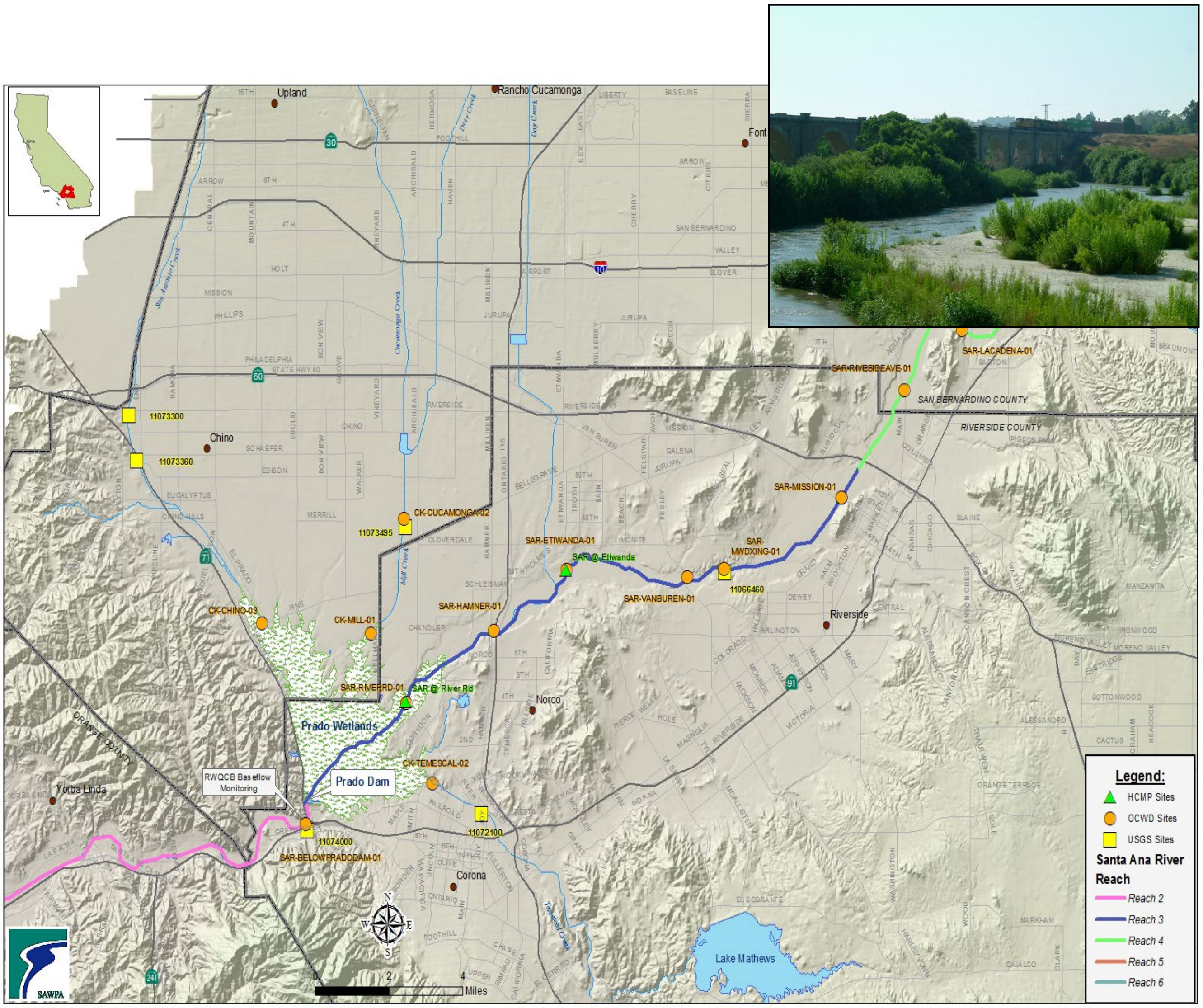
2022 Annual Report

of Santa Ana River Water Quality

Final Report



P:\projects\Rick_Whetsel\SAR\SAR_Surface_Monitoring_2014.mxd

Prepared by:

SANTA ANA WATERSHED PROJECT AUTHORITY

August 2023

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

Acronym and Abbreviations List

AFY	acre-feet per year
COD	chemical oxygen demand
EC	electrical conductivity
HCMP	Hydraulic Control Monitoring Program
mg/L	milligrams per liter
umhos/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 nitrogen
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 several 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.

In December 2021, the Regional Board amended the Basin Plan to revise and update limited components of the total dissolved solids (TDS) and nitrogen management program. These updates were approved by the Office of Administrative Law on July 27, 2023. These amendments resulted in the Task Force updating the Surface Water Ambient Monitoring Program, which will be reflected in the 2024 Annual Report for the SAR.

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*[1]. 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 base flow 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 base flow objectives at Prado Dam (see Chapter 4 of the Basin Plan), whereas base flow 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 base flow 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 base flow objectives are considered protective of the Orange County Groundwater Basin and the existing monitoring program designed to measure compliance is sufficient.

[1] The 2022 Annual Report was prepared in accordance with the Santa Ana River Water Quality Work Plan approved by the Regional Board in Res. No. R8-2005-0063.

In addition to the base flow 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 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. Section 4 provides Conclusions and Recommendations of the report. Section 5 presents the Response to Comments. The complete set of 2022 surface water quality data is included as Appendix B, available on the SAWPA website.

2 Data Collection

Water quality and discharge data used to prepare the 2022 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, representing the 2022 calendar year, follows:

Regional Board staff typically conducts annual water quality monitoring of base flow 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 base flow objectives. In 2022, base flow monitoring consisted of five sampling events from August 30 through September 29, as shown in Table 3-3. The complete set of 2022 base flow water quality data collected exiting Reach 3 below Prado Dam by the Regional Board is included in Appendix B, available on the SAWPA website.

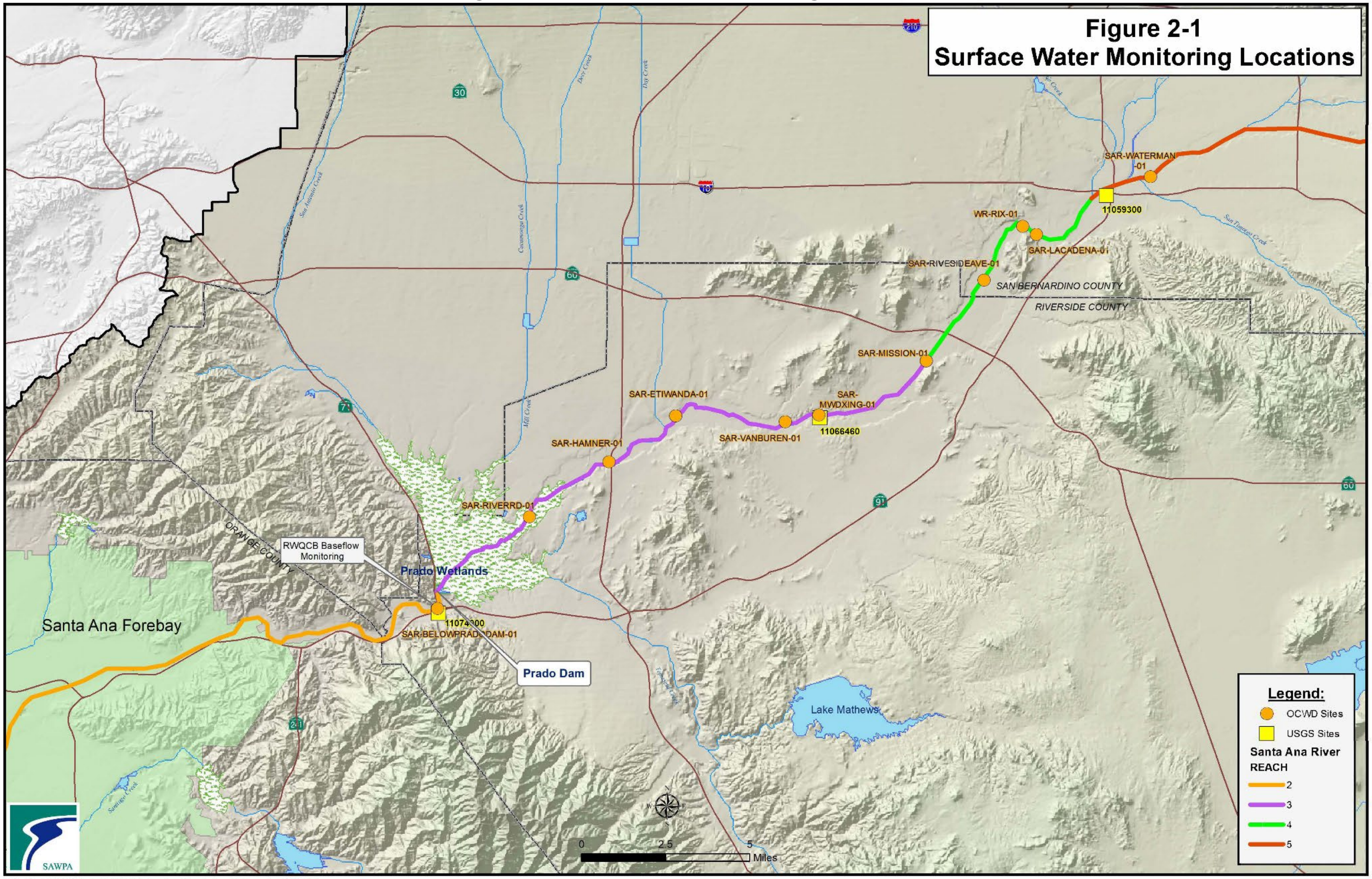
OCWD conducts a monitoring program for the SAR to assess the quality of the SAR water recharged into the Orange County Groundwater Basin. OCWD collects monthly and quarterly samples from the SAR at Imperial Highway in Anaheim and other locations along the SAR below Prado Dam and its tributaries. During the months of August and September, monitoring is performed with a greater sampling frequency to capture base flow conditions within the Watershed. At sites Above Prado Dam, OCWD collects samples from a single monitoring event in August (event took place on 08/23/2022). These data are used in this report to evaluate water quality for Reaches 2, 3, 4, and 5 of the SAR 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 the name of the reach. The complete set of 2022 SAR water quality data collected by OCWD and used in this report is included in Appendix B, available on the SAWPA website.

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

Station ID	Station Name	Tributary	X Coordinate	Y Coordinate
8105	SAR-BELOWDAM-01	Santa Ana River Reach 2	- 117.644996	33.883665
8096	SAR-RIVERRD-01	Santa Ana River Reach 3	- 117.666485	33.948989
8111	SAR-HAMNER-01	Santa Ana River Reach 3	- 117.556597	33.947337
9672	SAR-ETIWANDA-01	Santa Ana River Reach 3	- 117.522230	33.967365
8112	SAR-VANBUREN-01	Santa Ana River Reach 3	- 117.465465	33.965049
8113	SAR-MWDXING-01[1]	Santa Ana River Reach 3	- 117.448032	33.968027
8114	SAR-MISSION-01[1]	Santa Ana River Reach 4	- 117.392523	33.991576
8115	SAR-RIVERSIDEAVE-01	Santa Ana River Reach 4	- 117.362809	34.026480
8116	SAR-LACADENA-01[1]	Santa Ana River Reach 4	- 117.335710	34.046335
8117	SAR-WATERMAN-01[1]	Santa Ana River Reach 5	- 117.276721	34.071365

[1]*No data reported for these sites in 2022.*

Figure 2-1. Surface Water Monitoring Locations



P:\projects\Rick_Whetsel\SAR\SAR_Surface_Monitoring_2018.mxd SW-2804

The USGS maintains three active gauging stations to monitor flow and water quality along the SAR. 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*. Additionally, stream flow data is available for gauging station 11059300, located at *SAR at E St near San Bernardino*. The list of USGS gauging stations used in this report is presented in Table 2-2. The complete set of 2022 flow and water quality data available from these USGS gauging stations is included in Appendix B, available on the SAWPA website.

Table 2-2. USGS Stream Gauge Stations

USGS ID	Station Name	2022 Flow (AFY)	Tributary	X Coordinate	Y Coordinate
11074000	SAR Below Prado Dam	107,244	SAR Reach 2	- 117.644446	33.881583
11066460	SAR at MWD Crossing	27,267	SAR Reach 3	- 117.447501	33.966858
11059300	SAR at E St near San Bernardino	6,183	SAR Reach 5	- 117.299444	34.065000

3 Analysis of Monitoring Data

3.1 *Santa Ana River Reach 2*

Table 4-1 of the Basin Plan specifies only a TDS objective for Reach 2 of the Santa Ana River. The determination of compliance with the TDS objective for Reach 2 is made by using the mean of the five most recent flow-weighted annual averages as reported by the SAR Watermaster, 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 (see Figure 2-1), and directly affects the quality of the groundwater. For that reason, compliance with the TDS water quality objective for Reach 2 is based on the five-year moving average, 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 Appendix F of the 2021-22 Annual SAR Watermaster Report[2]). 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[A]	Yearly Flow-weighted TDS (mg/L)
2018	625
2019	401
2020	468
2021	609
2022	499
5 Year Average	520

Note: [A] Santa Ana River Watermaster data reported for FY 2021-22 water year

Alternative Method to Determine Compliance with TDS Objective for Reach 2

In addition, to the method prescribed in the Basin Plan, as presented in Table 3-1, the Task Force employs an alternative method to determine compliance with the TDS objective for Reach 2 of the Santa Ana River. This alternative method was first employed in 2005 when the Task Force began preparing the Annual Reports of Santa Ana River Water Quality. This method computes compliance with the TDS objective in Reach 2 as a five-year average based on the 60-month volume-weighted[3] dataset. This alternative method was the sole method to demonstrate compliance through the first four reports (2005 through 2008). While this method was technically correct, the Task Force became concerned that it might not be legally correct. Additional review of the Basin Plan text indicated that the volume-weighted five-

[2] Determination of flow-weighted TDS for total flow at Below Prado for Water Year 2021-22 is based on records from a continuous monitoring device operated by the USGS for EC of the river flow below Prado Dam. This record is supplemented by grab samples for EC collected by the USGS and analyzed for TDS. Using the daily EC data, flow-weighted average daily concentrations for TDS are calculated using the following best fit correlation equation:

TDS = EC x 0.6068 (where the units of TDS and EC are mg/L and umhos/cm, respectively)

[3]

$$5-\mathit{Year\ Moving\ Average\ TDS}\ (mg/L)=\frac{\left(\sum_{n=\mathit{first\ month\ of\ 1st\ year}}^{\mathit{last\ month\ of\ 5th\ year}}\mathit{Monthly\ Flow}\right)x\left(\sum_{n=\mathit{first\ month\ of\ 1st\ year}}^{\mathit{last\ month\ of\ 5th\ year}}\mathit{Volume\ Weighted\ Monthy\ Average\ TDS}\right)}{\left(\sum_{n=\mathit{first\ month\ of\ 1st\ year}}^{\mathit{last\ month\ of\ 5th\ year}}\mathit{Monthly\ Flow}\right)}$$

year average should be computed as the arithmetic mean of the five discrete volume-weighted values for each of the five years (as presented in Table 3-1).

While it is true that the 60-month volume-weighted averaging approach implemented by the Task Force more accurately estimates the long-term volume weighted average TDS concentration in Reach 2, the approach, as prescribed in the Basin Plan provides a better estimate of the long-term volume-weighted average of TDS concentrations in the river flow that percolates through the streambed into the underlying groundwater basin. In very wet years, the volume-weighted average TDS concentration is much lower, but some of this high-quality water flows out to the Pacific Ocean rather than percolating to groundwater. By assuming the same volume of water percolates every year, the method specified by the Basin Plan tends to slightly overestimate the TDS concentrations entering the OC groundwater basin, whereas the 60-month volume-weighted averaging approach tends to slightly underestimate the TDS concentration.

Beginning with the 2009 Annual Report, the Task Force started applying and reporting both methods and results. The Task Force has continued with this approach because it provides the context for a better understanding of the data. It also helps illustrate how small changes in the assumptions and procedures used to perform the calculations can lead to consequential changes in the subsequent compliance determinations. Regardless of which method is used, the resulting five-year, volume-weighted average has never exceeded the Basin Plan objective of 650 mg/L for the period shown.

Computation of the 60-month Volume-weighted Average TDS Concentration

During the 2022 calendar year, 53 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:

$$TDS = (EC \times 0.6087) - 1.0183$$

The coefficient of determination (R^2) of the linear regression was 0.98, which indicates a strong correlation between TDS and EC; that is, about 98 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 2022 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 to yield a volume-weighted average for each month. These results are shown in Table 3-2. The 60-month volume-weighted moving average for the period January 2018 through December 2022 was 488 mg/L. This represents a increase of 20.0 mg/L from last year's 60-month volume-weighted moving average TDS of 468 mg/L.

Figure 3-1 compares the Reach 2 Basin Plan Objective for TDS to a time history for TDS observations for 2002 to the present at *Below Prado Dam* depicted as the mean TDS concentration of five annual flow-weighted averages, and the flow-weighted, 60-month moving average[4] TDS concentration.

4

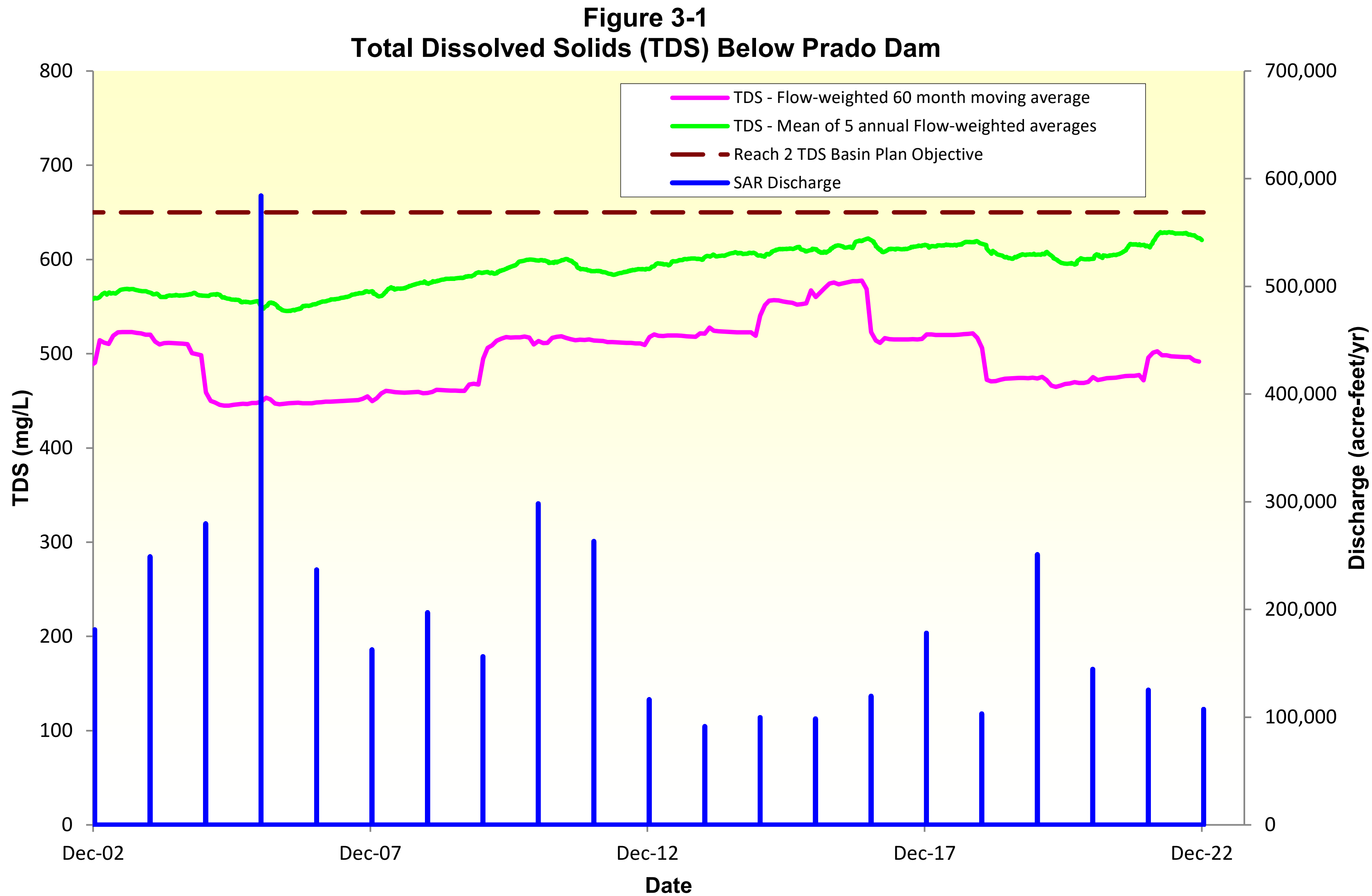
$$Volume\ Weighted\ Monthy\ Average\ TDS\ (mg/L) = \sum_{n=first\ day\ of\ month}^{last\ day\ of\ month} \frac{Daily\ TDS\ Sample\ \left(\frac{mg}{L}\right) x\ Daily\ Flow\ (cfs)}{\sum_{n=first\ day\ of\ month}^{last\ day\ of\ month} Daily\ Flow\ (cfs)}$$

Table 3-2. Monthly Volume-Weighted Moving Average TDS at Below Prado Dam (2022 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-18	8,373	516	4,322,665
Feb-18	3,508	661	2,320,359
Mar-18	7,407	558	4,131,392
Apr-18	3,270	688	2,250,705
May-18	2,855	681	1,943,094
Jun-18	2,346	695	1,629,552
Jul-18	1,840	709	1,304,255
Aug-18	1,681	728	1,223,652
Sep-18 **	1,986	717	1,423,443
Oct-18	3,529	647	2,284,490
Nov-18	3,311	630	2,084,681
Dec-18	11,799	453	5,350,226
Jan-19	14,494	323	4,680,018
Feb-19	44,004	248	10,896,992
Mar-19	15,464	403	6,227,282
Apr 19 **	11,236	531	5,963,072
May-19	11,137	566	6,298,555
Jun-19 **	3,572	680	2,428,738
Jul-19	2,927	661	1,934,719
Aug-19	2,484	672	1,668,363
Sep-19	2,601	685	1,780,391
Oct-19	2,517	674	1,696,256
Nov-19 **	3,468	591	2,049,773
Dec-19	12,047	341	4,111,578
Jan-20	11,716	499	5,846,560
Feb-20	4,400	701	3,086,465
Mar-20	7,376	411	3,032,135
Apr-20	15,982	371	5,926,254
May-20	8,432	489	4,120,666
Jun-20	6,364	615	3,911,894
Jul-20	1,408	729	1,026,766
Aug-20	2,142	694	1,487,298
Sep-20	2,282	688	1,570,905
Oct-20	2,400	698	1,673,975
Nov-20	3,723	653	2,429,466
Dec-20	3,138	680	2,133,983
Jan-21	4,872	568	2,764,882
Feb-21	6,681	423	2,826,040
Mar-21	7,499	534	4,004,962
Apr-21	5,736	657	3,770,455
May-21	3,220	675	2,172,964
Jun-21	2,481	673	1,668,541
Jul-21 **	1,419	687	974,212
Aug-21 **	1,916	678	1,298,803
Sep-21	2,328	689	1,604,558
Oct-21	2,821	670	1,891,328
Nov-21	3,104	682	2,115,825
Dec-21	18,111	291	5,266,752
Jan-22	13,198	433	5,714,329
Feb-22	3,902	694	2,707,979
Mar-22	4,158	636	2,645,333
Apr-22	3,961	651	2,577,507
May-22	2,702	684	1,847,520
Jun-22	2,458	650	1,598,610
Jul-22 **	1,570	696	1,092,528
Aug-22	1,357	751	1,018,981
Sep-22	2,172	662	1,438,527
Oct-22	2,782	679	1,889,132
Nov-22	8,452	419	3,540,976
Dec-22	7,192	515	3,706,454
Total	**361,310**		**176,387,819**
60 - Month Volume Weighted Average: 488mg/L			

Note: ** ***Denotes monthly results 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 Weighted = Monthly flow weighted TDS calculated from EC. Data prior to October 2003 from Watermaster; October 2003 to December 2004 from WeInc, 2005 to 2022 from SAWPA.

K:\projects\PA-20 Basin Monitoring Prog\2022 SAR WQ Basin Monitoring Report\Figures

3.2 *Santa Ana River Reach 3*

3.2.1 Below Prado Dam

In order to determine whether water quality objectives for base flow in Reach 3 are being met, the Regional Board typically collects a series of grab and composite samples at *Below Prado Dam* during August and September when the influence of storm flows and non-tributary flows is at a minimum. In 2022, 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 2022, base flow 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 2022 Annual Base Flow Monitoring Program for the Santa Ana River at Below Prado Dam (Regional Board Data Only)

Parameter	Units	Basin Plan Objectives SAR Reach 3	8/30/2022	9/6/2022	9/13/2022	9/22/2022	9/29/2022
Ammonia-Nitrogen	mg/L	**X[1]**	0.02	0.04	0.20	0.08	0.08
Bicarbonate (as CaCO3)	mg/L		250	260	160	250	240
Boron (dis)[3]	mg/L	**0.75**	0.33	0.33	<0.1	0.37	0.42
Calcium	mg/L		na	na	na	83	na
Calcium (dis)[3]	mg/L		83	91	57	84	82
Carbonate (as CaCO3)	mg/L		<5	<5	<5	<5	<5
Chemical Oxygen Demand	mg/L	**30**	<10	11	43	8.4	24
Chloride	mg/L	**140**	160	160	100	160	160
Electrical Conductivity (field)	umhos/c		1160	1200	786	1165	1153
Hydroxide (as CaCO3)	mg/L		<5	<5	<5	<5	<5
Kjeldahl Nitrogen (total)	mg/L		na	na	na	0.8	0.7
Kjeldahl Nitrogen (dis)[3]	mg/L		0.4	0.5	1.1	0.5	0.3
Magnesium	mg/L		na	na	na	18	na
Magnesium (dis)[3]	mg/L		18	21	13	18	19
Nitrate/Nitrite as N	mg/L		1.8	3.1	0.68	3.5	3.5
Nitrate-Nitrogen	mg/L		na	na	na	3.4	3.2
Nitrite-Nitrogen	mg/L		na	na	na	0.019	0.029
Organic Nitrogen	mg/L		0.4	0.4	0.9	0.7	0.6
Potassium (dis)[3]	mg/L		18	19	17	18	18
Sodium (dis)[3]	mg/L	**110**	130	120	75	120	120
Sulfate	mg/L	**150**	110	120	93	110	110
Total Alkalinity (as CaCO3)	mg/L		250	260	160	250	240
Total Dissolved Solids	mg/L	**700**	700	730	480	700	690
Total Hardness (as CaCO3)	mg/L	**350**	na	na	na	77	na
Total Hardness (as CaCO3) (dis)[3]	mg/L		na	na	na	79	78
Total Inorganic Nitrogen (calc)	mg/L	**10[2]**	1.8	3.1	0.9	3.6	3.6
Total Nitrogen (calc)	mg/L		2.2	3.5	1.8	4.3	4.2
Total Nitrogen (dis)[3]	mg/L		2.2	3.5	na	3.9	4.2
Organic Carbon (total)	mg/L		4.3	4.1	16	4.1	4.1
Organic Carbon (dis)[3]	mg/L		4.3	4.1	15	4.1	3.9
Turbidity	NTU		12	17	68	60	49

Notes: *All nitrogen species filtered*

na not available

X[1] *Santa Ana River Basin Plan specifies an un-ionized ammonia objectives for WARM designated surface water bodies including site specific objectives for the Santa Ana River and certain tributaries including the middle Santa Ana River, Chino Creek, Mill Creek (Prado Area), Temescal Creek, and San Timoteo Creek. Site specific objectives must be computed based upon temperature and pH.*

X[2] *Santa Ana River Basin Plan specifies that Total Nitrogen Samples are to be filtered.*

X[3] *Dissolved fraction results presented, but Basin Plan reports based upon the Total fraction.*

A summary of all base flow monitoring data collected by the USGS, OCWD and the Regional Board at *Below Prado Dam* during 2022 along with Basin Plan objectives for base flow 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 base flow in the SAR during August and September of 2022. OCWD conducted six base flow monitoring events at Below Prado Dam in 2022. However, as the nitrogen species data collected by OCWD was not filtered, it was not used to evaluate the water quality objective because the Basin Plan currently states that the water quality objective is based on a filtered sample of Total Inorganic Nitrogen. The USGS conducted monthly base flow sampling events at Below Prado Dam in August and September 2022. Table 3-4 presents the results of this monitoring.

Table 3-4. Summary of Base Flow Water Quality Observations for the Santa Ana River at Below Prado Dam (2022 OCWD, USGS and Regional Board at Below Prado Dam)

Constituent	Units	Basin Plan Objectives SAR Reach 3	Base Flow Average	# of Samples
Ammonia-Nitrogen (filtered)	mg/L		0.07	7
Ammonia-Nitrogen (unfiltered)	mg/L	**X[1]**	<0.1	6
Bicarbonate (as CaCO3)	mg/L		235	13
Boron (total)	mg/L	**0.75**	0.39	4
Boron (dis)[3]	mg/L		0.31	5
Calcium (total)	mg/L		88	4
Calcium (dis)[3]	mg/L		79	5
Carbonate (as CaCO3)	mg/L		<5	13
Chemical Oxygen Demand (filtered)	mg/L		13.7	9
Chemical Oxygen Demand (unfiltered)	mg/L	**30**	16.8	4
Chloride	mg/L	**140**	151	11
Electrical Conductivity	umhos/cm		1147	12
Electrical Conductivity (field)	umhos/cm		1122	11
Fluoride	mg/L		0.38	2
Hydroxide (as CaCO3)	mg/L		<5	11
Magnesium	mg/L		20.6	3
Magnesium (dis)	mg/L		17.8	6
Nitrate/Nitrite as N (filtered)	mg/L		2.5	5
Nitrate-Nitrogen (filtered)	mg/L		3.2	4
Nitrate-Nitrogen (unfiltered)	mg/L		1.9	6
Nitrite-Nitrogen (filtered)	mg/L		0.024	4
Nitrite-Nitrogen (unfiltered)	mg/L		0.075	6
Organic Nitrogen (filtered)	mg/L		0.55	7
Organic Nitrogen (unfiltered)	mg/L		0.72	6
Potassium	mg/L		14.5	3
Potassium (dis)[3]	mg/L		18.0	5
Sodium	mg/L	**110**	123	3
Sodium (dis)[3]	mg/L		113	5
Sulfate	mg/L	**150**	111	11
Total Alkalinity (as CaCO3)	mg/L		230	13
Total Dissolved Solids	mg/L	**700**	686	15
Total Hardness (as CaCO3)	mg/L	**350**	252	4
Total Hardness (as CaCO3) (dis)[3]	mg/L		79	2
Total Inorganic Nitrogen (calculated filtered)	mg/L	**10[2]**	2.8	7
Total Inorganic Nitrogen (calc unfiltered)	mg/L		2.0	6
Total Nitrogen (calculated filtered)	mg/L		3.3	7
Total Nitrogen (calculated unfiltered)	mg/L		2.7	6
Total Nitrogen (dis)[3]	mg/L		3.2	3
Total Kjeldahl Nitrogen (filtered)	mg/L		0.75	2
Total Kjeldahl Nitrogen (unfiltered)	mg/L		0.73	6
Dissolved Kjeldahl Nitrogen	mg/L		0.56	5
Total Organic Carbon (filtered)	mg/L		5.9	7
Total Organic Carbon (unfiltered)	mg/L		7.1	6
Dissolved Organic Carbon	mg/L		6.3	5
Turbidity	NTU		24.3	13

Notes: Table summarizes base flow monitoring data collected by USGS, OCWD and the Regional Board at Below Prado Dam during 2022

na not available

X[1] *Santa Ana River Basin Plan specifies an un-ionized ammonia objectives for WARM designated surface water bodies including site specific objectives for the Santa Ana River and certain tributaries including the middle Santa Ana River, Chino Creek, Mill Creek (Prado Area), Temescal Creek, and San Timoteo Creek. Site specific objectives must be computed based upon temperature and pH.*

X[2] *Santa Ana River Basin Plan specifies that Total Nitrogen Samples are to be filtered.*

X[3] *Dissolved fraction results presented, but Basin Plan reports based upon the Total fraction.*

The USGS also maintains a gauging station, 11074000, located on the SAR below Prado Dam, shown in Figure 2-1. In 2022, this station recorded flows totaling 107,244 AFY.

A long time-history of water quality data has been collected by USGS along with data collected by OCWD, Regional Board base flow 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 2002 through to current and are included in Appendix A, to show the longer-term trends in base flow data 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 OCWD for their SAR Water Quality Monitoring Program and the USGS at MWD Crossing. OCWD typically monitors sites, the following locations: *MWD Crossing, Van Buren Blvd., Etiwanda Avenue, Hamner Road, and River Road*, as shown in Figure 2-1*;* however, in 2022 due to on-going streambed restoration activities being conducted by the U.S. Army Corps of Engineers no monitoring was conducted at the MWD Crossing location.

OCWD conducted a single monitoring event for each of the available locations on August 23, 2022. However, as the nitrogen species data collected by OCWD was not filtered it was not used to evaluate the water quality objective for TIN. Additionally, the USGS collects electrical conductivity and TDS at their gauge located *Santa Ana River at MWD Crossing*. Table 3-5 presents a summary of the results of these monitoring efforts for base flow conditions.

An assessment of base flow conditions, represented by water quality data collected in August and September of 2022, showed no exceedances of water quality objectives specified in the Basin Plan. The USGS maintains a gauging station, 11066460, located along Reach 3 of the SAR at the MWD Crossing, shown in Figure 2-1. In 2022, this station recorded flows totaling 27,267 AFY.

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

Constituent	Units	Basin Plan Objectives SAR Reach 3	Base Flow Average	# of Samples
Ammonia-Nitrogen (unfiltered)	mg/L	**X[1]**	<0.1	4
Bicarbonate (as CaCO3)	mg/L		239	4
Carbonate (as CaCO3)	mg/L		1.5	4
Chemical Oxygen Demand (filtered)	mg/L		<3	4
Chemical Oxygen Demand (unfiltered)	mg/L	**30**	5.8	4
Chloride	mg/L	**140**	132	4
Electrical Conductivity	umhos/cm		1081	8
Electrical Conductivity (field)	umhos/cm		936	4
Hydroxide (as CaCO3)	mg/L		<1	4
Nitrate-Nitrogen (unfiltered)	mg/L		5.5	4
Nitrite-Nitrogen (unfiltered)	mg/L		0.012	4
Organic Nitrogen (unfiltered)	mg/L		0.11	4
Sulfate	mg/L	**150**	111	4
Total Alkalinity (as CaCO3)	mg/L		240	4
Total Dissolved Solids	mg/L	**700**	678	8
Total Inorganic Nitrogen (calculated unfiltered)	mg/L	**10[2]**	5.5	4
Total Kjeldahl Nitrogen (unfiltered)	mg/L		<0.2	4
Total Nitrogen (unfiltered)	mg/L		5.6	4
Total Organic Carbon	mg/L		3.0	4
Turbidity	NTU		1.4	4

Note: Table presents average concentration data

X[1] *Santa Ana River Basin Plan specifies an un-ionized ammonia objectives for WARM designated surface water bodies including site specific objectives for the Santa Ana River and certain tributaries including the middle Santa Ana River, Chino Creek, Mill Creek (Prado Area), Temescal Creek, and San Timoteo Creek. Site specific objectives must be computed based upon temperature and pH.*

Santa Ana River Basin Plan specifies that Total Nitrogen Samples are to be filtered

- Site SAR River Road includes data collected by 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 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 Crossing" and OCWD at "SAR-MWD Crossing-01"

X[2] *Santa Ana River Basin Plan specifies that Total Nitrogen Samples are to be filtered.*

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.

In 2022, only the *SAR-RIVERSIDEAVE-01* site was monitored once by OCWD on August 23, 2022, no data was collected at the *SAR-MISSION-01*, due to on-going streambed restoration activities being conducted by the U.S. Army Corps of Engineers impacting the *SAR-MISSION-01* location, nor at the *SAR-LACADENA-01* location, due to the lack of flow.

A review of this data showed an insufficient amount of available surface water quality monitoring data to evaluate compliance with the water quality objective specified in the Basin Plan. Table 3-6 presents a summary of the results of this monitoring.

Table 3-6. Summary of Water Quality Observations for Santa Ana River Reach 4

Constituent	Units	Basin Plan Objective SAR Reach 4	SAR Reach 4 Average	# of Samples
Ammonia-Nitrogen (unfiltered)	mg/L	**X[1]**	<0.1	1
Bicarbonate (as CaCO3)	mg/L		179	1
Carbonate (as CaCO3)	mg/L		<1	1
Chemical Oxygen Demand (filtered)	mg/L		<3	1
Chemical Oxygen Demand (unfiltered)	mg/L	**30**	5	1
Chloride	mg/L		95	1
Electrical Conductivity	umhos/c		819	1
Electrical Conductivity (field)	umhos/c		806	1
Hydroxide (as CaCO3)	mg/L		<1	1
Nitrate-Nitrogen (unfiltered)	mg/L		8.7	1
Nitrite-Nitrogen (unfiltered)	mg/L		0.067	1
Organic Nitrogen (unfiltered)	mg/L		<0.1	1
Sulfate	mg/L		75	1
Total Alkalinity (as CaCO3)	mg/L		179	1
Total Dissolved Solids	mg/L	**550**	520	1
Total Inorganic Nitrogen (calc unfiltered)	mg/L	**10**	8.8	1
Total Kjeldahl Nitrogen (unfiltered)	mg/L		<0.2	1
Total Nitrogen (unfiltered)	mg/L		8.8	1
Total Organic Carbon	mg/L		8.8	1
Turbidity	NTU		0.40	1

Note: Table presents average concentration data
X[1] *Santa Ana River Basin Plan specifies un-ionized ammonia objectives for WARM designated surface water bodies including site specific objectives for the Santa Ana River and certain tributaries including the Middle Santa Ana River, Chino Creek, Mill Creek (Prado Area), Temescal Creek, and San Timoteo Creek. Site specific objectives must be computed based upon temperature and pH.*
- Site SAR Mission Avenue includes data collected by OCWD at " SAR-MISSION-01"
- Site SAR Riverside Avenue includes only data collected by OCWD at " SAR-RIVERSIDEAVE-01"
- Site SAR La Cadena Drive includes only data collected by OCWD at " SAR-LACADENA-01"

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 2022, no data was collected at *SAR- WATERMAN -01,* as during the time scheduled for sampling there was no stream flow.

The USGS maintains a gauging station, 11059300, located along the SAR at E Street near San Bernardino, shown in Figure 2-1. In 2022, this station recorded flows totaling 6,183 AFY.

4 Conclusions and Recommendations

4.1 Conclusions

In 2015, the Basin Monitoring Program Task Force commissioned an investigation to determine the cause for the steady increase in the average TDS concentrations measured during the summer base flow conditions since about 2005. The study found that average TDS concentrations were increasing because the POTWs, while still meeting their discharge obligations were discharging less volume of treated wastewater to the Santa Ana River system.[5] Additionally, the watershed is in a long term dry period[7], which makes the interpretation of trend data more difficult, as shown in Figure 4-1. During the late summer months of August and September, the combined volume-weighted average TDS concentration for the nine municipal effluents that eventually converge at Prado Dam ranges between 535-570 mg/L.[6] High quality (low TDS) municipal effluent tends to dilute low quality (high TDS) discharges from other sources (e.g. dry weather urban runoff, rising groundwater, etc.) that also contribute flows to Reach 3. In the period from 2005 to 2014, POTWs reduced the total volume of treated wastewater discharged to Reach 3 of the Santa Ana River (and its major tributaries) by 45%; from 145 mgd down to 79 mgd. Additional modeling revealed that, if the total volume of municipal effluent discharge had remained unchanged, average TDS concentrations at Prado Dam would also have remained stable. The reduction in wastewater flows, and the subsequent loss of dilution, also appears to be a correlation to the long-term rising trend in the average concentration of various individual salt ions (i.e. chloride, sodium, and sulfate) during base flow conditions.

In 2022, a follow-up investigation was conducted to extend the analysis to cover the years 2015 to 2021. The 2022 study showed the average TDS concentration of baseflow sampled at Below Prado Dam in August and September to have exceeded the Reach 3 TDS objective in each 2017, 2018, 2019, and 2020, which corresponded with years of lower total POTW discharge (about 4,600 to 4,800 million gallons). The results and observations of this investigation are consistent with those in the POTW TDS Investigation 1[6], which indicated that 2004 to 2014 volume-weighted TDS concentration of the total POTW discharge in August and September were relatively low (about 560 mgl) and remained below the Reach 3 TDS objective of 700 mgl. The findings of these POTW TDS investigations continue to support previous estimations that the observed August and September increases of the TDS concentration in Reach 3, may be correlated with a decrease in POTW discharges of relatively low TDS concentration. And there are likely other gains and losses of discharge and mass that occur in Reach 3 and Reach 4 (e.g., rising groundwater, streambed recharge, evapotranspiration, dry-weather runoff, etc.) that contribute to the increasing TDS concentration of baseflow in Reach 3 during August and September.[7]

In 2022, the five-year running average TDS concentration, for samples collected immediately below Prado Dam, continued to comply with the water quality objectives established for Reach 2 of the Santa Ana River and the underlying Orange Country Groundwater Management Zone (650 mg/L and 580 mg/, respectively). The average TDS concentration of the 15 samples collected at

[5] Wildermuth Environmental, Inc. Investigation and Characterization of the Cause(s) of Recent Exceedances of the TDS Concentration Objective for Reach 3 of the Santa Ana River. Feb. 11, 2015.

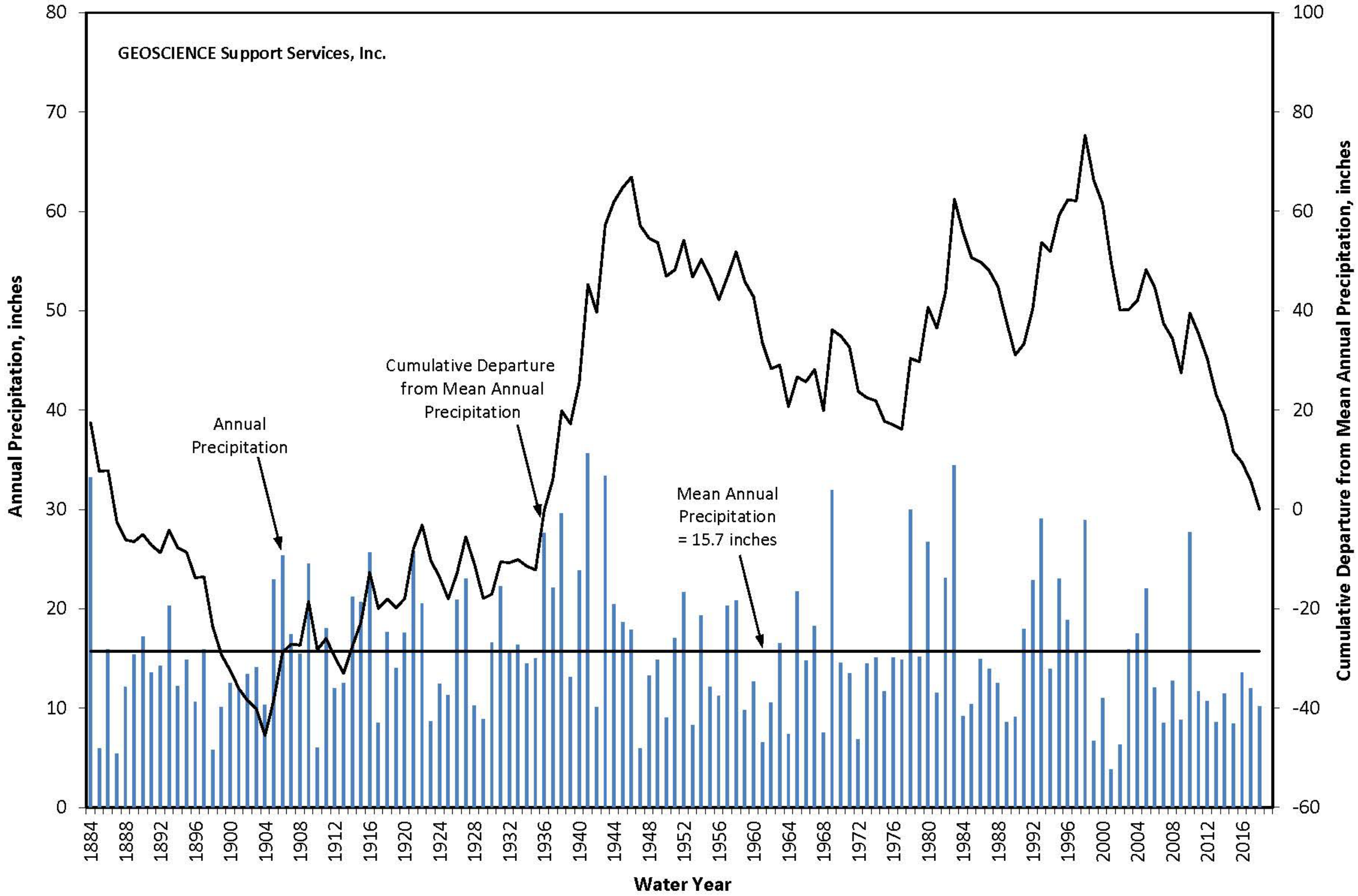
[6] Wildermuth Environmental, Inc. Volume-Weighted TDS Concentration of POTW Discharges above Prado Dam during August-September. June 15, 2015.

[7] West Yost Technical Memorandum. 2015 to 2021 Volume-Weighted TDS Concentration of POTW Discharges above Prado Dam during August and September. October 11, 2022.

the same location in August and September of 2022 were in compliance with the water quality objective established for Reach 3 during baseflow conditions (686 mg/L vs. 700 mg/L, respectively).

In 2022, the average base flow concentration of Total Nitrogen at below Prado Dam was 3.3 mg/L, well below the water quality objective established for Reach 3. Long-term water quality monitoring data confirms that average nitrogen concentrations are continuing to slowly decline over time (see Figure 3-2). This is the result of discharging less volume of treated wastewater into the river system because the average nitrogen concentration in municipal effluent ranges from 8-10 mg/L, as well as, de-nitrification (N loss) processes through the uptake of nitrogen by plants in Prado wetlands and along the Santa Ana River.

Figure 4-1. Cumulative Departure from Mean Annual Precipitation San Bernardino County Hospital Station (1884-2018)



In addition, some of the observed trend toward lower average nitrogen concentrations is likely due to the operation of OCWD's treatment wetlands immediately above Prado Dam.

Base flow samples are also collected for Reach 3 of the Santa Ana River mainstem between Riverside Narrows and Prado Wetlands. The average TDS concentration of these samples was 678 mg/L and the average TIN concentration was 5.5 mg/L. Both values were in compliance with the water quality objective for Reach 3 of the river.

The average TDS concentration for single sample collected in Reach 4 of the Santa Ana River was 520 mg/L which complies with the applicable water quality objective of 550 mg/L. The average TIN concentration in these same single sample was 8.8 mg/,L which complies with the applicable water quality objective of 10 mg/L.

4.2 Recommendations

The Task Force has now been implementing the approved monitoring plan for more than fifteen years. Through the implementation of the existing monitoring plan, some issues have been identified regarding the most appropriate way to collect, analyze, interpret, and report the resulting data. To address these issues, the Task Force identified some recommendations in Basin Plan Amendments, which were adopted by the Regional Board in December of 2022 and the approved by the State Water Resources Control Board in May of 2022. The relevant recommendations that were adopted into the most recent Basin Plan Amendment are as follows:

1) The monitoring plan should be reviewed to ensure that we are collecting all data necessary to assess compliance with relevant water quality objectives and the overall effectiveness of the newly approved wasteload allocation model (WLAM), which was completed in June 2020. The Basin Plan was amended to require stakeholders to submit an update to the 2005 monitoring plan to the Regional Water Board by August of 2022 for Regional Board review and approval. For surface water, the update to the 2005 monitoring plan should consider if the monitoring program should be expanded to include the major tributaries to the Santa Ana River (e.g. Chino Cr., Mill-Cucamonga Cr., Temescal Cr., Hole Lake Cr., San Timoteo Cr., etc.).

2) As part of the 2005 monitoring plan update discussed in paragraph 1 above, the update should include a list of parameters to be analyzed, sites to be sampled, and the sampling schedule. A Quality Assurance Project Plan (QAPP) should also be prepared to support the monitoring program. It should also be decided if monitoring data collected should be uploaded to CEDEN or other state database.

3) Additional future Basin Plan amendments should consider revisions to include a clear definition of what constitutes "base flow" with respect to the water quality objectives for Reach 3 that is consistent with the Annual Report and the updated Wasteload Allocation Model. For example, should data influenced by summer precipitation in August and September be included? Can we use data from other months to characterize base flow conditions provided that no recent

precipitation has occurred? Should data influenced by State Water Project transfers be excluded?

4) In order to assure more consistent application of water quality standards, the Basin Plan should be amended to clarify that filtered samples should be used to evaluate all surface water TIN objectives. This approach would be consistent with the approach used for evaluating compliance with TIN objectives in Reach 3.

5) The application of existing WQOs for various salt ions may no longer be necessary. Most were established based on very limited sampling data collected in the early 1980's. All were intended to represent antidegradation targets - not use impairment thresholds. The Basin Monitoring Task Force continues to recommend that the Basin Plan be amended in the future to properly clarify application of the existing WQOs for individual salt ions (chloride, sodium, sulfate, etc.) that references and integrates prior Regional Board decisions that pertain to application of the WQOs.

   In March of 2023, the Task Force submitted a proposed update to the 2005 Santa Ana River Water Quality Work Plan, *2022 Santa Ana River Total Dissolved Solids (TDS) and Total Inorganic Nitrogen (TIN) Monitoring Workplan,* in response to Basin Plan amendments adopted by the Santa Ana Water Board in December of 2021. The 2022 Work Plan proposes an updated surface water monitoring program to assess current compliance with TDS and TIN objectives for the Santa Ana River Reaches 2, 3, 4, and 5. Once the 2022 Workplan is approved by the Santa Ana Water Board and implemented by the Task Force, which is estimated to begin with monitoring year 2024, this Annual Report will also be modified accordingly.

5 Response to Comments

Comments and Responses to 2022 Draft Annual Report of Santa Ana River Water Quality

Comments Received	Agency	Page/Table/ Section	Detail	Response to Comments
Al Javier	**EMWD**	Introduction	End of pragraph 2: Basin Plan was update and approved by OAL more recently.	In December 2021, the Regional Board amended the Basin Plan to revise and update limited components of the total dissolved solids (TDS) and nitrogen management program. These updates were approved by the Office of Administrative Law on July 27, 2023. These amendments resulted in the Task Force updating the Surface Water Ambient Monitoring Program, which will be reflected in the 2024 Annual Report for the SAR.
		Table 2-2/ Figure 2-1	Suggestion: provide these locations within Figure 2-1	USGS Stream Gauge Stations are included on Figure 2-1 as yellow squares.
		Section 3	Delete text "true"	text revised
		Section 4.1	also years within CA drought?	Reviewing the Annual rainfall reports produced by RCFC&WCD only 2018 was considered a "very dry" year, 2017 and 2019 were considered "wet" years and 2020 an "average" year.
Cindy Li	**RWQCB**	Figure 2-1	What are these TMDL Rivers listed for? What are the contaminants that caused impairment?	Removed TMDL Rivers from graphic legend and colored stream layer.
		Section 3.2.1	Delete text "and quantity"	text revised
		Table 3-3	Referring to 9/13/2022: What happened on this date? The concentration is lower than those of other dates.	Communication with Heather Boyd, Santa Ana Regional Water Quality Control Board revealed that the field sheet notes from the 9/13/2022 sampling event indicated isolated showers within the last 24 hours, which likely impacted the sampling results. It was suggested to add a footnote for that sample in Table 3-3, and not include it in the average base flow results presented in Table 3-4.
		Section 4.1	At end of last paragraph on page 4-1: Prado wetlands and other plants along SAR may have caused the de-nitrification (N loss) process as well.	text added - , as well as, de-nitrification (N loss) processes through the uptake of nitrogen by plants in Prado wetlands and along the Santa Ana River
		Section 4.1	Referring to this paragraph: "Base flow samples are also collected further upstream where the MWD pipeline crosses the Santa Ana River in Riverside. The average TDS concentration of these samples was 678 mg/L and the average TIN concentration was 5.5 mg/L. Both values were in compliance with the water quality objective for Reach 3 of the river." This is not in the Basin Plan. It might be more meaningful to compare the monitoring data from the entire SAR R3 with the objectives, not only the data from MWD crossing.	Text revised as follows: Base flow samples are also collected for Reach 3 of the Santa Ana River mainstem between Riverside Narrows and Prado Wetlands.
		Figures A-1 through A-15	SAR R3 objectives are not meant to be measured as a 5yr moving averages.	In 2016 (comments to the 2015 report), based upon the recommendation of the Task Force, the individual baseflow results (points) were removed because it was determined that it made the figure too busy. Instead, the Task Force determined that we should show only the "baseflow 5 yr moving average plots on the figures, because this provided the best way to look at the available data. This does not change the annual report determination with respect to evaluating SAR R3 objectives as a baseflow, annual average.

Comments and Responses to 2022 Draft Annual Report of Santa Ana River Water Quality

Comments Received	Agency	Page/Table/ Section	Detail	Response to Comments
Jennifer McMullin	**WMWD**	Section 4	this is a long sentence, suggest rewording to below. In 2022, a follow-up investigation was conducted to extend the analysis to cover the years 2015 to 2021. The 2022 study showed the average TDS concentration of baseflow sampled at Below Prado Dam in August and September to have exceeded the Reach 3 TDS objective in 2017, 2018, 2019, and 2020, which orresponded with years of lower total POTW discharge (about 4,600 to 4,800 million gallons).	text revised
		End of Section 4.1	samples?	In 2022 only a single TIN sample was collected for Reach 4.
		Figure 4-1	Wondering if we have data all the way to 2022? or is this from a previous report?	This figure was created by a consultant no longer under contract with the Basin Monitoring Program Task Force and is beyond the scope of this report to update.
		Section 4-2	Referring to last paragraph on 4-4: Just confirming this was due in August and submitted in March 2023?	The 2021 Basin Plan Amendment did perscribe that a Santa Ana River Total Dissolved Solids (TDS) and Total Inorganic Nitrogen (TIN) Monitoring Workplan be submitted to Regional board for approval by August 1, 2022. However, because the Basin Plan Amendment was not approved by OAL until July 27, 2023, the Basin Plan was revised to state that the due date was August 1, 2022, or the effective date of the Basin Plan amendment, whichever was later. Thus, the March 2023 submittal is in compliance with the final Basin Plan amendments.
		Figure A-1	Does not include SAR discharge in the key	legend (key) updated
		Figure A-3	Does not include SAR discharge in the key	legend (key) updated
		Figure A-5	Does not include SAR discharge in the key	legend (key) updated
		Figure A-6	Does not include SAR discharge in the key	legend (key) updated
Ashley Gibson	**YVWD**	Table 2-2	The coordinates for USGS station 11059300 listed in Table 2-2 are incorrect.	USGS gauge station coordinates corrected
		Figure 3-1	Figure 3-1 includes a “TDS – 5-year non-weighted moving average” line (green) in the chart. I believe it should be a weighted average based on the discussion about using the 60-month volume-weighted dataset. The description of Figure 3-1 in the text of the report does read, “…depicted as the mean TDS concentration of five annual flow-weighted averages, and the flow-weighted, 60-month moving average TDS concentration.”	Figure 3-1 Legend corrected
		Section 3-2	In Section 3.2, is it correct that the Regional Board collects samples Below Prado Dam to determine whether water quality objectives in Reach 3 are being met? There is no mention of the Board sampling below the dam in the Basin Plan. In fact, the Basin Plan states that, “additional sampling in Reach 3 by the Board and other agencies will help evaluate the fate and effects of the various constituents of base flow…”, implying that the Board is sampling above Prado Dam to characterize water quality in Reach 3. I do see that the report includes results for sampling in Reach 3, so I don’t understand why reporting just below the dam is representative of conditions in reach 3. Is there a continuous bypass flow through the dam in August and September?	As shown in previous years comments by Regional Board staff (comments to the 2017 report), their intrepretation of the Basin Plan language is that the monitoring at SAR below Prado Dam is intended to be used to assess if the water quality objective for base flow in Reach 3 are being met (Page 4-29 of the Basin Plan). Further, the Reach 3 baseflow objective was adopted to protect groundwater recharge downstream of Prado into Orange County's groundwater management zones. Thus, measuring water quality at Prado for Reach 3 is considered appropriate as it protects the downstream beneficial uses.
		Section 4-1	I don’t understand the Conclusions section. It’s not really a conclusion, but more of an update to an investigation to determine the reason for the increasing trend in TDS during the summer months. They look at TDS in August and September below the Dam and compare the results to the WQO for Reach 3, which is above the dam. I don’t know the dynamics of flow through the dam, but I wonder if what they’re measuring below the dam is truly representative of conditions in Reach 3.	The conclusions section is intended to summarize the compliance status of TDS and Total Nitrogen in the mainstem of the Santa Ana River above Prado Dam The additional narrative is intended to provide additional context to the relative status of TDS and Total Nitrogen in the mainstem of the Santa Ana River above Prado Dam.

Comments and Responses to 2022 Draft Annual Report of Santa Ana River Water Quality

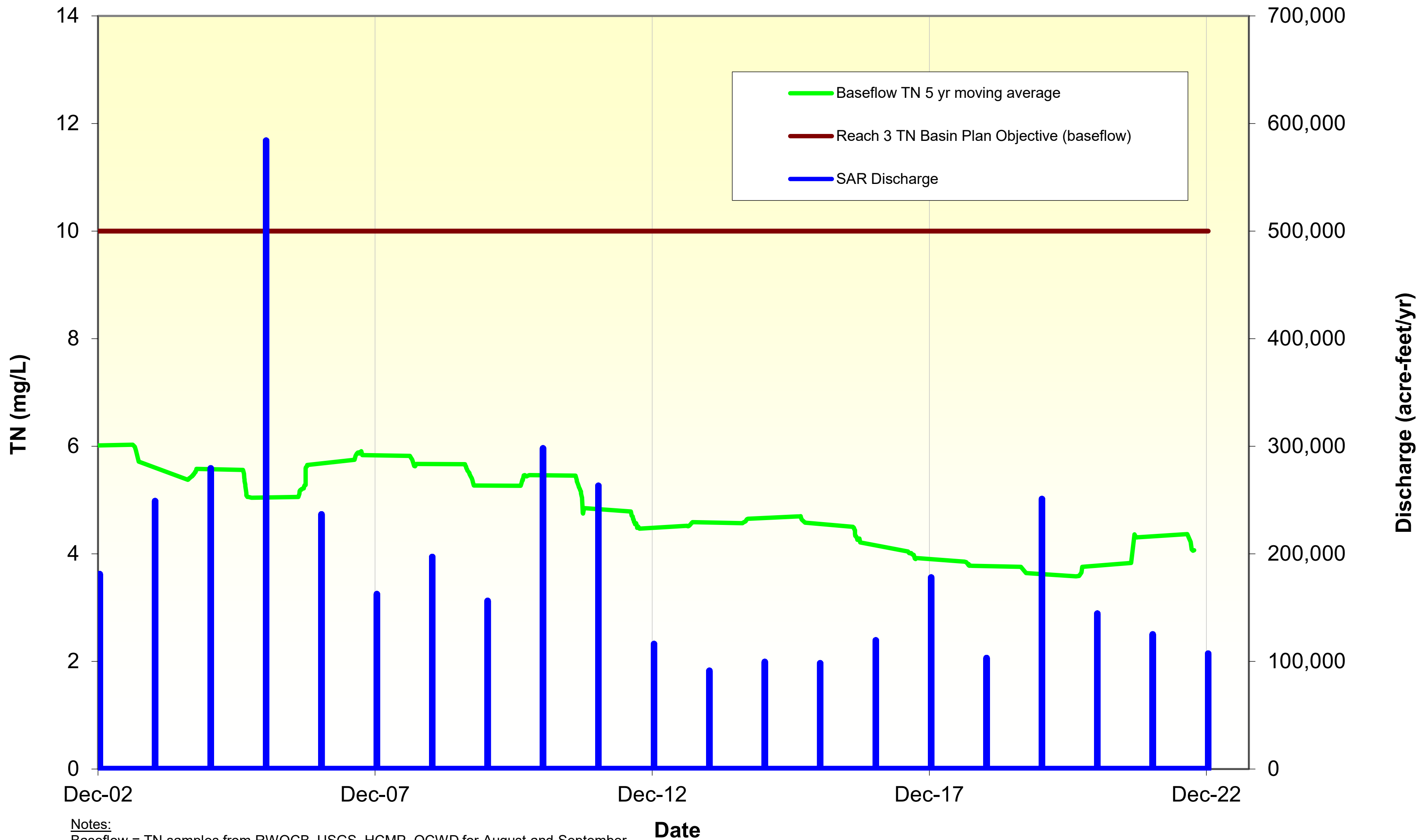
Comments Received	Agency	Page/Table/ Section	Detail	Response to Comments
Greg Woodside	SBVMWD	Section 4-1	Narrative text does not seem necessary or relevant – this report should be focused on presenting the data for 2022 and does not need to include this additional discussion.	The additional narrative is intended to provide additional context to the relative status of TDS and Total Nitrogen in the mainstem of the Santa Ana River above Prado Dam.
		Section 4-1	Regarding the item below, the main sentence that I wanted to comment on is: The findings of these POTW TDS investigations continue to support that the observed August and September increases of the TDS concentration in Reach 3, and the exceedances of the Reach 3 TDS objective is correlated with a decrease in POTW discharges of relatively low TDS concentration. The Integrated Report did not find that there were enough exceedances of the Reach 3 TDS objective such that there was a listing for impairment. So would like to suggest that we revise the wording '… the exceedances of the Reach 3 TDS objective' Perhaps reword that to '… the sporadic exceedances of the Reach 3 TDS objective' or words to that effect. Does that sound ok?	based upon discussion with Tess Dunham, the text was revised as follows: The findings of these POTW TDS investigations continue to support previous estimations that the observed August and September increases of the TDS concentration in Reach 3, may be correlated with a decrease in POTW discharges of relatively low TDS concentration.

Comments Received	Agency	Page/Table/ Section	Detail	Response to Comments
Tess Dunham	KSC	Page 3-6	Add the following to this sentence: "However, as the nitrogen species data collected by OCWD was not filtered, it was not used to evaluate the water quality objective because the Basin Plan currently states that the water quality objective is based on a filtered sample of Total Nitrogen."	text added
		Section 4.2	We should add in a short paragraph that identifies the proposed new workplan that was submitted in March 2023. Here is what could be the last paragraph: "In March of 2023, the Task Force submitted a proposed update to the 2005 Santa Ana River Water Quality Work Plan, 2022 Santa Ana River Total Dissolved Solids (TDS) and Total Inorganic Nitrogen (TIN) Monitoring Workplan, in response to Basin Plan amendments adopted by the Santa Ana Water Board in December of 2021. The 2022 Work Plan proposes an updated surface water monitoring program to assess current compliance with TDS and TIN objectives for the Santa Ana River Reaches 2, 3, 4, and 5. Once the 2022 Workplan is approved by the Santa Ana Water Board and implemented by the Task Force, which is estimated to begin with monitoring year 2024, this Annual Report will also be modified accordingly."	text added
		Full Report	Go through report and make sure that base flow is either consistently lower case or capitalized. Right now we have it both ways.	text corrected
		Full Report	MWD Crossing is sometimes referred to as MWD Xing. Please be consistent and remove Xing and replace with Crossing.	text corrected
		Table 3-4	Add a footnote	footnote added

Appendix A

Water Quality Trends at Below Prado Dam and MWD Crossing 2002 to Current

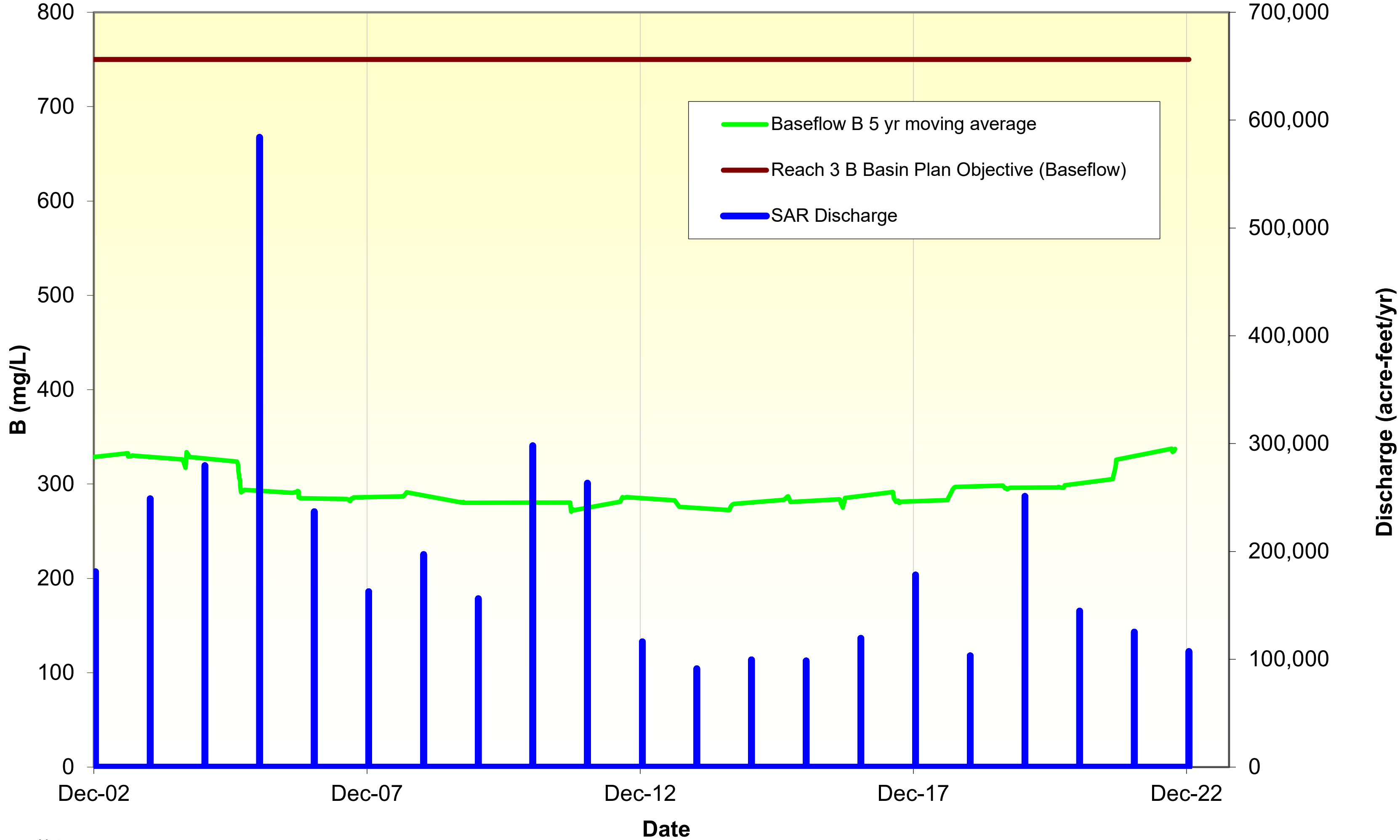
Figure A-1. Total Nitrogen (TN) Below Prado Dam



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

K:\projects\PA-20 Basin Monitoring Prog\2022 SAR WQ Basin Monitoring Report\Figures

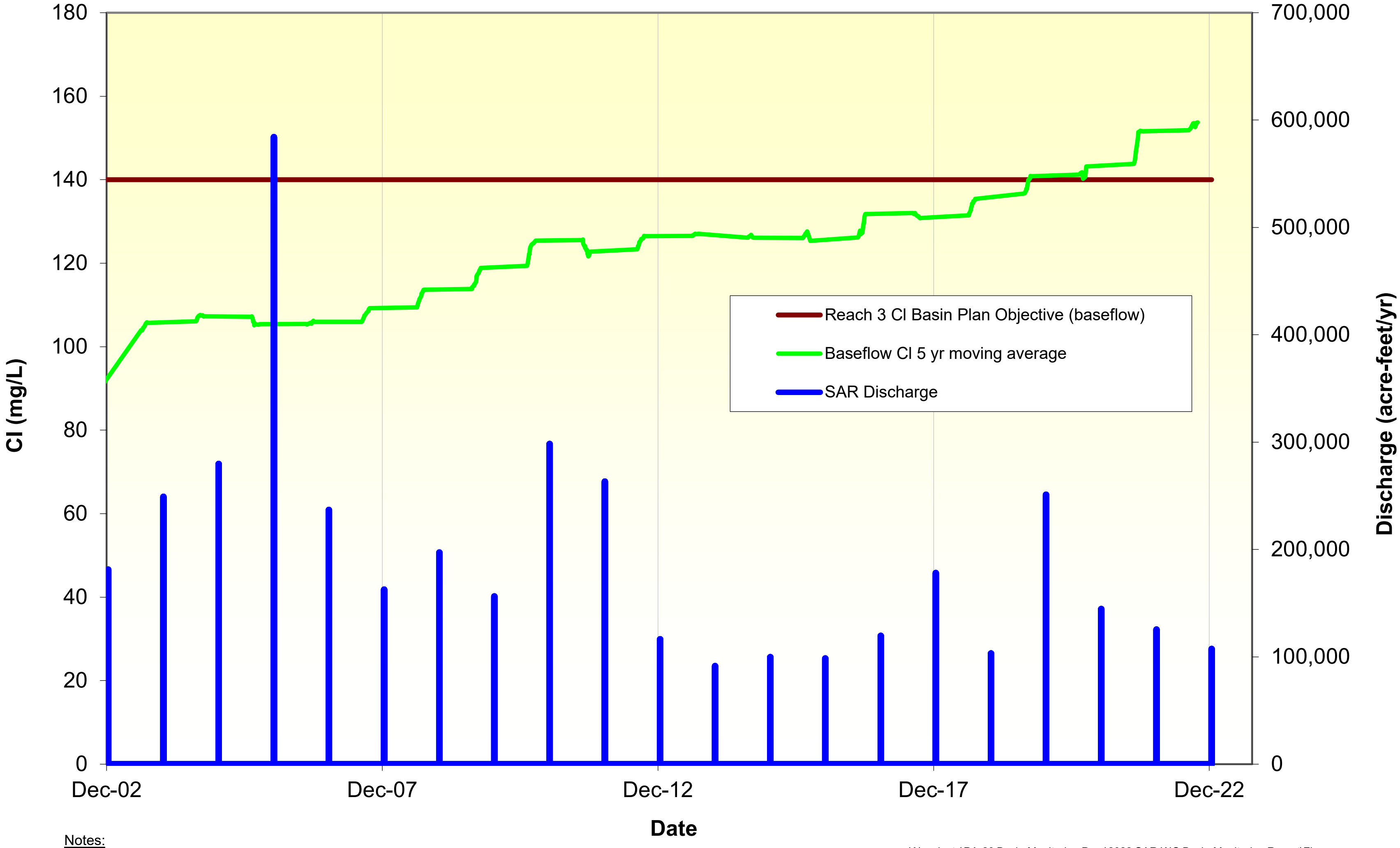
Figure A-2. Boron (B) Below Prado Dam



Notes:
Baseflow = B samples from RWQCB, USGS, HCMP, OCWD for August and September.
Samples from RWQCB for 2021 were not used because of higher than normal detection limits.

K:\projects\PA-20 Basin Monitoring Prog\2022 SAR WQ Basin Monitoring Report\Figures

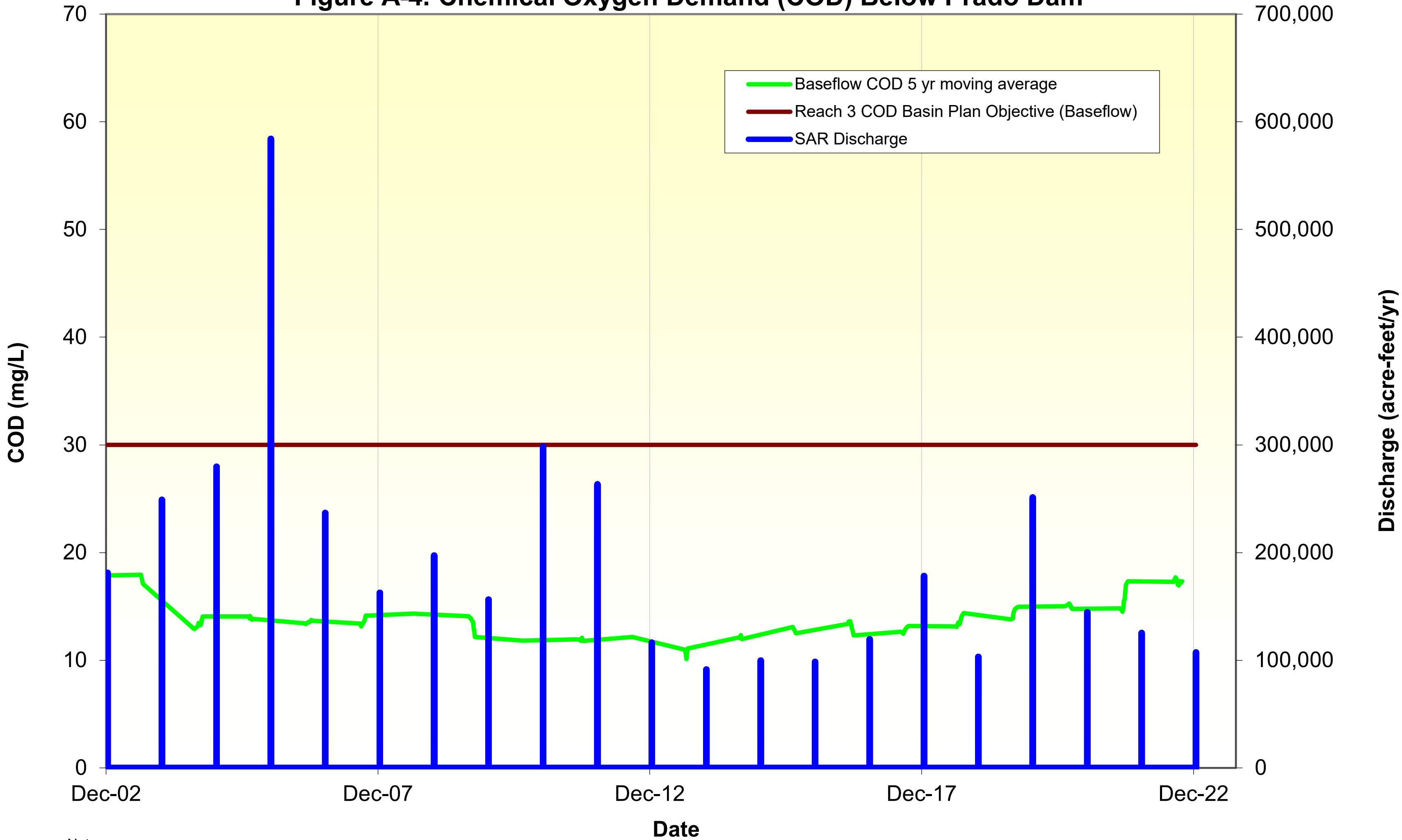
Figure A-3. Chloride (Cl) Below Prado Dam



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

K:\projects\PA-20 Basin Monitoring Prog\2022 SAR WQ Basin Monitoring Report\Figures

Figure A-4. Chemical Oxygen Demand (COD) Below Prado Dam



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

K:\projects\PA-20 Basin Monitoring Prog\2022 SAR WQ Basin Monitoring Report\Figures

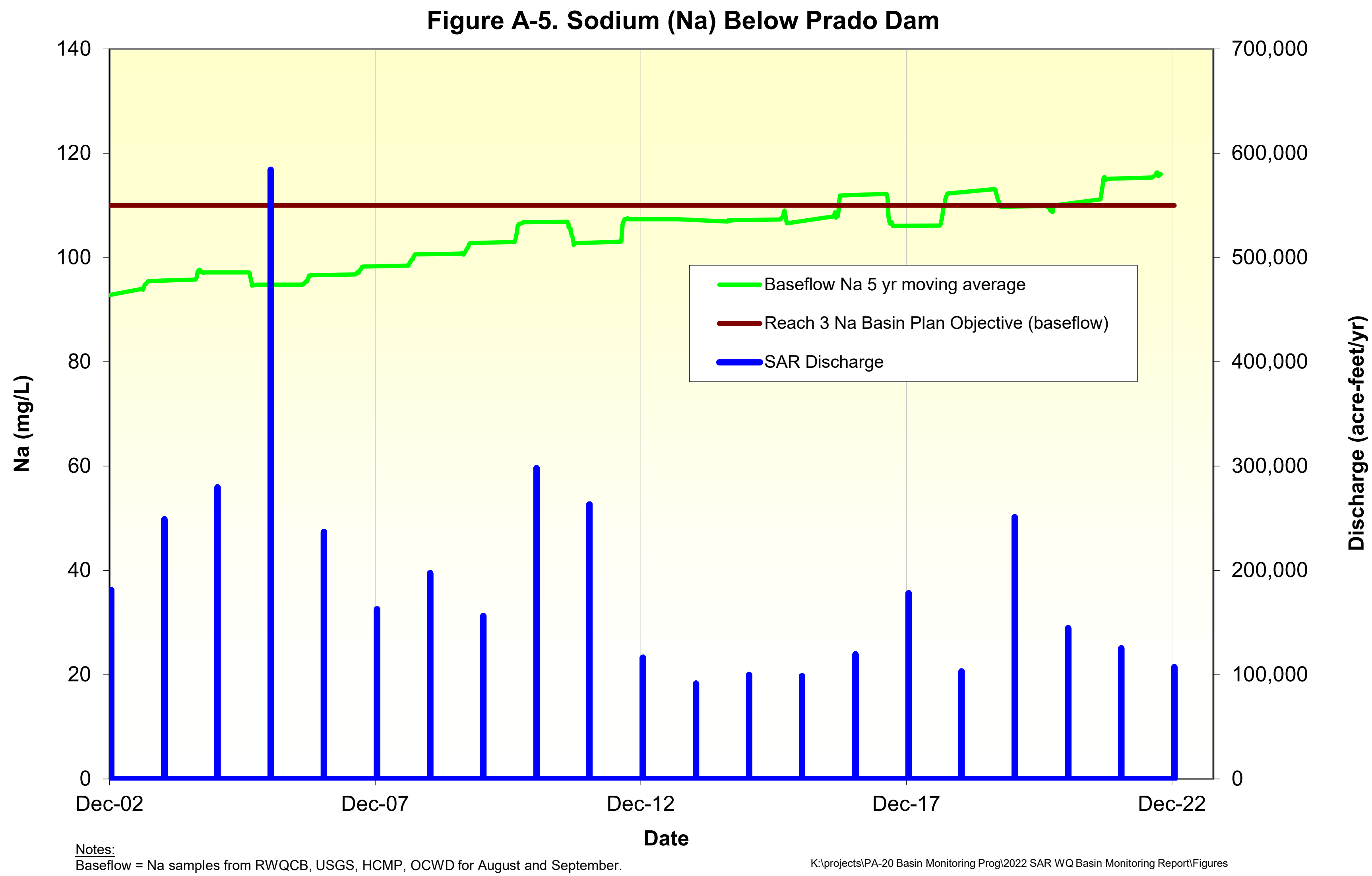
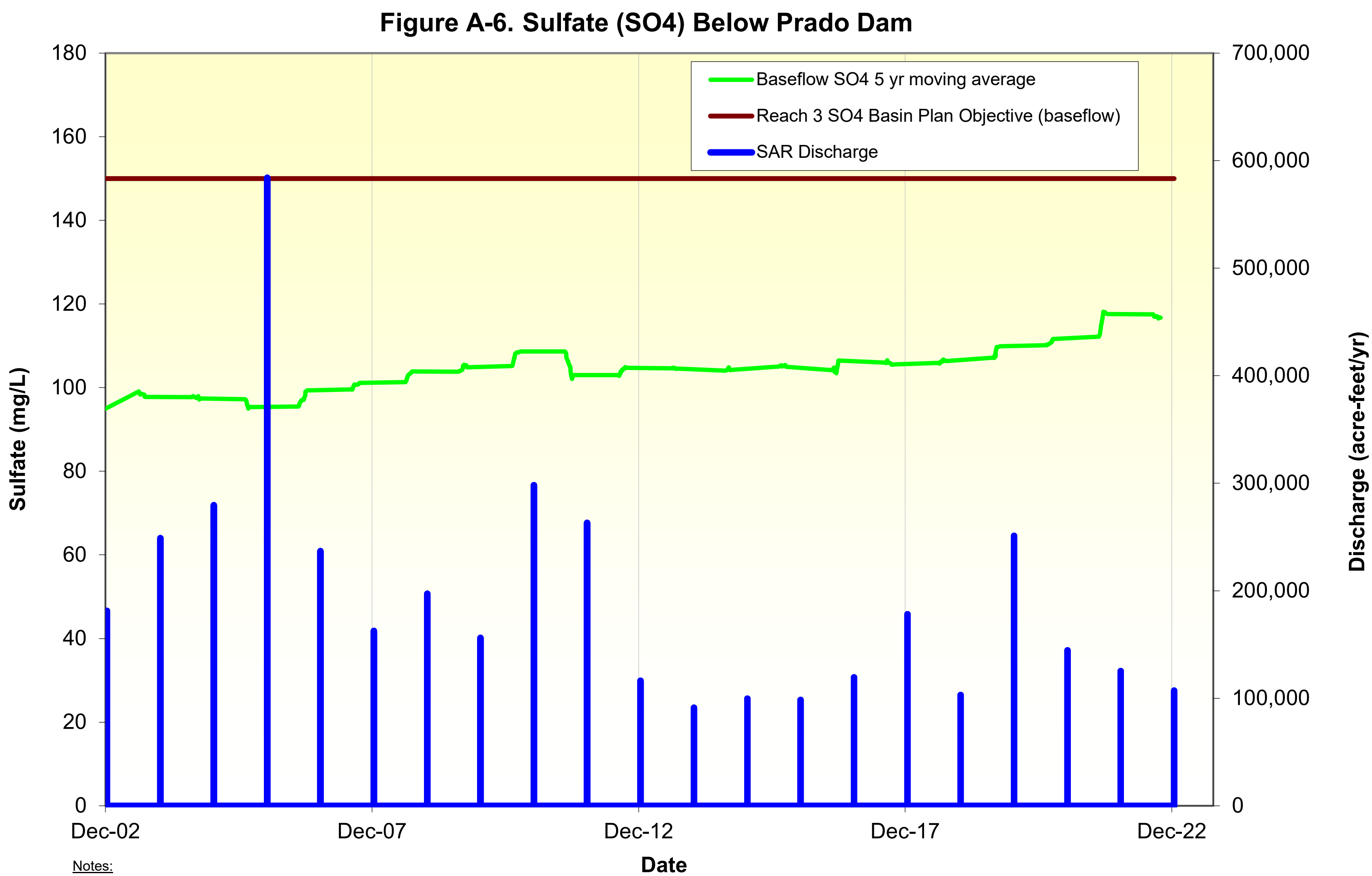
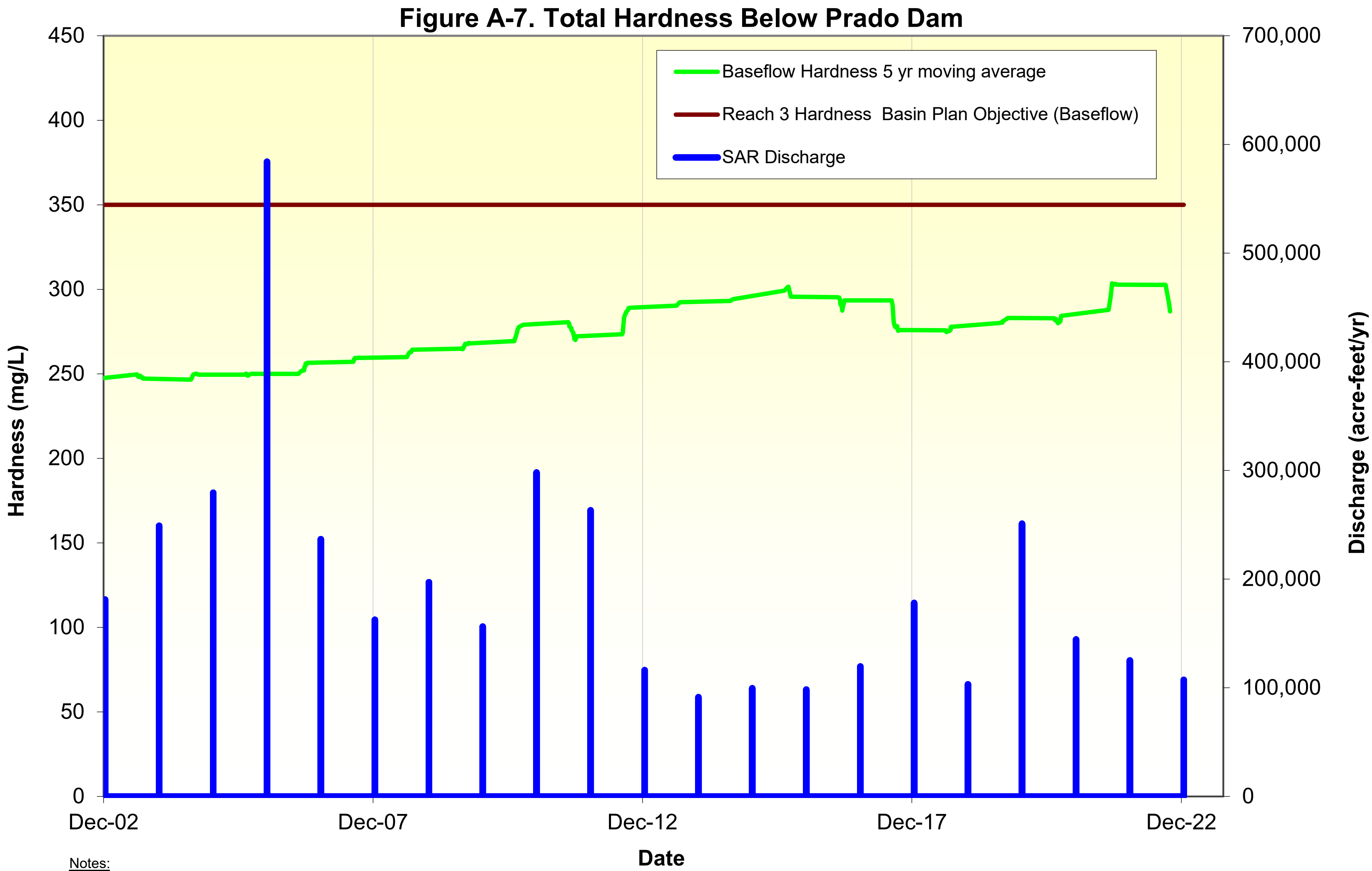


Figure A-5. Sodium (Na) Below Prado Dam
140
120
100
80
60
40
20
0
Na (mg/L)
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
Discharge (acre-feet/yr)
Dec-02
Dec-07
Dec-12
Dec-17
Dec-22
Date
Baseflow Na 5 yr moving average
Reach 3 Na Basin Plan Objective (baseflow)
SAR Discharge
Notes:
Baseflow = Na samples from RWQCB, USGS, HCMP, OCWD for August and September.
K:\projects\PA-20 Basin Monitoring Prog\2022 SAR WQ Basin Monitoring Report\Figures



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

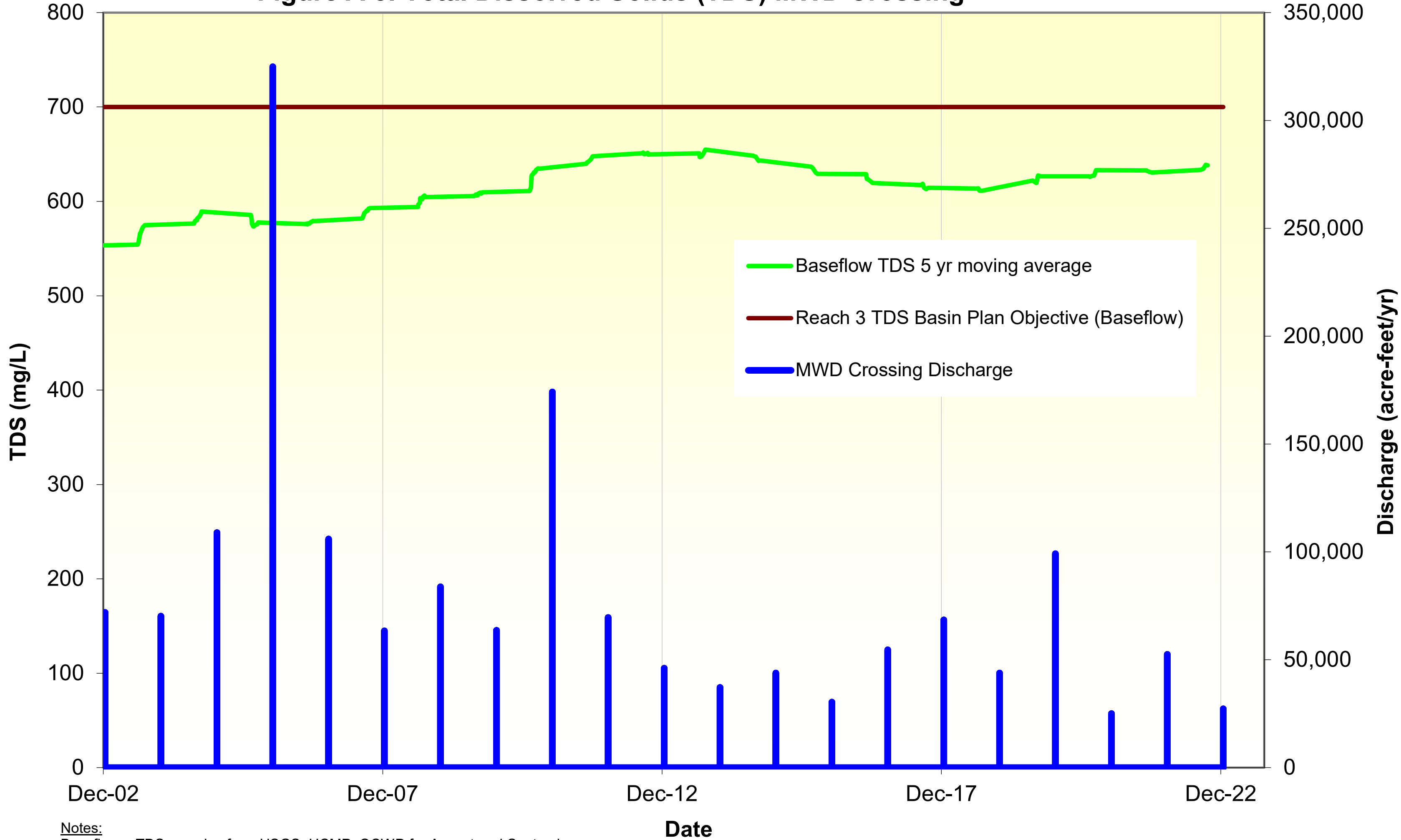
K:\projects\PA-20 Basin Monitoring Prog\2022 SAR WQ Basin Monitoring Report\Figures



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

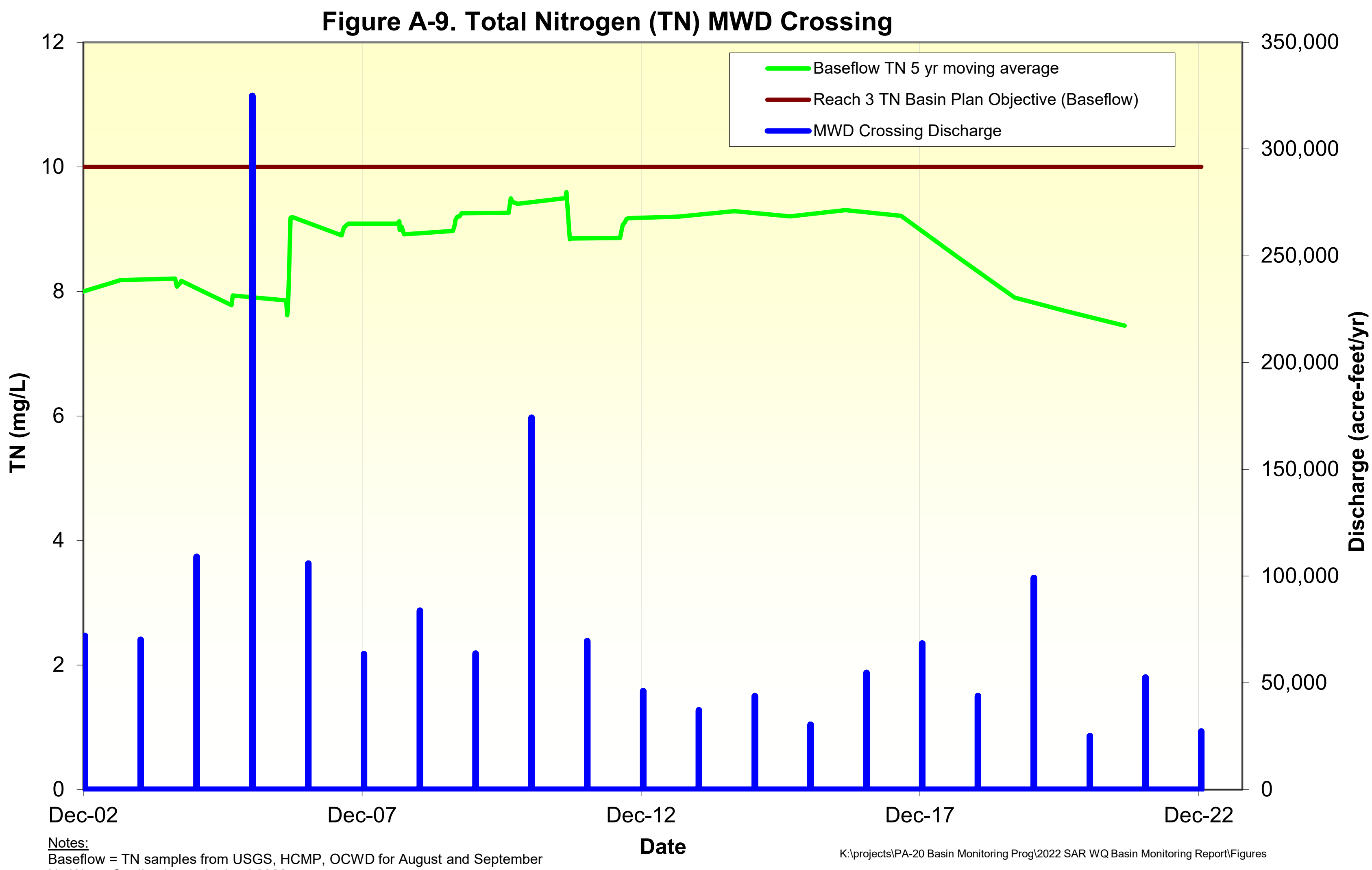
K:\projects\PA-20 Basin Monitoring Prog\2022 SAR WQ Basin Monitoring Report\Figures

Figure A-8. Total Dissolved Solids (TDS) MWD Crossing



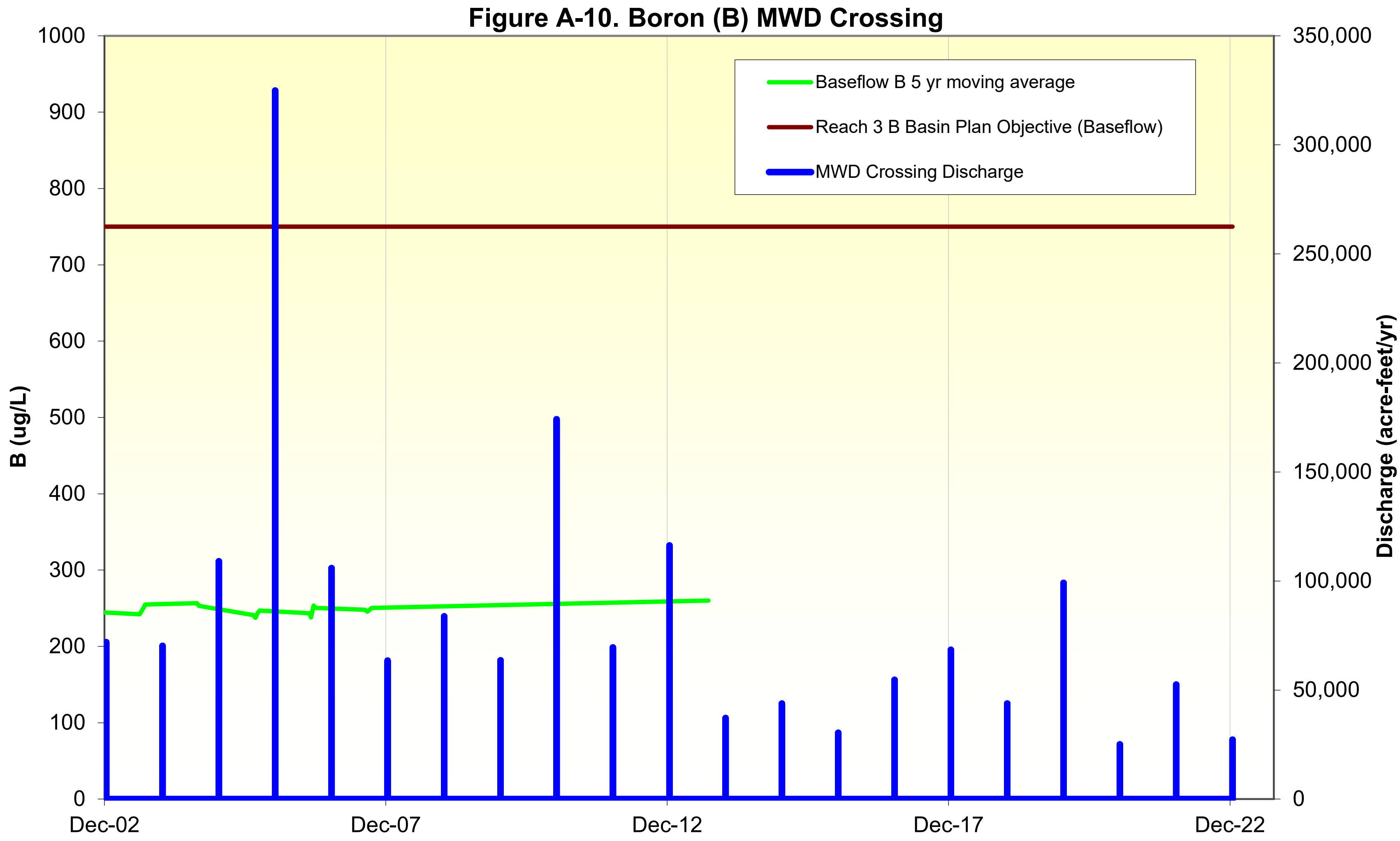
Notes:
Baseflow = TDS samples from USGS, HCMP, OCWD for August and September

K:\projects\PA-20 Basin Monitoring Prog\2022 SAR WQ Basin Monitoring Report\Figures



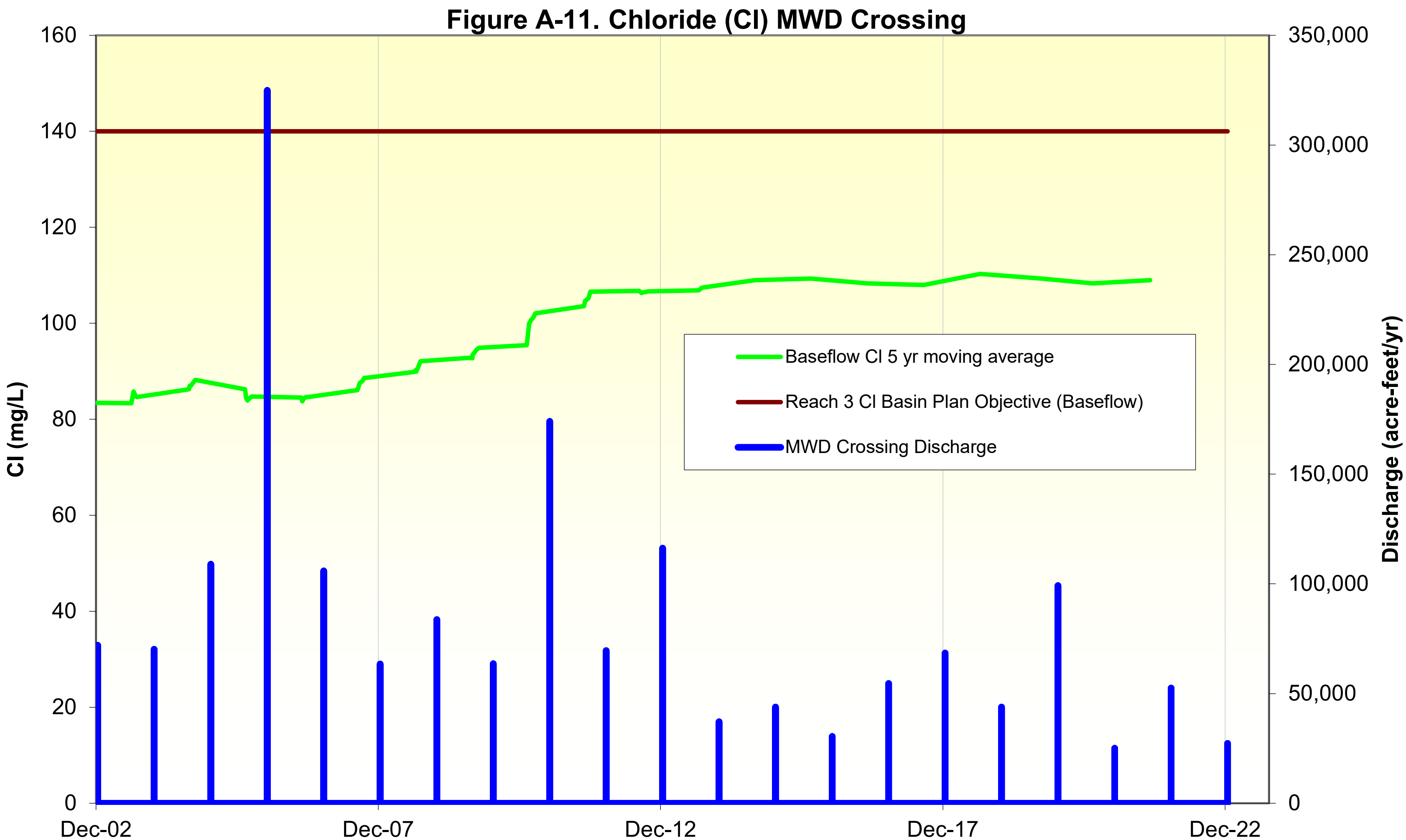
Notes:
Baseflow = TN samples from USGS, HCMP, OCWD for August and September
No Water Quality data submitted 2022

K:\projects\PA-20 Basin Monitoring Prog\2022 SAR WQ Basin Monitoring Report\Figures



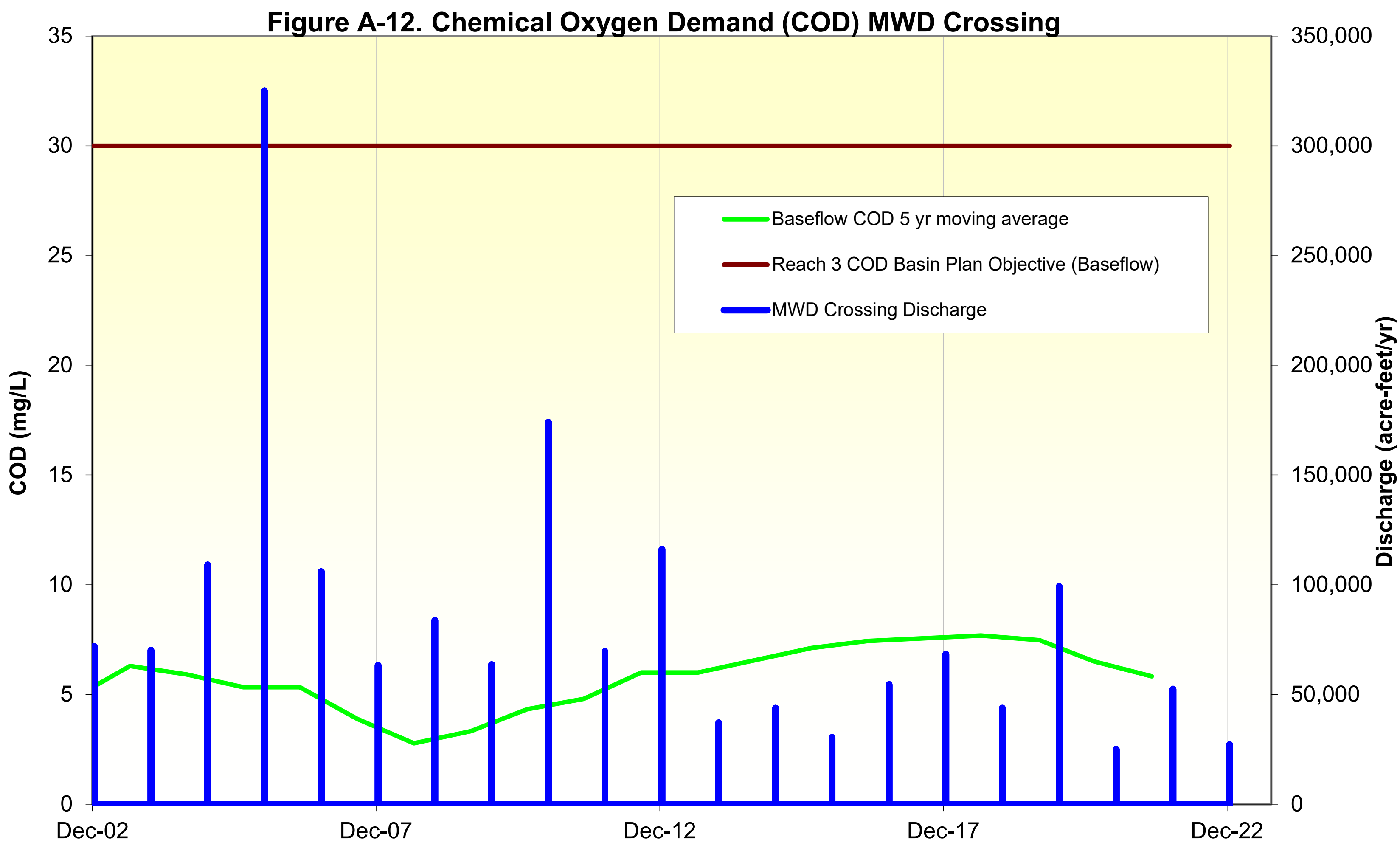
Notes:
No Water Quality data submitted since 2013.

K:\projects\PA-20 Basin Monitoring Prog\2022 SAR WQ Basin Monitoring Report\Figures



Notes:
Baseflow = Cl samples from USGS, HCMP, OCWD for August and September.
No Water Quality data submitted 2022

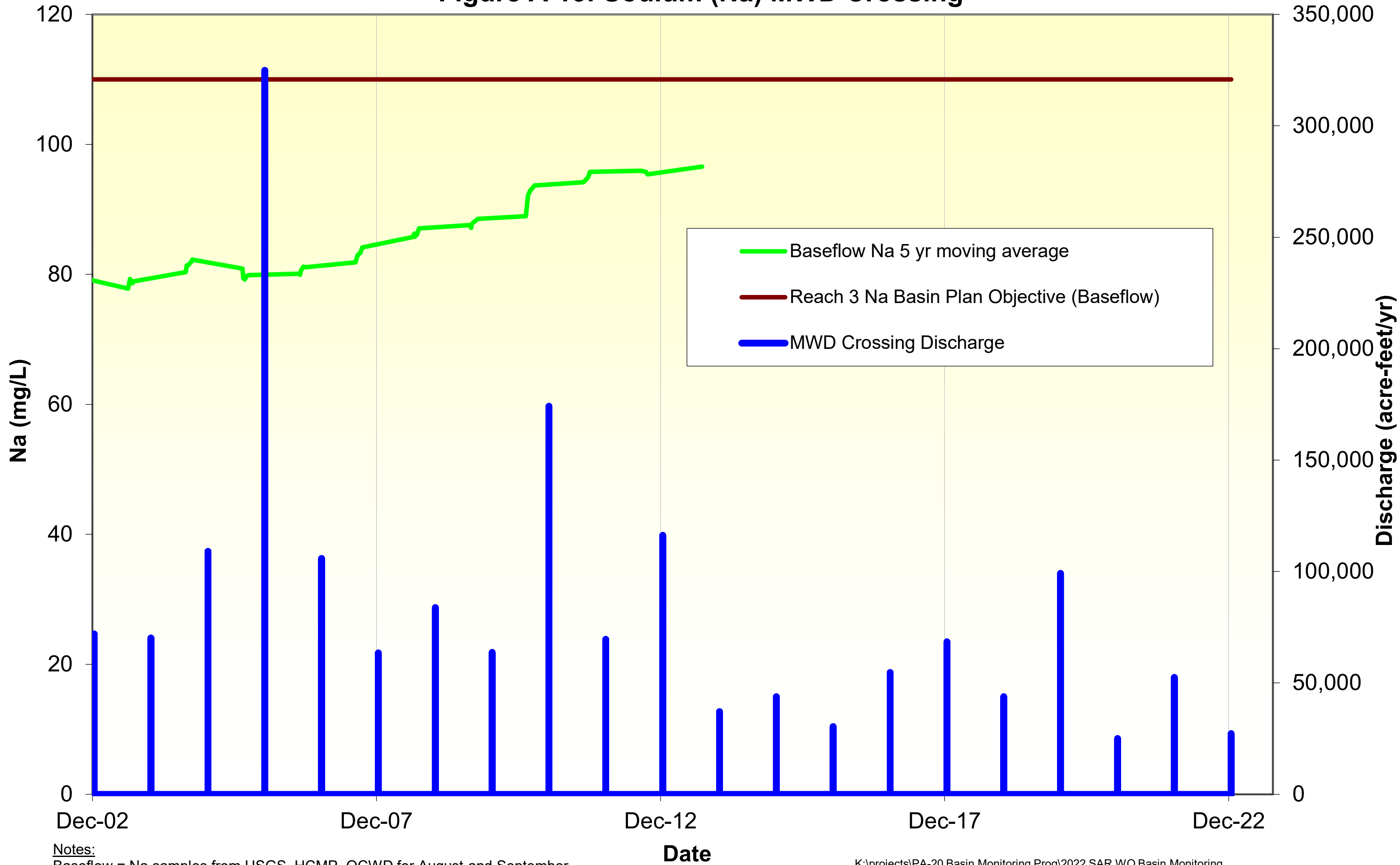
K:\projects\PA-20 Basin Monitoring Prog\2022 SAR WQ Basin Monitoring Report\Figures



Notes:
Baseflow = COD samples from USGS, HCMP, OCWD for August and September.
No Water Quality submitted 2022

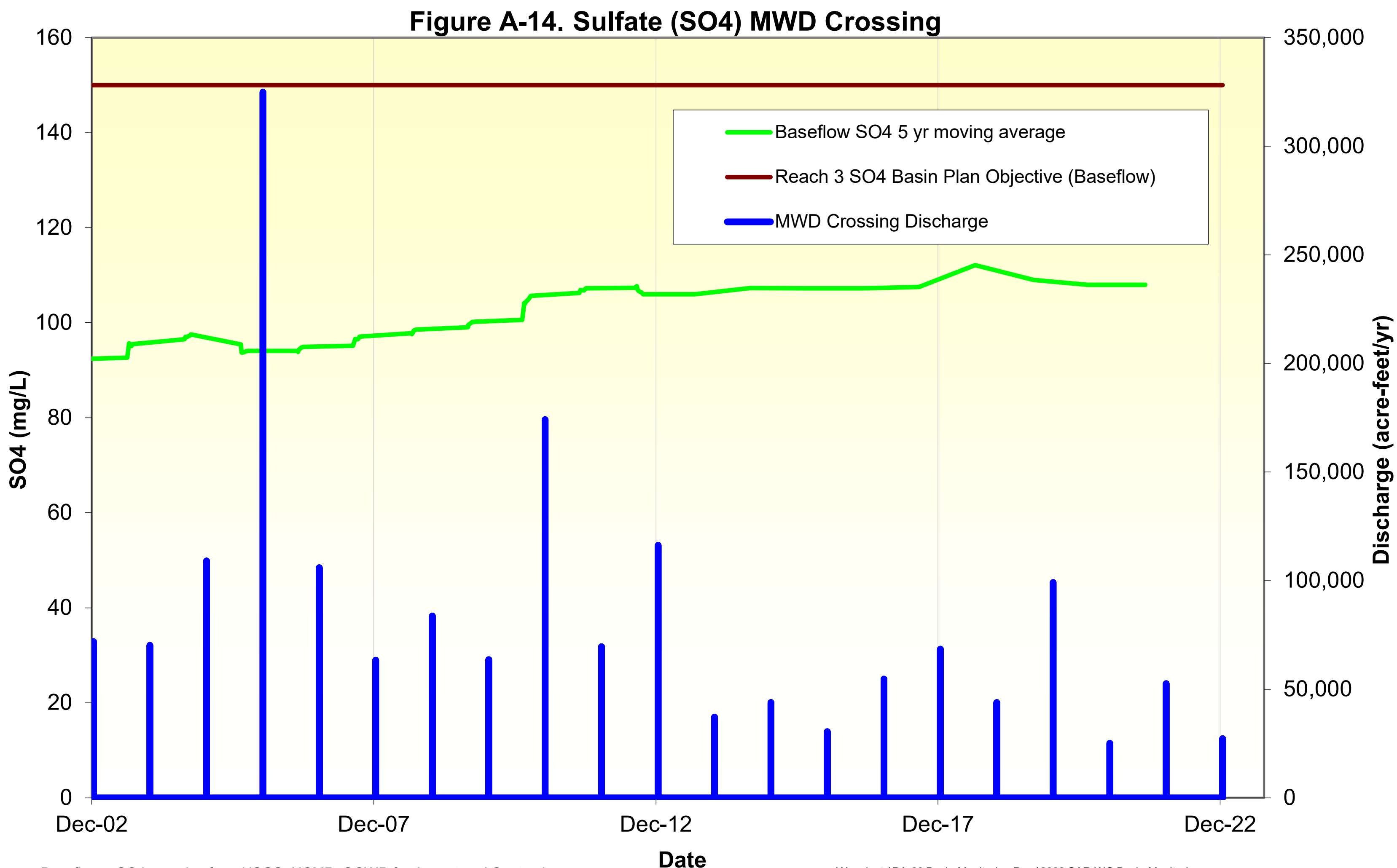
K:\projects\PA-20 Basin Monitoring Prog\2022 SAR WQ Basin Monitoring Report\Figures

Figure A-13. Sodium (Na) MWD Crossing



Notes:
Baseflow = Na samples from USGS, HCMP, OCWD for August and September.
No Water Quality data submitted for 2014 - 2022.

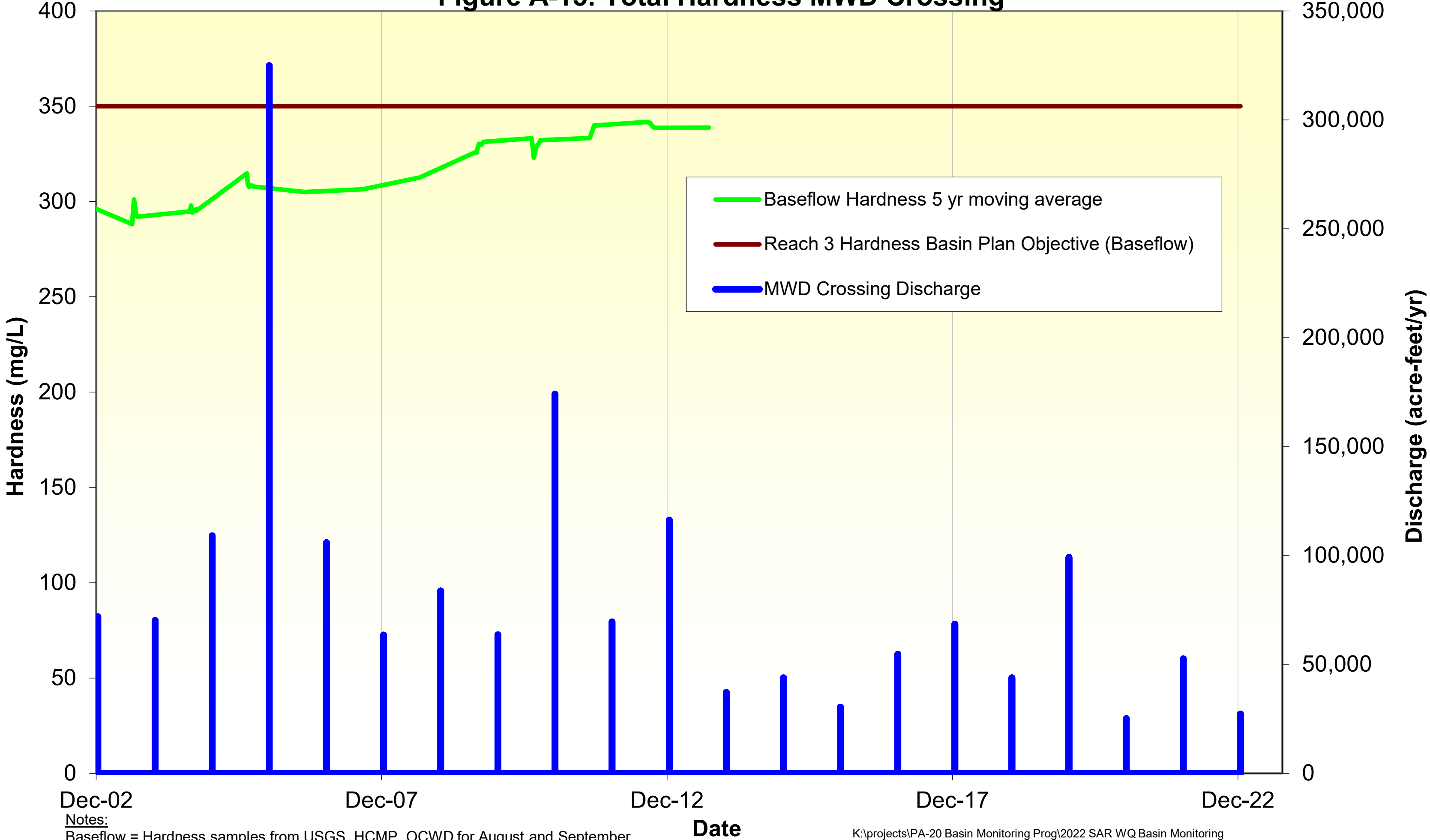
K:\projects\PA-20 Basin Monitoring Prog\2022 SAR WQ Basin Monitoring Report\Figures



Baseflow = SO4 samples from USGS, HCMP, OCWD for August and September.
No Water Quality data submitted 2022

K:\projects\PA-20 Basin Monitoring Prog\2022 SAR WQ Basin Monitoring Report\Figures

Figure A-15. Total Hardness MWD Crossing



Notes:
Baseflow = Hardness samples from USGS, HCMP, OCWD for August and September.
No Water Quality data submitted for 2014 - 2022.

K:\projects\PA-20 Basin Monitoring Prog\2022 SAR WQ Basin Monitoring Report\Figures

Appendix B
All 2022 Water Quality and Flow Data
(Available on the SAWPA Website)