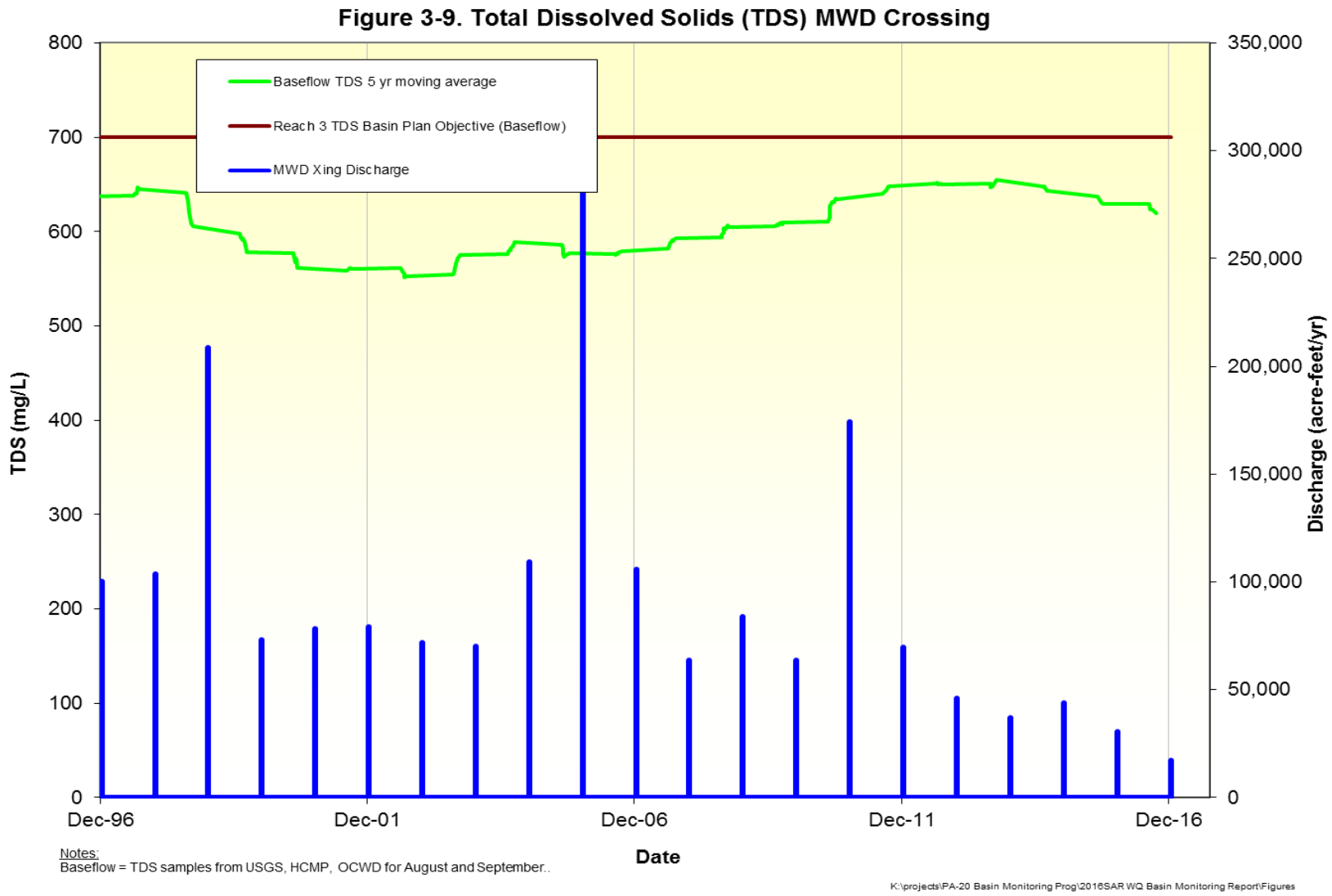
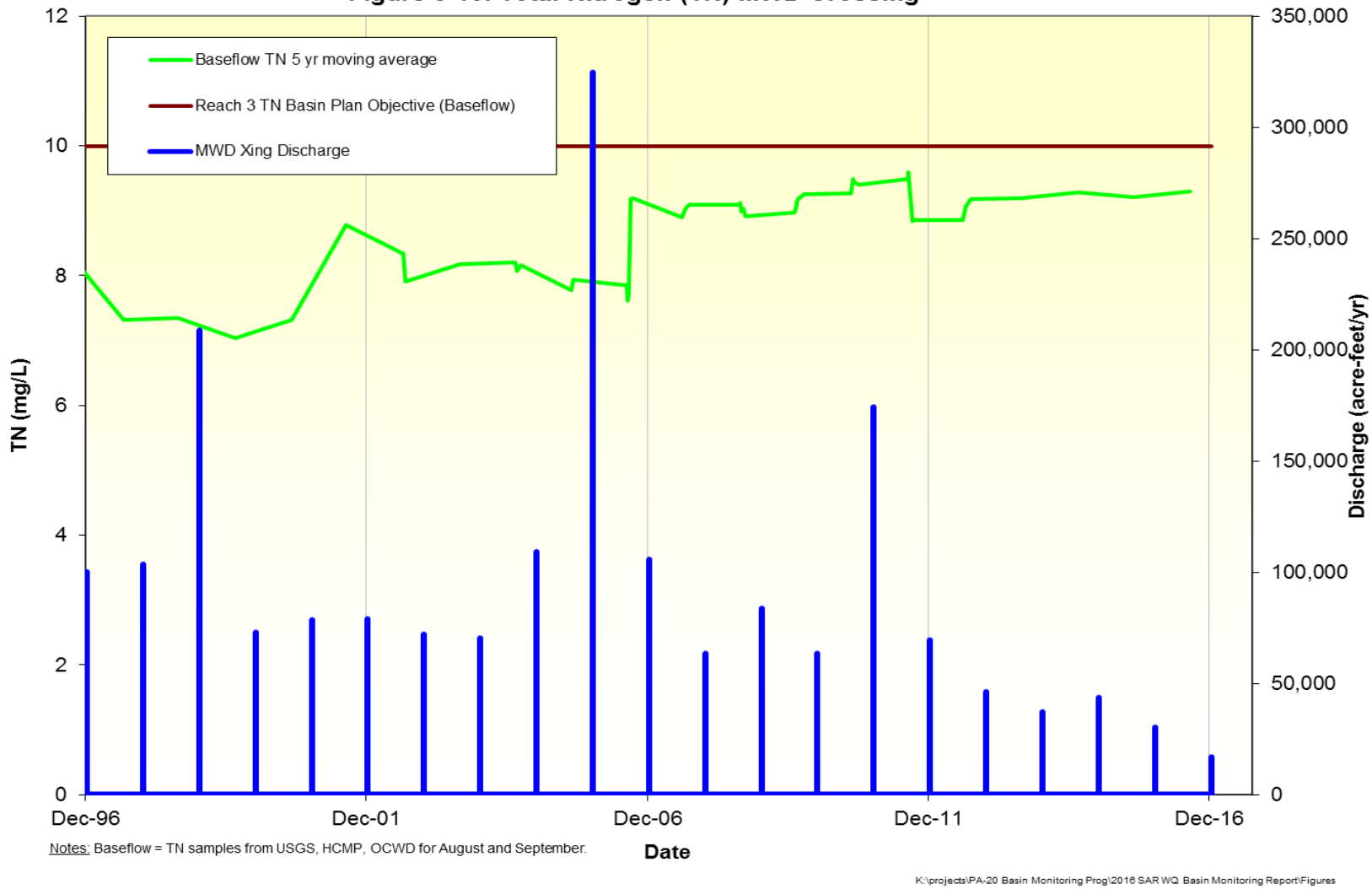


Figure 3-9. Total Dissolved Solids (TDS) MWD Crossing
Baseflow TDS 5 yr moving average
Reach 3 TDS Basin Plan Objective (Baseflow)
MWD Xing Discharge
TDS (mg/L)
Discharge (acre-feet/yr)
800
700
600
500
400
300
200
100
0
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
Dec-96
Dec-01
Dec-06
Dec-11
Dec-16
Date
Notes:
Baseflow = TDS samples from USGS, HCMP, OCWD for August and September..
K:\projects\PA-20 Basin Monitoring Prog\2016SAR WQ Basin Monitoring Report\Figures

Figure 3-10. Total Nitrogen (TN) MWD Crossing



Notes: Baseflow = TN samples from USGS, HCMP, OCWD for August and September.

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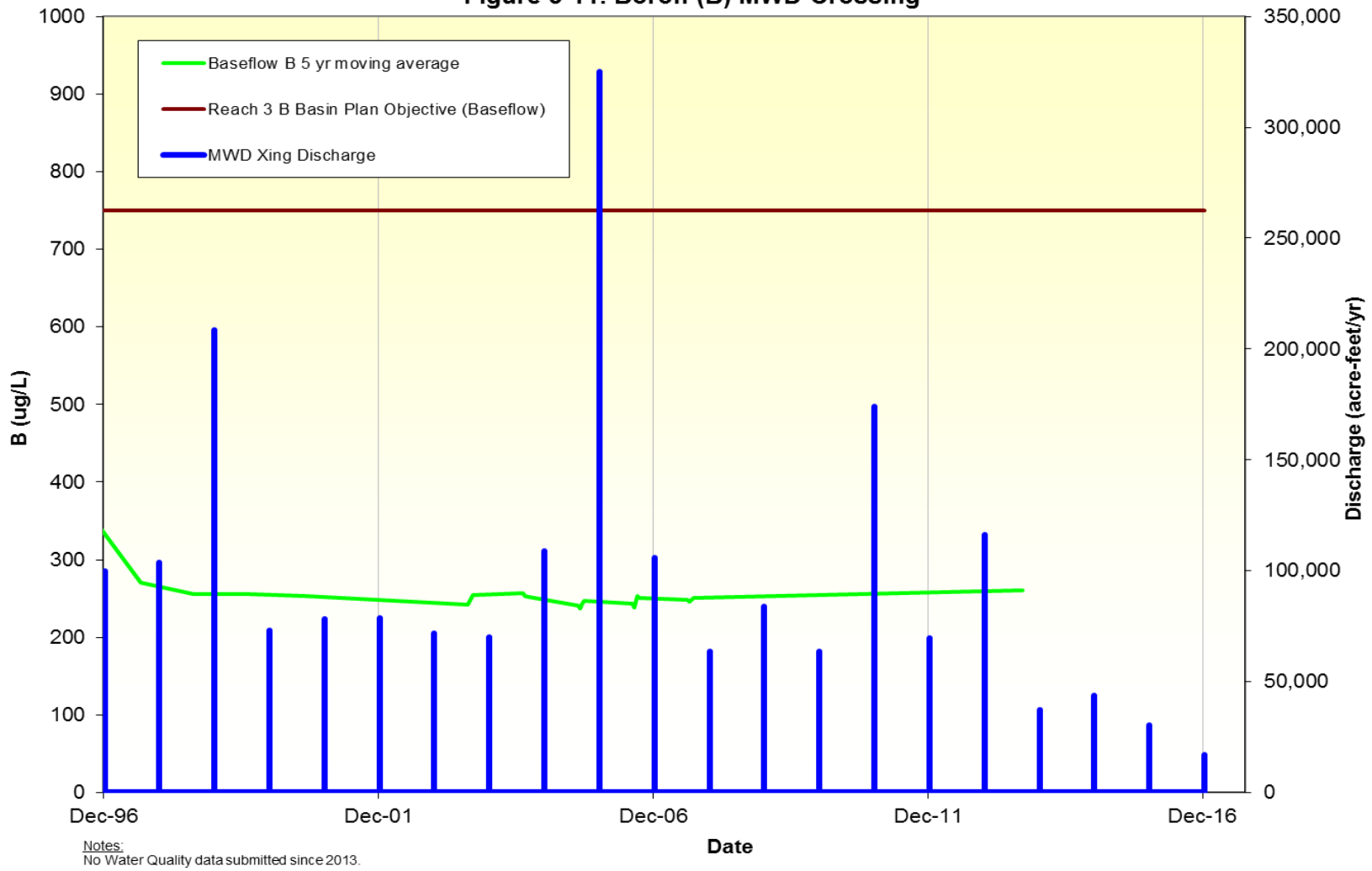
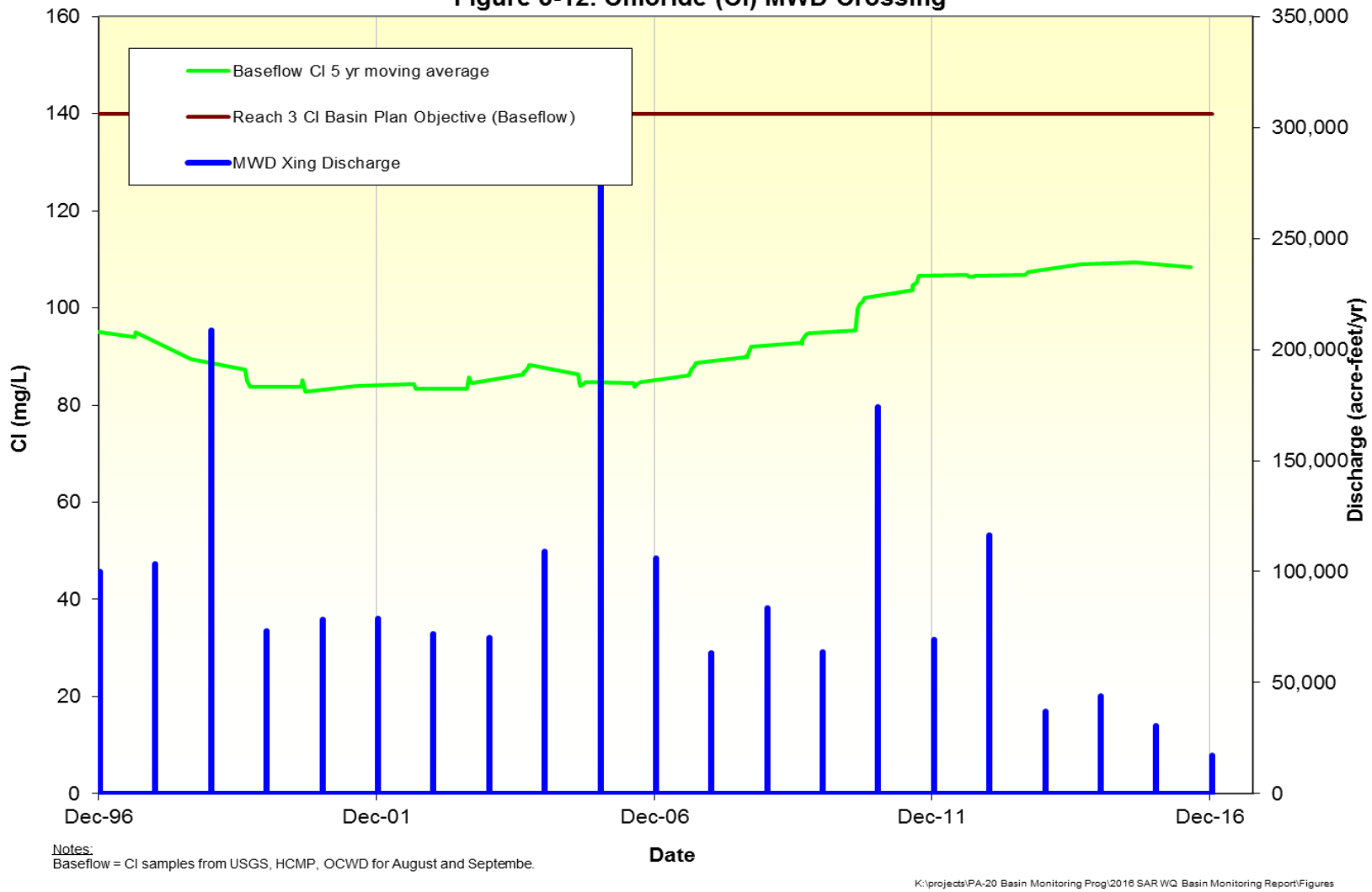
Figure 3-11. Boron (B) MWD Crossing



Notes:
No Water Quality data submitted since 2013.

Figure 3-12. Chloride (Cl) MWD Crossing



Notes:
Baseflow = Cl samples from USGS, HCMP, OCWD for August and Septembe.

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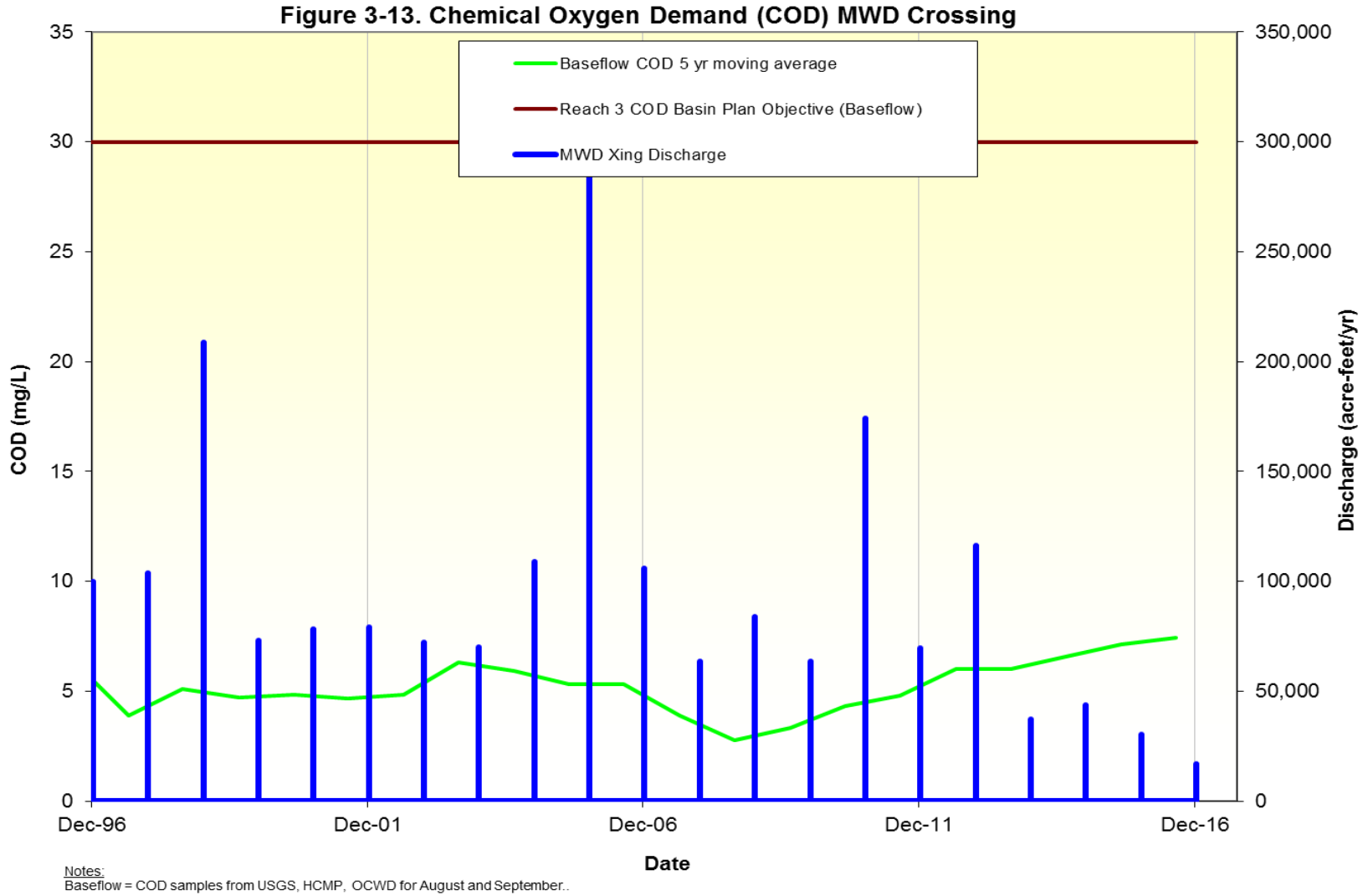
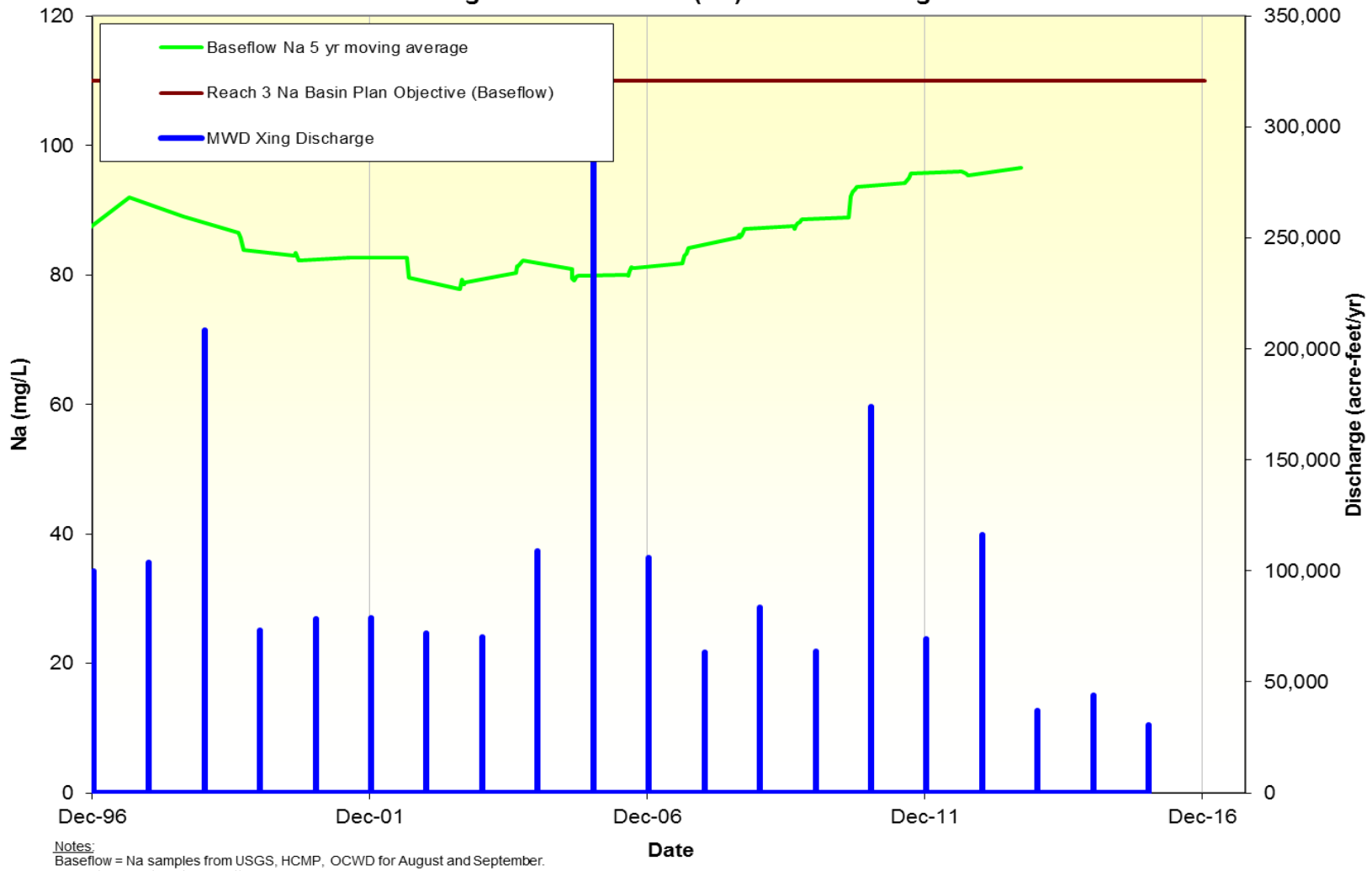


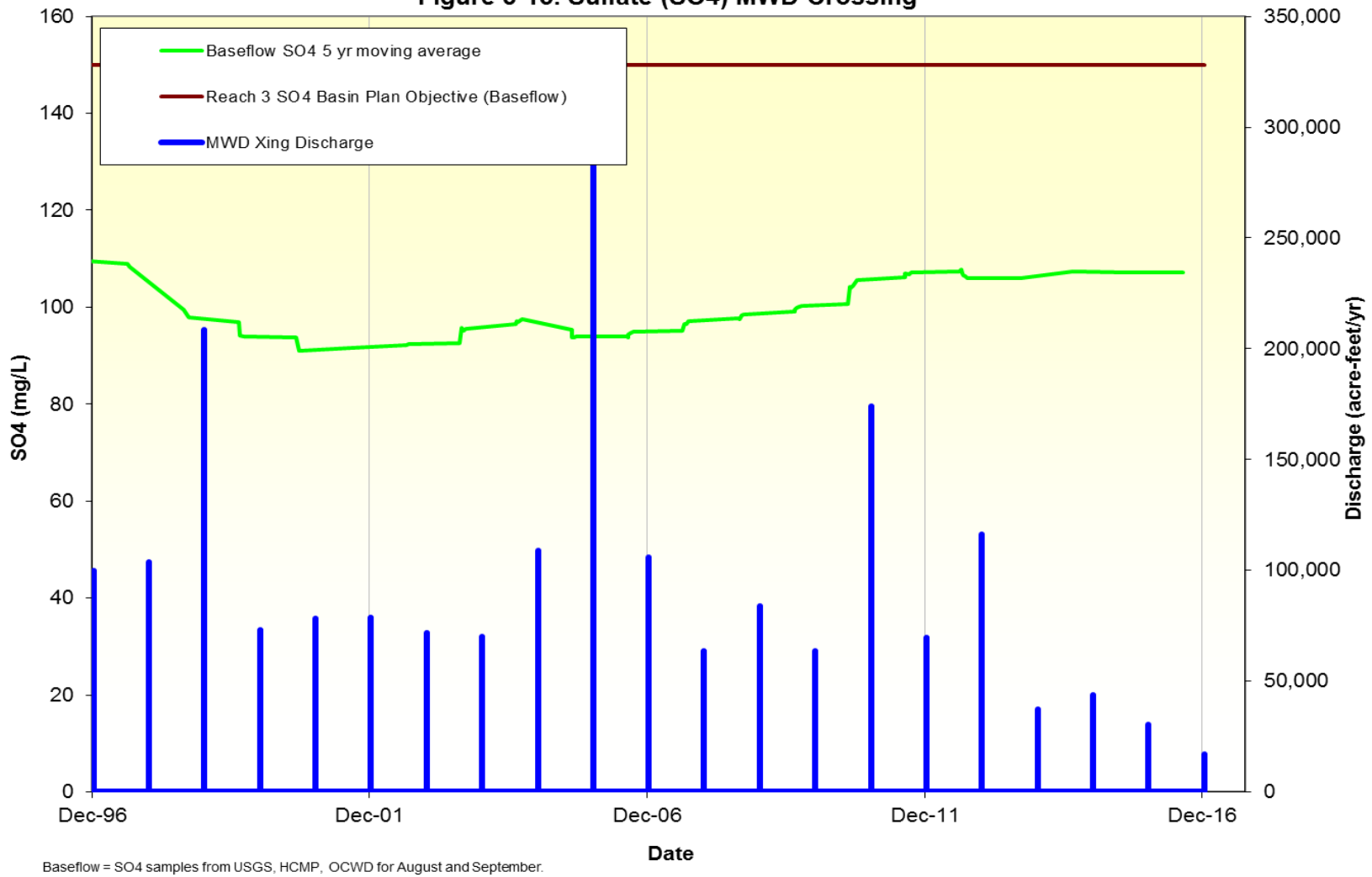
Notes:
Baseflow = COD samples from USGS, HCMP, OCWD for August and September..

Figure 3-14. Sodium (Na) MWD Crossing



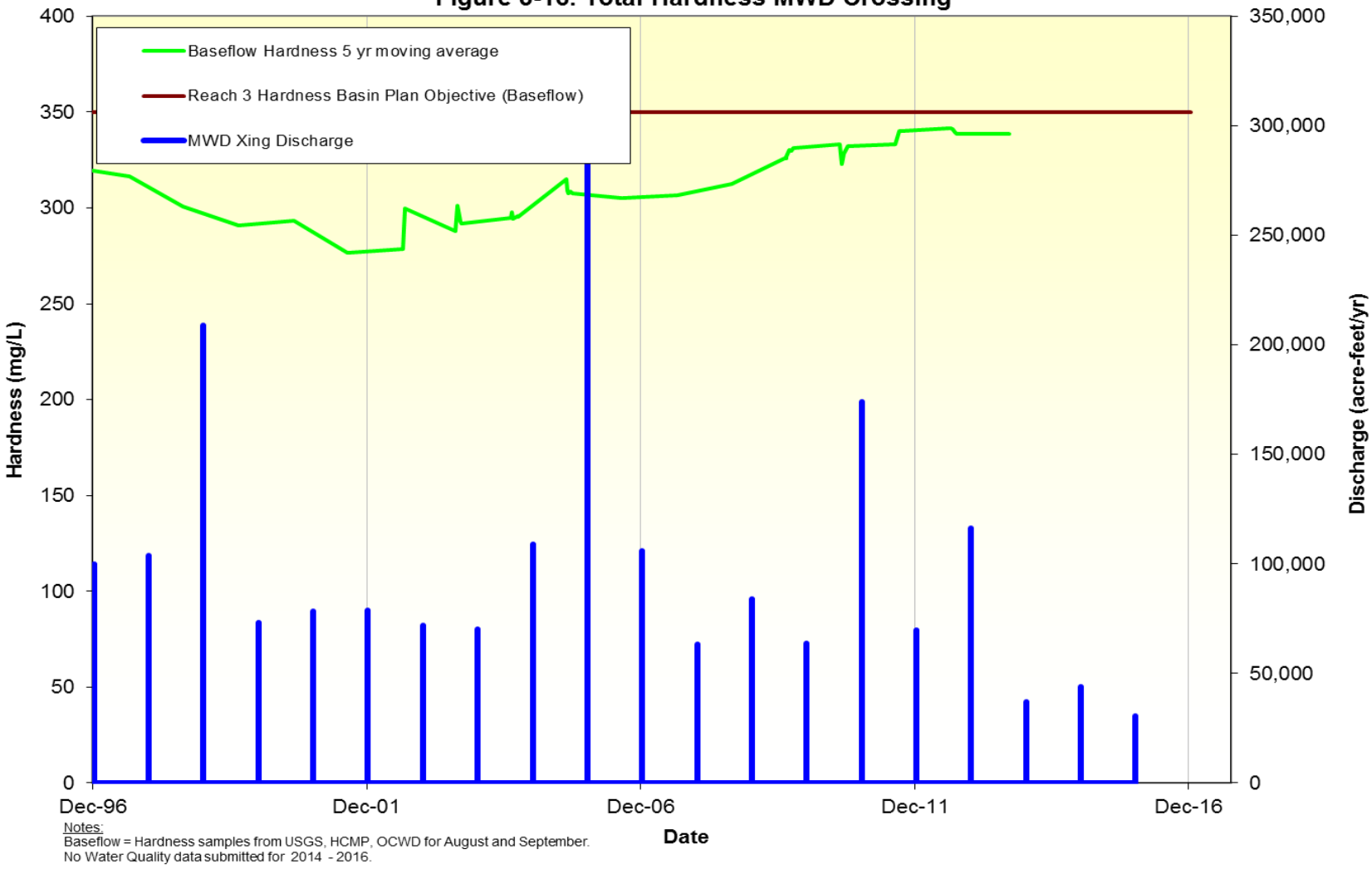
Notes:
Baseflow = Na samples from USGS, HCMP, OCWD for August and September.
No Water Quality data submitted for 2014 - 2016.

Figure 3-15. Sulfate (SO4) MWD Crossing



Baseflow = SO4 samples from USGS, HCMP, OCWD for August and September.

Figure 3-16. Total Hardness MWD Crossing



Notes:
Baseflow = Hardness samples from USGS, HCMP, OCWD for August and September.
No Water Quality data submitted for 2014 - 2016.

Appendix C
All 2016 Water Quality and Flow Data
(*Included on Enclosed CD*)