Appendix A

Presentations from the Task Force Workshops on the Development of an Updated Surface Water Monitoring Program

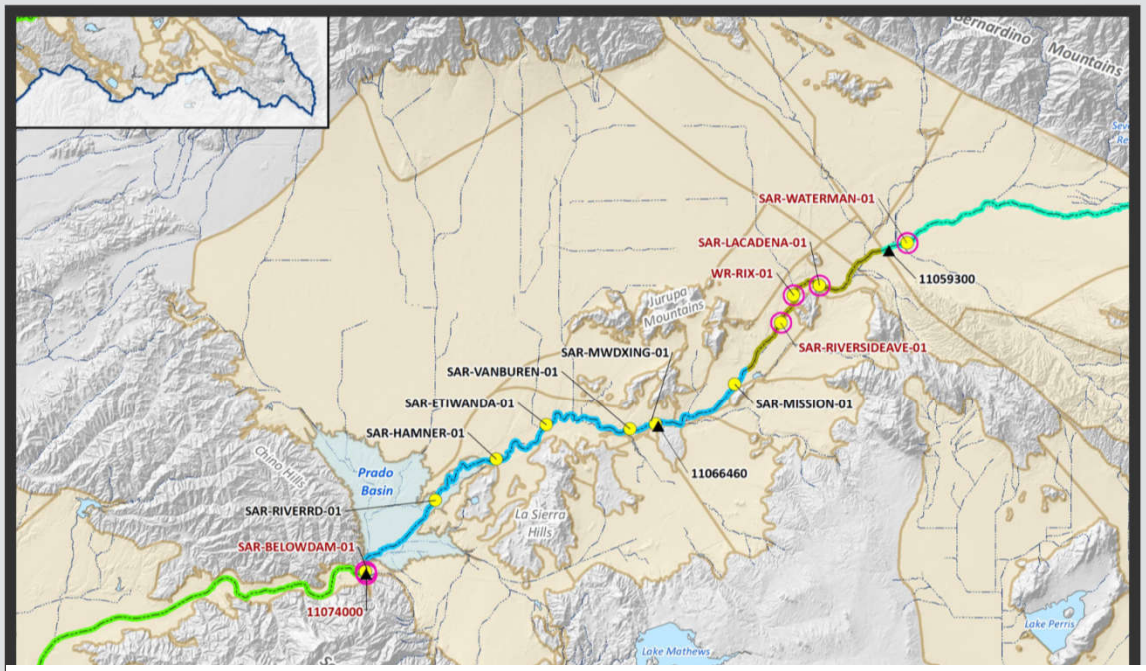
Basin Planning Priorities Task 1 Workshop – Surface Water Monitoring Requirements and Goals for the Santa Ana River Watershed, Part 1

January 27, 2022

WEST YOST

Water. Engineered.

Task 1 – Prepare Updated Surface Water Monitoring Program for TDS/N for Santa Ana Reaches 2, 3, 4, and 5

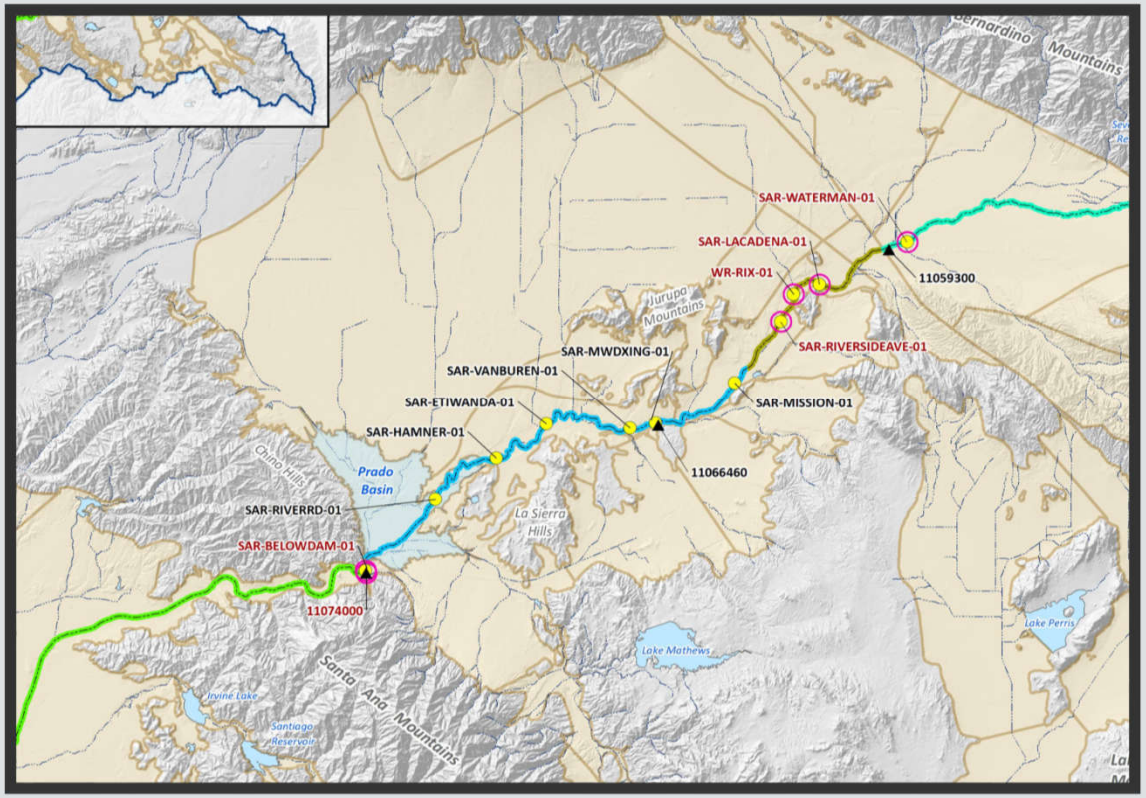


Task Force and SAWPA conduct the surface water monitoring program to collect data to assess compliance with objectives.
→ Annual Reports of SAR Water Quality

Approach - end point in mind → Questions that need to be answered by the surface water monitoring:

- Compliance with objectives
- Collect sufficient data for input/calibration of WLAM

Task 1 – Prepare Updated Surface Water Monitoring Program for TDS/N for Santa Ana Reaches 2, 3, 4, and 5



For each Reach, review:

- SW Objectives
- Metrics for compliance
- Data used
- What is metric protecting
- Data gaps? Uncertainty ?

Feedback on questions related to the monitoring program

Table 1 . Basin Plan Surface Water TDS and TIN Objectives for the Santa Ana River Reaches 2, 3, 4, and 5 and Metrics, Data, and Methods Used to Assess Compliance

Reach	Objective (mgl)		Assessment of Compliance as Specified in the Basin Plan		Assessment of Compliance with Basin Plan Objectives Conducted by the Task Force in the SAWPA Annual Report of Santa Ana River Water Quality	
	TDS	TIN(a)	Compliance Metric	Monitoring Data		
Reach 2	650	--	The "five-year moving average of the annual TDS content of **total flow**"	The SARWM calculates the volume-weighted TDS of total flow annually for the water year - using continuous monitoring of flow and EC, and grab samples by the USGS at Below Prado Dam. "The SARWM's annual determination of **total flow** quality will be used to determine compliance..."	The annual report utilizes two methods to evaluate compliance:	
					1) Based on Basin Plan	1) Average of the last five years of SARWM's annual determination of the flow-weighted TDS at Below Prado Dam for total flow
					2) Alternative	2) 60-month flow-weighted moving average of the TDS concentration of the total flow at Below Prado Dam. This is calculated using continuous monitoring of flow and EC by the USGS, and grab samples by the USGS and others (OCWD, Regional Board, CBWM/IEUA) at Below Prado Dam
Reach 3	700	10(b)	"... grab and composite samples when the influence of storm flows and nontributary flows is at a minimum. This typically occurs during August and September" -Table 4-1 indicates "**Base Flow**"	Regional Board collects grab samples in August and September at Below Prado Dam. "Results can be compared to the continuous monitoring by the USGS and data from other sources"	The annual report utilizes three methods to assess compliance:	
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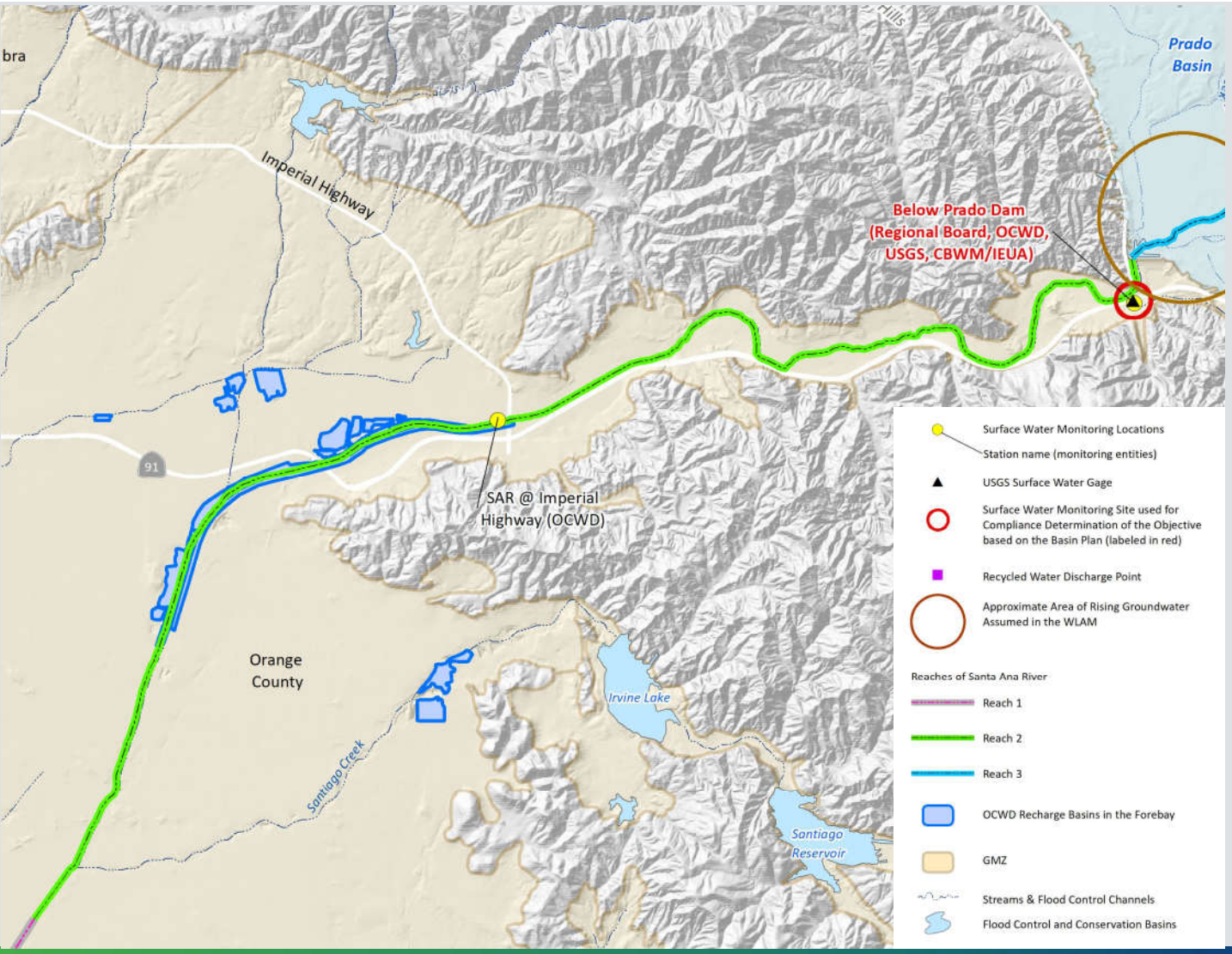
Reach 4	550	10	Undefined	Undefined	Grab sample of **base flow** in August at WR-RIX-01, SAR-RiversideAve-01, SAR-Lacadena-01.	
Reach 5	300	5	Undefined	Undefined	Grab sample of **base flow** in August at SAR-Waterman-01.	



Reach 2

Surface Water Objectives:

TDS = 650 mgl TIN = n/a

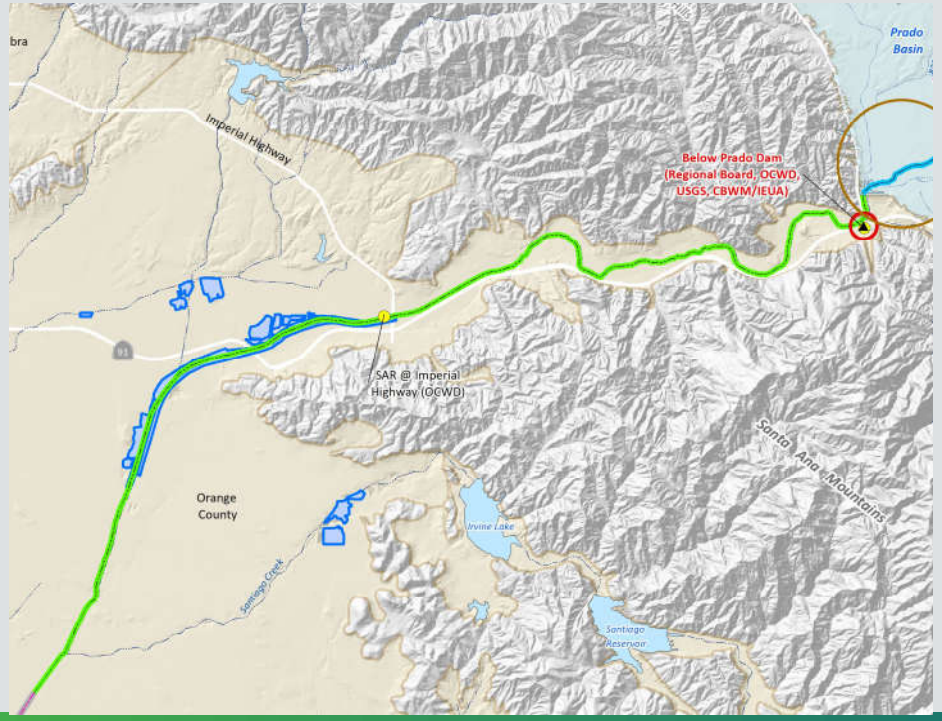
Basin Plan Metric/Data:

Compliance for "*Reach 2 will be based on the five-year moving average of the annual TDS content of total flow*."

"*The Watermaster's* [SARWM] *annual determination of total flow quality [at Prado] will be used to determine compliance with the total flow objective…*"

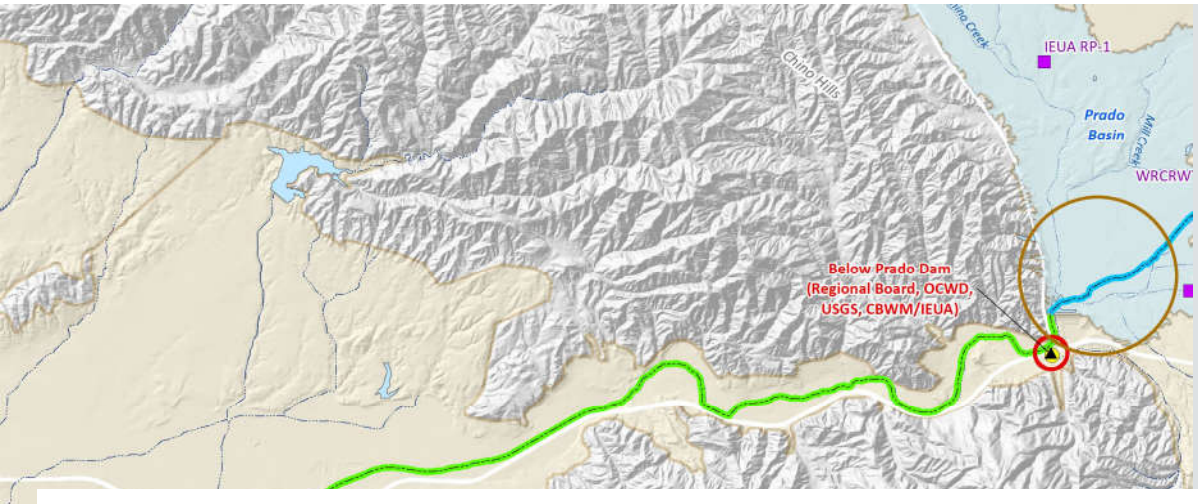
Reach 2 - What does the Surface Water Objective Protect?

- **Protective of** recharge in Orange County GMZ



Basin Plan , Page 4-28:
"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."

Question to be answered by the surface water monitoring data to compare to the Reach 2 objective: What is the flow-weighted quality of the Santa Ana River at Prado Dam



Assessment of Compliance with Surface Water Objective in Reach 2

Reach	Objective (mg/l)		Assessment of Compliance as Specified in the Basin Plan		Assessment of Compliance with Basin Plan Objectives Conducted by the Task Force in the SAWPA Annual Report of Santa Ana River Water Quality	
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Five-year average of the SARWM Annual TDS for Total Flow (Basin Plan Method)

SARWM Annual Calculation of Volume-Weighted TDS for Total Flow:

WATER QUALITY SAMPLES BELOW PRADO
WATER YEAR 2018-19

Date	TDS (mg/L)	EC (um/cm)	TDS/EC Ratio
10/9/2018	679	1120	0.6063
10/12/2018	672	1130	0.5947
10/24/2018	713	1180	0.6042
11/14/2018	706	1190	0.5933
11/14/2018	719	1180	0.6093
11/27/2018	654	1120	0.5839
12/7/2018		423	0.0000
12/19/2018	434	742	0.5849
12/19/2018	417	703	0.5932
1/30/2019	285	478	0.5962
1/30/2019	284	480	0.5917
1/31/2019	285	488	0.5840
2/7/2019	264	454	0.5815
2/12/2019	288	490	0.5878
2/26/2019	396	655	0.6046
2/28/2019	450	745	0.6040
3/4/2019	305	530	0.5755
3/14/2019	486	807	0.6022
3/19/2019	469	812	0.5776
3/25/2019	536	895	0.5989
4/1/2019	472	809	0.5834

Average TDS/EC Ratio = 0.5978

SUMMARY OF FLOW-WEIGHTED TDS BELOW PRADO DAM
WATER YEAR 2018-19

October 2018

Day	Prado Outflow (cfs)	Daily Mean EC (microsiemens/cm)	Computed TDS [1]	Outflow X TDS
1	84	1,130	676	56,716
2	83	1,100	658	54,746
3	81	1,110	664	53,518
4	100	1,090	652	65,200
5	91	1,070	640	58,112
6	80	1,100	658	52,443
7	77	1,130	676	52,187
8	81	1,140		55,229
23	169	1,170		118,131
24	164	1,200	717	117,588
25	150		693	103,950
26	119		676	79,768
27	110		681	74,910
28	109	1,140	681	74,229
29		1,100	658	75,670
30		1,090	652	74,980
31		1,090	652	72,372
	3,529			2,252,132

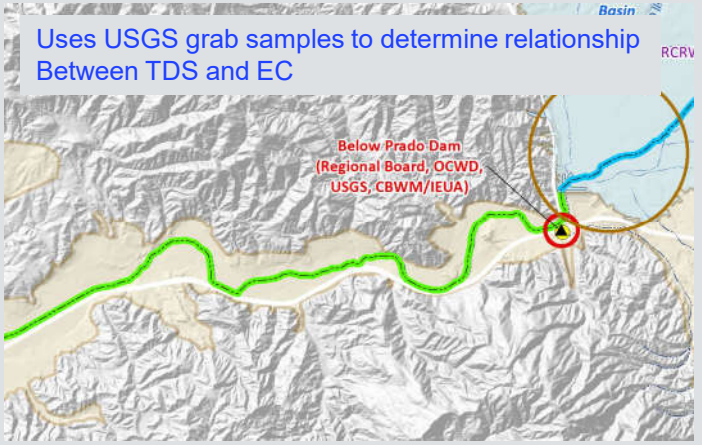
Monthly Flow-weighted TDS = 638 mg/L

[1] TDS = EC x 0.5978

Relationship used to calculate daily TDS from EC

WY 2019 Annual Flow-weighted TDS = 401 mgl

Uses USGS grab samples to determine relationship Between TDS and EC



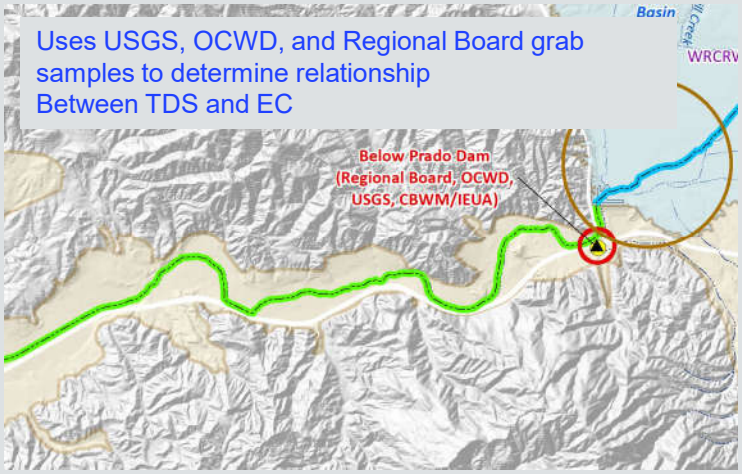
Five-Year Avg of SARWM Annual TDS in SAWPA 2019 Annual Report, Table 3-1:

Water Year Ending[A]	Yearly Flow-weighted TDS (mg/L)
2015	522
2016	560[B]
2017	408
2018	625
2019	401
5 Year Average	503

Note: [A] Santa Ana River Watermaster data reported for FY 2018-19 water year
[B] FY 2015-16 water year data adjusted from 541 mg/L to remove the influence of non-tributary water transfer flow from OC59.

2019 5-Year Avg of Flow-weighted TDS = 503 mgl

60-Month Volume-Weighted TDS for Total Flow (Alternative Method)



Graphically plot USGS, OCWD, and Regional Board samples for the year → linear regression of TDS versus EC yielded the following equation (in 2019):

$$TDS = (EC \times 0.6028) + 1.7288$$
$$R^2 = 0.95$$

60-month Volume-Weighted Avg in SAWPA 2019 Annual Report:

Table 3-2. Monthly Volume-Weighted Moving Average TDS at Below Prado Dam (2019 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-15[1]	8,443	558	4,713,608
Feb-15[1]	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[1]	2,031	658	1,335,858
Jul-15[1]	3,114	553	1,722,216
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[2]	11,236	531	5,963,072
May-19	11,137	566	6,298,555
Jun-19[2]	3,572	680	2,428,738
Jul-19		661	1,934,719
Aug-19		672	1,668,363
	2,601	685	1,780,391
	2,517	674	1,696,256
Nov-19[2]	3,468	591	2,049,773
Dec-19	12,047	341	4,111,578
Total	**369,679**		**174,909,232**
	60 - Month Volume Weighted Average:	**473 mg/L**	

Note: [1]Denotes monthly results with missing EC readings due to instrumentation issues with USGS equipment
Monthly Flow weight
[2]Denotes monthly result
ilable EC data was

Relationship used to calculate daily TDS from EC for 2019

2019 60-month Flow-weighted TDS = 473 mgl

Reach 2 Compliance – Basin Plan Method versus Alternative Method

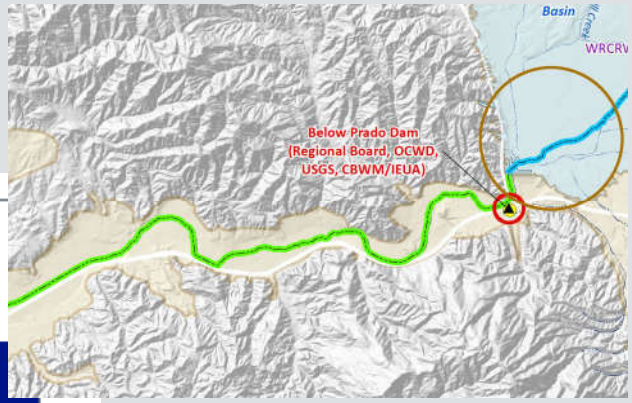


Table 2. Difference between the Two Methods used to Calculate the Five-year Volume-Weighted TDS Concentration at Below Prado Dam for Reach 2

Method	Year Type	Source of Grab Sample Data Used to Calculate a TDS and EC Relationship	Type of Calculation used to Determine Relationship between TDS and EC, to calculate a daily TDS	Calculation Type
Described in the Basin Plan	Water Year	USGS	Average Ratio	Arithmetic Mean of five different annual volume-weighted averages
Alternative	Calendar Year	USGS, OCWD, Regional Board	Linear Regression Model	Five-year (60-month) volume-weighted average

→ **2019 = 503 mgl**

→ **2019 = 473 mgl**

Reach 2

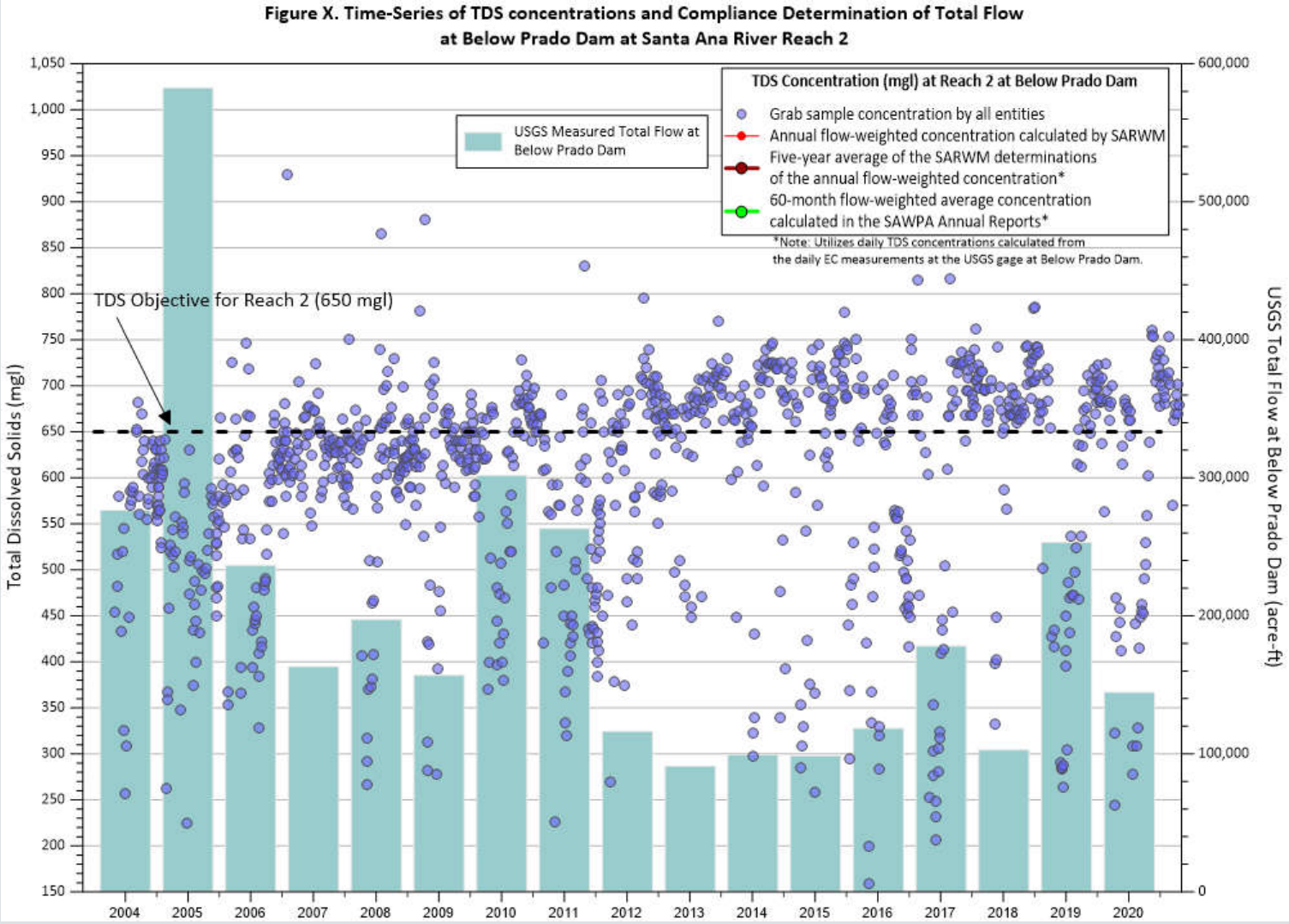


Figure X. Time-Series of TDS concentrations and Compliance Determination of Total Flow at Below Prado Dam at Santa Ana River Reach 2
TDS Concentration (mgl) at Reach 2 at Below Prado Dam
Grab sample concentration by all entities
Annual flow-weighted concentration calculated by SARWM
Five-year average of the SARWM determinations of the annual flow-weighted concentration*
60-month flow-weighted average concentration calculated in the SAWPA Annual Reports*
*Note: Utilizes daily TDS concentrations calculated from the daily EC measurements at the USGS gage at Below Prado Dam.
USGS Measured Total Flow at Below Prado Dam
TDS Objective for Reach 2 (650 mgl)
Total Dissolved Solids (mgl)
USGS Total Flow at Below Prado Dam (acre-ft)
1,050
1,000
950
900
850
800
750
700
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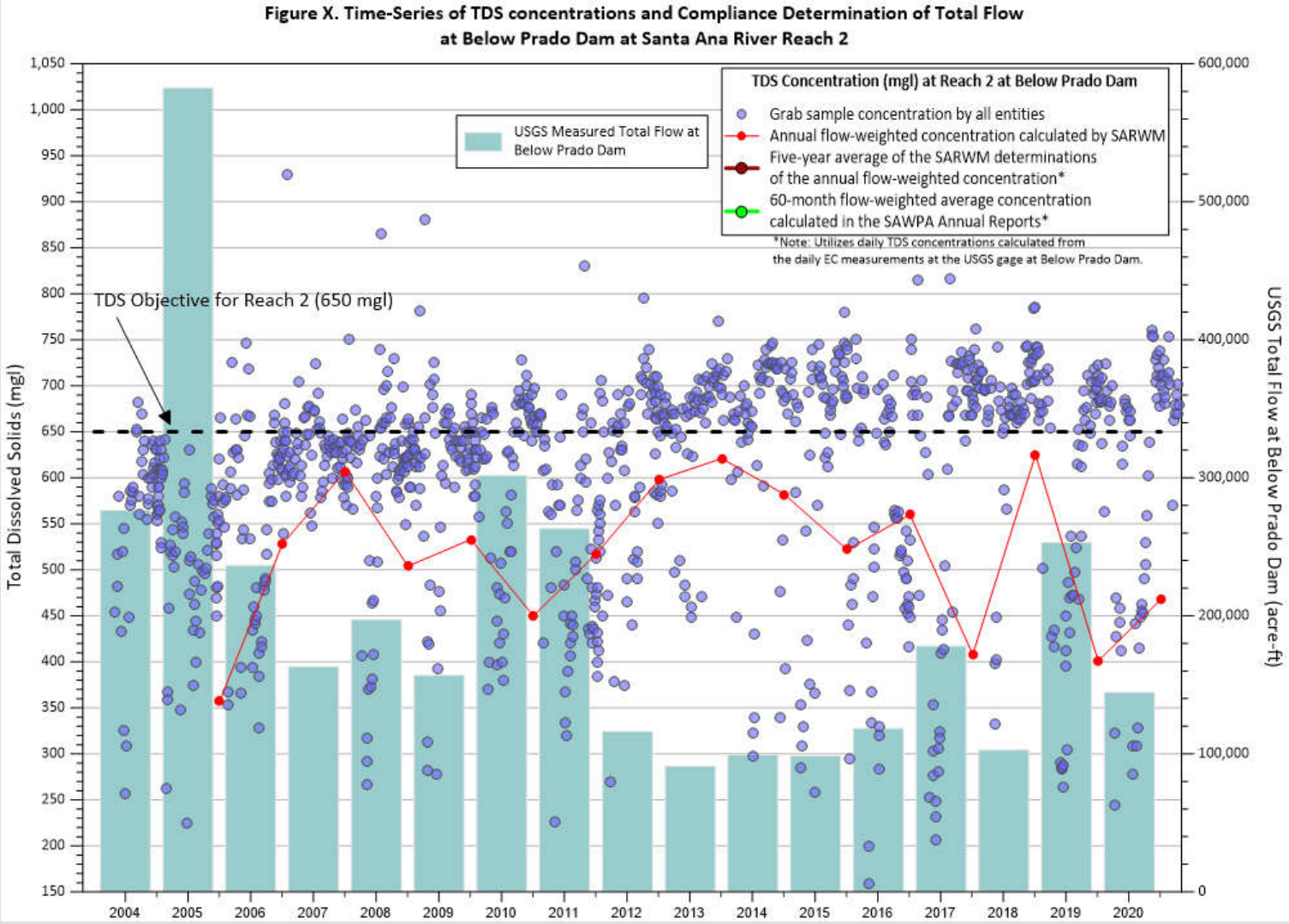
Reach 2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TDS Concentration (mgl) at Reach 2 at Below Prado Dam
Grab sample concentration by all entities
Annual flow-weighted concentration calculated by SARWM
Five-year average of the SARWM determinations of the annual flow-weighted concentration*
60-month flow-weighted average concentration calculated in the SAWPA Annual Reports*
*Note: Utilizes daily TDS concentrations calculated from the daily EC measurements at the USGS gage at Below Prado Dam.
USGS Measured Total Flow at Below Prado Dam
TDS Objective for Reach 2 (650 mgl)
Total Dissolved Solids (mgl)
USGS Total Flow at Below Prado Dam (acre-ft)
1,050
1,000
950
900
850
800
750
700
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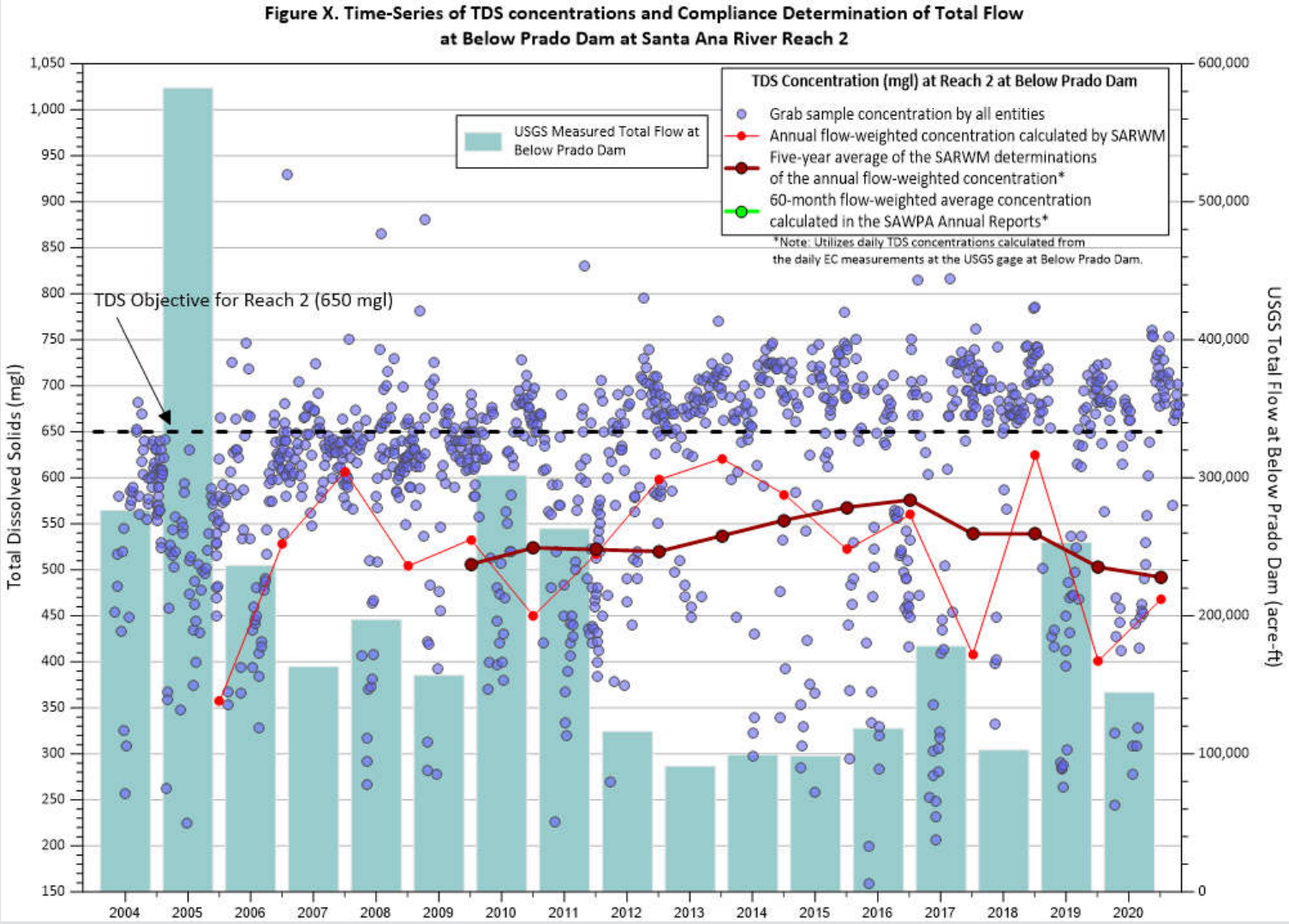
Reach 2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USGS Measured Total Flow at Below Prado Dam
TDS Objective for Reach 2 (650 mgl)
Total Dissolved Solids (mgl)
USGS Total Flow at Below Prado Dam (acre-ft)
1,050
1,000
950
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850
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750
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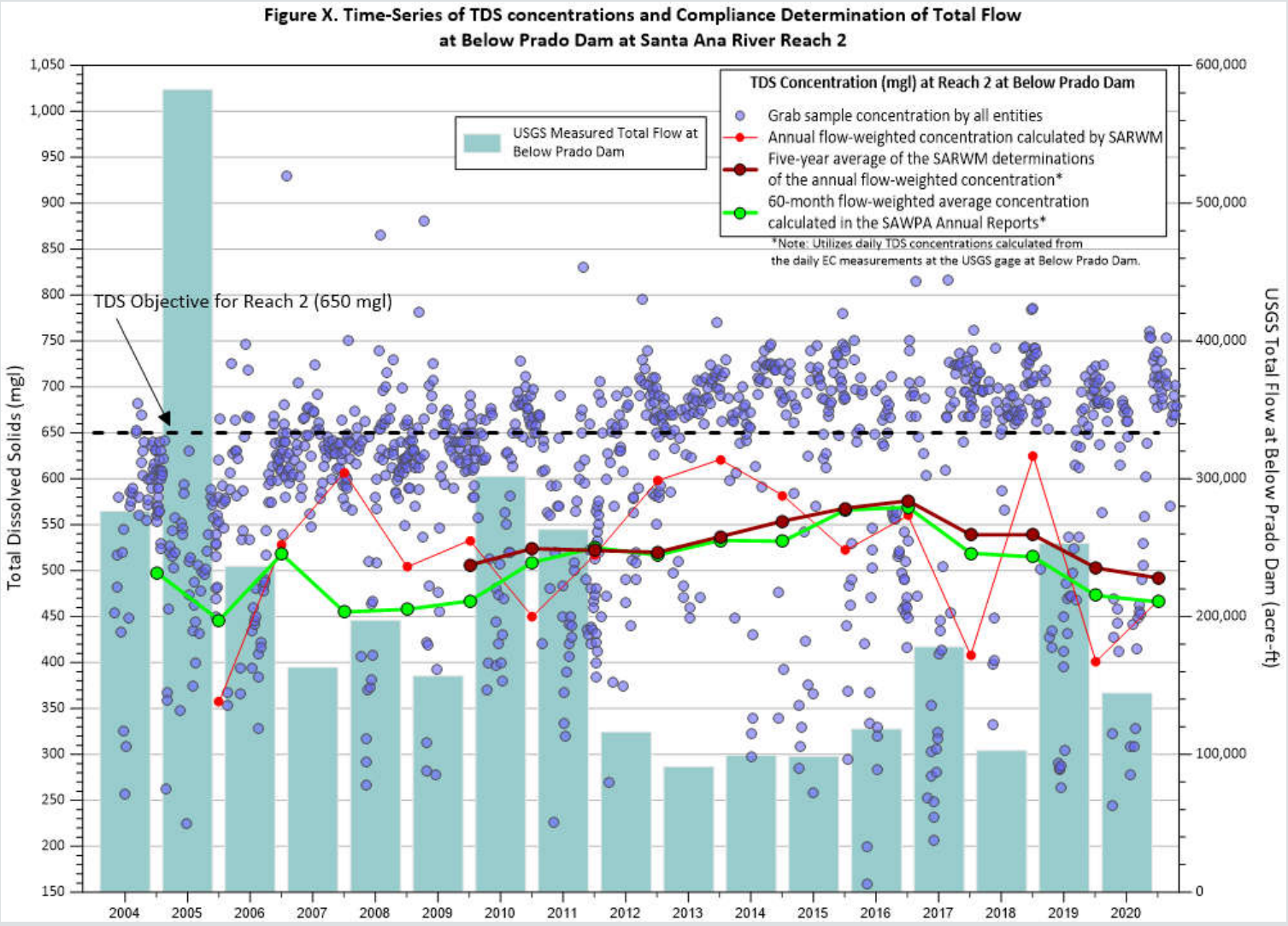
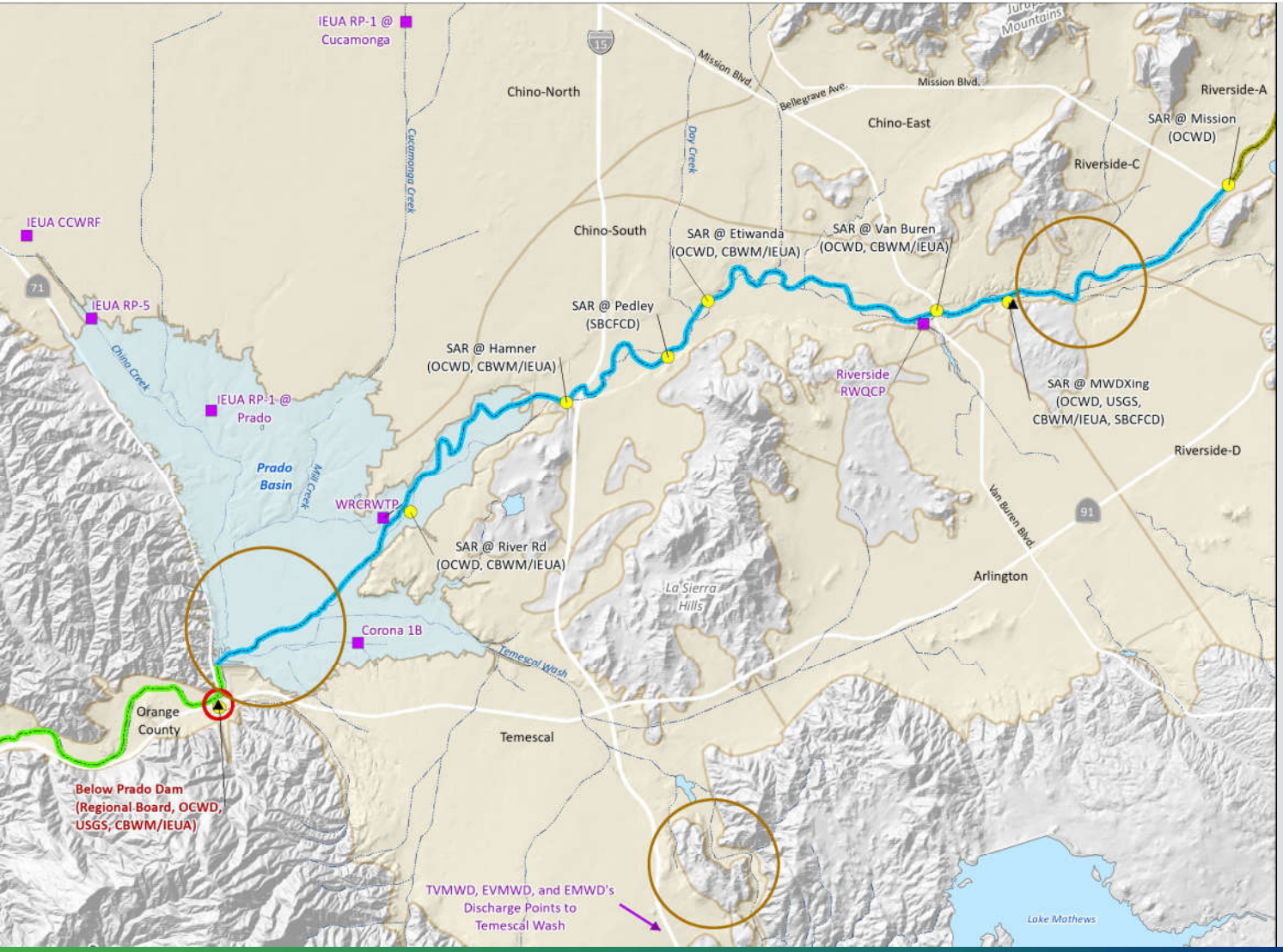


Reach 2 Questions

- **Is the data collected enough to competently assess compliance with Reach 2 TDS objective?**
- **Do you see any gaps in the data to understand the quality in Reach 2 ?**

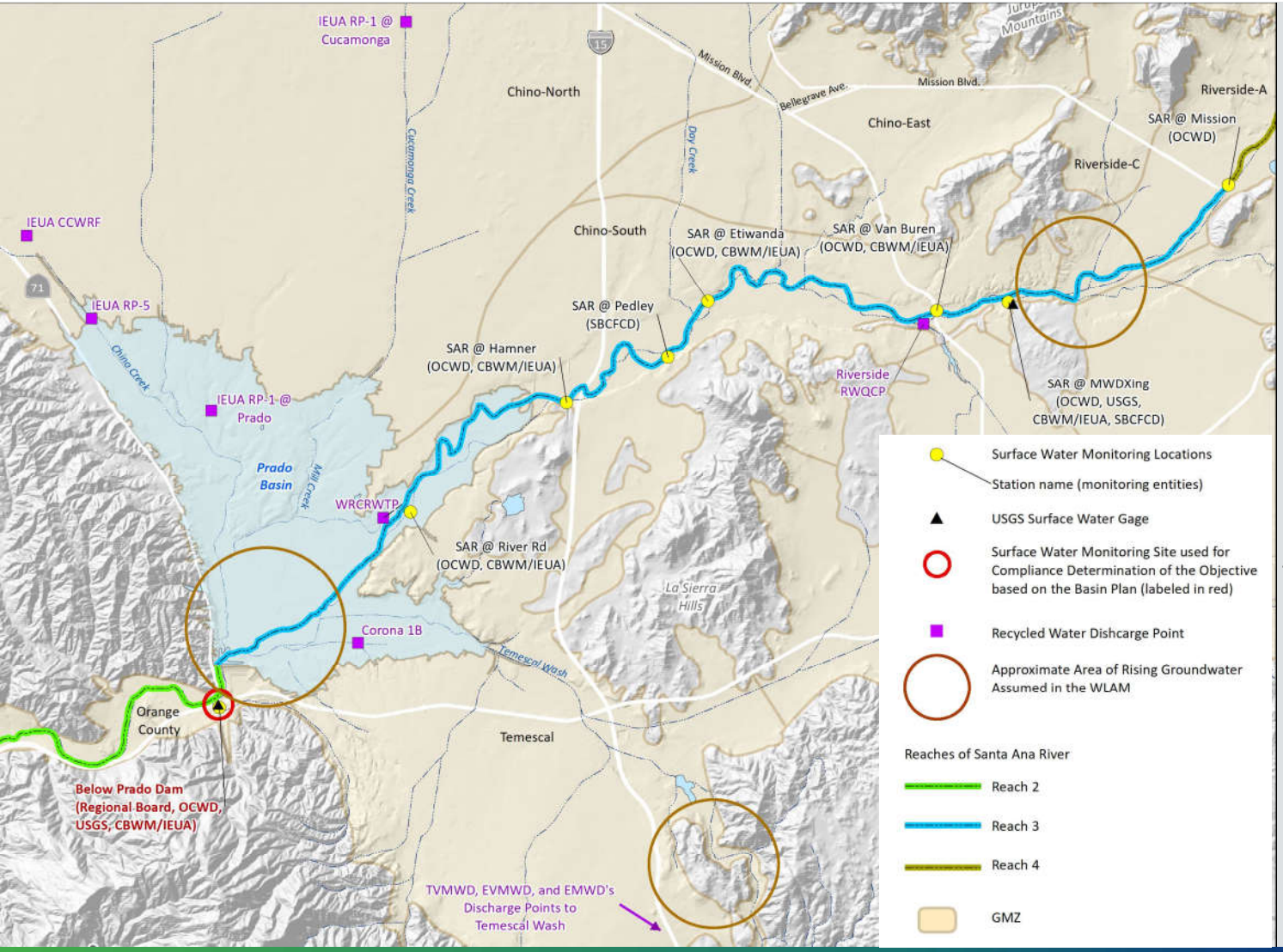
Reach 3



- Surface Water Monitoring Locations
  - Station name (monitoring entities)
- USGS Surface Water Gage
- Surface Water Monitoring Site used for Compliance Determination of the Objective based on the Basin Plan (labeled in red)
- Recycled Water Dishcarge Point
- Approximate Area of Rising Groundwater Assumed in the WLAM

Reaches of Santa Ana River

- Reach 2
- Reach 3
- Reach 4
- GMZ



Reach 3

Surface Water Objectives:

TDS = 700 mgl TIN = 10 mgl *

- Total nitrogen, filtered sample

Basin Plan Metric/Data:

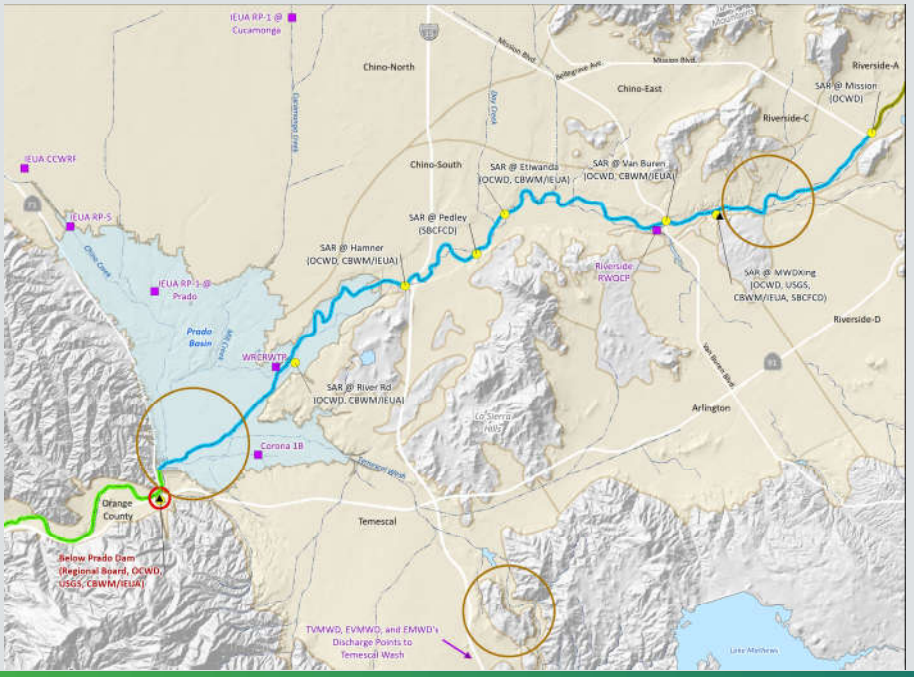
"Regional Board will collect a series of *grab and composite samples when the influence of storm flows and nontributary flows is at a minimum [baseflow]*. This typically occurs during August and September*"

"Results can be compared to the continuous monitoring by the USGS and data from other sources"

*Baseflow in Basin Plan = POTW discharge, rising groundwater, and dry weather runoff

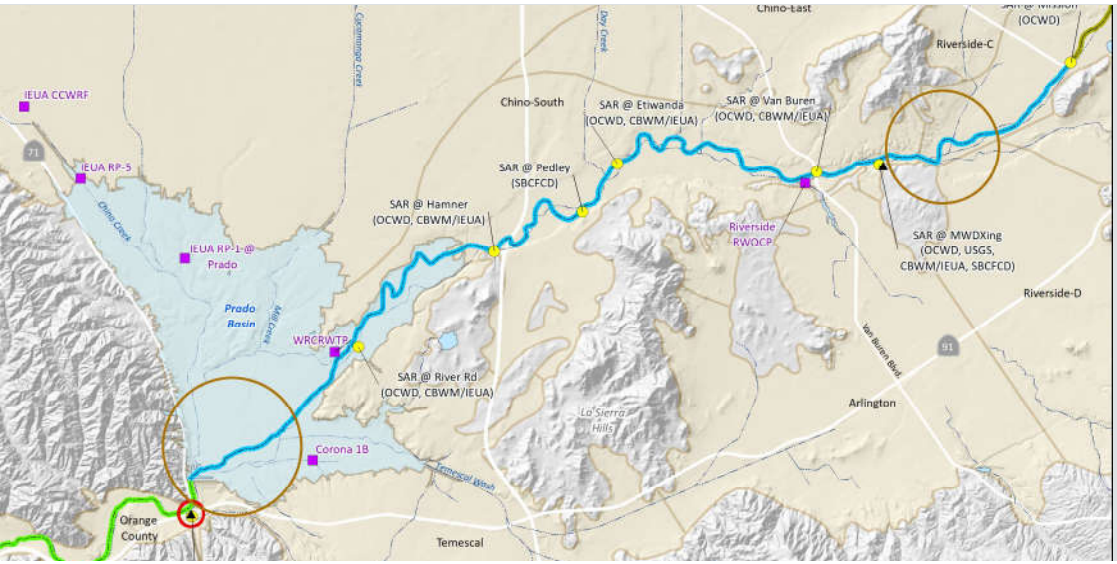
Reach 3 - What does the Surface Water Objective Protect?

- **Protective of** beneficial uses in Orange County GMZ



Basin Plan , Page 5-15:
"Baseflow generally provides 70% or more of the water recharged in the Orange County GMZ. In wet years…. (40%)… Therefore, to protect Orange County groundwater, it is essential to control the quality of the baseflow. To do so, baseflow TDS and nitrogen objectives are specified in this Plan for Reach 3 of the River."

Question to be answered by the surface water monitoring data to compare to the objective:
What is the quality of the baseflow in Reach 3, flowing into Reach 2?



Assessment of Compliance with Surface Water Objective in Reach 3

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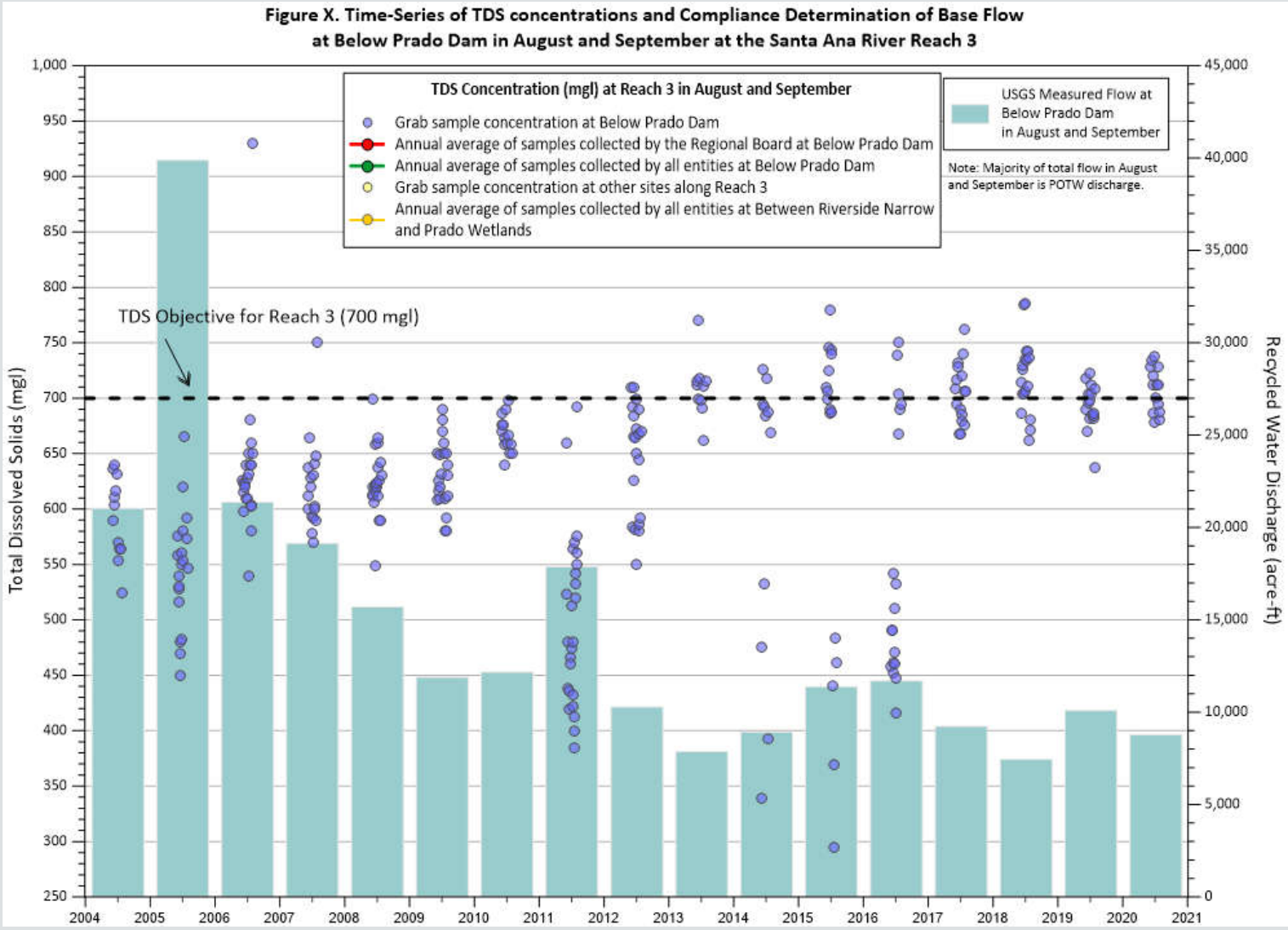

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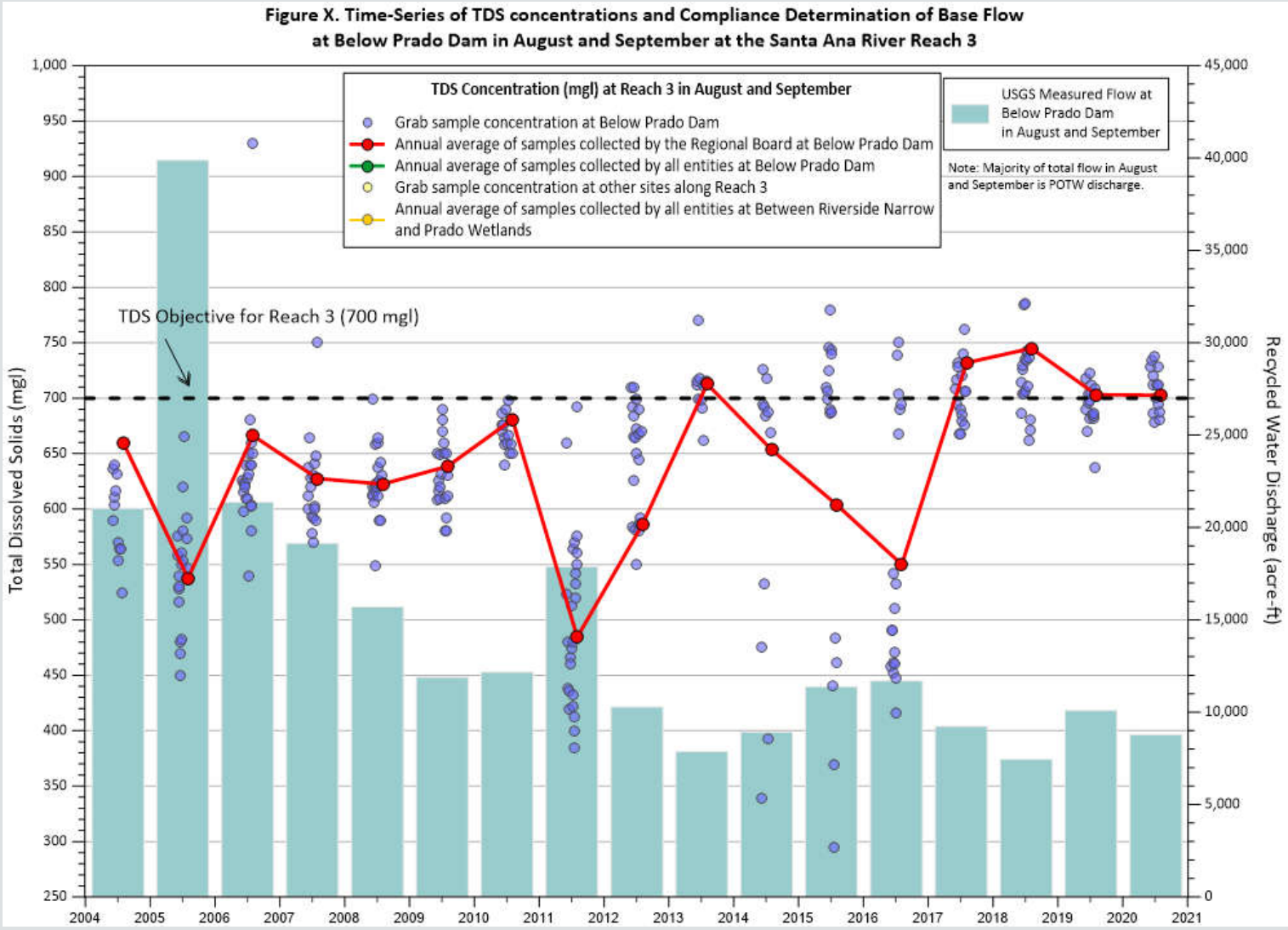

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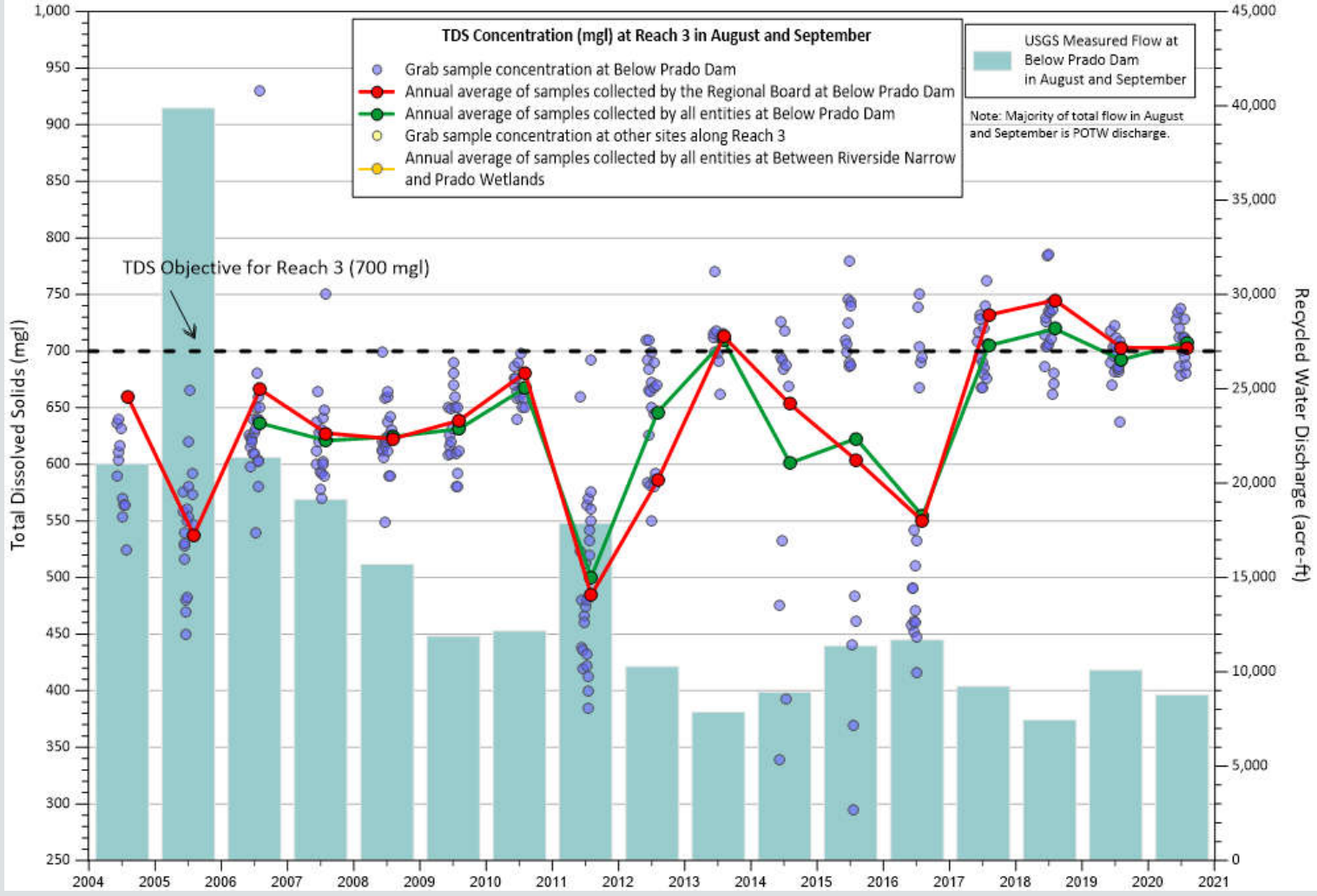

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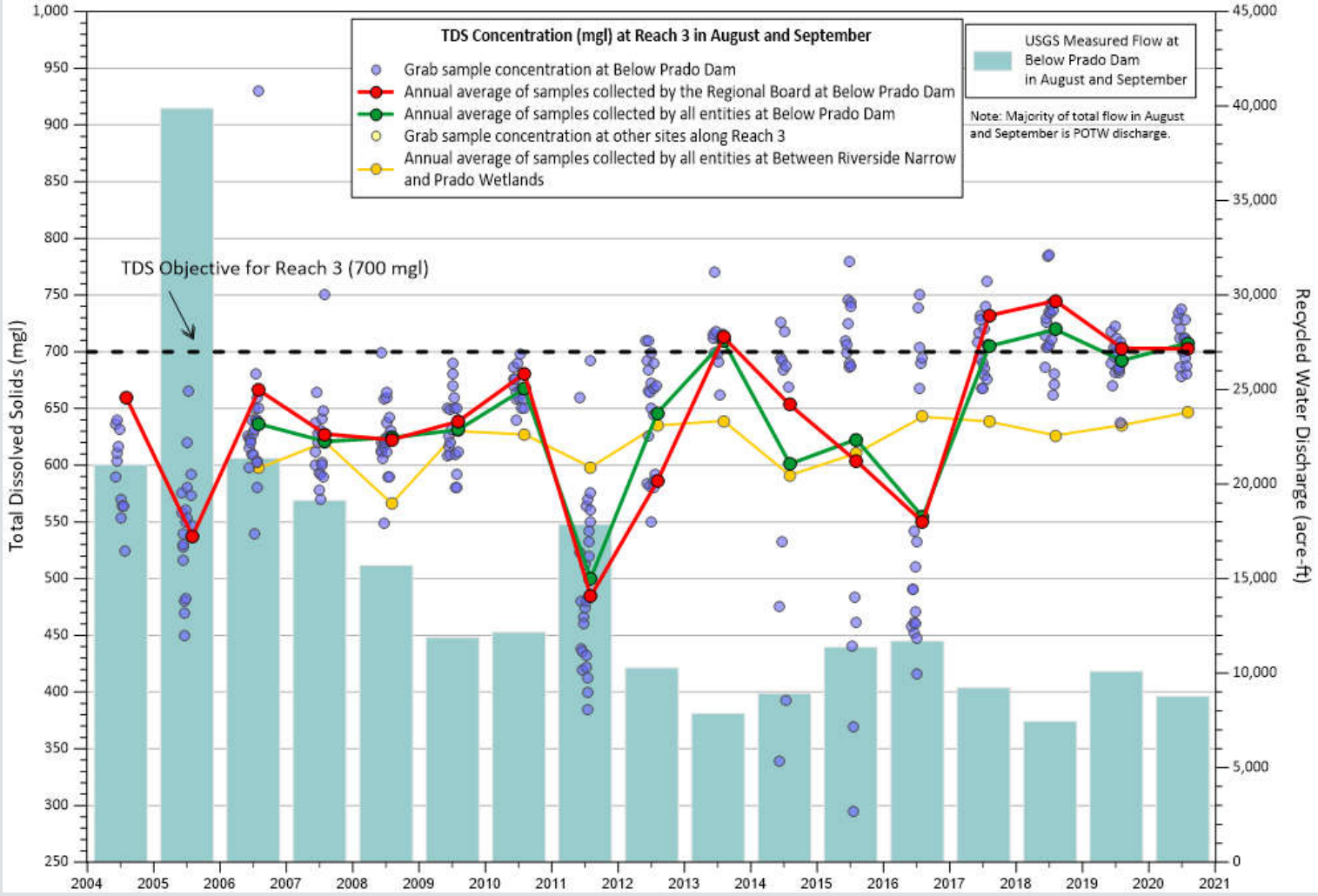

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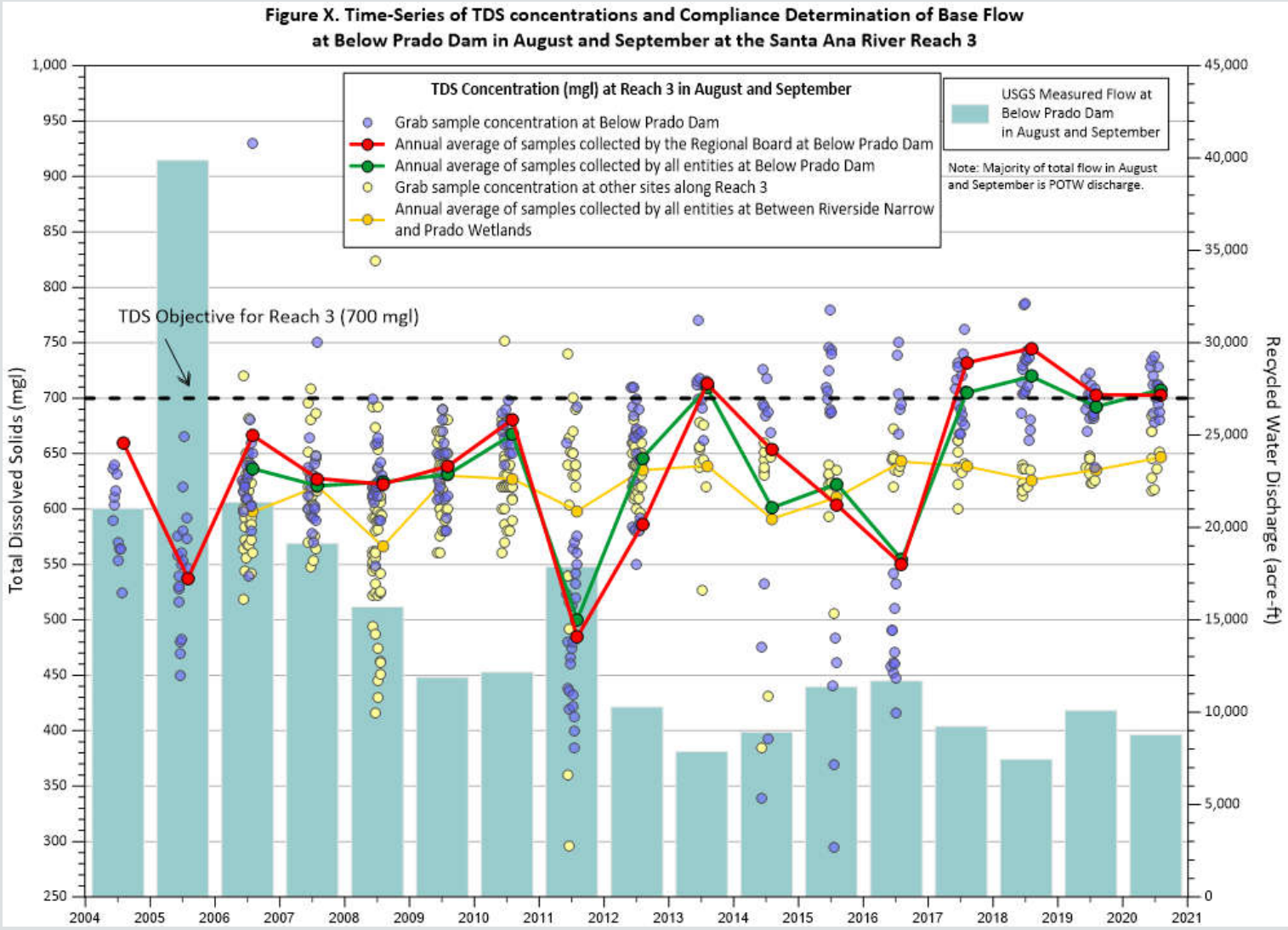


Figure X. Time-Series of TN concentrations and Compliance Determination of Base Flow at Below Prado Dam in August and September at the Santa Ana River Reach 3

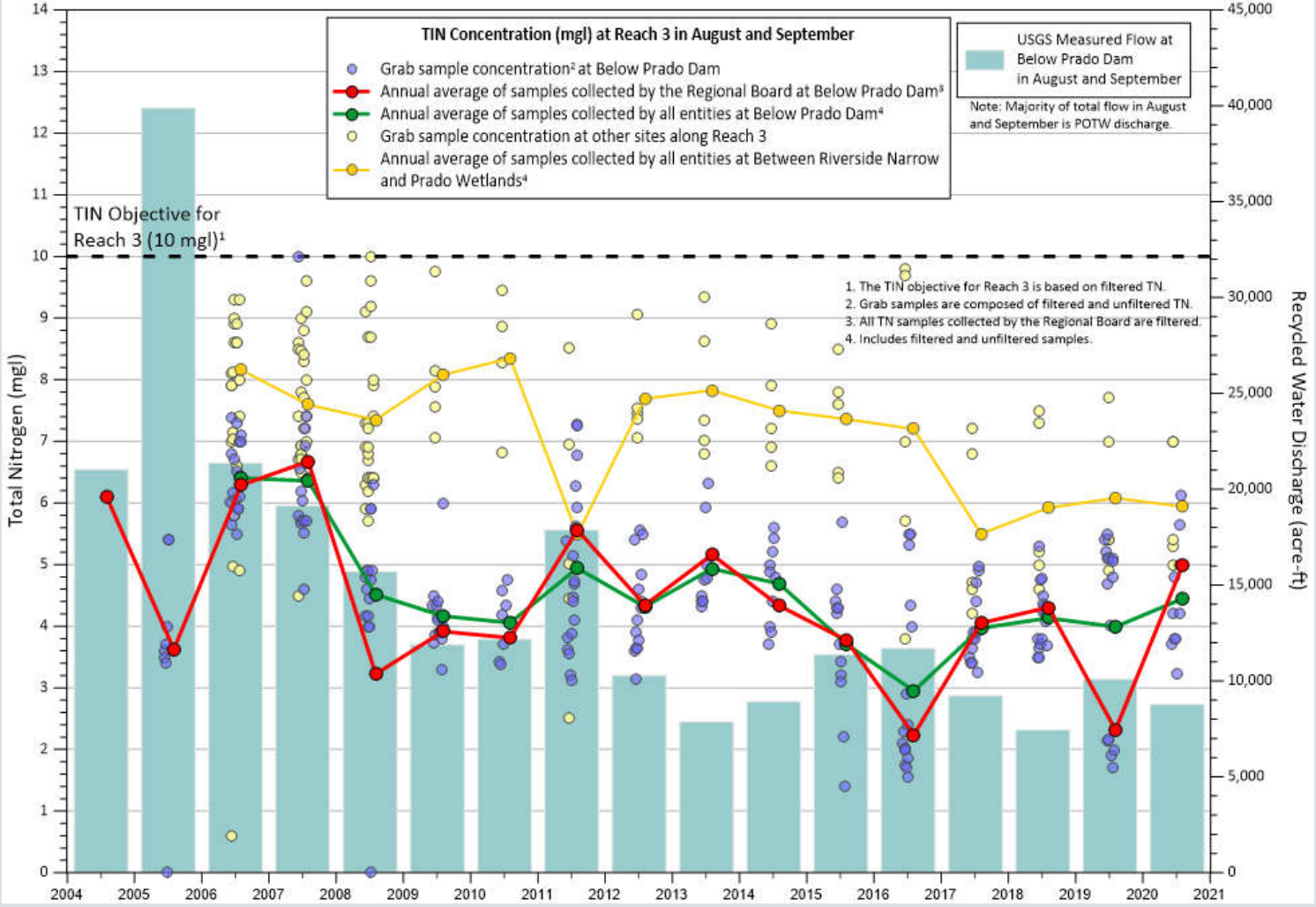
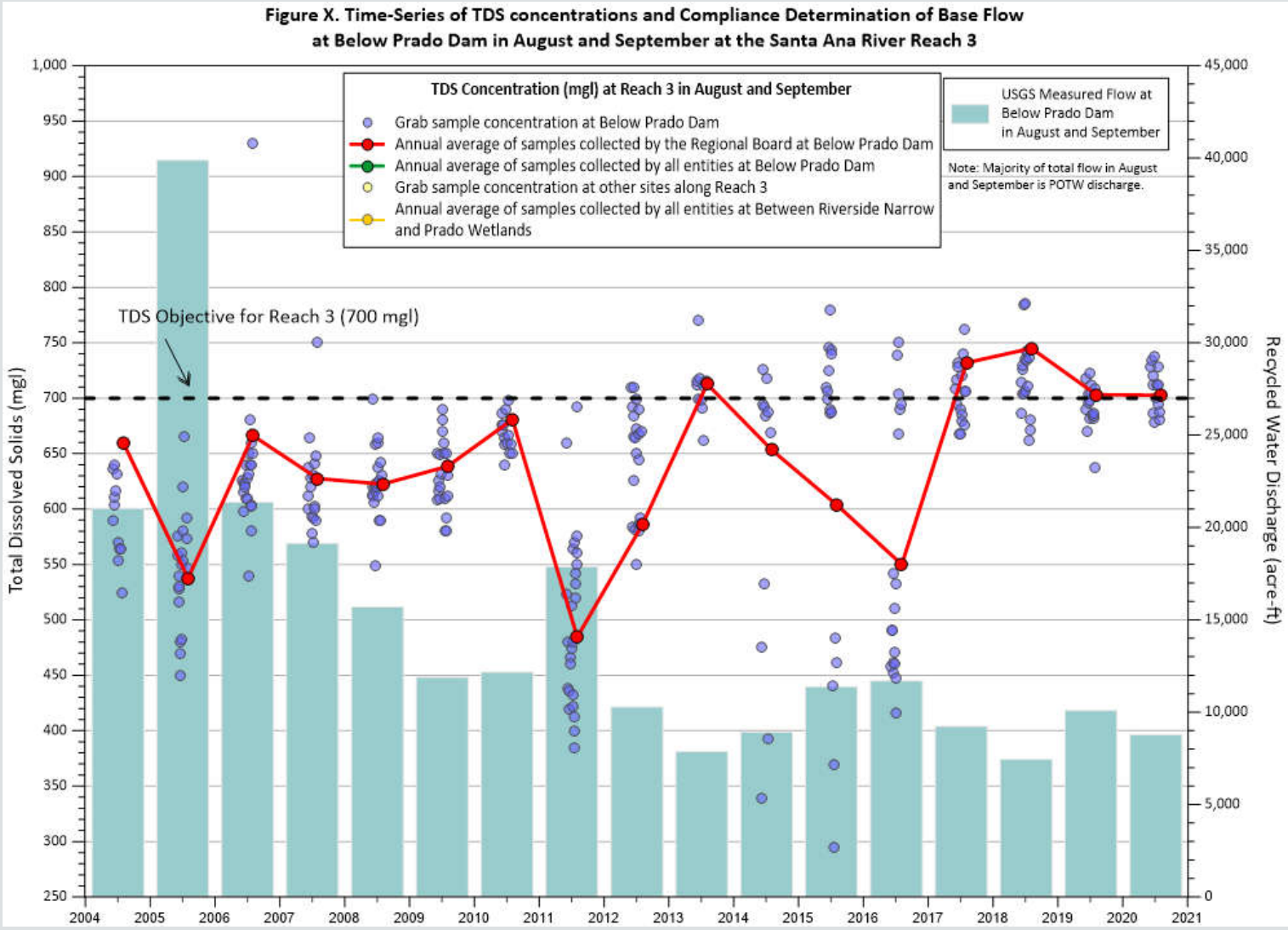
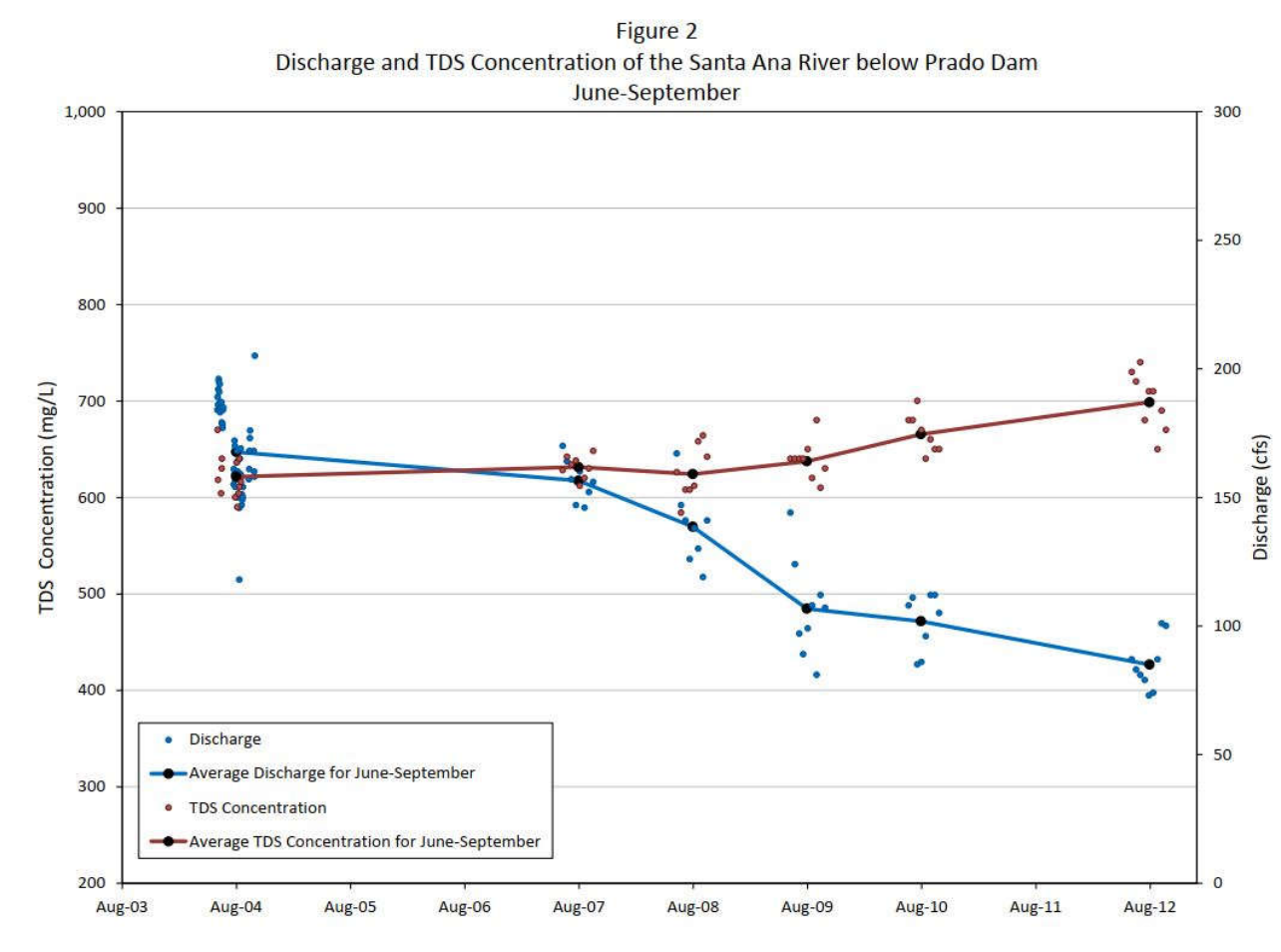


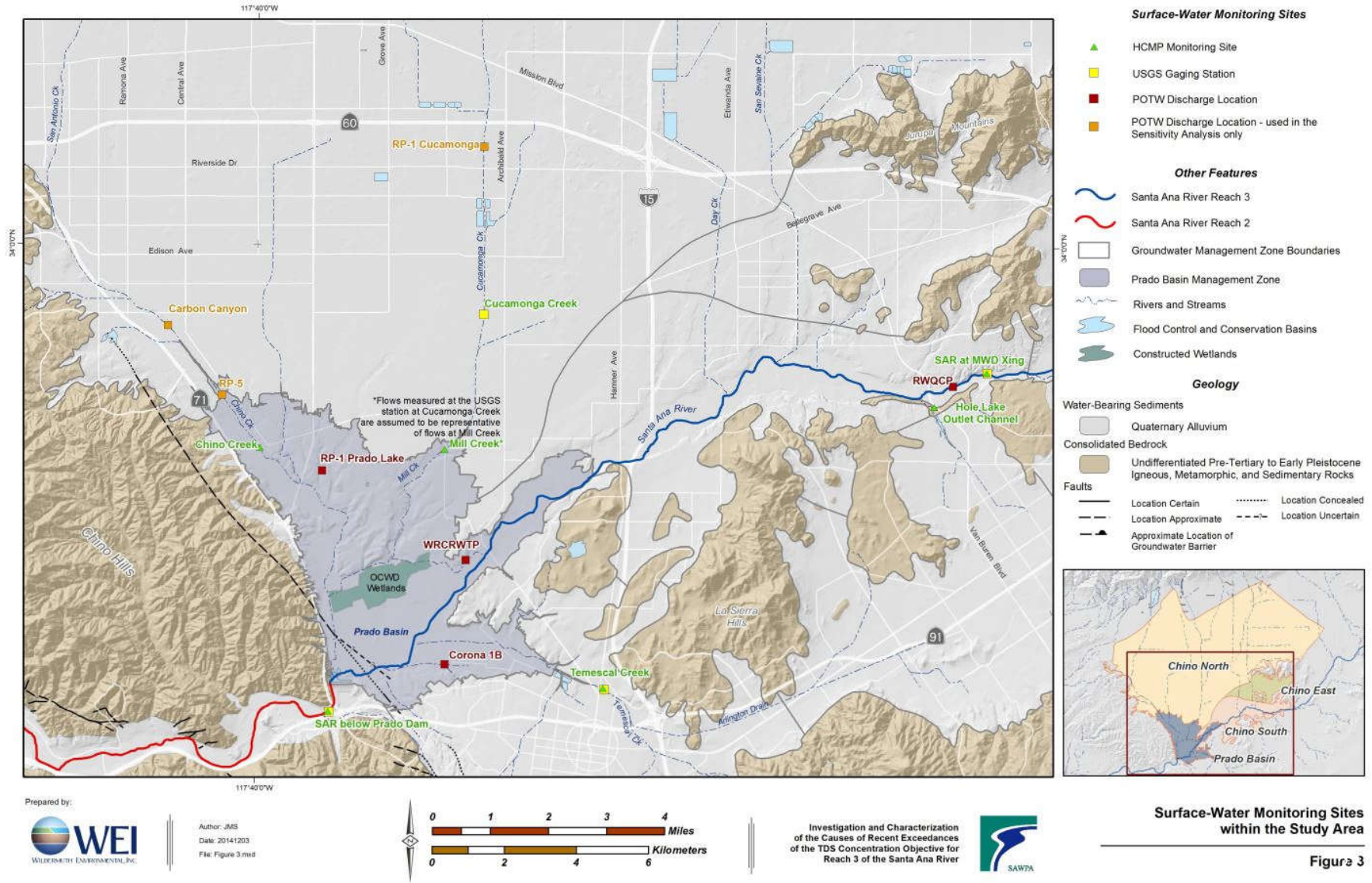
Figure X. Time-Series of TDS concentrations and Compliance Determination of Base Flow at Below Prado Dam in August and September at the Santa Ana River Reach 3



Study of TDS Exceedances in Reach 3 (WEI, 2015)

- **What are the causes of recent exceedances of the Reach 3 TDS objective?**
- Summertime discharge decreased and TDS increased since 2004
- Developed mass balance to attribute flow and TDS to components of flow in Reach 3 (summer 2004, 2007-2010, 2012)
- Calculated Residual term incorporating unmeasured inflows/outflows (e.g., rising water, streambed recharge)





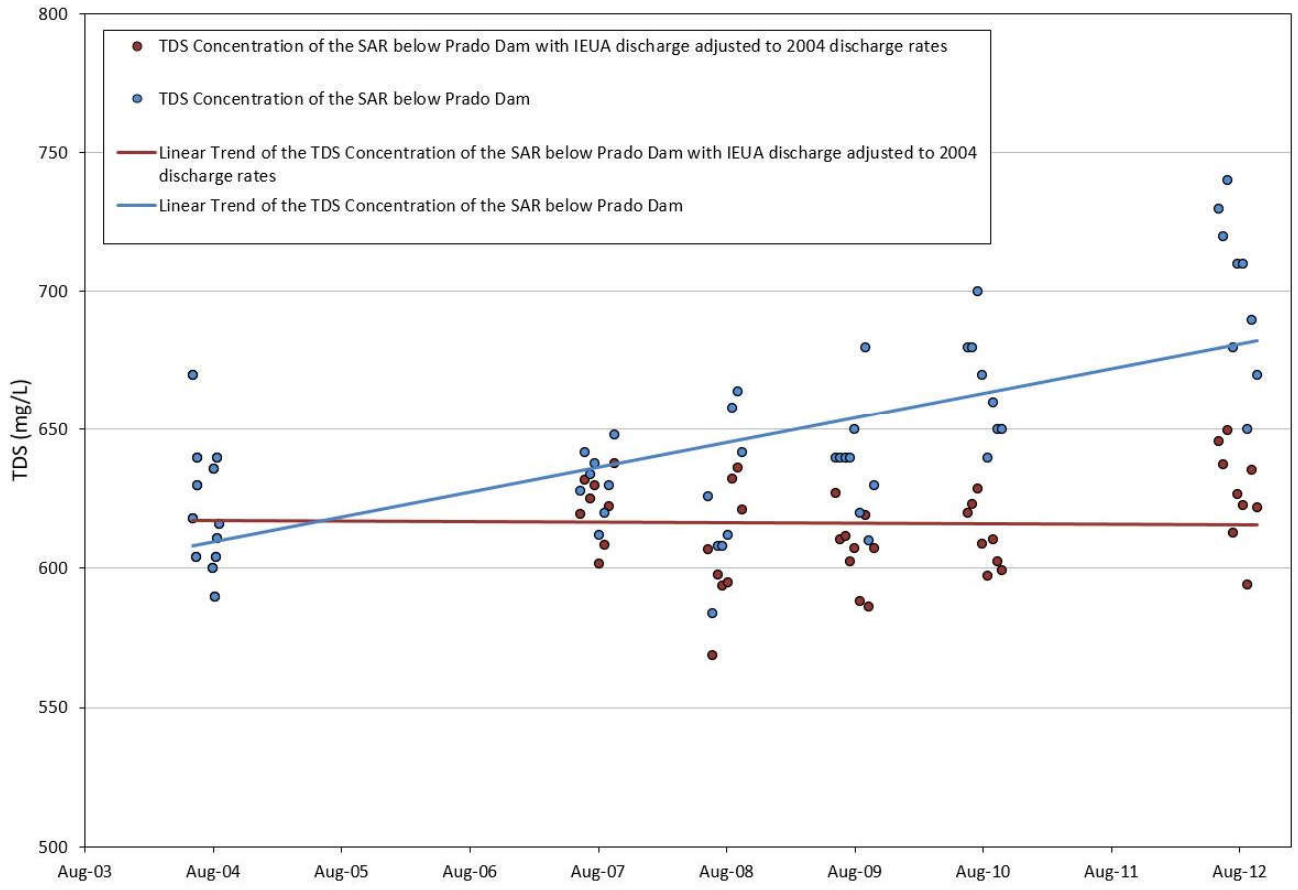
Surface-Water Monitoring Sites within the Study Area

Figura 3

Study of TDS Exceedances in Reach 3 (WEI, 2015)

- Performed sensitivity analysis, reconstructed TDS and flow of the SAR below Prado Dam by increasing IEUA discharges to match 2004 rates
- Concluded that IEUA discharges are diluting the TDS in the SAR below Prado Dam
- Recommended further investigation of Residual to understand causes of exceedances

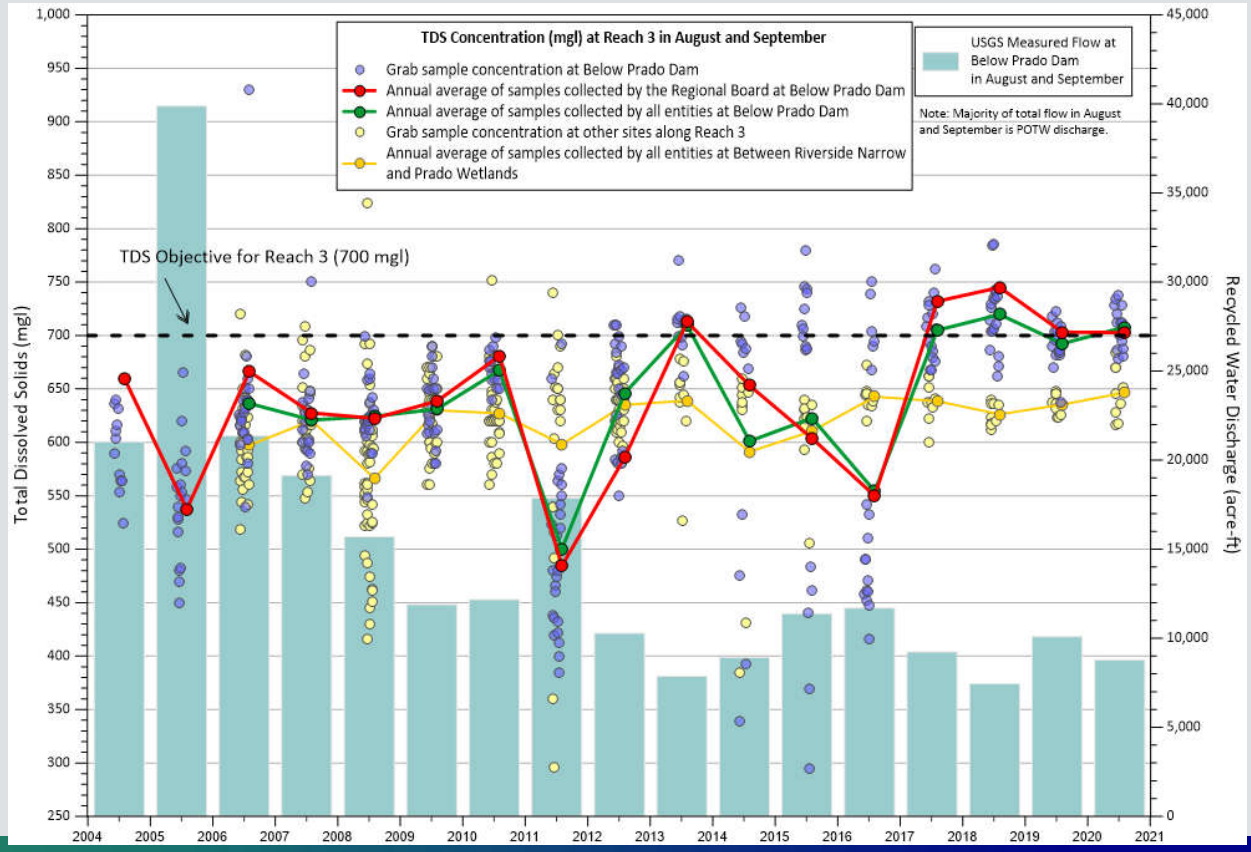
Figure 17
Influence of IEUA Discharge on the TDS Concentration of the Santa Ana River below Prado Dam



Reach 3 – Questions on the Monitoring for Compliance of SW Objectives

If our goal in assessing compliance with the Reach 3 objective is to ensure protection of Orange County GMZ during baseflow conditions,…

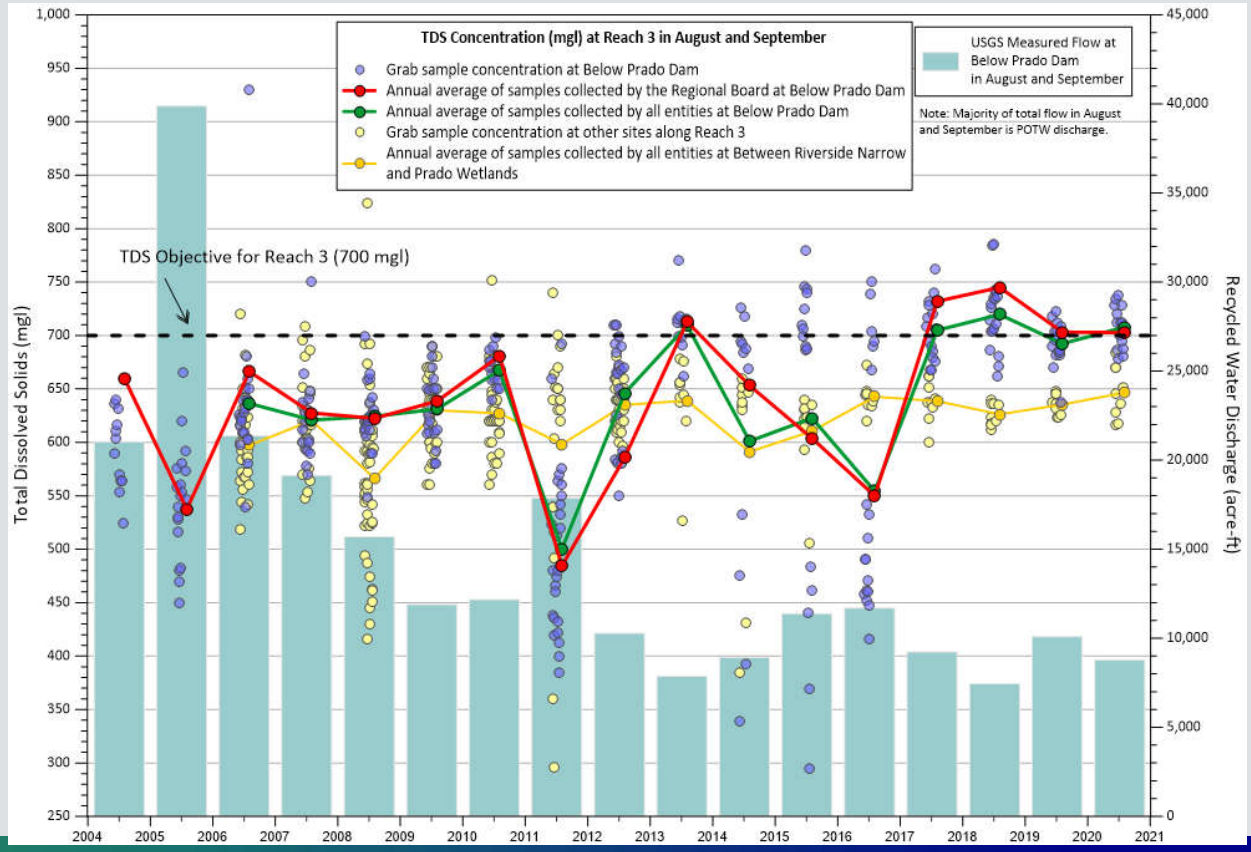
- **Is the data collected enough to competently assess compliance with Reach 3 objectives?**
- **Do we have enough data to understand the drivers of the observed trends in TDS and nitrate?**
  - Should sampling be done more than the months of August and September?
  - Should there be use of the continuous USGS measurements (as mentioned in the Basin Plan)?



Reach 3 – Questions on the Monitoring for Compliance of SW Objectives

If our goal in assessing compliance with the Reach 3 objective is to ensure protection of Orange County GMZ during baseflow conditions,…

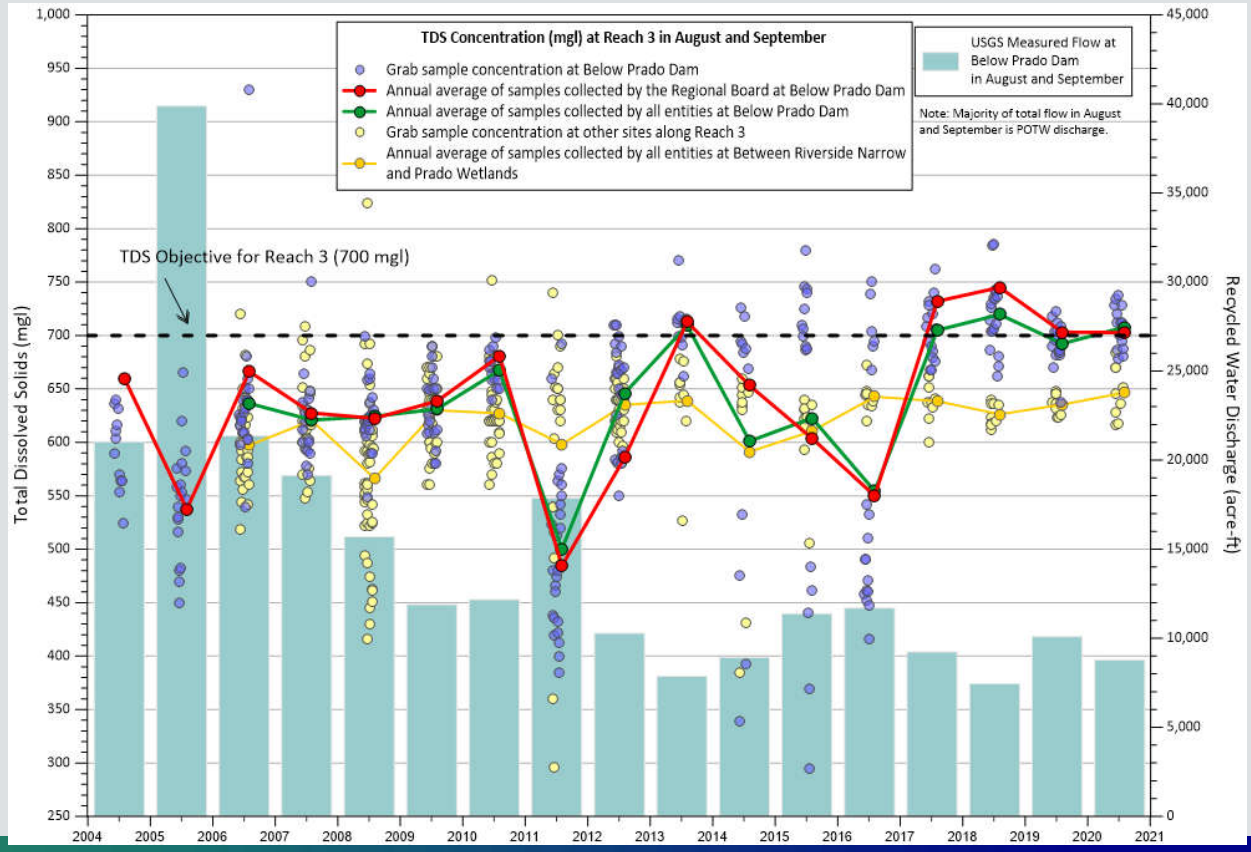
- **Is the data collected enough to competently assess compliance with Reach 3 objectives?**
- **Do we have enough data to understand the drivers of the observed trends in TDS and nitrate?**
  - Should data influenced by summer precipitation or imported water transfers in August and September be included?
  - Should sampling be done at locations other than just below Prado Dam?



Reach 3 – Questions on the Monitoring for Compliance of SW Objectives

If our goal in assessing compliance with the Reach 3 objective is to ensure protection of Orange County GMZ during baseflow conditions,…

- **Is the data collected enough to competently assess compliance with Reach 3 objectives?**
- **Do we have enough data to understand the drivers of the observed trends in TDS and nitrate?**
  - Should there be further characterization of rising groundwater along Reach 3 (quality/location)?
    - For example: What percentage of baseflow is rising groundwater in August and September?



Next Steps

- **Continue feedback on questions through February 2022.**
  - Send to Veva Weamer vweamer@westyost.com
- **February 2022 Workshop #2 –** Reaches 4 and 5, review of modeling tools
- **Late March/Early April 2022 -** Prepared Draft Technical Memorandum Surface Water Monitoring Requirements and Goals for the Santa Ana River Watershed

WESTYOST.COM

WE SUPPORT OUR COMMUNITIES

WE ARE WATER FOCUSED

WE TAKE PRIDE IN WHAT WE DO

WE DO WHAT'S RIGHT

WE STRIVE TO BECOME OUR BEST

WE BELIEVE IN QUALITY

WE LISTEN

WE SOLVE HARD PROBLEMS

WE SEE THE BIGGER PICTURE

WE TAKE OWNERSHIP

WE COLLABORATE

WE HAVE FUN

WE ARE WEST YOST

WEST YOST
Water. Engineered.

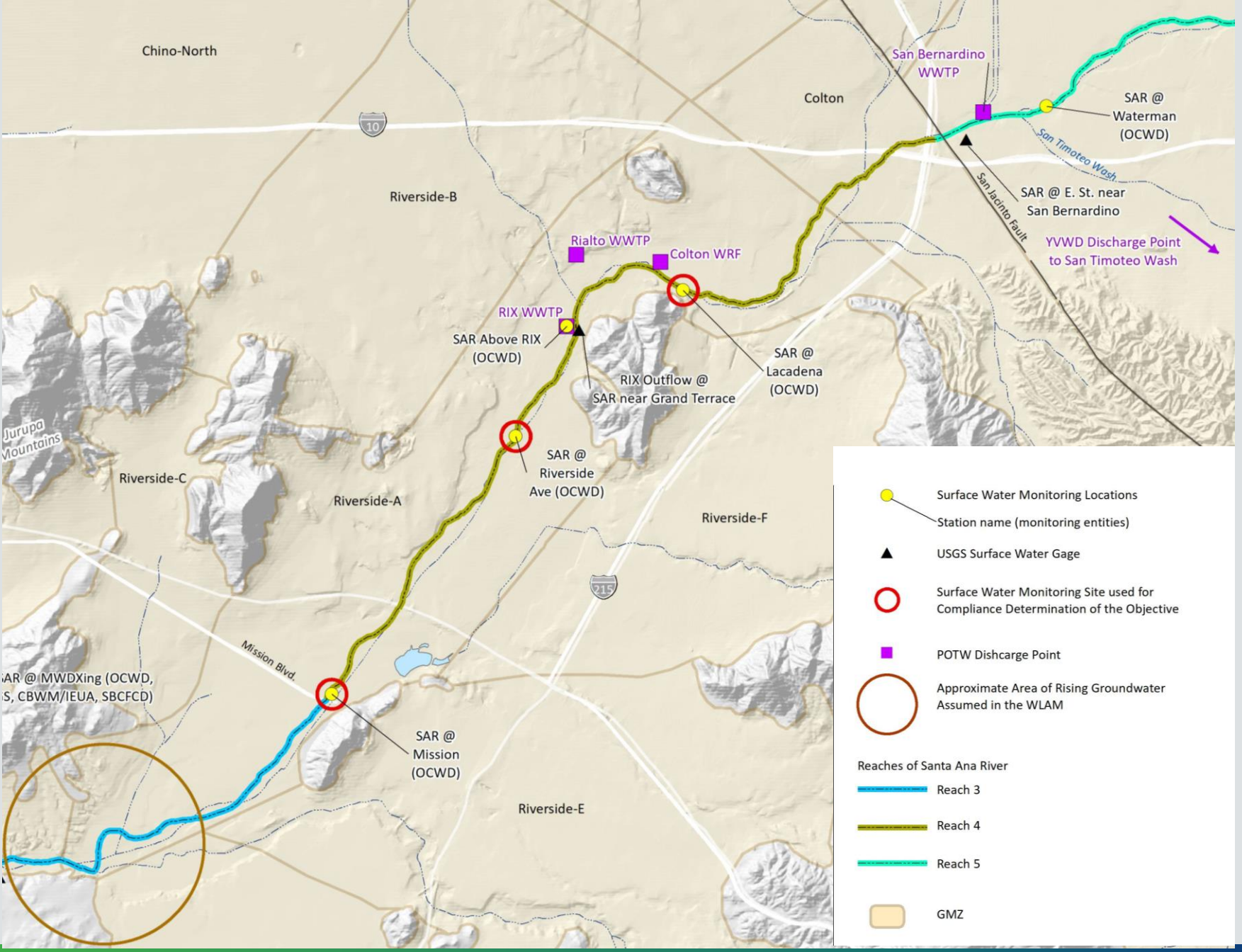
Basin Planning Priorities Task 1 Workshop

Surface Water Monitoring Requirements and Goals for the Santa Ana River Watershed Part 2 and Analysis of Modeling Tools

February 22, 2022

WEST YOST

Water. Engineered.



Reach 4

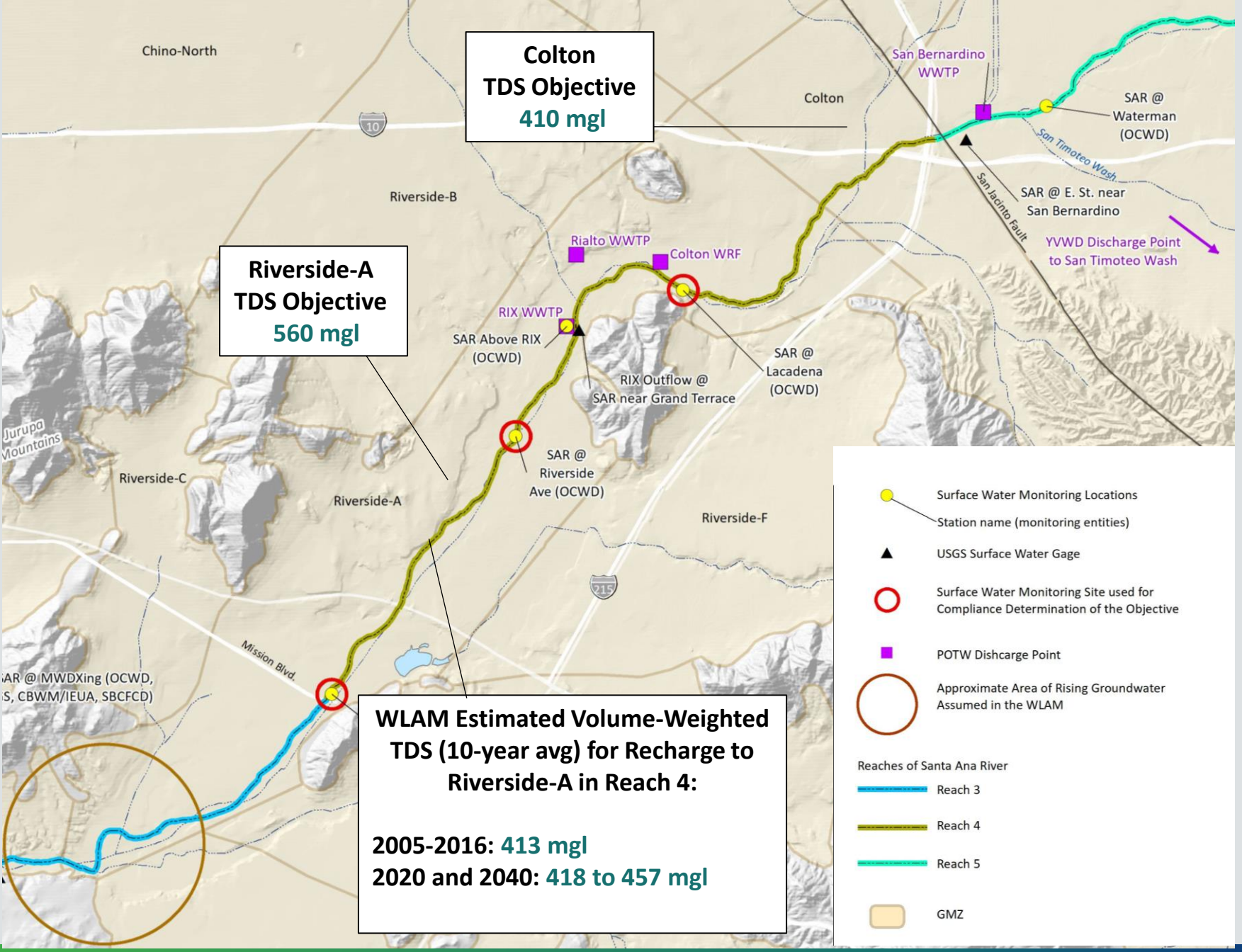
Surface Water Objectives:

TDS = 550 mgl TIN = 10 mgl

Basin Plan Metric/Data:

No description in the Basin Plan of the data required for sampling and assessment for the Reach 4 objectives.

Reach 4



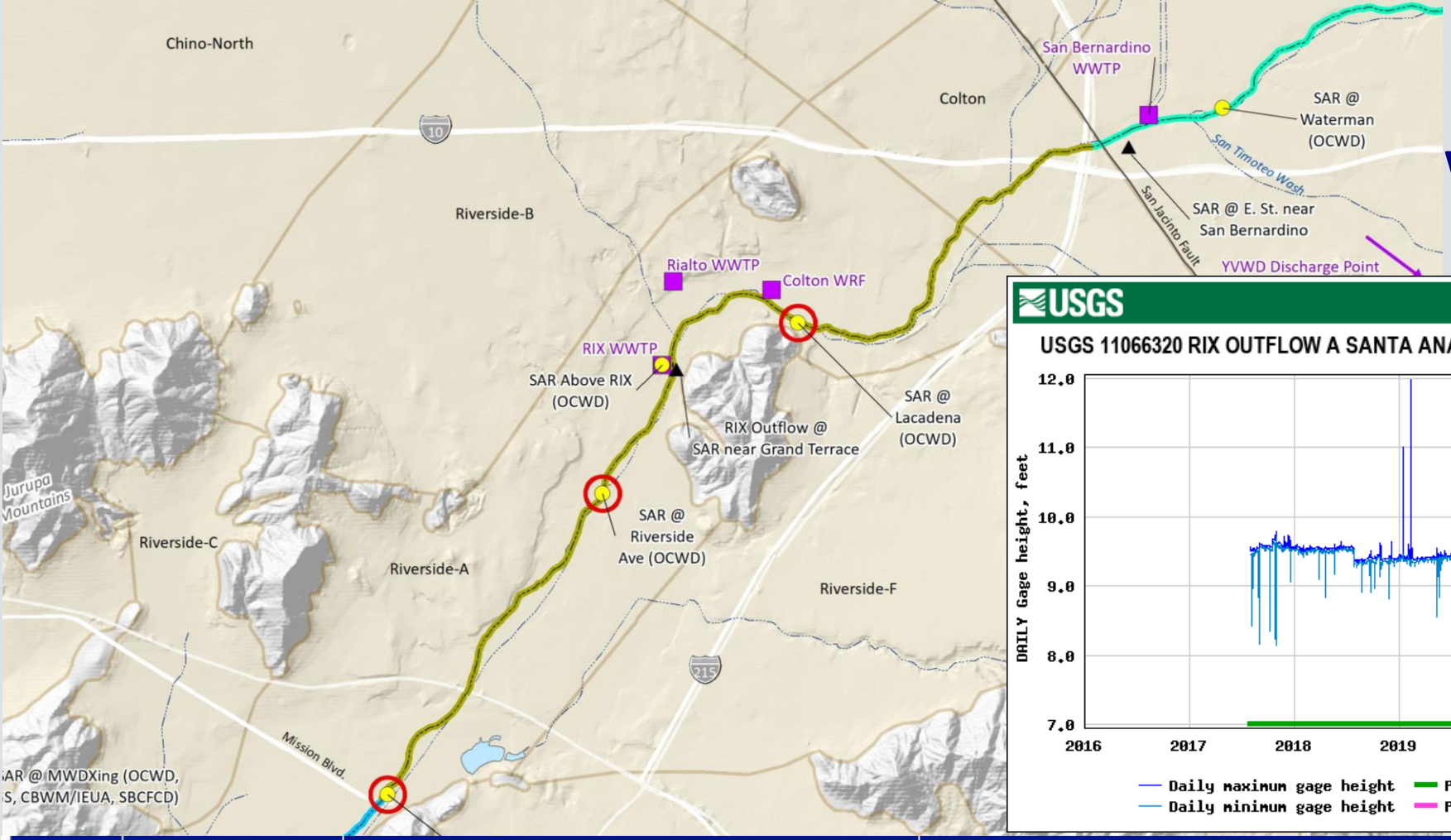
Surface Water Objectives:

TDS = 550 mgl TIN = 10 mgl

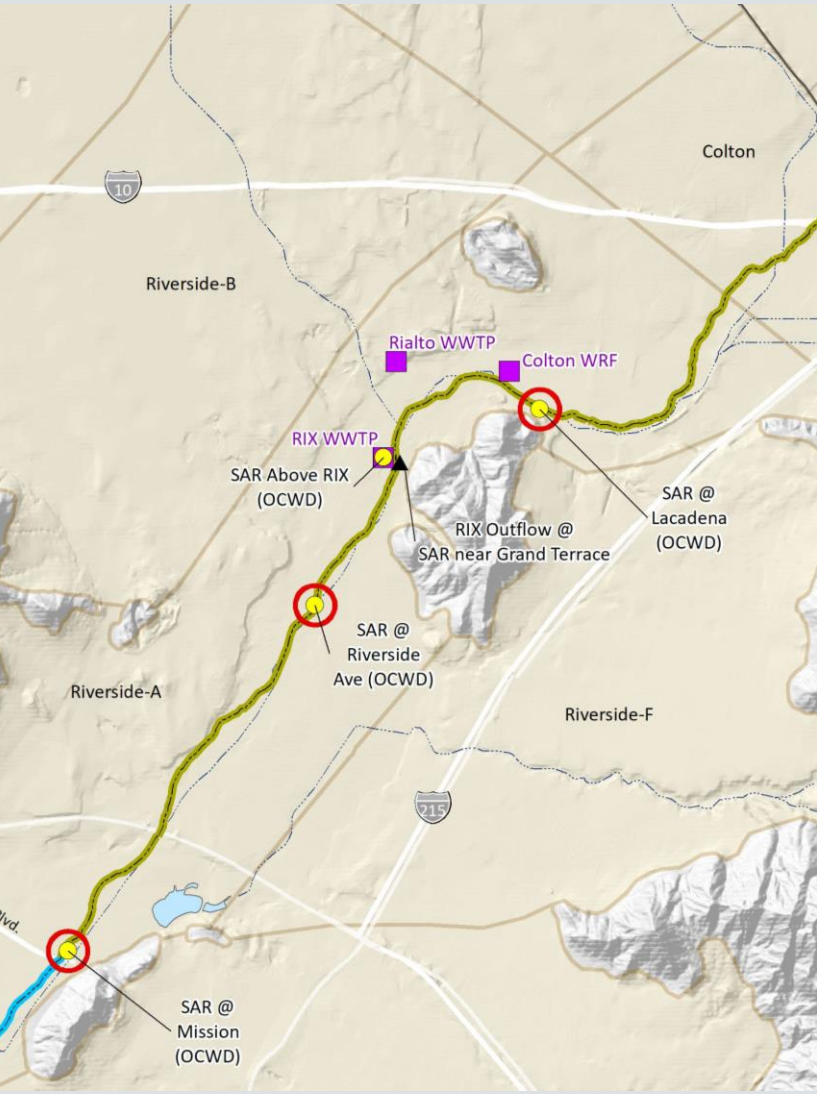
What are the Surface Water Objectives in Reach 4 Protecting ? Recharge to Riverside-A GMZ

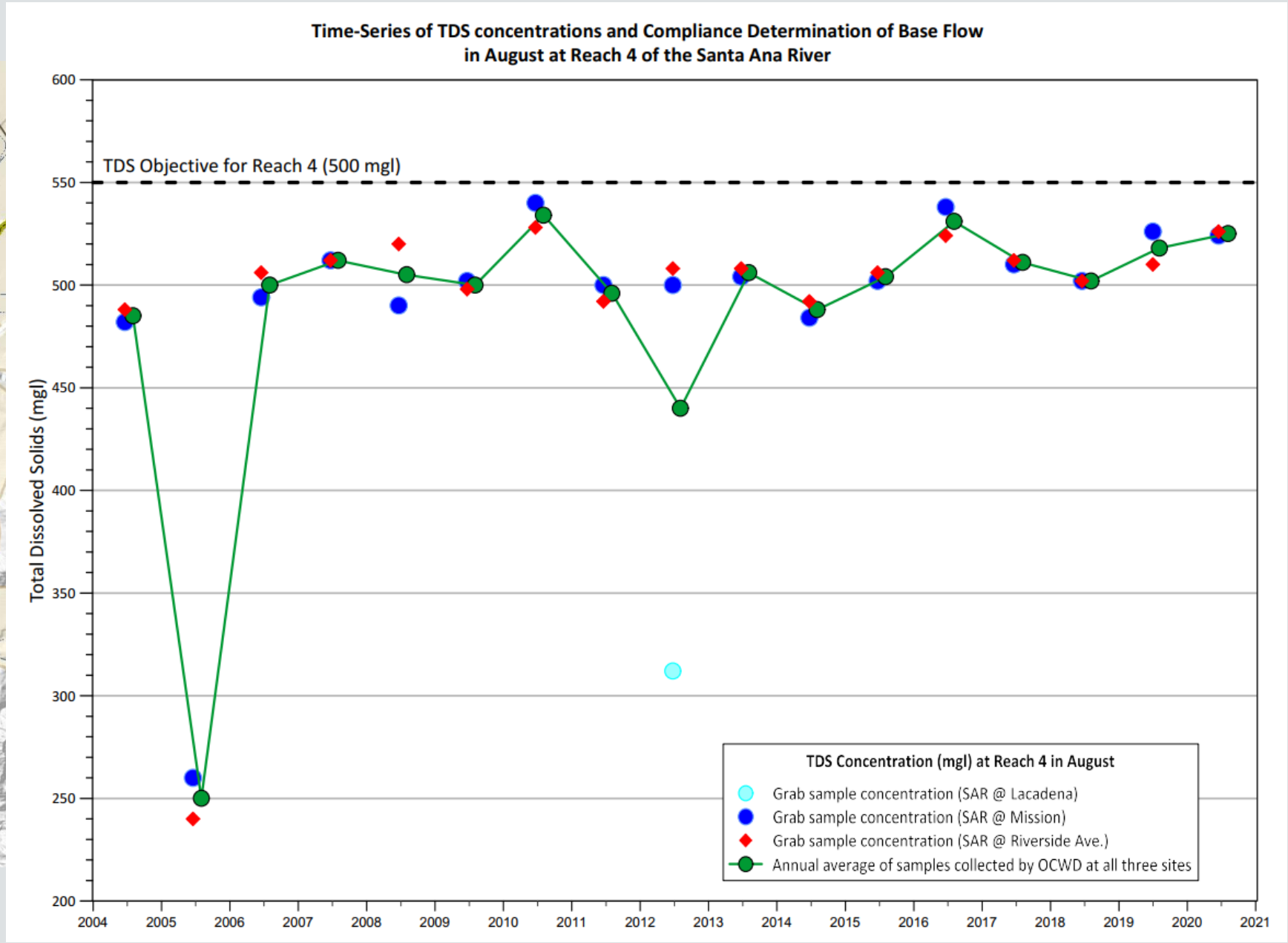
Question to be answered by the surface water monitoring data to compare to the objective: What is the quality of the flow in Reach 4?

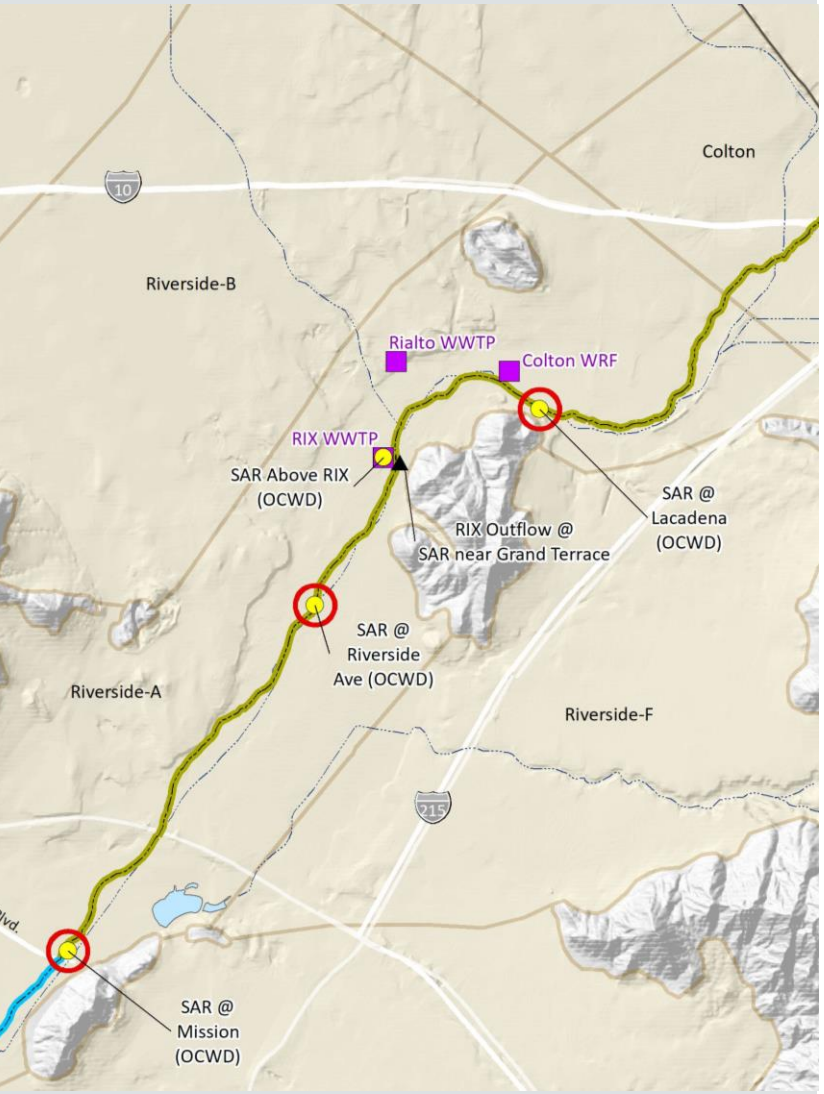
Assessment of Compliance with Surface Water Objective for Reach 4

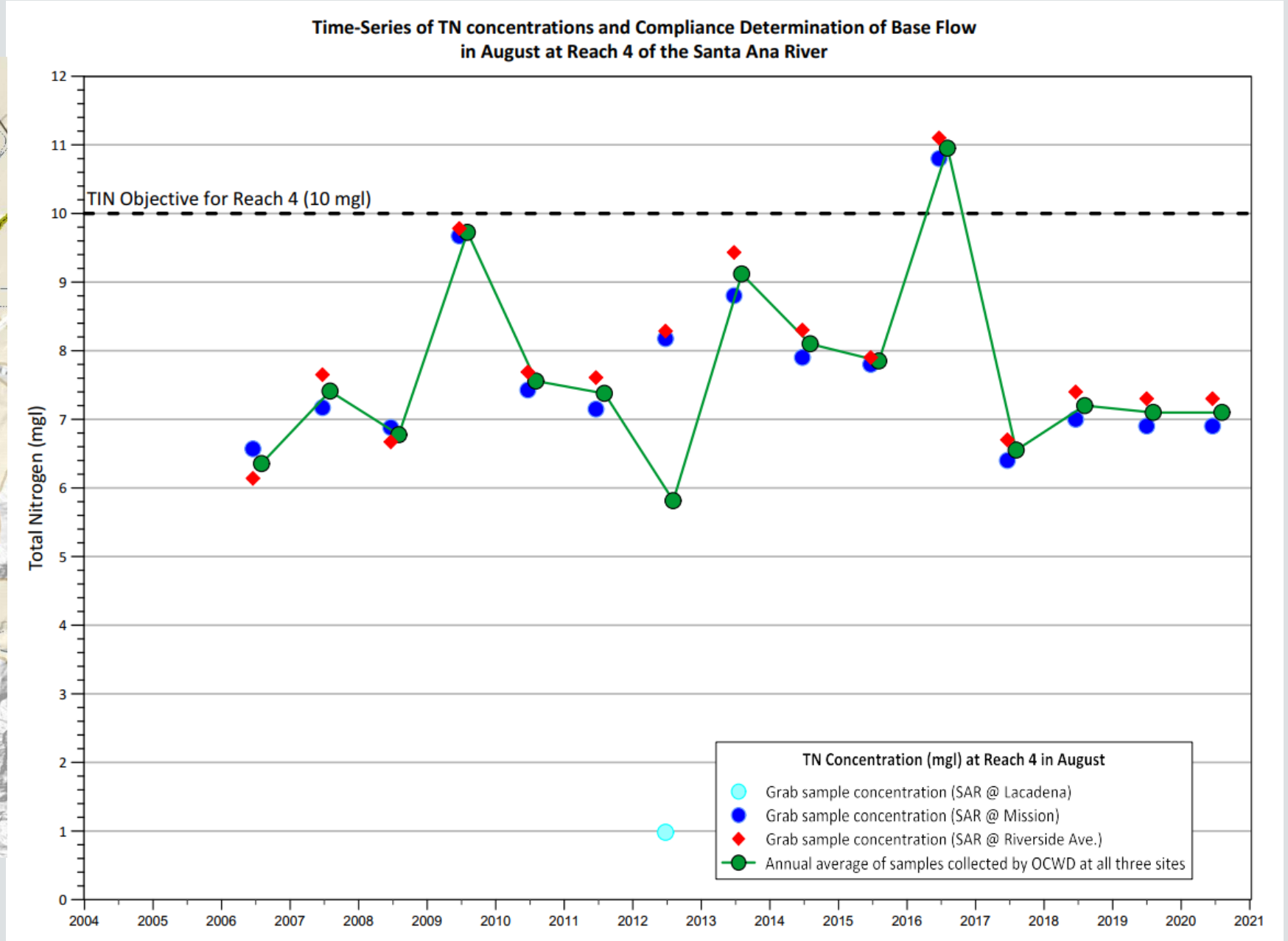


Reach	Objective (mgl)		Assessment of Compliance as Specified in the Basin Plan		Assessment of Compliance with Basin Plan Objectives Conducted by the Task Force in the SAWPA Annual Report of Santa Ana River Water Quality
	TDS	TIN(a)	Compliance Metric	Monitoring Data	
Reach 4	550	10	Undefined	Undefined	Average of grab sample of **base flow** in August at WR-RIX-01, SAR-RiversideAve-01, SAR-Lacadena-01.


Colton
Riverside-B
Rialto WWTP
Colton WRF
RIX WWTP
SAR Above RIX (OCWD)
RIX Outflow @ SAR near Grand Terrace
SAR @ Lacadena (OCWD)
SAR @ Riverside Ave (OCWD)
Riverside-A
Riverside-F
SAR @ Mission (OCWD)


Time-Series of TDS concentrations and Compliance Determination of Base Flow in August at Reach 4 of the Santa Ana River
TDS Objective for Reach 4 (500 mgl)
Total Dissolved Solids (mgl)
600
550
500
450
400
350
300
250
200
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
TDS Concentration (mgl) at Reach 4 in August
Grab sample concentration (SAR @ Lacadena)
Grab sample concentration (SAR @ Mission)
Grab sample concentration (SAR @ Riverside Ave.)
Annual average of samples collected by OCWD at all three sites

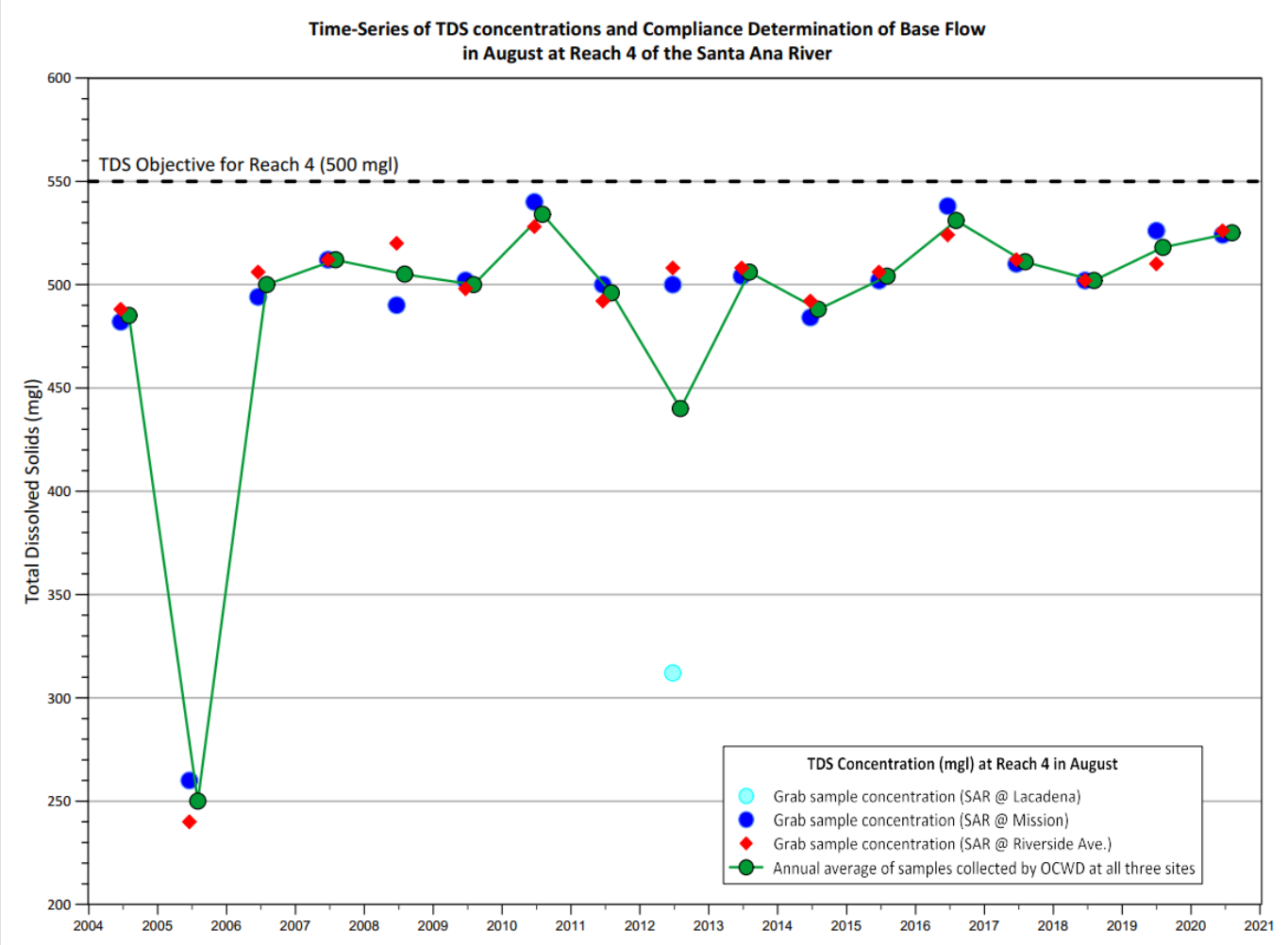

Colton
Riverside-B
Rialto WWTP
Colton WRF
RIX WWTP
SAR Above RIX (OCWD)
RIX Outflow @ SAR near Grand Terrace
SAR @ Lacadena (OCWD)
SAR @ Riverside Ave (OCWD)
Riverside-A
Riverside-F
SAR @ Mission (OCWD)


Time-Series of TN concentrations and Compliance Determination of Base Flow in August at Reach 4 of the Santa Ana River
TIN Objective for Reach 4 (10 mgl)
Total Nitrogen (mgl)
0
1
2
3
4
5
6
7
8
9
10
11
12
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
TN Concentration (mgl) at Reach 4 in August
Grab sample concentration (SAR @ Lacadena)
Grab sample concentration (SAR @ Mission)
Grab sample concentration (SAR @ Riverside Ave.)
Annual average of samples collected by OCWD at all three sites

Reach 4 – Questions on the Monitoring for Compliance of Surface Water Objectives

Is the data collected enough to assess the quality of flow in Reach 4 and compliance with Reach 4 objectives?

- Should sampling be representative of baseflow or total flow?
- Should sampling be done more than the month of August?
- Should there be more than one sample per year at each site?
- Should sampling be done at different locations than the three used currently?



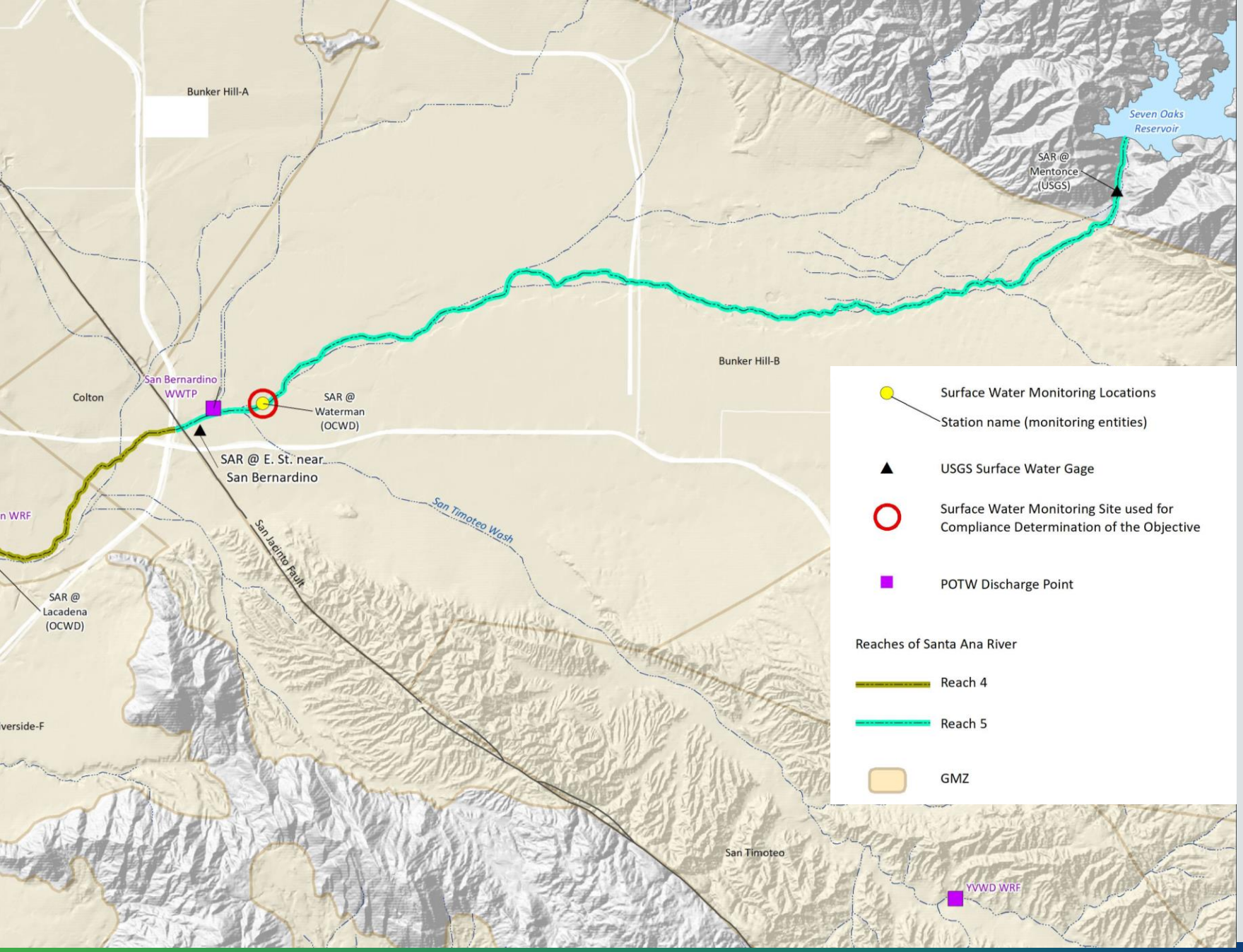
Reach 5

Surface Water Objectives:

TDS = 300 mgl TIN = 5 mgl

Basin Plan Metric/Data:

No description in the Basin Plan of the data required for sampling and assessment for the Reach 5 objectives.



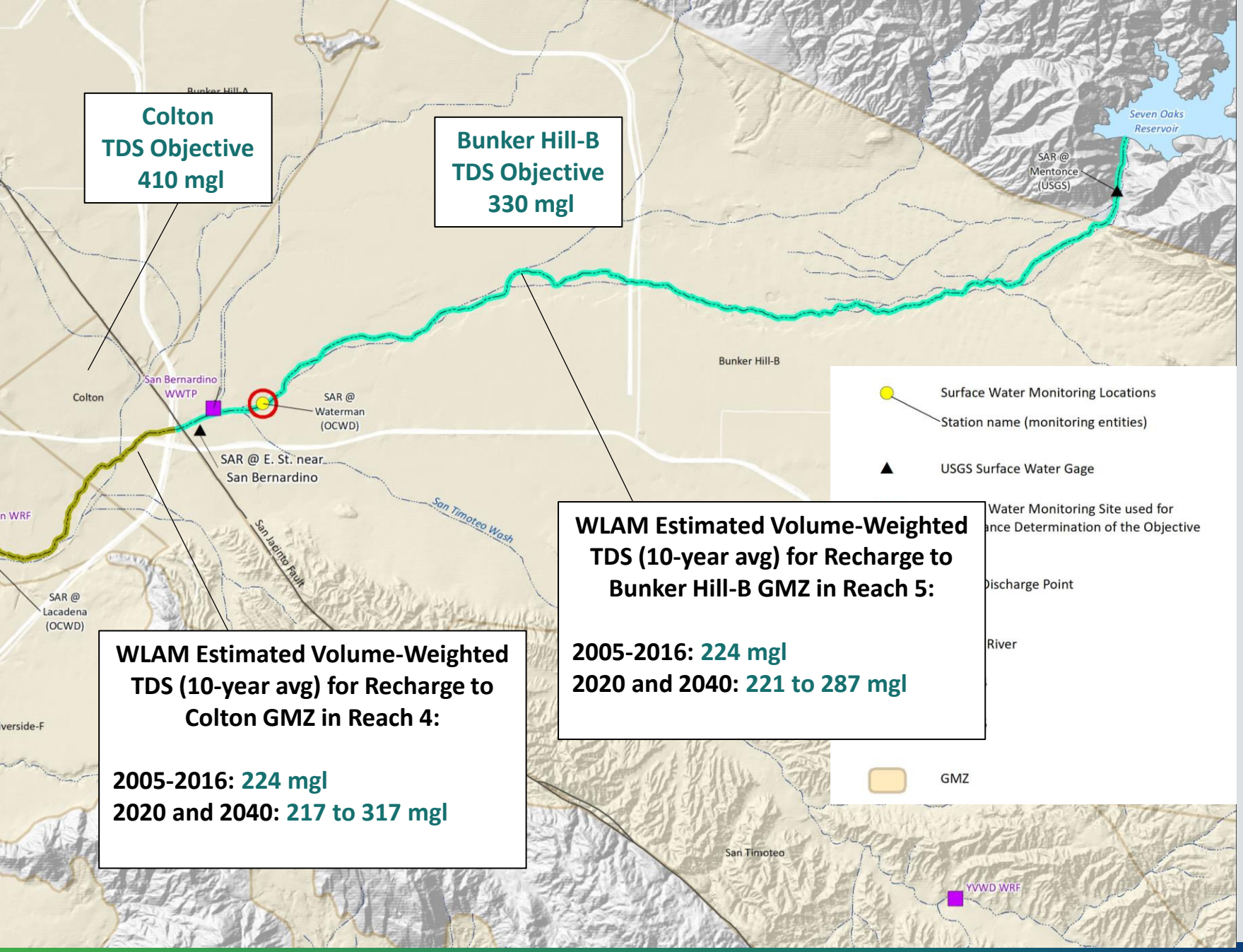
Reach 5

Surface Water Objectives:

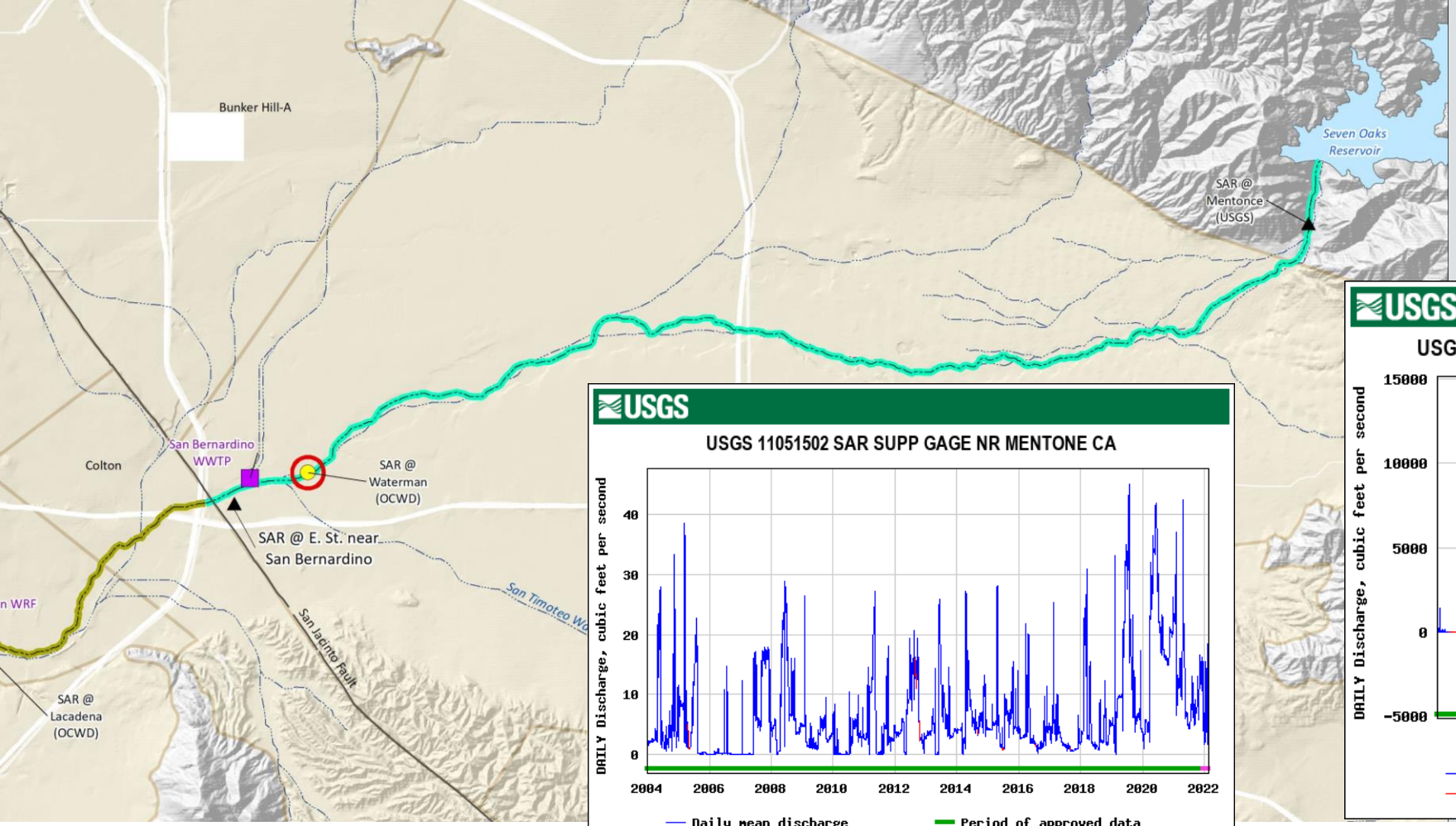
TDS = 300 mgl TIN = 5 mgl

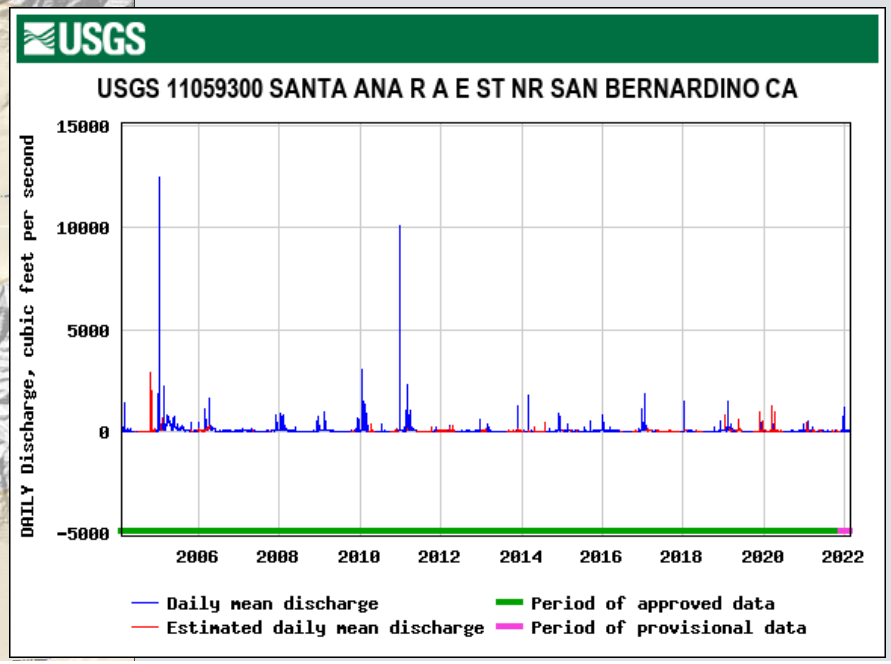
What are the Surface Water Objectives in Reach 5 Protecting? Recharge in the Bunker Hill-B and Colton GMZs.

Question to be answered by the surface water monitoring data to compare to the objective: What is the quality of the discharge in Reach 5



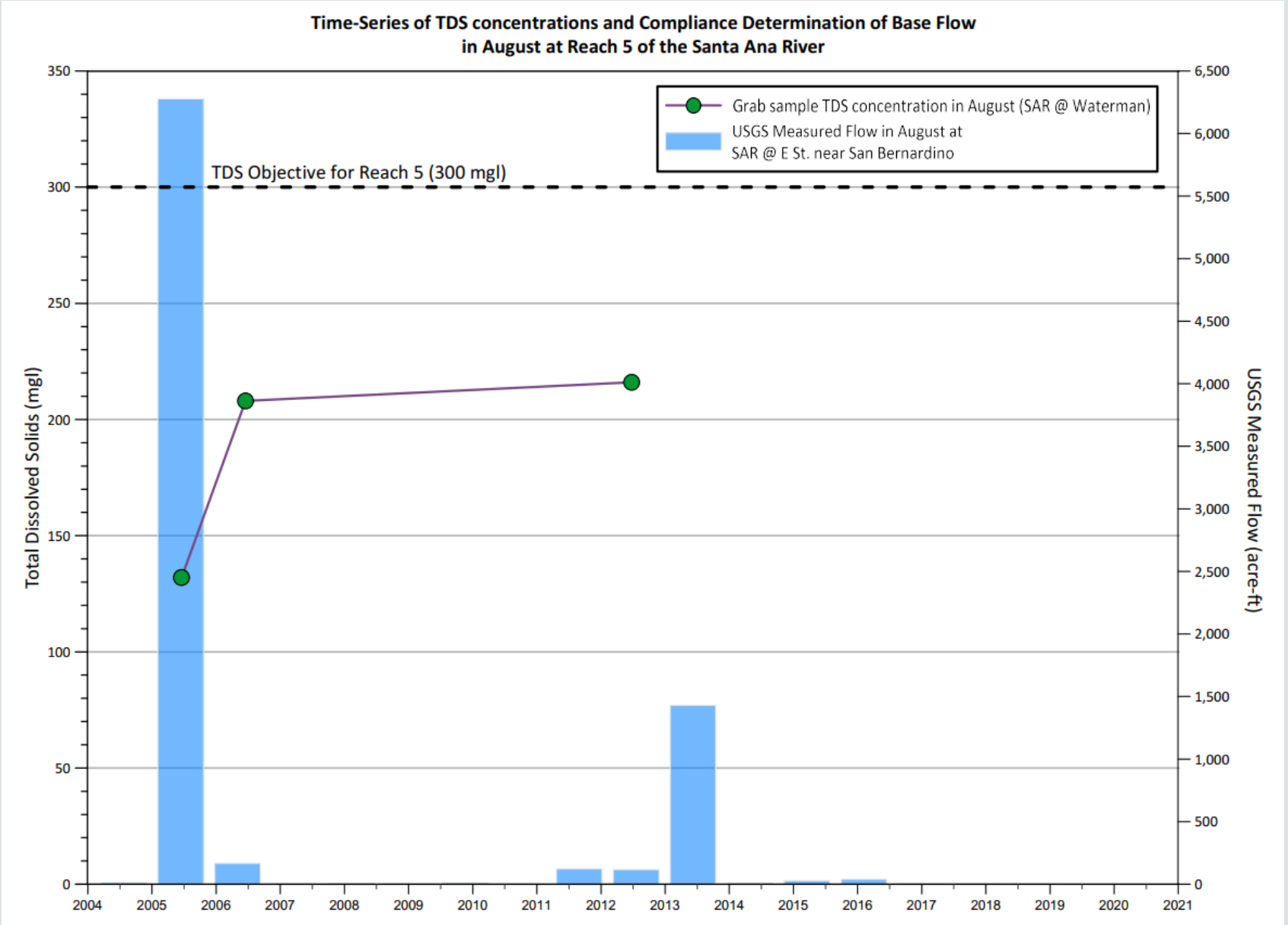
Assessment of Compliance with Surface Water Objective for Reach 5



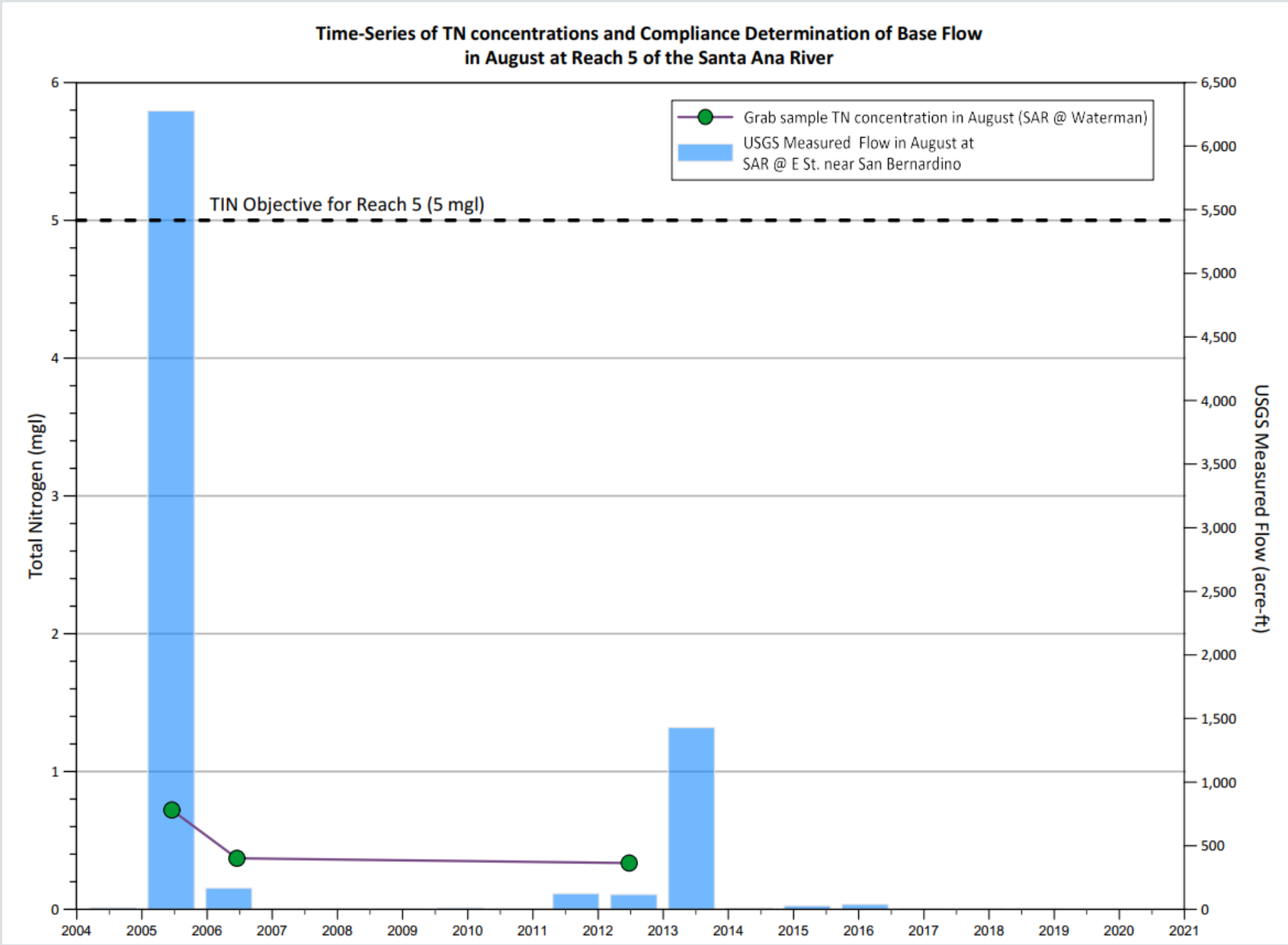


Reach	Objective (mgl)		Assessment of Compliance as Specified in the Basin Plan		Assessment of Compliance with Basin Plan Objectives Conducted by the Task Force in the SAWPA Annual Report of Santa Ana River Water Quality
	TDS	TIN(a)	Compliance Metric	Monitoring Data	
Reach 5	300	5	Undefined	Undefined	Grab sample of **base flow** in August at SAR-Waterman-01.


Bunker Hill-A
San Bernardino WWTP
Colton
SAR @ Waterman (OCWD)
SAR @ E. St. near San Bernardino
San Jacinto Fault
SAR @ Lacadena (OCWD)


Time-Series of TDS concentrations and Compliance Determination of Base Flow in August at Reach 5 of the Santa Ana River
Grab sample TDS concentration in August (SAR @ Waterman)
USGS Measured Flow in August at SAR @ E St. near San Bernardino
TDS Objective for Reach 5 (300 mgl)
Total Dissolved Solids (mgl)
USGS Measured Flow (acre-ft)
0
50
100
150
200
250
300
350
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
5,000
5,500
6,000
6,500
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

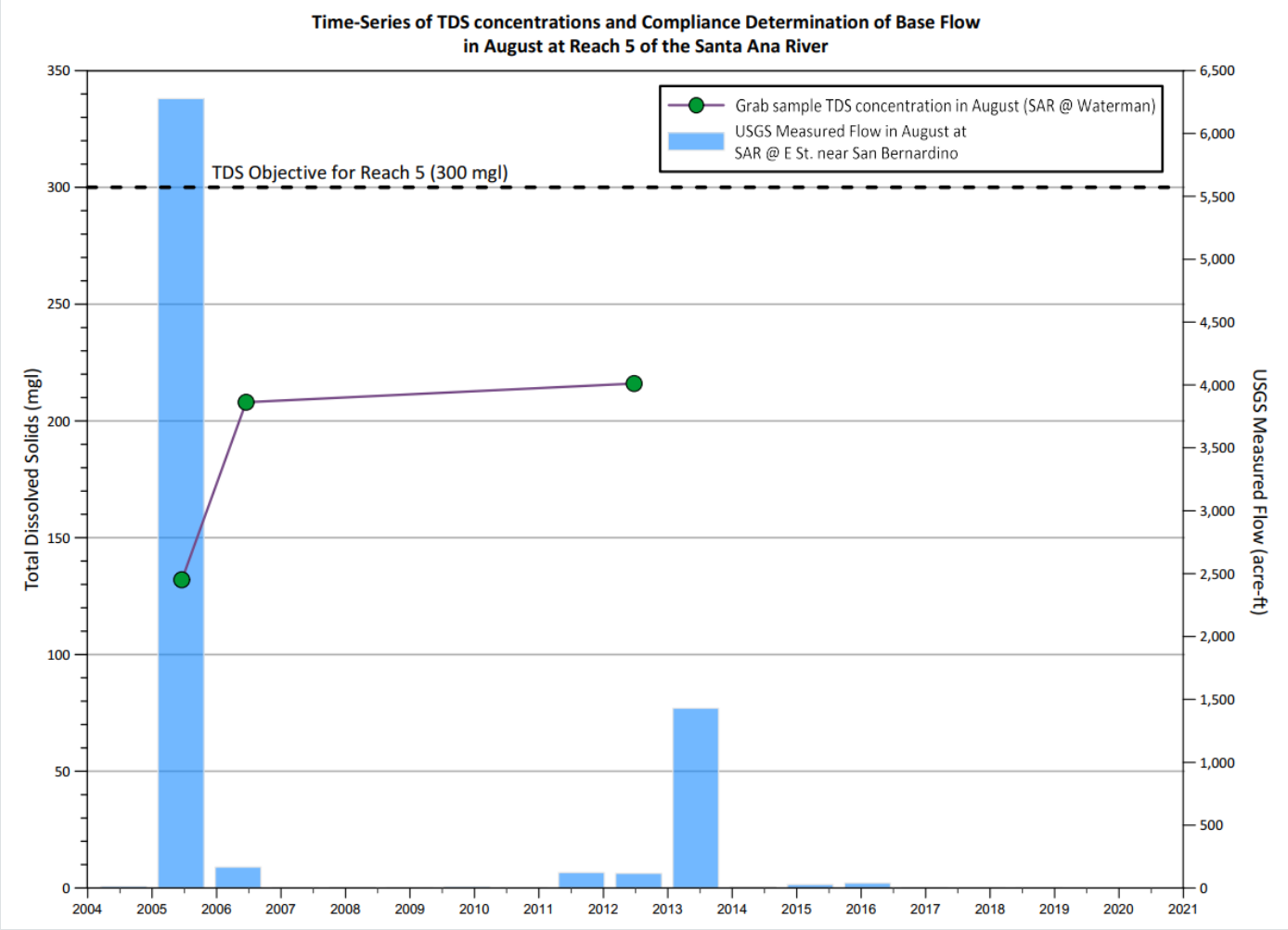

Bunker Hill-A
San Bernardino WWTP
Colton
SAR @ Waterman (OCWD)
SAR @ E. St. near San Bernardino
San Jacinto Fault
SAR @ Lacadena (OCWD)


Time-Series of TN concentrations and Compliance Determination of Base Flow in August at Reach 5 of the Santa Ana River
Grab sample TN concentration in August (SAR @ Waterman)
USGS Measured Flow in August at SAR @ E St. near San Bernardino
TIN Objective for Reach 5 (5 mgl)
Total Nitrogen (mgl)
USGS Measured Flow (acre-ft)
0
1
2
3
4
5
6
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
5,000
5,500
6,000
6,500
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

Reach 5 – Questions on the Monitoring for Compliance of Surface Water Objectives

Is the data collected enough to assess the quality of flow in Reach 5 and compliance with Reach 5 objectives?

- Should sampling be representative of baseflow or total flow?
- Should sampling be done more than the month of August?
- Should there be more than one sample per year?
- Should sampling be done at different locations than the one used currently?



Analysis of Modeling Tools

Relationship of the WLAM to the Basin Plan

- Simulates fate of TDS/TIN in watershed to determine wasteload allocations (i.e., maximum TDS/TIN loads that can be discharged to achieve and maintain compliance with water quality objectives)
- Why is monitoring data important?
  - Evaluate current compliance
  - Used for model to predict future compliance and wasteload allocations

Question for model analysis

- What gaps in our understanding of the Santa Ana River become apparent from reviewing the models?
  - To answer this question, we will:
    - Examine assumptions in WLAM
    - Review WLAM results – What is the uncertainty in how the model represents the flow components and dynamics of the Santa Ana River?
    - Compare WLAM assumptions to ISARM and CVM
    - Compare model results – Do the model results differ?

Once we understand the model uncertainties…

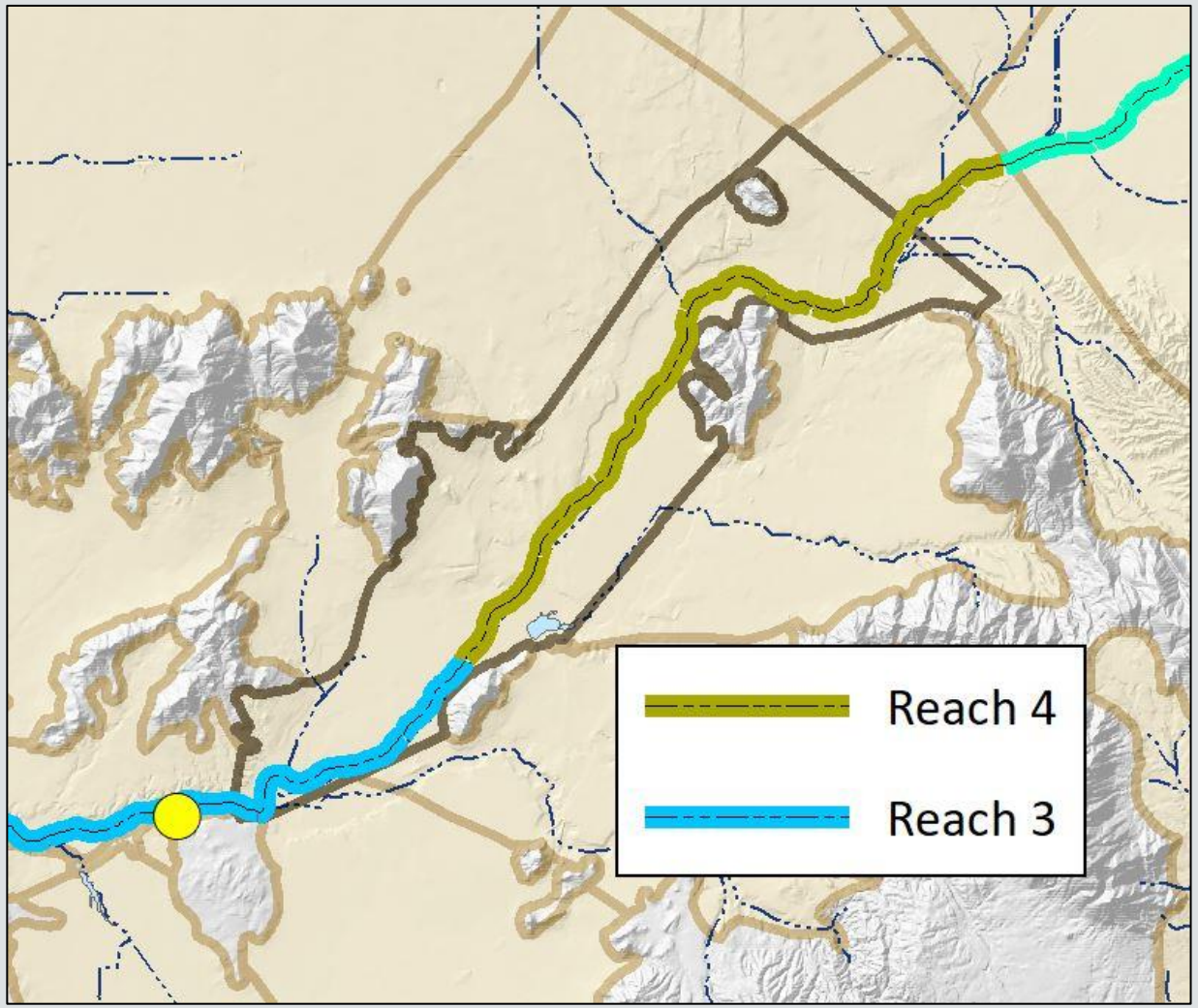
- How could the monitoring be improved to reduce these uncertainties?

WLAM – Assumptions

https://sawpa.org/

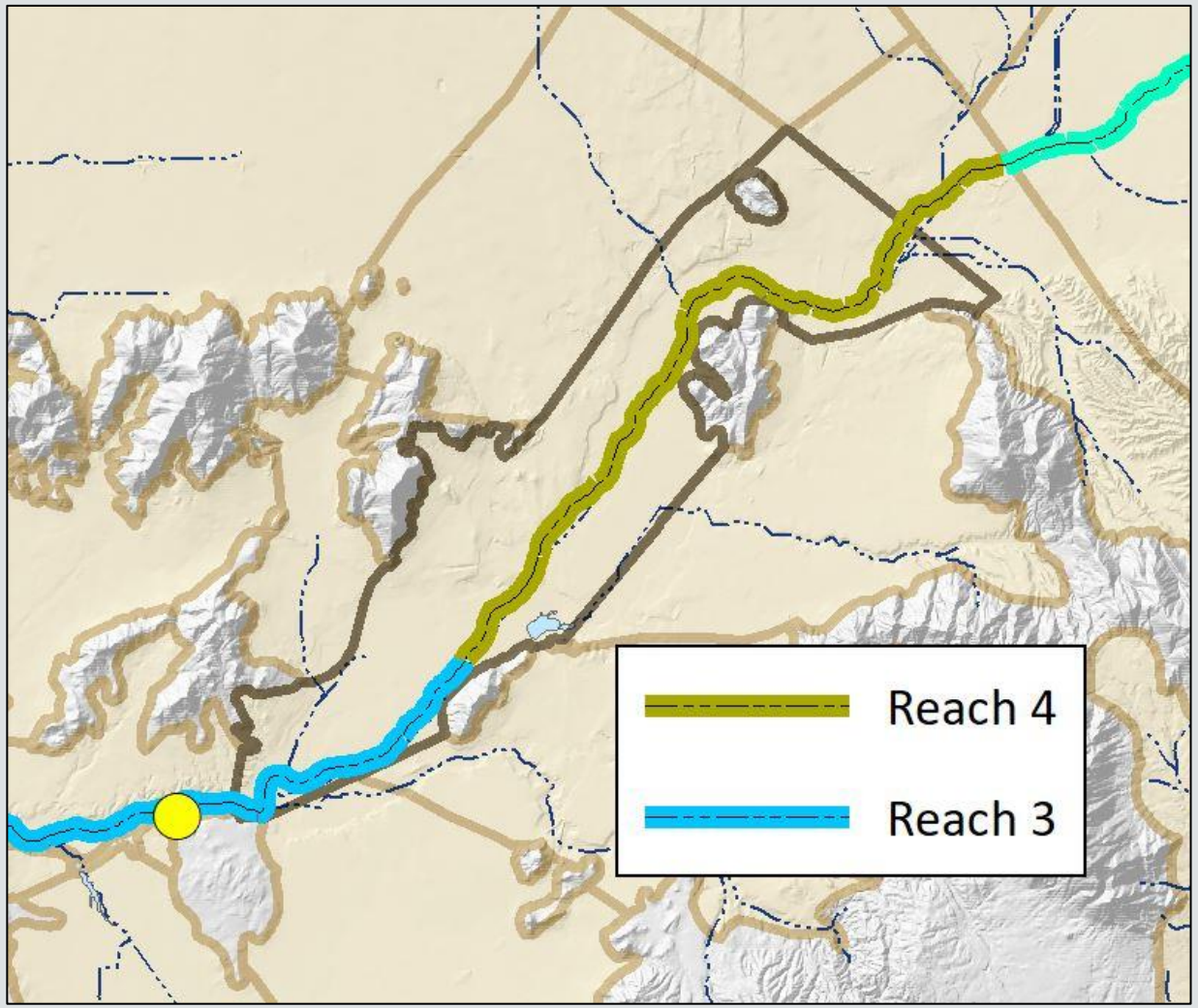
- HSPF does not directly simulate surface water/groundwater interaction
- Losing reaches:
  - Specified infiltration rate
- Gaining reaches:
  - Point inflow

WLAM – Sensitivity Analysis for Reaches 3 and 4

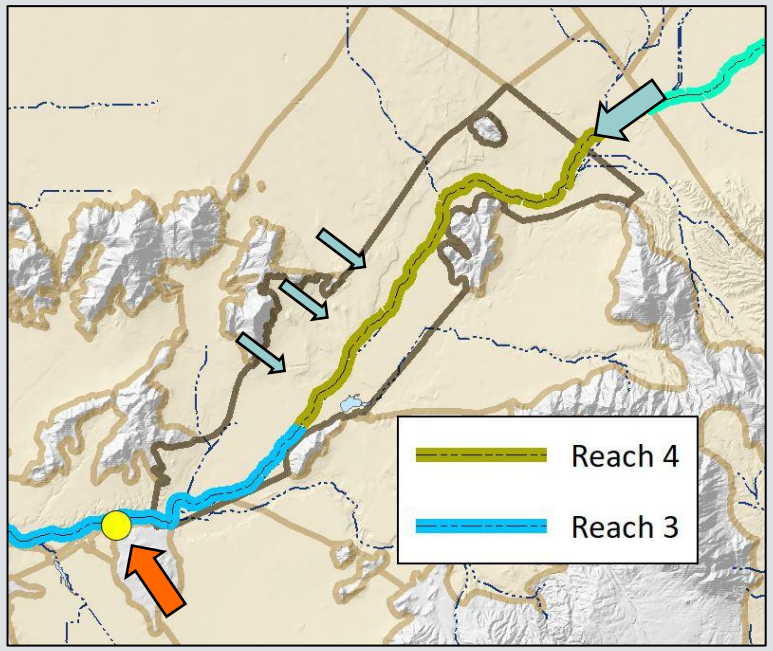


- Purpose: determine effect of changes in rising water on model-calculated streambed recharge
- WLAM is calibrated to flow/quality at Riverside Narrows (RN)
  - Different parameters can yield similar results
  - Uncertainty in the quantity/quality of rising water

WLAM – Sensitivity Analysis for Reaches 3 and 4



- Two scenarios:
  1. Final Calibration Run
  2. Sensitivity Run - Calibration run with rising water at Riverside Narrows (RN) reduced by 50%
- Calibrated Sensitivity Run to match flow/quality at RN (MWD Xing)
- What is the water/salt budget of different segments?



Other Inflows
Rising Water

Simulated components of Flow and TDS in the SAR overlying Riverside-A GMZ as evaluated in the 2017 WLAM sensitivity analysis

Annual Average Flow (afy)/TDS Load (tons)

Flow

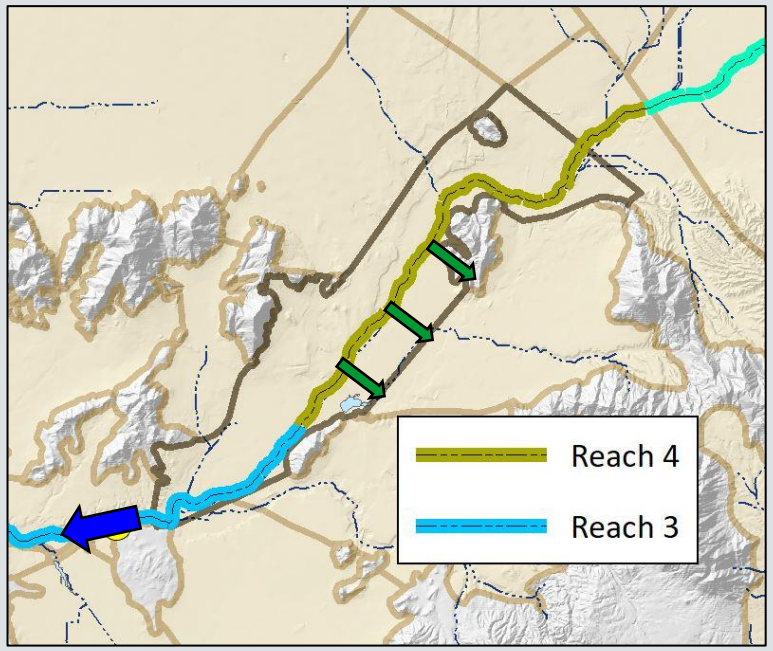
TDS

Volume-weighted TDS (mgl)

795
305
795
305

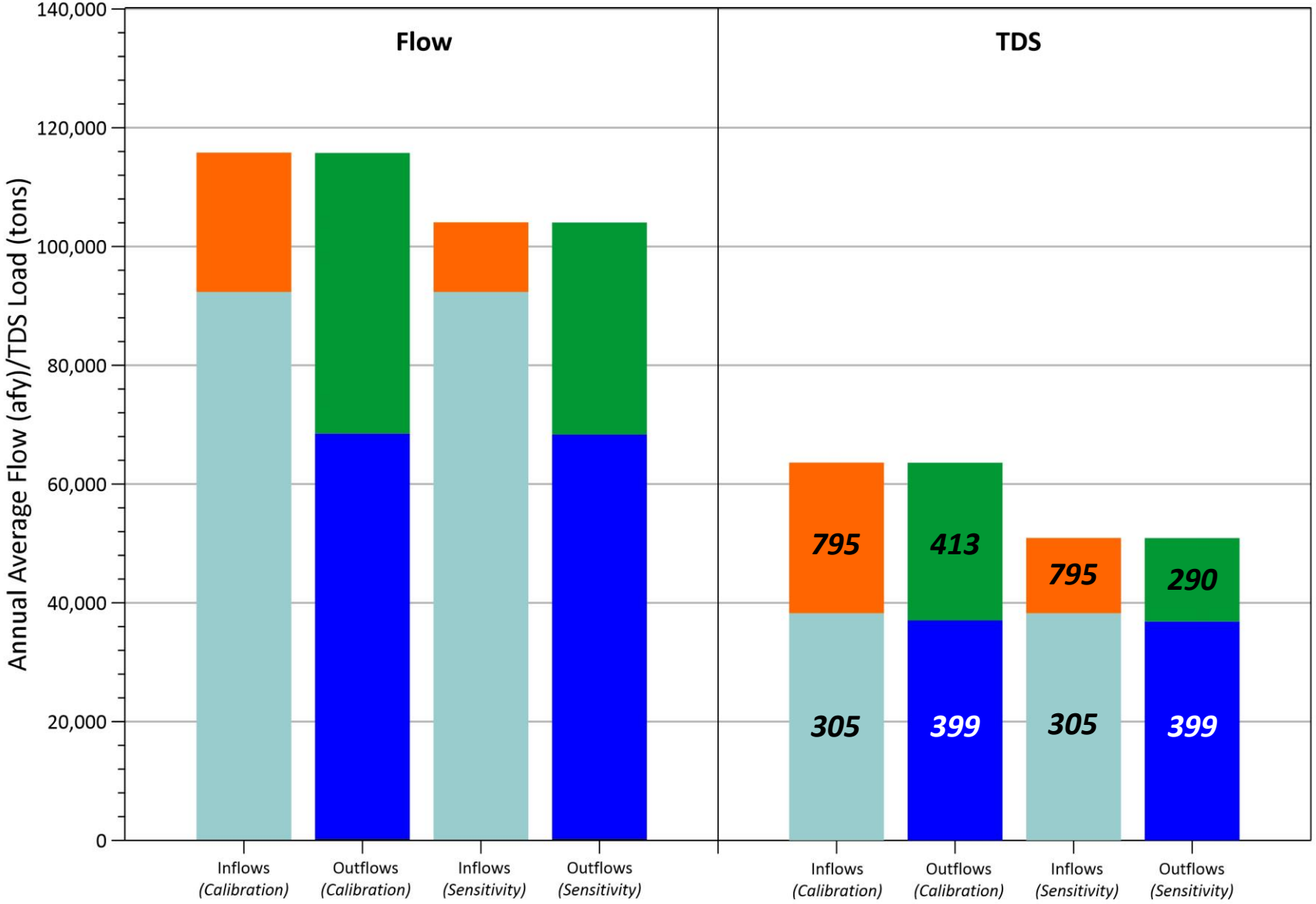
Inflows (Calibration)
Outflows (Calibration)
Inflows (Sensitivity)
Outflows (Sensitivity)

DRAFT



- Other Inflows
- Rising Water
- ET
- Flow at Riverside Narrows
- Streambed Infiltration to Riverside-A GMZ

Simulated components of Flow and TDS in the SAR overlying Riverside-A GMZ as evaluated in the 2017 WLAM sensitivity analysis



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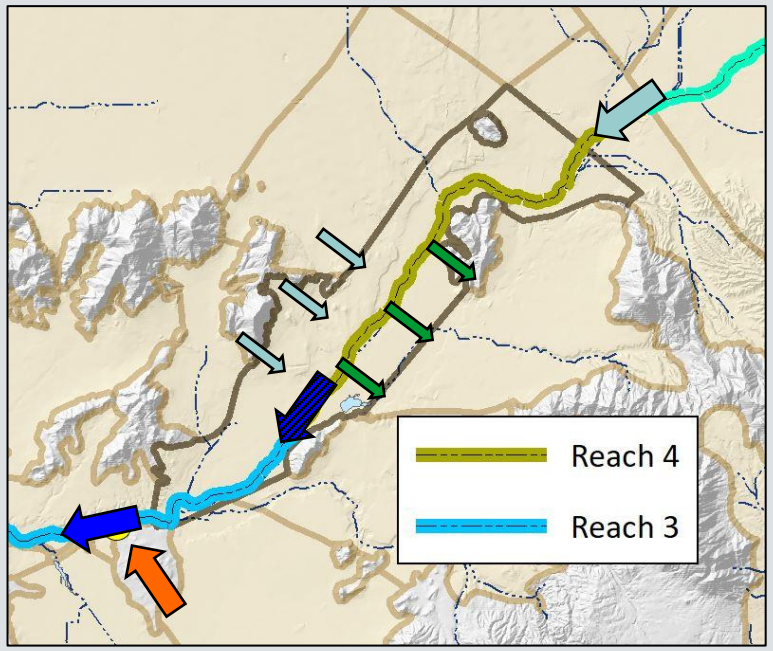
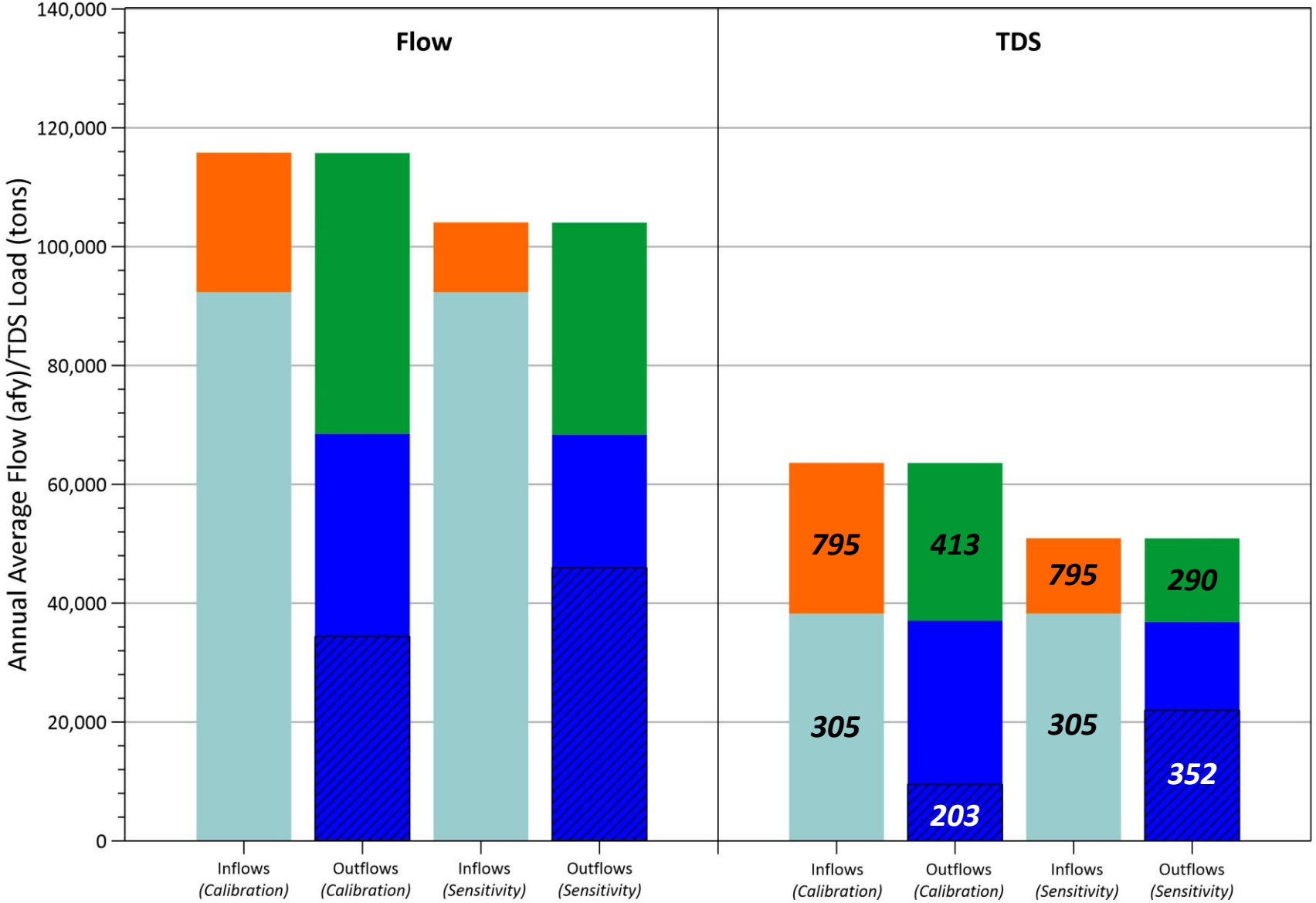


Other Inflows
Rising Water
ET
Flow at Riverside Narrows
Streambed Infiltration to Riverside-A GMZ
Flow from Reach 4 into Reach 3

Simulated components of Flow and TDS in the SAR overlying Riverside-A GMZ as evaluated in the 2017 WLAM sensitivity analysis



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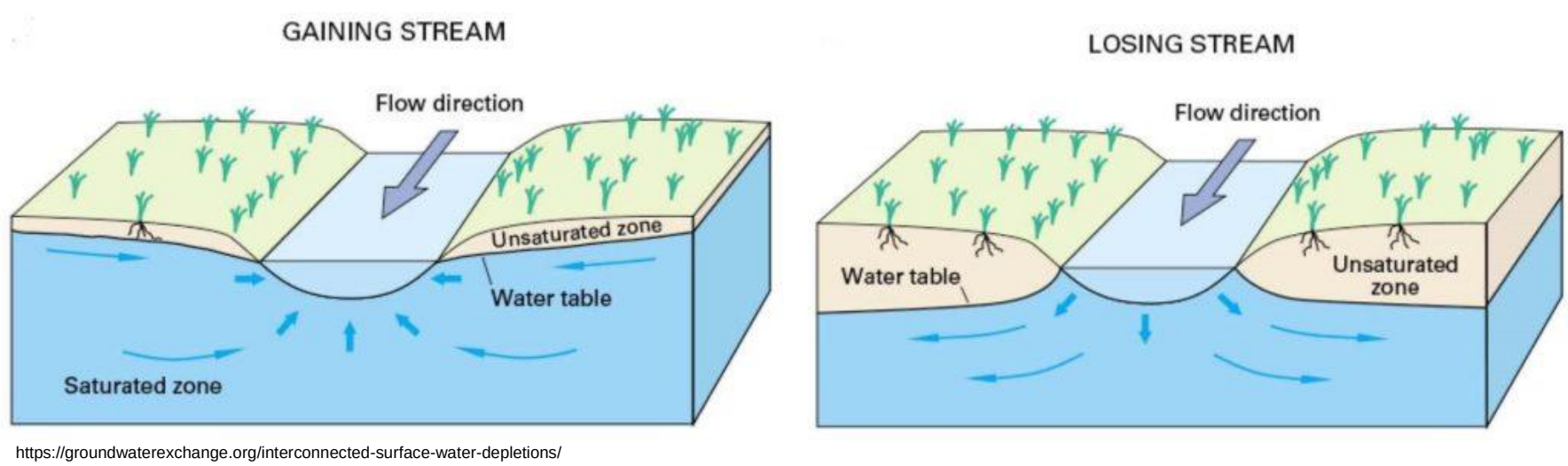
WLAM – Sensitivity Analysis

- Multiple combinations of streambed recharge and rising water can yield the same flow/quality at RN
- Monitoring data used for calibration leaves considerable uncertainty in the Santa Ana River dynamics

Groundwater Models - Assumptions

- MODFLOW simulates surface water/groundwater interaction
- Based on relationship between:
  - Water table depth
  - Streambed characteristics
  - Water level in stream



https://groundwaterexchange.org/interconnected-surface-water-depletions/

Integrated SAR Model (Geoscience, 2020)

- MODFLOW (plus HSPF) model developed for support of the Upper SAR Habitat Conservation Plan
- Domain covers entire SAR watershed tributary to Prado Dam
- Calibrated to flow in SAR at Prado Dam
- Calibration period: 1966 through 2016

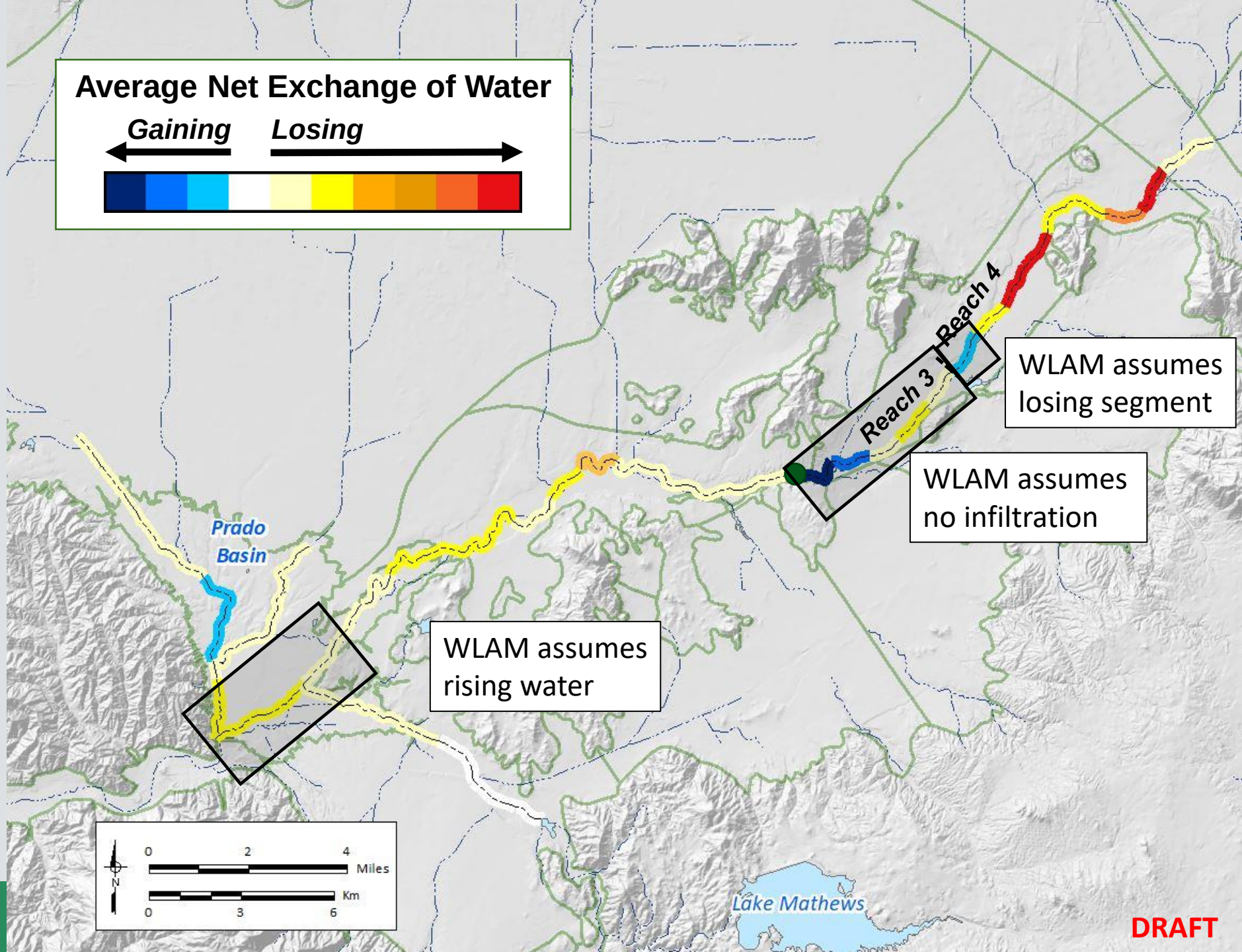
Chino Valley Model (WEI, 2020)

- MODFLOW (plus HSPF and R4) model developed for recalculation of Chino Basin Safe Yield and other studies
- Domain covers watershed tributary to Chino Basin to Prado Dam
- Calibrated to flow in SAR at Prado Dam
- Calibration period: 1978 through 2018

Analysis of Groundwater Models

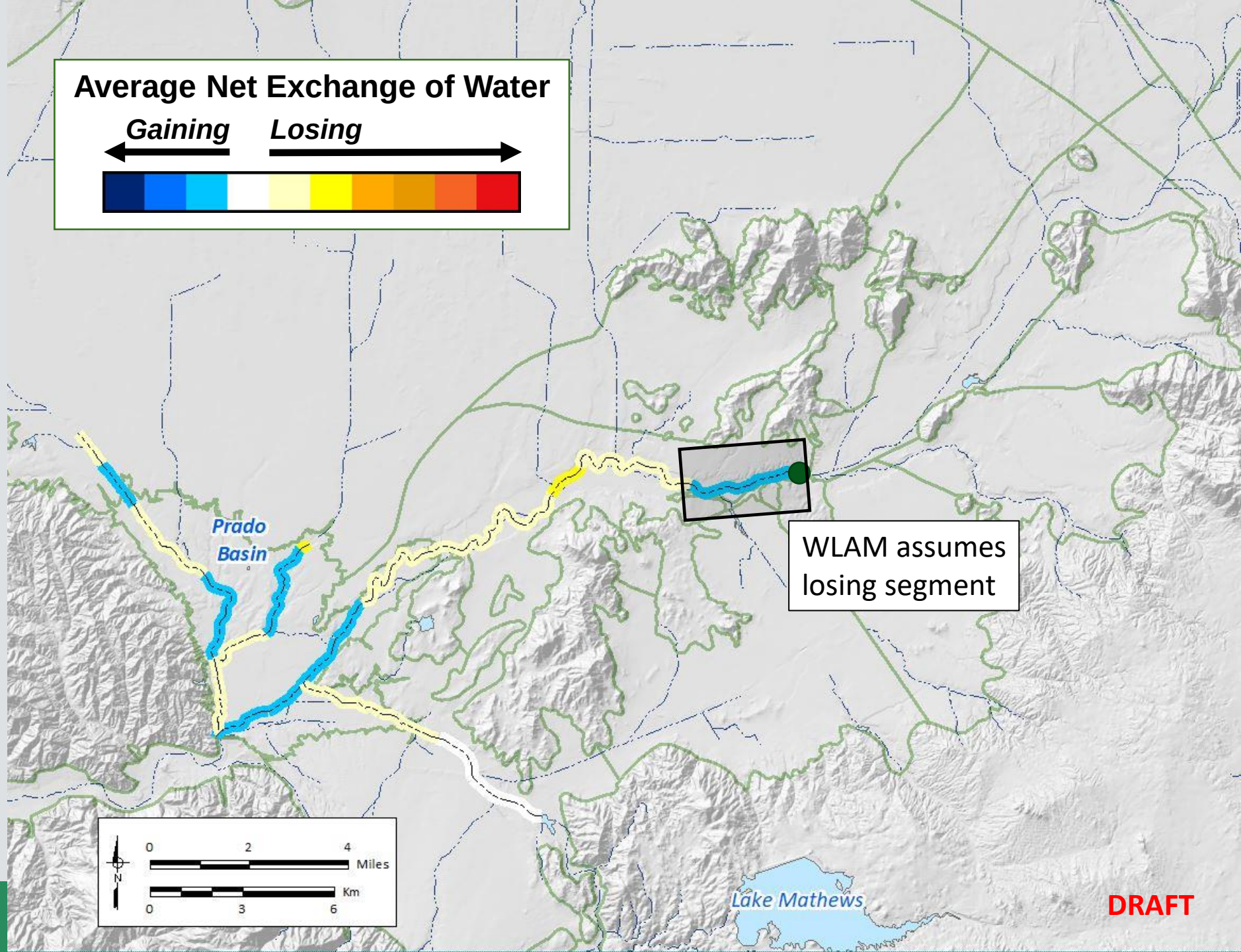
- Objective is to understand how model-estimated surface water-groundwater interaction compares to WLAM assumptions
  - Compared the average net exchange of water over the common period of analysis (WY 2007 through 2016)

Integrated Model



DRAFT

CVM


Average Net Exchange of Water
Gaining
Losing
Prado Basin
WLAM assumes losing segment
0
2
4
Miles
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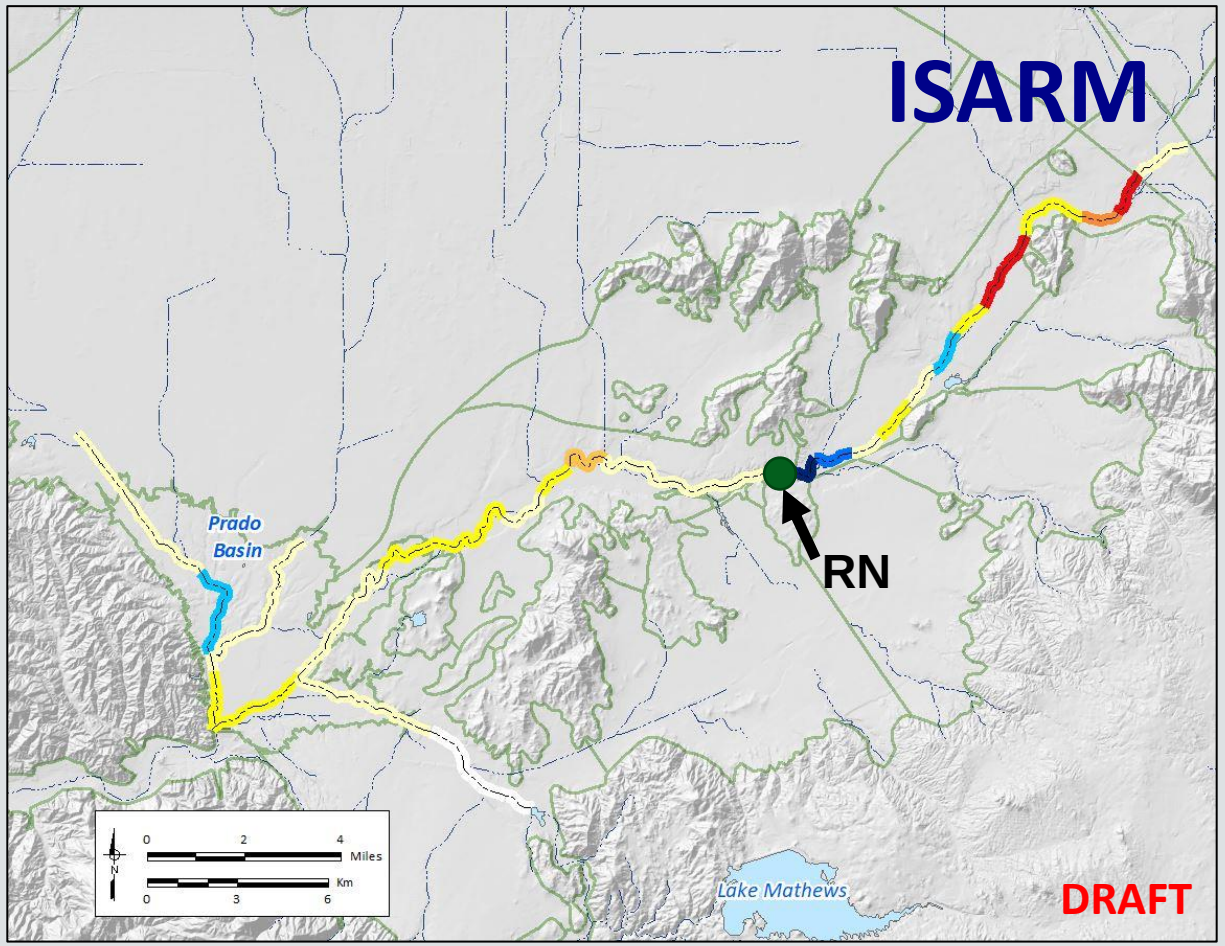
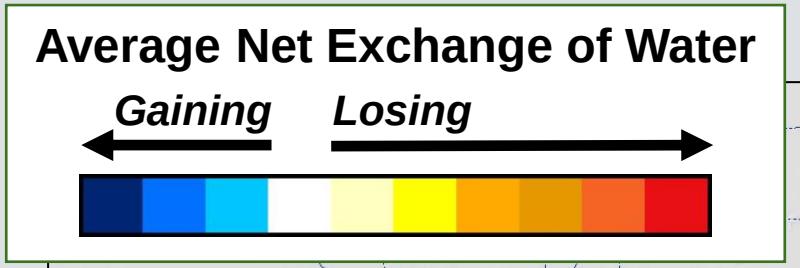
3
6
Lake Mathews
DRAFT

Comparison


ISARM
Prado Basin
RN
Lake Mathews
DRAFT
0 2 4 Miles
0 3 6 Km


Average Net Exchange of Water
Gaining
Losing

CVM
Prado Basin
RN
Lake Mathews
DRAFT
0 2 4 Miles
0 3 6 Km

How do the models inform the gaps in our understanding of the SAR?

- Multiple representations of the Santa Ana River can yield the same flow/quality at monitoring (calibration) points.
- Unknown quantity and quality of streambed infiltration or rising water; insufficient to understand the quality/quantity of water infiltrating into the GMZs
- The models that simulate groundwater-surface water interaction have results that disagree with the WLAM assumptions/results.
- Field data to understand these dynamics and represent them in a model is lacking.

How could the monitoring be improved to reduce these uncertainties?

- Monitoring objective is to better understand surface water-groundwater interactions as opposed to evaluating current compliance with objectives
- Special study to address these uncertainties can inform long-term monitoring program to support the calibration of modeling tools and assess annual compliance
- Potential improvements:
  - Expanding current surface water monitoring to include other locations and/or constituents (e.g., temperature)
  - Groundwater level/quality monitoring near the Santa Ana River to constrain groundwater-surface water interaction

Proposed Surface Water Monitoring Program Work Product

- Two elements:
  - Description of monitoring program needed to assess current compliance with the surface water objectives
  - Commitment to develop workplan for special monitoring studies that will improve our modeling and understanding of the dynamics of the Santa Ana River

Next Steps

- **Continue feedback on questions through March 2, 2022.**
  - Send to Veva Weamer vweamer@westyost.com or Garrett Rapp grapp@westyost.com

- **Late March/Early April 2022 -** Prepared Draft Technical Memorandum Surface Water Monitoring Requirements and Goals for the Santa Ana River Watershed

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Options for Definition of Base Flow Conditions in the Santa Ana River for Assessment of Compliance with the Reach 3 Surface Water Objectives

May 24, 2022

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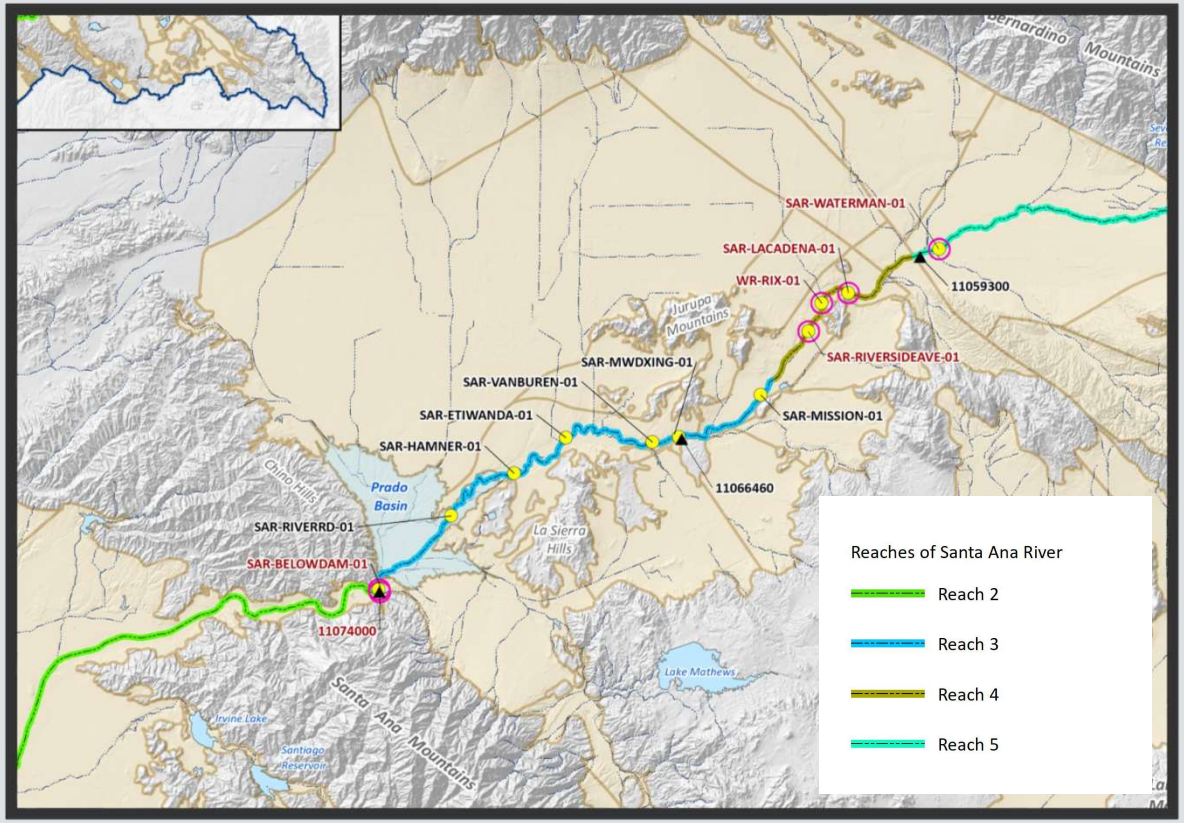
Task 1 – Prepare Updated Surface Water Monitoring Program for TDS/N for Santa Ana Reaches 2, 3, 4, and 5



2022 Workshops for Task 1 - For each Reach we reviewed:

- The TDS/N Objectives defined in Basin Plan
- Metrics for compliance
- The data collected and used
- What is objective protecting
- If the data collected and analyzed is sufficient to access compliance

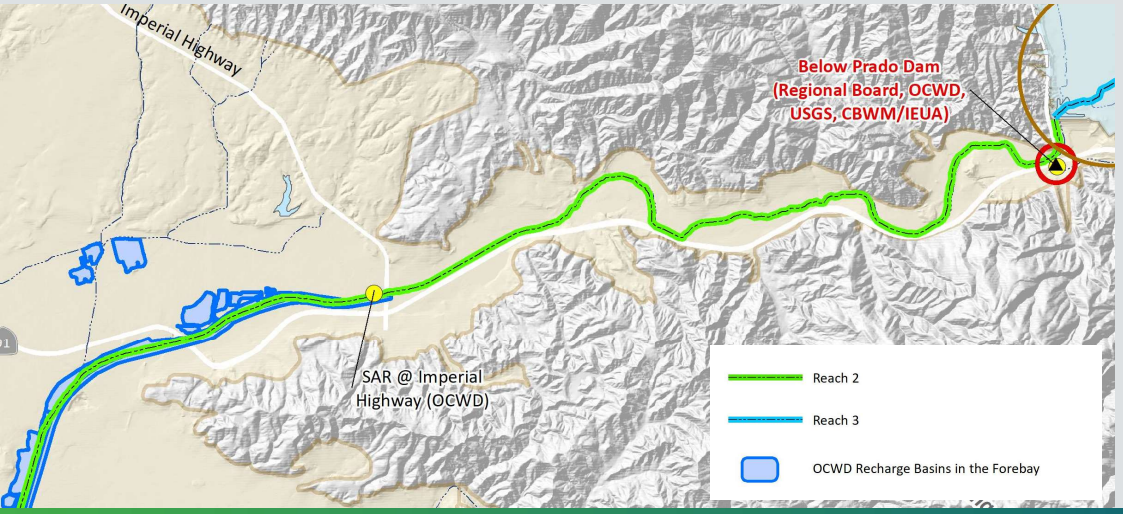
Task 1 – Prepare Updated Surface Water Monitoring Program for TDS/N for Santa Ana Reaches 2, 3, 4, and 5

Reach 2 Surface Water Objectives:

TDS = 650 mgl
TIN = N/A

Basin Plan Description: "*Reach 2 will be based on the five-year moving average of the annual TDS content of total flow.*"

"*The Watermaster's* [SARWM] *annual determination of total flow quality [at Prado] will be used to determine compliance with the total flow objective…*"



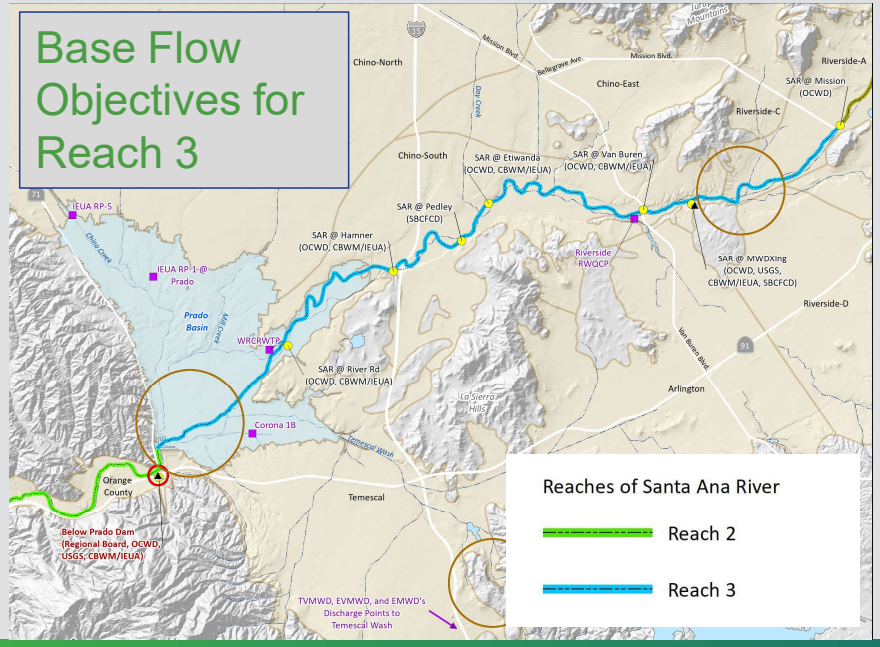
2022 Workshops for Task 1:

- Questions on how TDS/N Objectives and assessment of Objectives are described in the Basin Plan
- Regional Board's need for alignment of monitoring and assessment for Basin Plan and the 303D Listing
- Basin Plan should better clarify the required monitoring and assessment of the TDS/N Objectives
- "Base Flow" – better characterization and definition needed in Basin Plan to assess compliance with Reach 3 TDS/N Objective

Characterization of Santa Ana River Base Flow Conditions in Reach 3

Perform analysis to define Base Flow Conditions in Reach 3, and based on those conditions what data can be used to assess compliance with the Reach 3 TDS/N Objectives

Purpose: potential update to the Basin Plan to better describe what are the conditions in Reach 3 that define Base Flow and data that can be used to assess compliance



Steps:

- Look at daily data to define when there are Base Flow conditions
- With defined baseflow conditions→ evaluate the available data that can be used to assess compliance for Reach 3.
- Perform assessment of compliance with Reach 3 TDS Objective with all Base Flow data
- Determine monitoring needed for compliance

Basin Plan Description of Reach 3 Monitoring and Assessment of Base Flow Surface Water Objectives

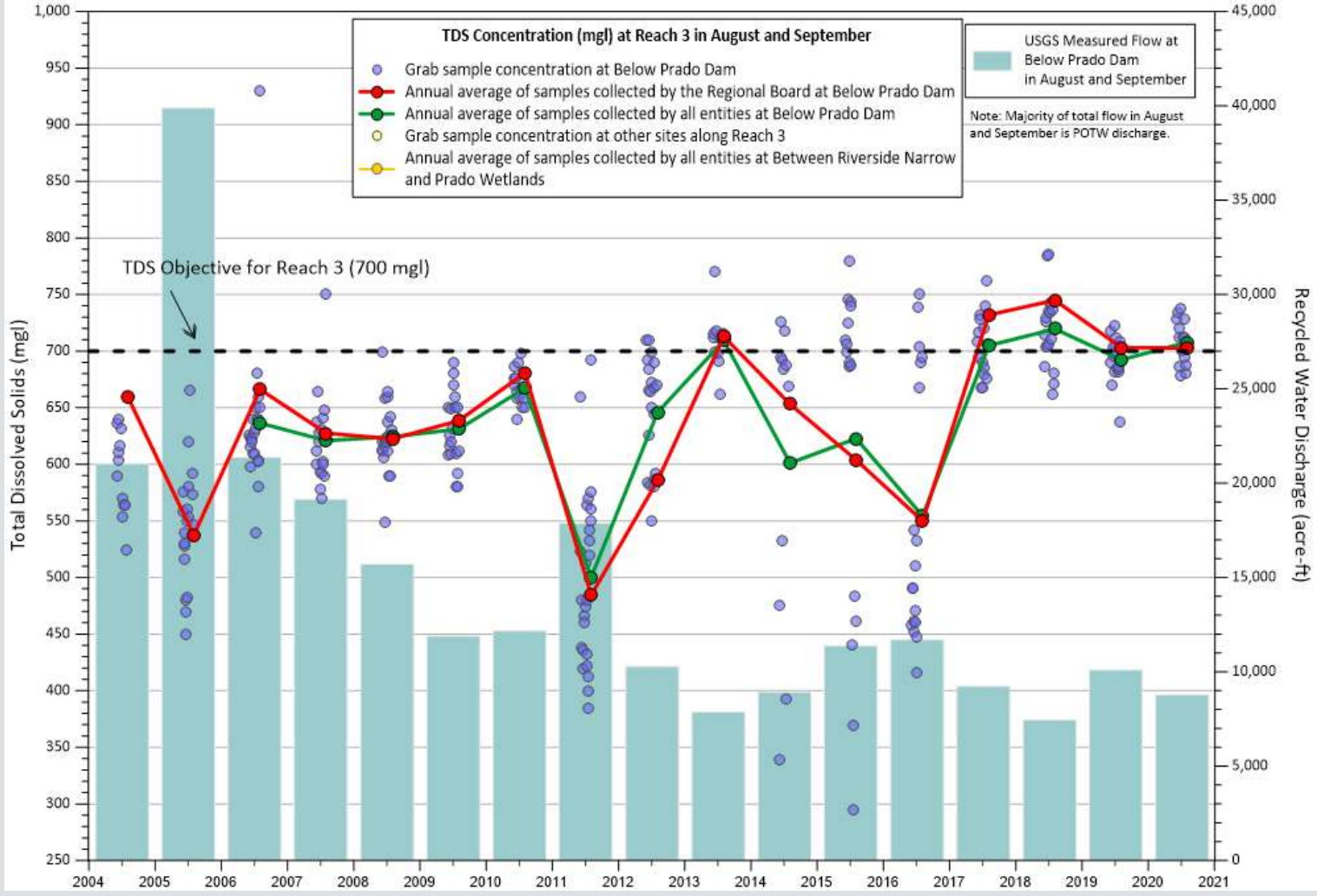
Page 4-28 of the Basin Plan:

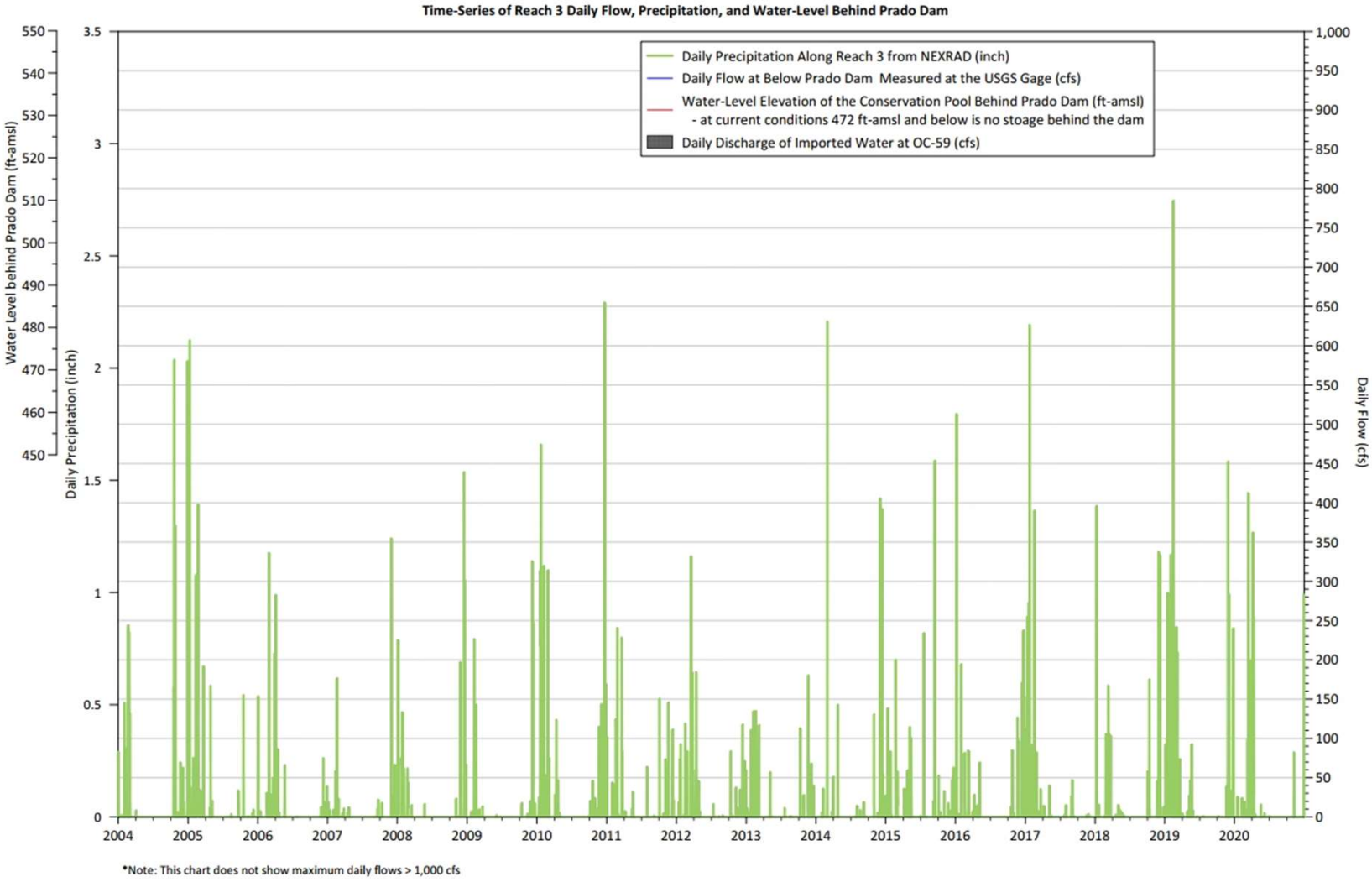
may reach the River via Temescal Creek. Most storms occur during the winter rainy season (December through April). Base flow is composed of wastewater discharges, rising groundwater, and nonpoint source discharges. Wastewater discharges are the

Page 4-29 of the Basin Plan:

In order to determine whether the water quality and quantity objectives for base flow in Reach 3 are being met, the Regional Board will collect a series of grab and composite samples when the influence of storm flows and nontributary flows is at a minimum. This typically occurs during August and September. At this time of year, there is usually no water impounded behind Prado Dam. The volumes of storm flows, rising water and nonpoint source discharges tend to be low. The major component of base flow at this time is municipal wastewater. The results of this sampling will be compared with the continuous monitoring data collected by USGS and data from other sources. These data will be used to evaluate the efficacy of the Regional

Figure X. Time-Series of TDS concentrations and Compliance Determination of Base Flow at Below Prado Dam in August and September at the Santa Ana River Reach 3



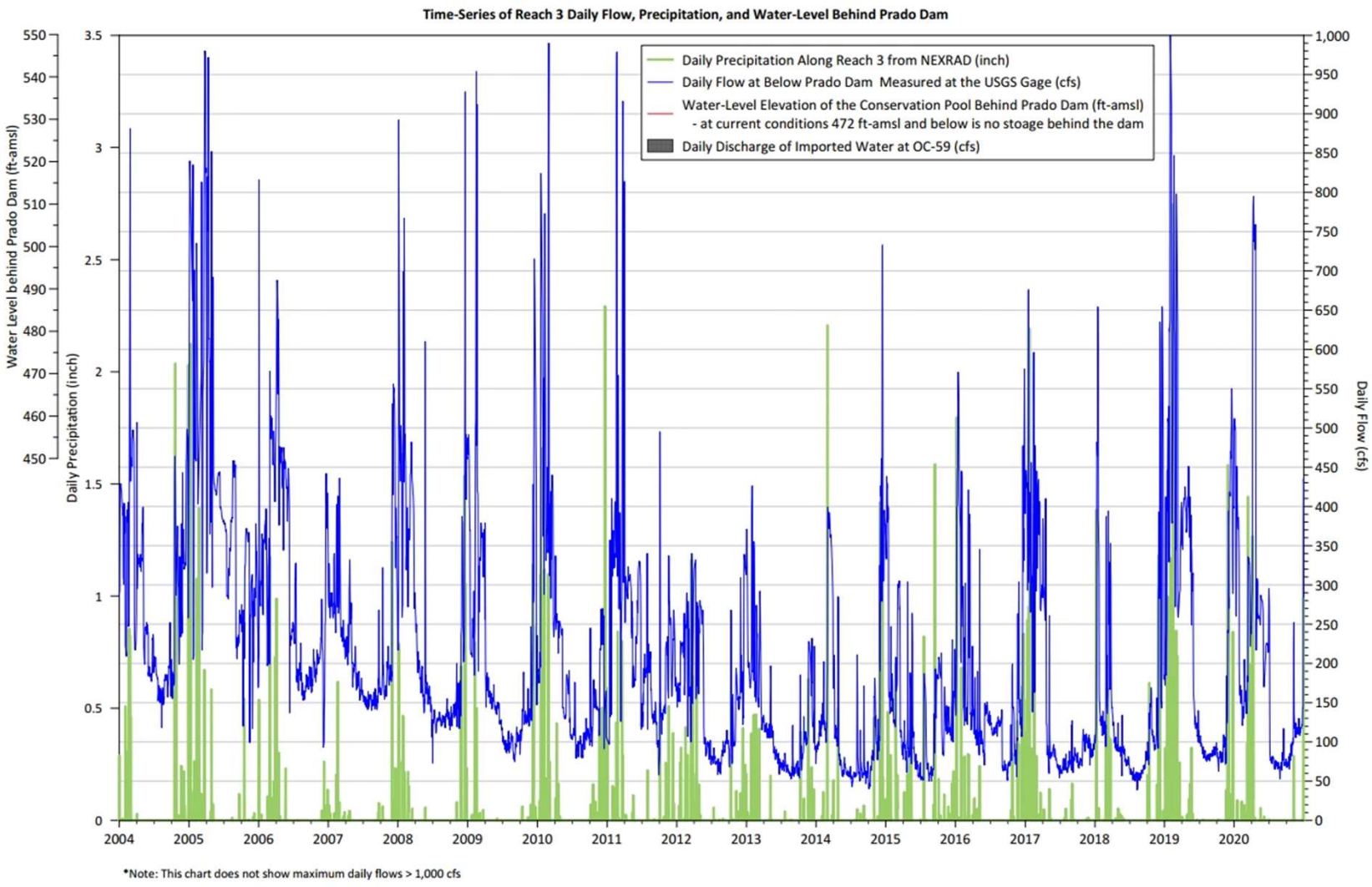


Look at Daily Data to Define When There are Base Flow Conditions.

Basin Plan language:

"… the influence from storm flows and non-tributary flows is at a minimum."

"…usually no water impounded behind Prado Dam"



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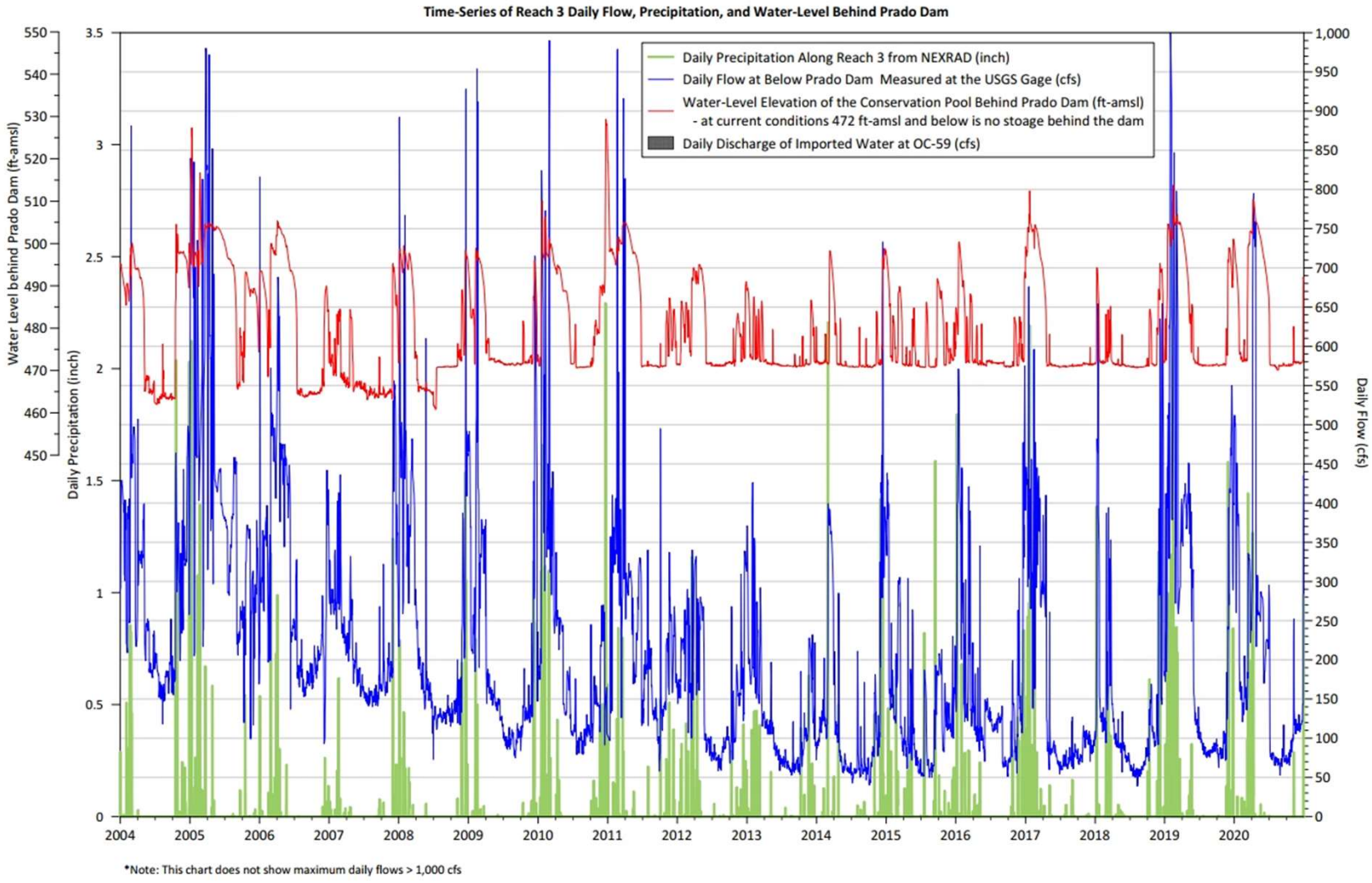

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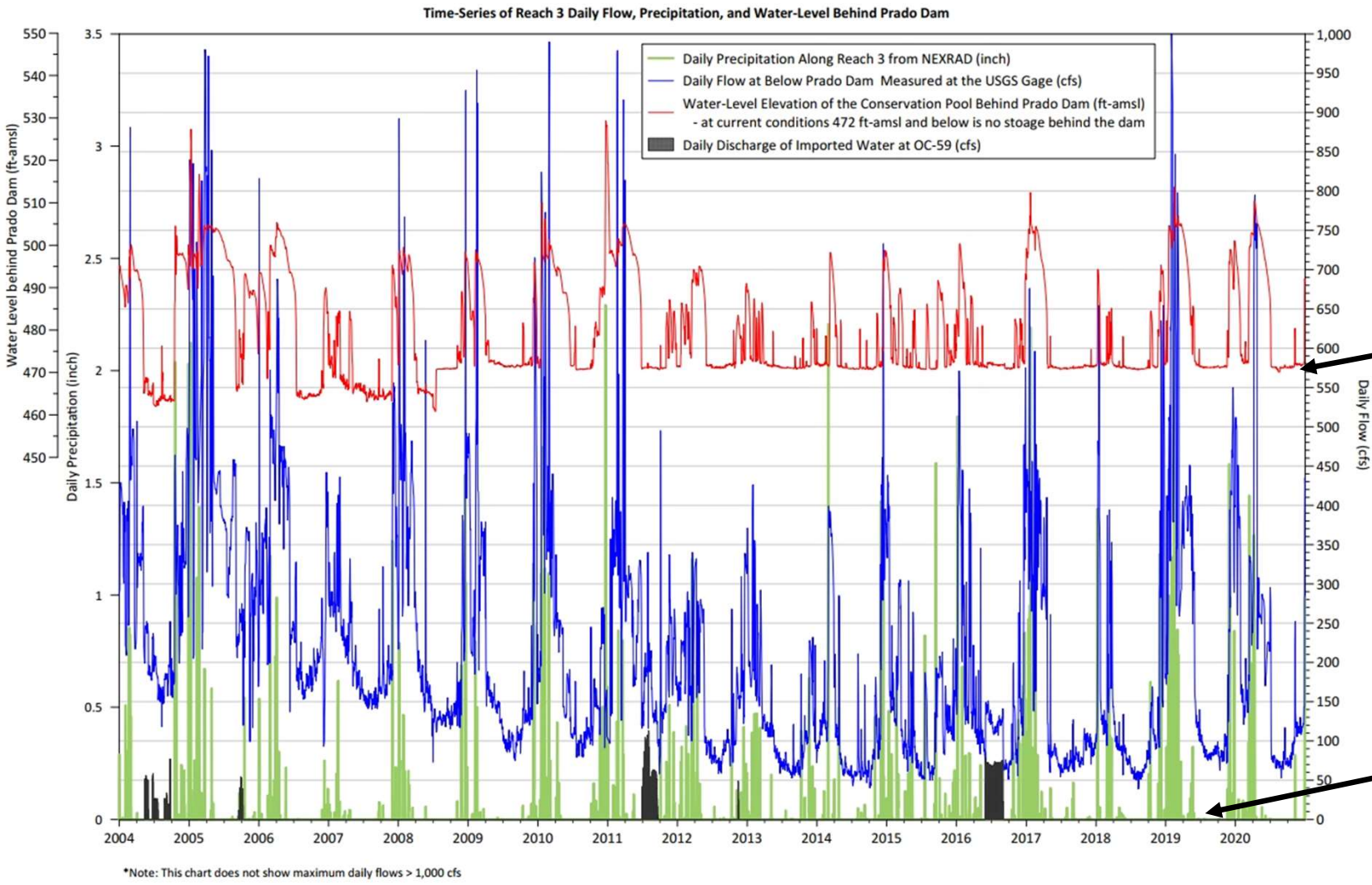
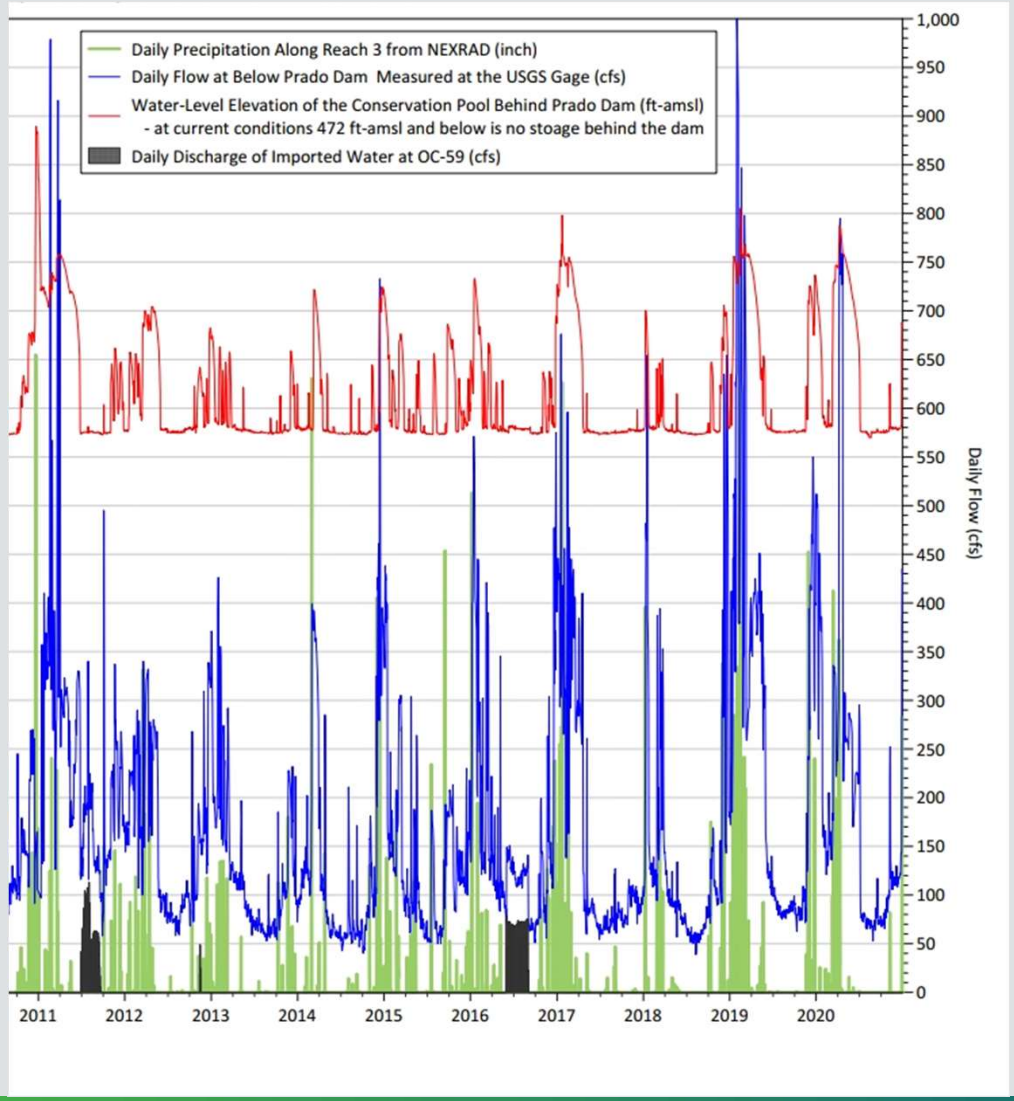


Baseflow Conditions

Water-level elevation at and below 472 ft-amsl is the condition where there is no storage pool behind the dam

No precipitation events or OC-59 discharge (non-tributary flow)



Look at Daily Data to Define When There are Base Flow Conditions

Base Flow Conditions in Reach 3 can be defined as days where:

- There were no precipitation events or OC-59 discharge in the last 4 days
  - *The time of concentration is* the time it takes for runoff from the most distant upstream part of the watershed to reach a specified point of interest → *The time of concentration to Prado Dam for the Santa Ana River is estimated to be between 1 to 2 days.*
- Water-level elevation behind Prado Dam is below 472 ft-amsl (no storage pool behind dam)

Summary of Annual Days and Months with Base Flow Conditions

Year	# of Days	# of Months	Months
2004	67	6	May-Oct
2005	11	1	Sep
2006	132	6	Jul-Dec
2007	223	9	Mar-Dec
2008	199	8	Apr-Nov
2009	138	9	Feb, May-Dec
2010	107	6	Jan, Jun-Oct
2011	36	5	Jun, Sep-Dec
2012	132	6	Jan, Jun-Oct
2013	187	9	Apr-Dec
2014	194	12	Jan-Dec
2015	119	10	Feb-Sep, Nov-Dec
2016	74	8	Feb-May, Sep-Nov
2017	209	9	Apr-Dec
2018	203	11	Jan-Feb, Apr-Dec
2019	120	6	Jun-Nov
2020	155	6	Jul-Dec

Look at Daily Data to Define When There are Base Flow Conditions

Base Flow Conditions in Reach 3 can be defined as days where:

- There were no precipitation events or OC-59 discharge in the last 4 days
- Water-level elevation behind Prado Dam is below 472 ft-amsl (no storage pool behind dam)

Evaluate Data that Can be Used to Assess Compliance with Reach 3 SW Objectives

With defined Base Flow Conditions→ evaluate available data that can be used to assess Reach 3 compliance

Compliance monitoring location for Reach 3 is ***Below Prado Dam*** →the Reach 3 SW Objectives are intended to protect Orange County GMZ

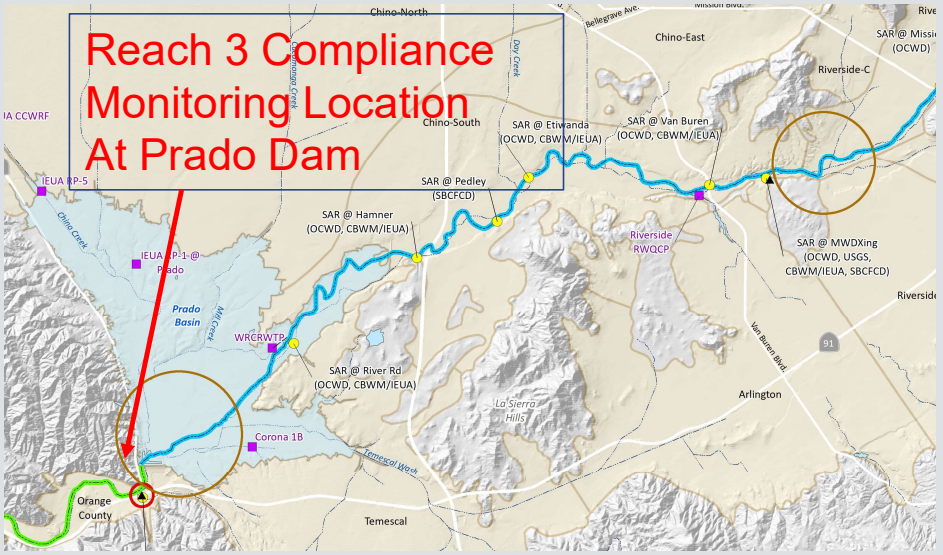
Multiple entities monitor at ***Below Prado Dam***:

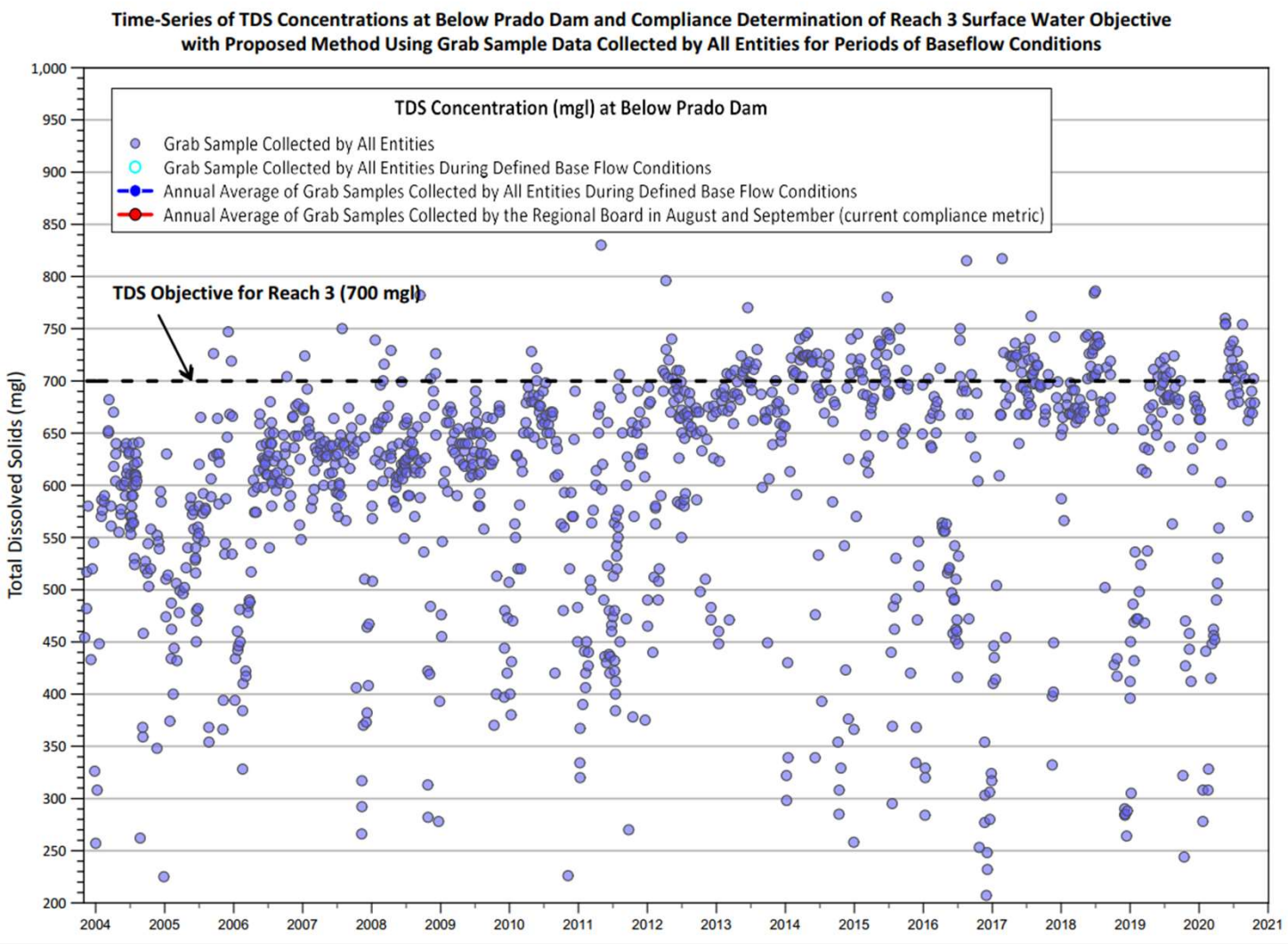
1) Grab samples collect by multiple entities:

- Regional Board (~5 samples in August-September)
  * current samples used for compliance
- OCWD (1-2 samples a month)
- USGS (1-3 samples a month)

2) Daily EC measurements at the USGS gage that can be used to calculate daily TDS

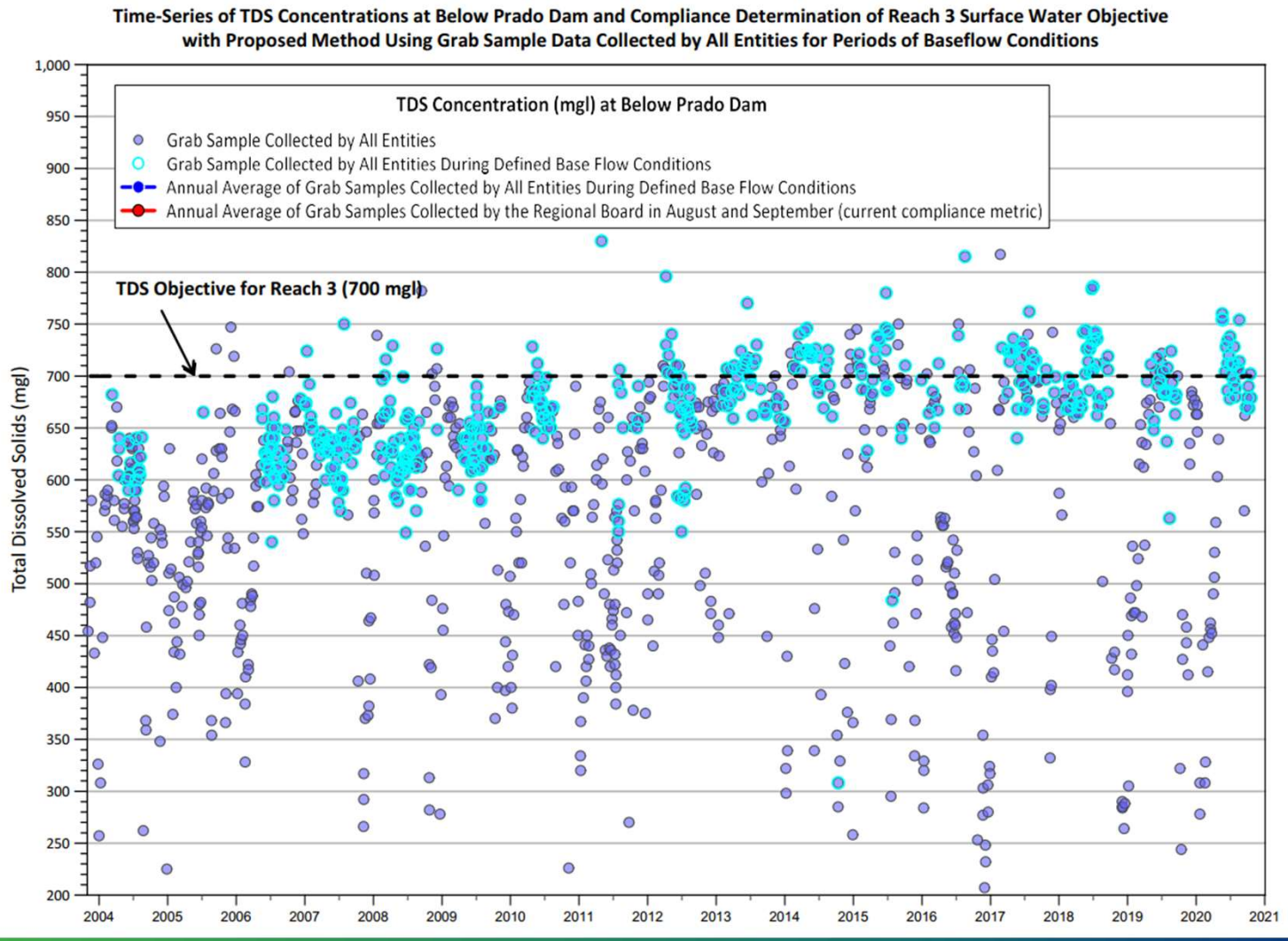
Next: Assess compliance with all available data for 1 & 2 during defined Base Flow Conditions





Perform Assessment of Compliance with Reach 3 SW Objectives with All Available Data During Base Flow Conditions

- All Grab Samples Collected by Multiple Entities



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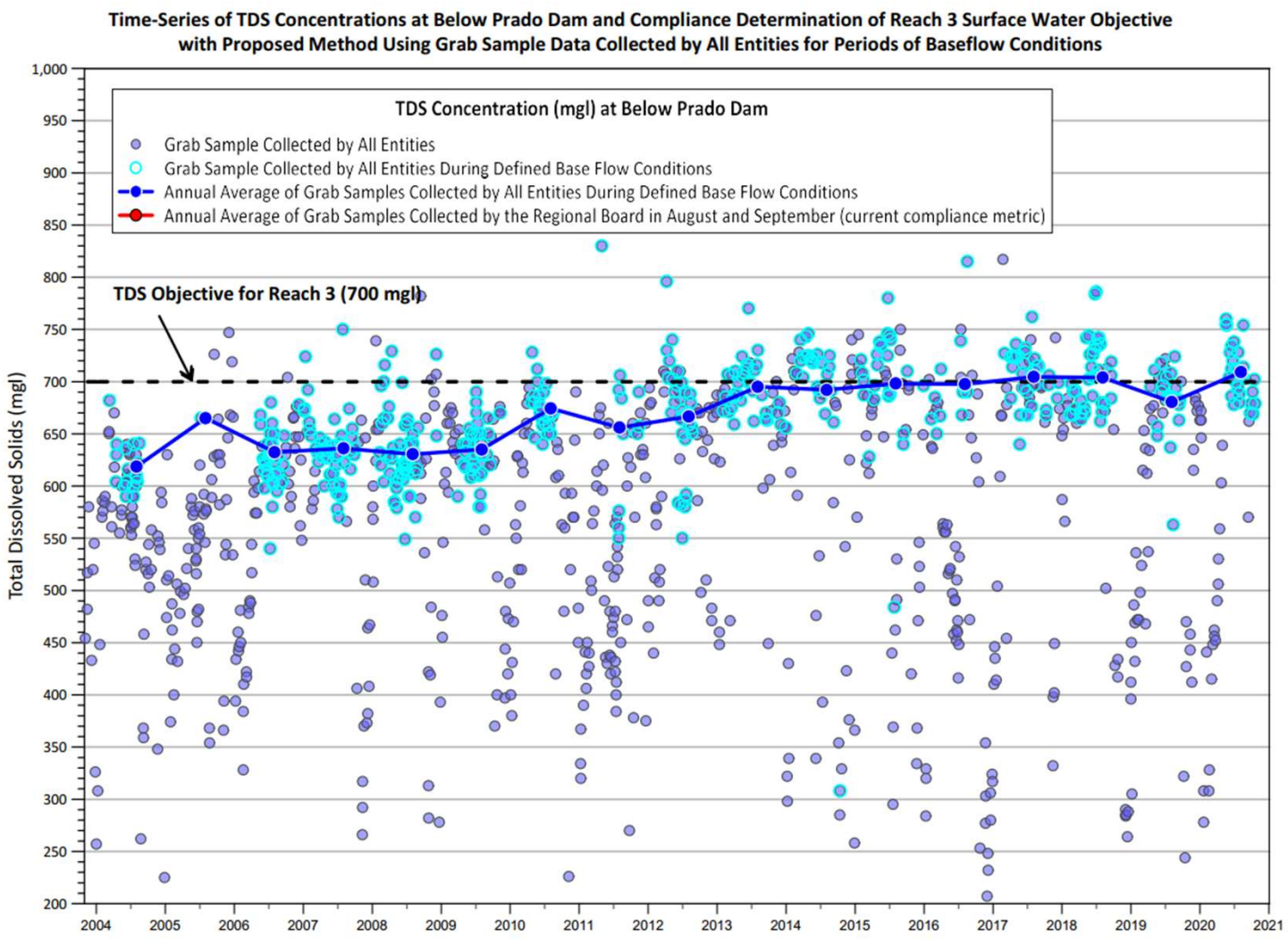

Perform Assessment of Compliance with Reach 3 SW Objectives with All Available Data During Base Flow Conditions

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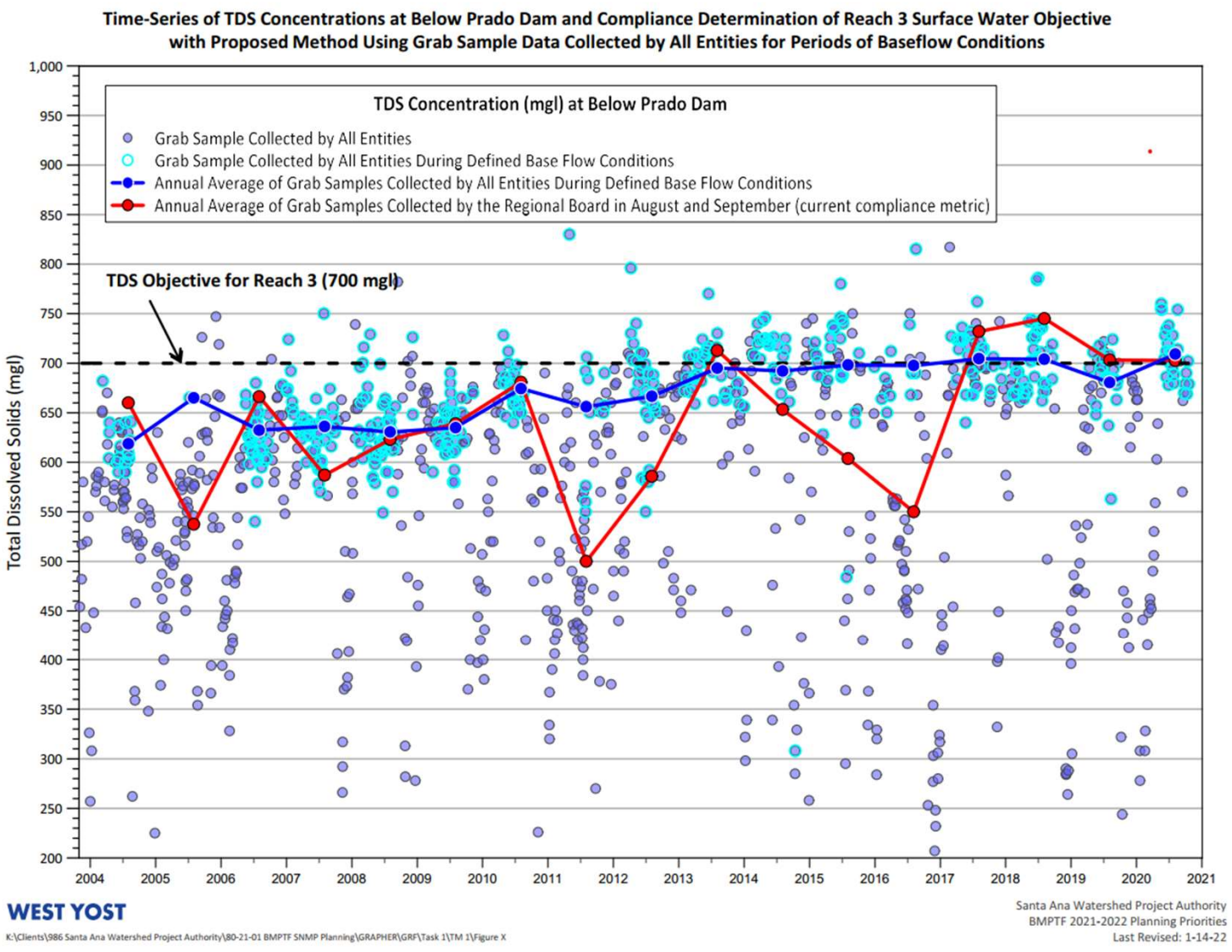

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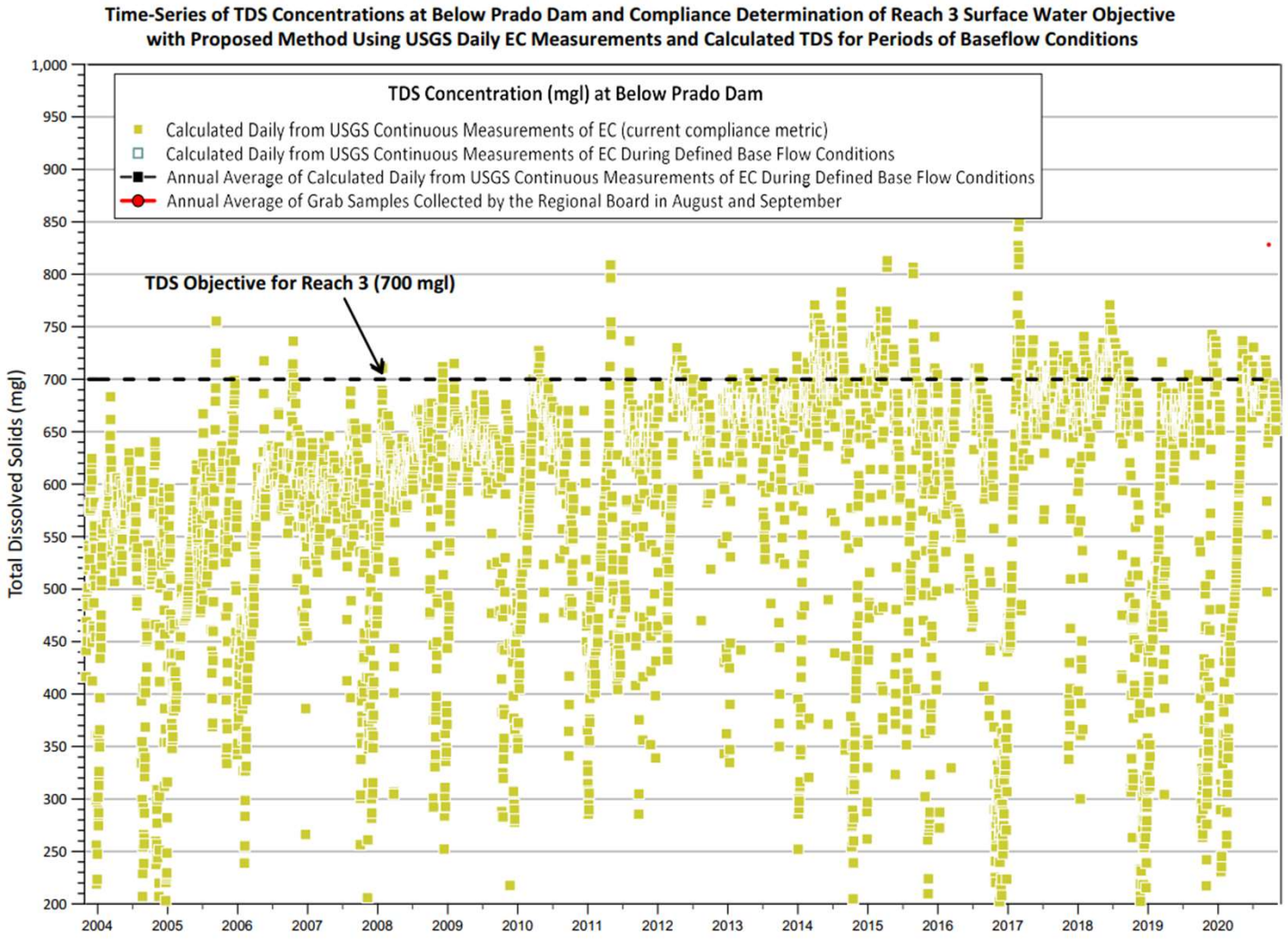
K:\Clients\986 Santa Ana Watershed Project Authority\80-21-01 BMPTF SNMP Planning\GRAPHER\GRF\Task 1\TM 1\Figure X

Santa Ana Watershed Project Authority
BMPTF 2021-2022 Planning Priorities
Last Revised: 1-14-22

Perform Assessment of Compliance with Reach 3 SW Objectives with All Available Data During Base Flow Conditions

- All Grab Samples Collected by Multiple Entities



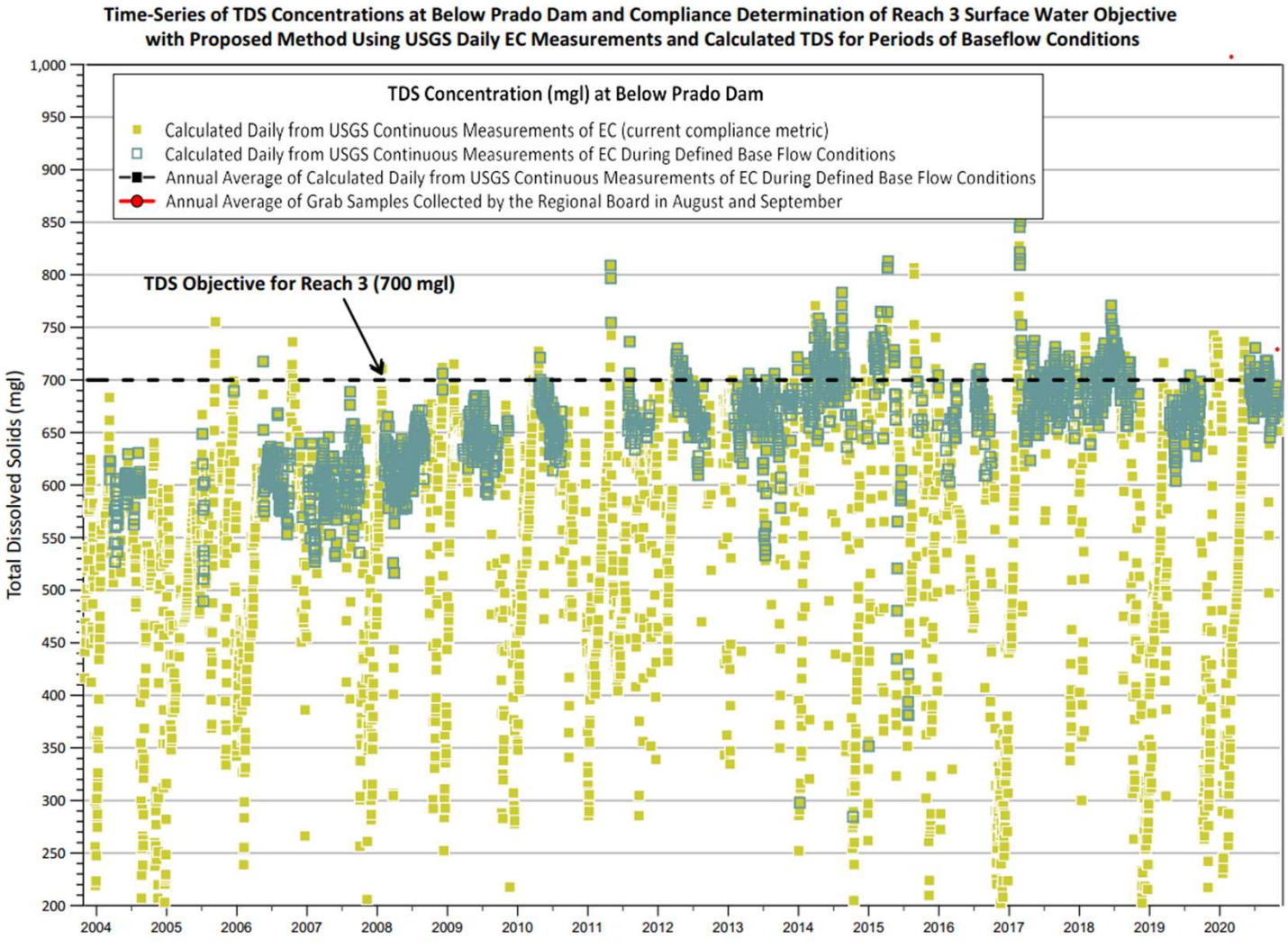
Perform Assessment of Compliance with Reach 3 SW Objectives with All Available Data During Base Flow Conditions

- All Calculated Daily TDS from the USGS EC Measurements

Use the average TDS/EC Ratio from grab samples to calculate daily TDS

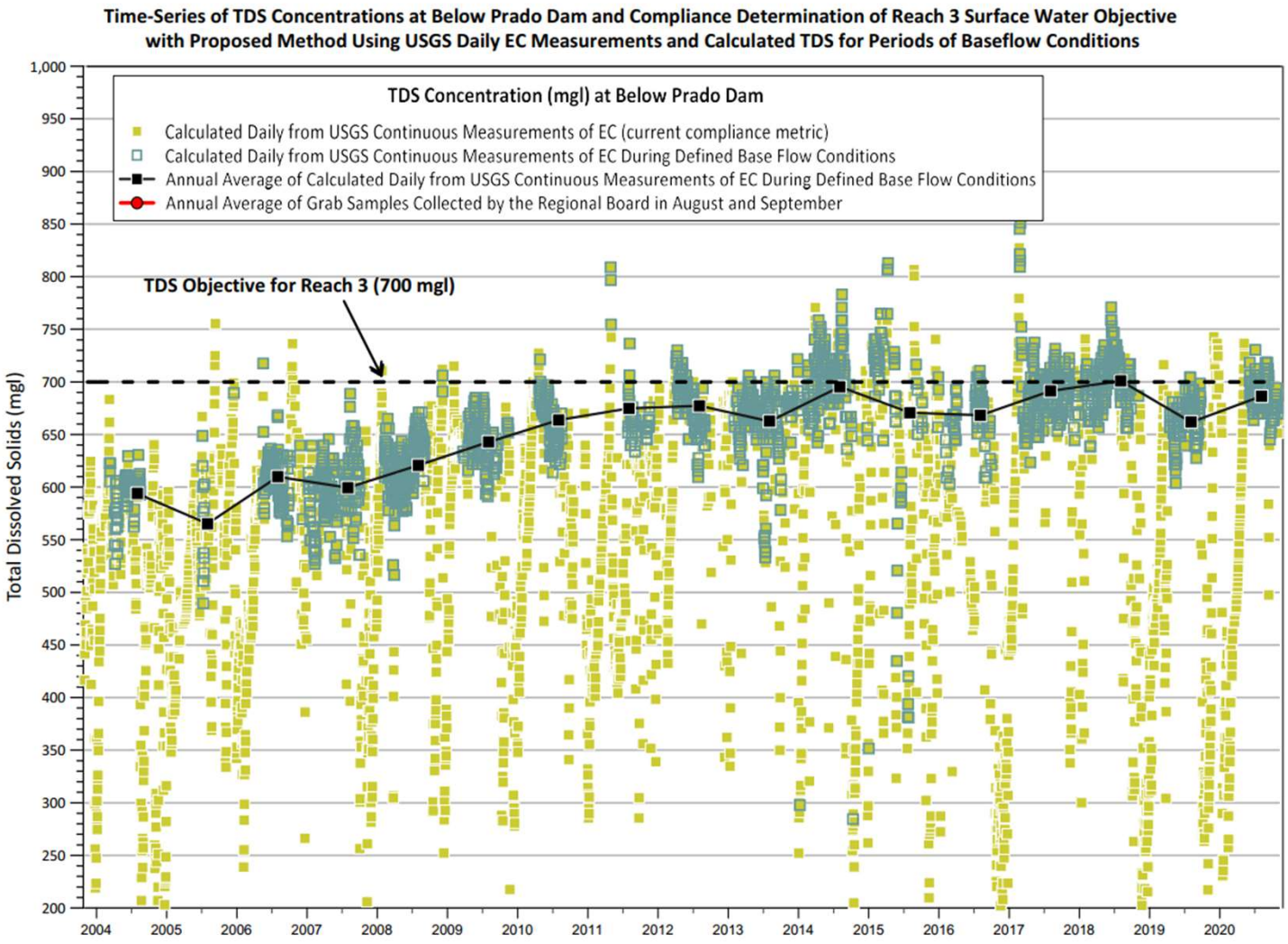
October 2018

Day	Prado Outflow (cfs)	Daily Mean EC (microsiemens/cm)	Computed TDS [1]
1	84	1,130	676
2	83	1,100	658
3	81	1,110	664
4	100	1,090	652
5	91	1,070	640
6	80	1,100	658
7	77	1,130	676
8	81	1,140	681



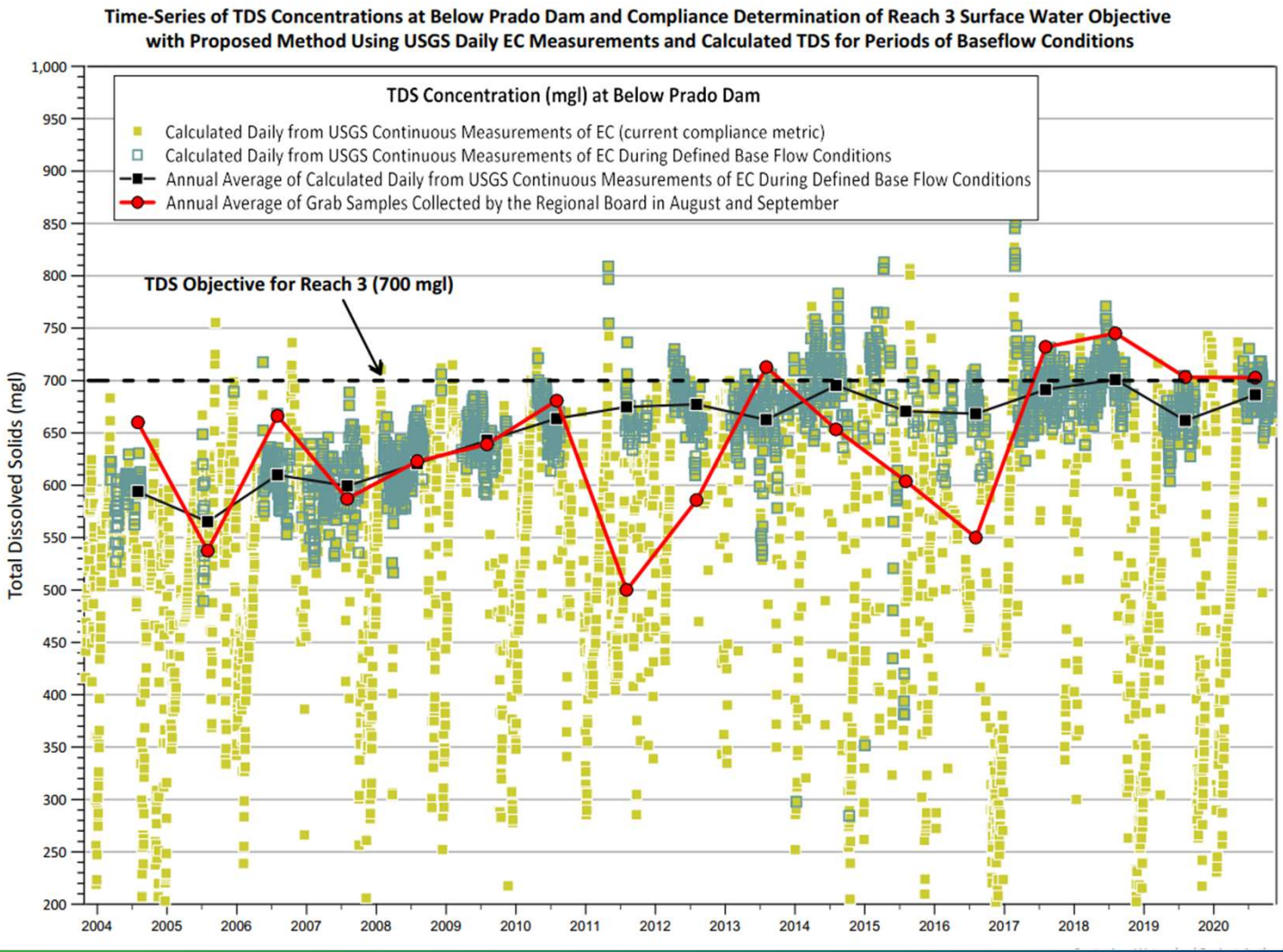
Perform Assessment of Compliance with Reach 3 SW Objectives with All Available Data During Base Flow Conditions

- All Calculated Daily TDS from the USGS EC Measurements



Perform Assessment of Compliance with Reach 3 SW Objectives with All Available Data During Base Flow Conditions

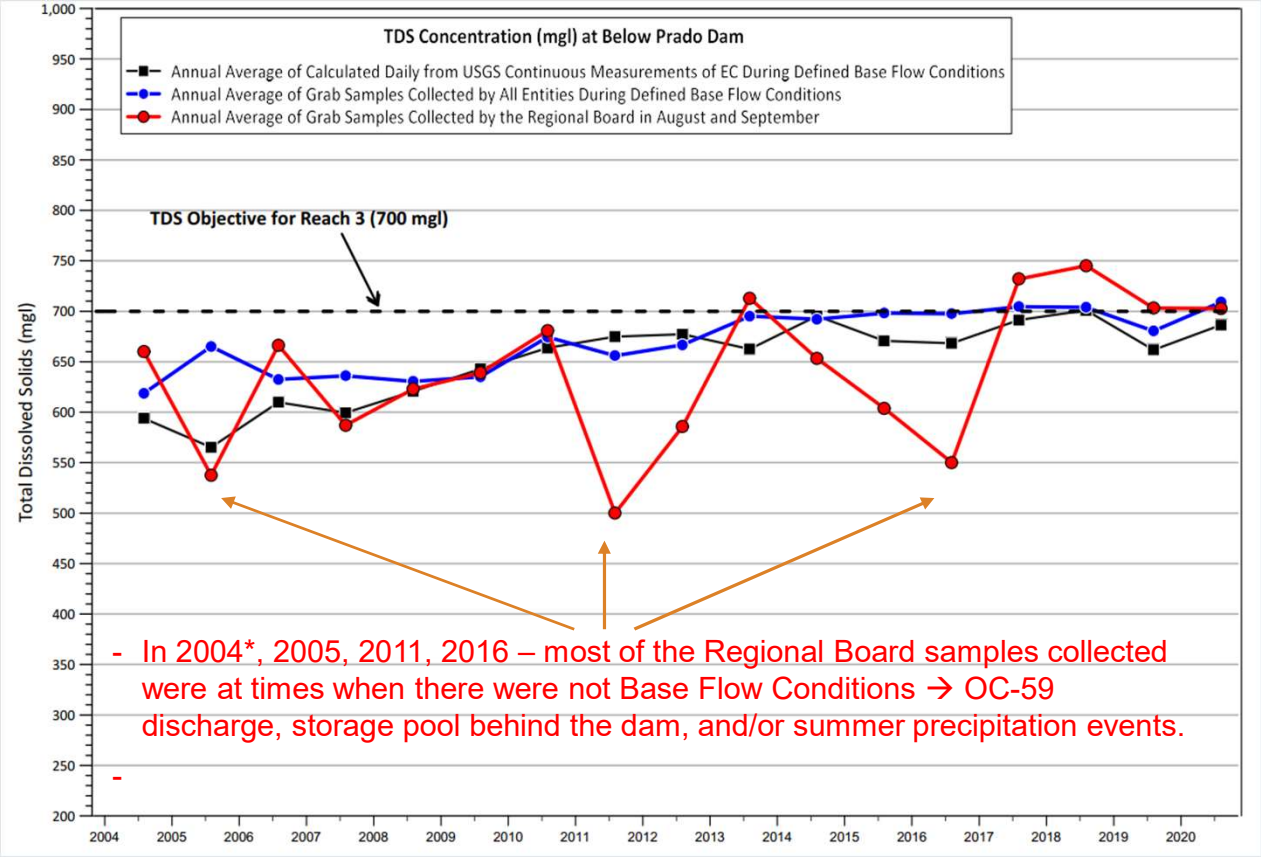
- All Calculated Daily TDS from the USGS EC Measurements



Perform Assessment of Compliance with Reach 3 SW Objectives with All Available Data During Base Flow Conditions

- All Calculated Daily TDS from the USGS EC Measurements

Comparison of Proposed Methods Using all Data for Defined Baseflow Conditions versus Samples Collected by the Regional Board (current method)



Summary of Number of Data Points for the Regional Board Samples and the Two Options for Defined Base Flow Samples

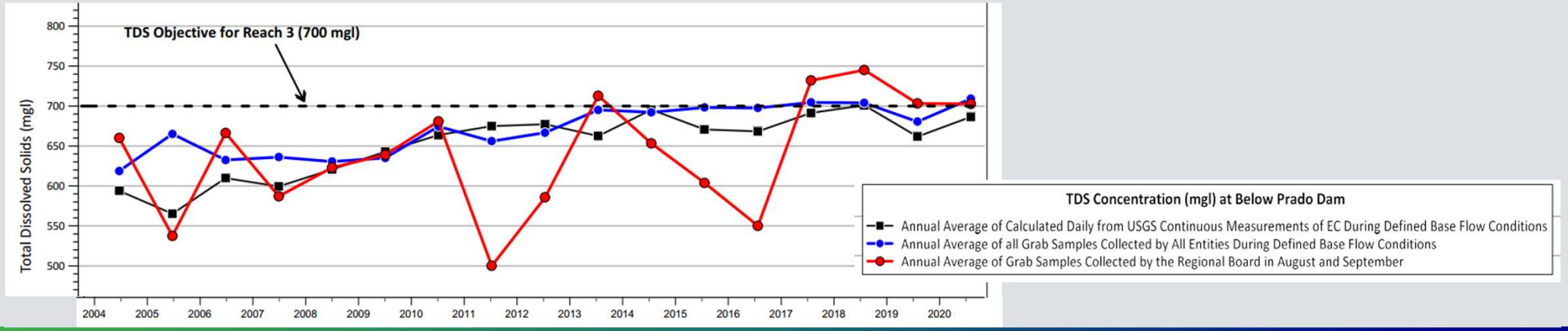
Year	Number of Data Points		
	Regional Board Grab Samples - In Aug/Sept *	Grab Samples by All Entities - During Base Flow Conditions	From Daily USGS Measurements of EC - During Base Flow Conditions
2004	8 (4)	17	67
2005	8 (0)	1	11
2006	8 (8)	33	98
2007	4 (4)	49	164
2008	4 (4)	53	196
2009	7 (7)	36	133
2010	5 (5)	24	107
2011	7 (2)	8	36
2012	7 (6)	34	132
2013	5 (4)	30	187
2014	5 (3)	29	194
2015	5 (3)	24	70
2016	5 (0)	12	74
2017	6 (4)	32	198
2018	6 (6)	40	201
2019	5 (3)	21	116
2020	3 (3)	27	130

(x) – # of Regional Board Aug/Sept samples during Base Flow Conditions

* Current method to assess compliance with Reach 3 objectives

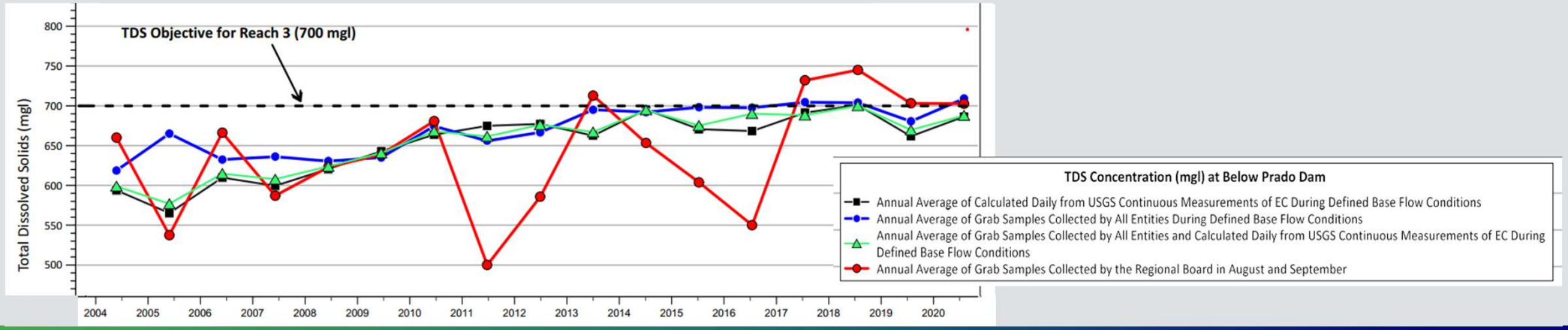
Options for Monitoring and Assessment of Compliance – TDS Reach 3

- **Current Method:** Average of Regional Board grab samples collected in August/September
- **Option A:** Define Base Flow conditions; and use data from **grab samples** collected during Base Flow conditions
- **Option B:** Define Base Flow conditions; and use data from USGS **daily** EC **measurements** collected during Base Flow conditions
- **Option AB:** Define Base Flow conditions; and use data from **grab samples** and USGS **daily** EC **measurements** collected during Base Flow conditions

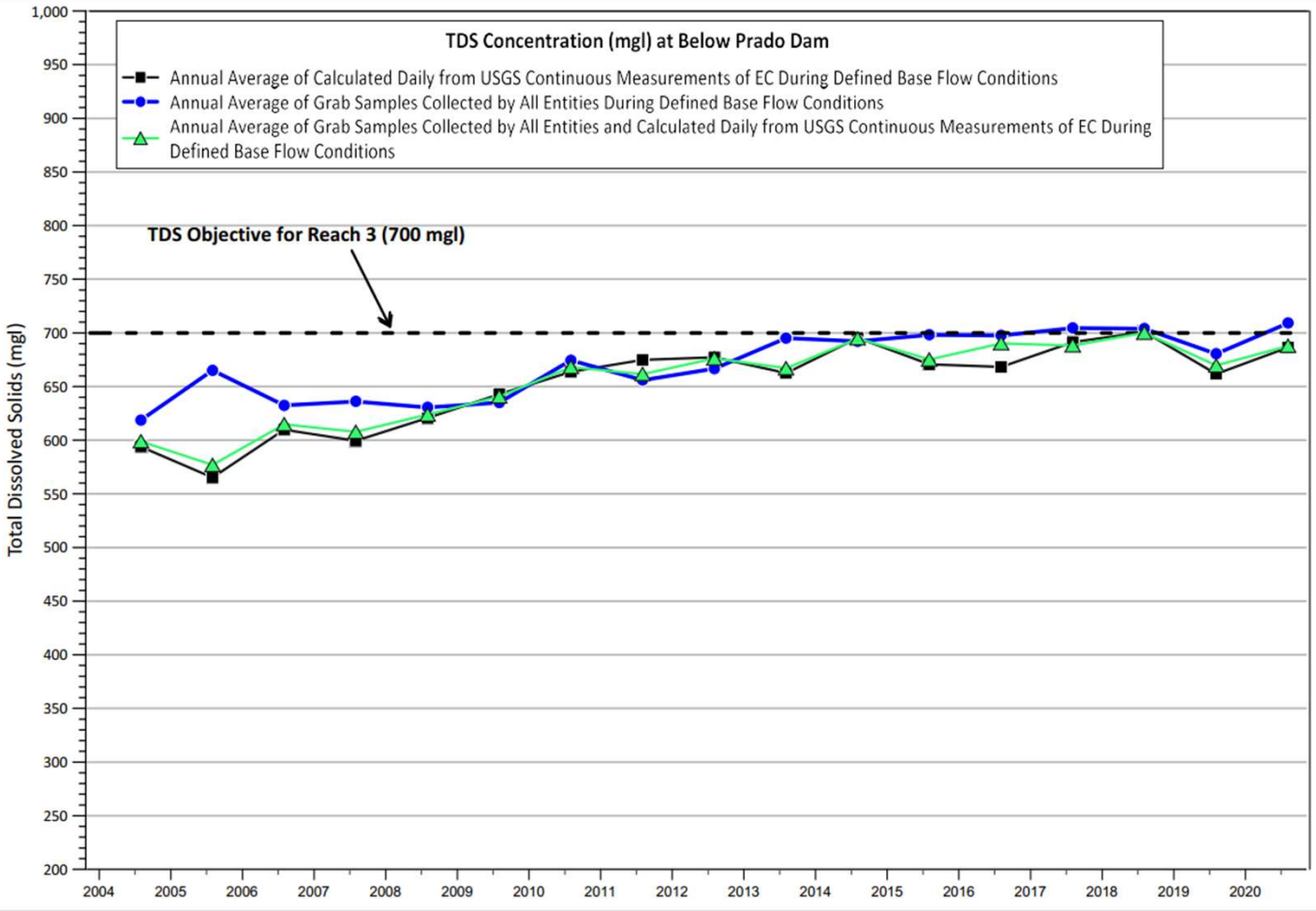


Options for Monitoring and Assessment of Compliance - TDS

- **Current Method:** Average of Regional Board grab samples collected in August/September
- **Option A:** Define Base Flow conditions; and use data from **grab samples** collected during Base Flow conditions
- **Option B:** Define Base Flow conditions; and use data from USGS **daily** EC **measurements** collected during Base Flow conditions
- **Option AB:** Define Base Flow conditions; and use data from **grab samples** and USGS **daily** EC **measurements** collected during Base Flow conditions

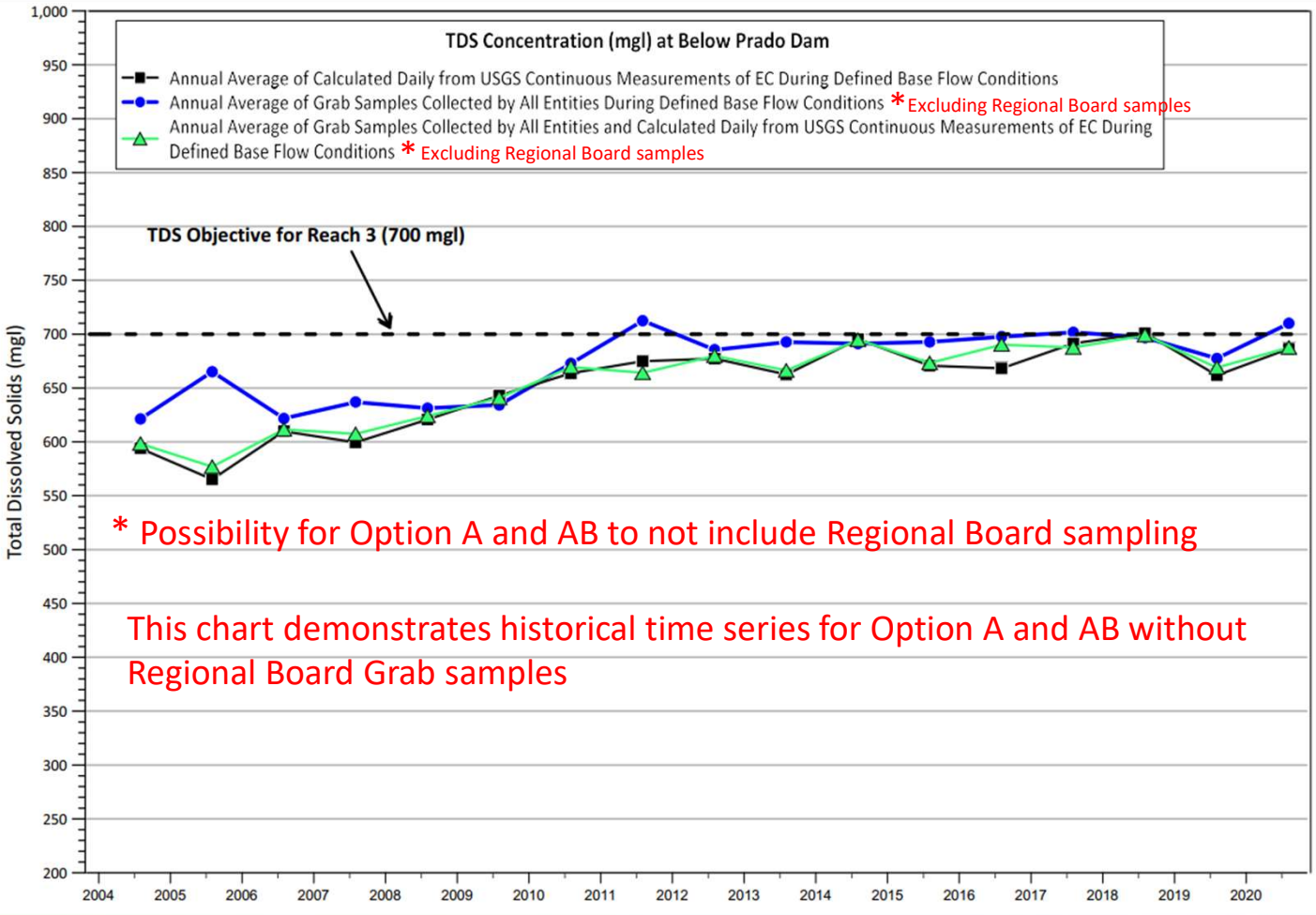


Options for Monitoring and Assessment of Compliance – TDS Reach 3



- **Option A:** Define Base Flow conditions; and use data from **grab samples** collected during Base Flow conditions
- **Option B:** Define Base Flow conditions; and use data from USGS **daily** EC **measurements** collected during Base Flow conditions
- **Option AB:** Define Base Flow conditions; and use data from **grab samples** and USGS **daily** EC **measurements** collected during Base Flow conditions

Options for Monitoring and Assessment of Compliance – TDS Reach 3

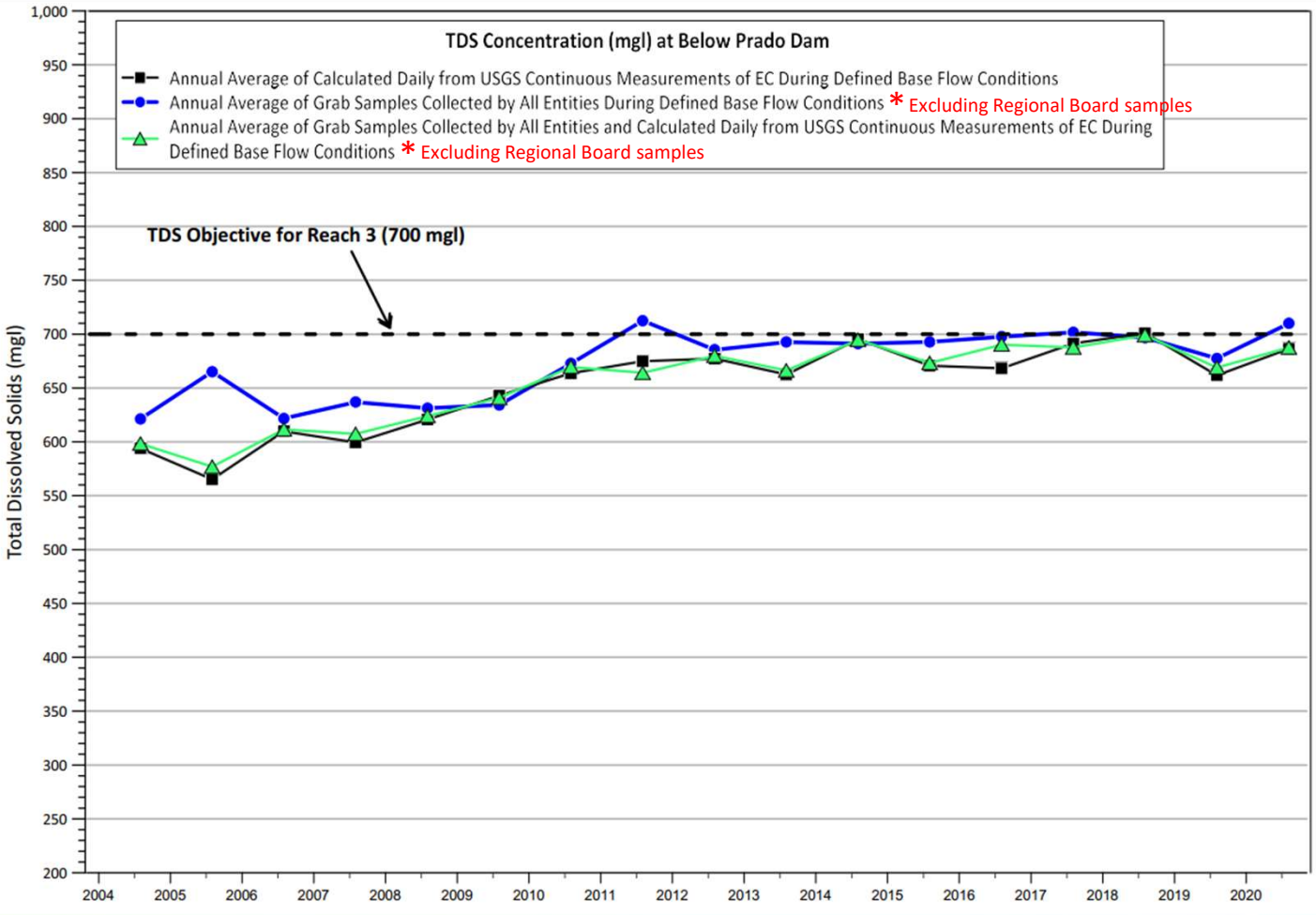


* Possibility for Option A and AB to not include Regional Board sampling

This chart demonstrates historical time series for Option A and AB without Regional Board Grab samples

- **Option A*:** Define Base Flow conditions; and use data from **grab samples** collected during Base Flow conditions
- **Option B:** Define Base Flow conditions; and use data from USGS **daily** EC **measurements** collected during Base Flow conditions
- **Option AB*:** Define Base Flow conditions; and use data from **grab samples** and USGS **daily** EC **measurements** collected during Base Flow conditions

Options for Monitoring and Assessment of Compliance - TDS Reach 3

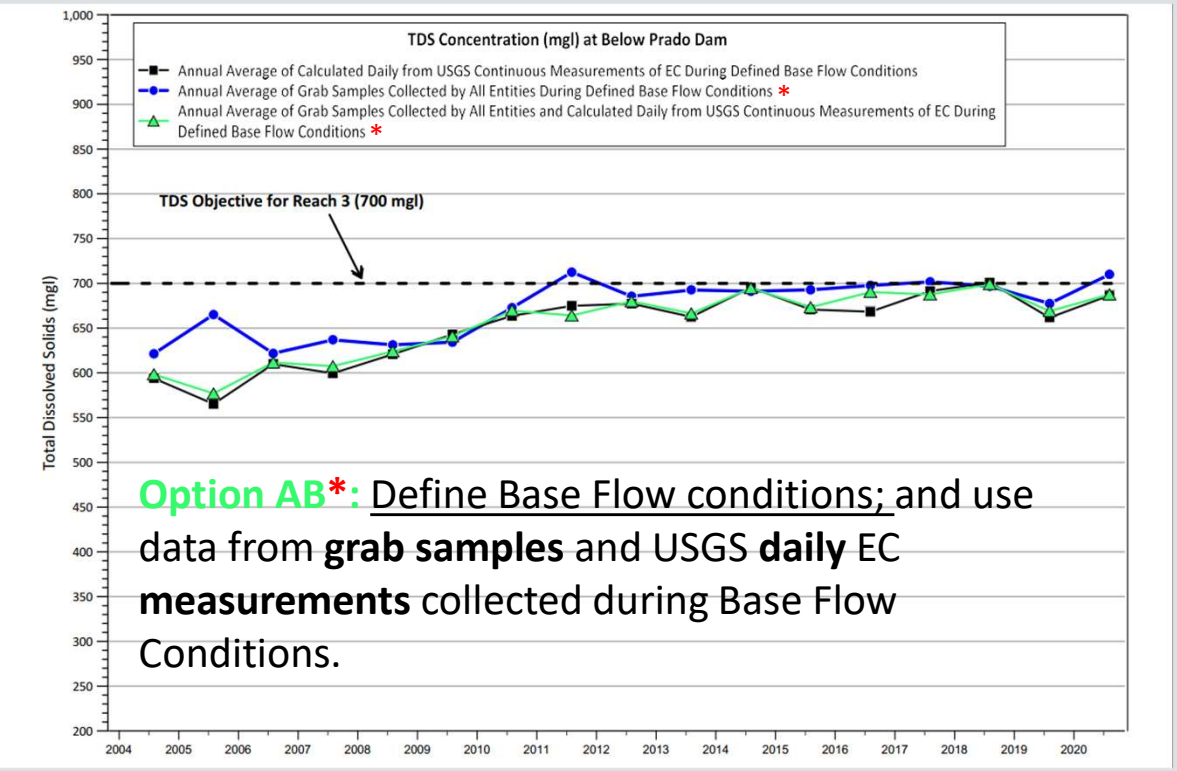


Recommended Option:

- **Option AB*:** <u>Define Base Flow conditions;</u> and use data from **grab samples** and USGS **daily** EC **measurements** collected during Base Flow conditions

*Excluding Regional Board Samples

Recommendation for Monitoring and Assessment of Compliance with the Reach 3 TDS Objective:



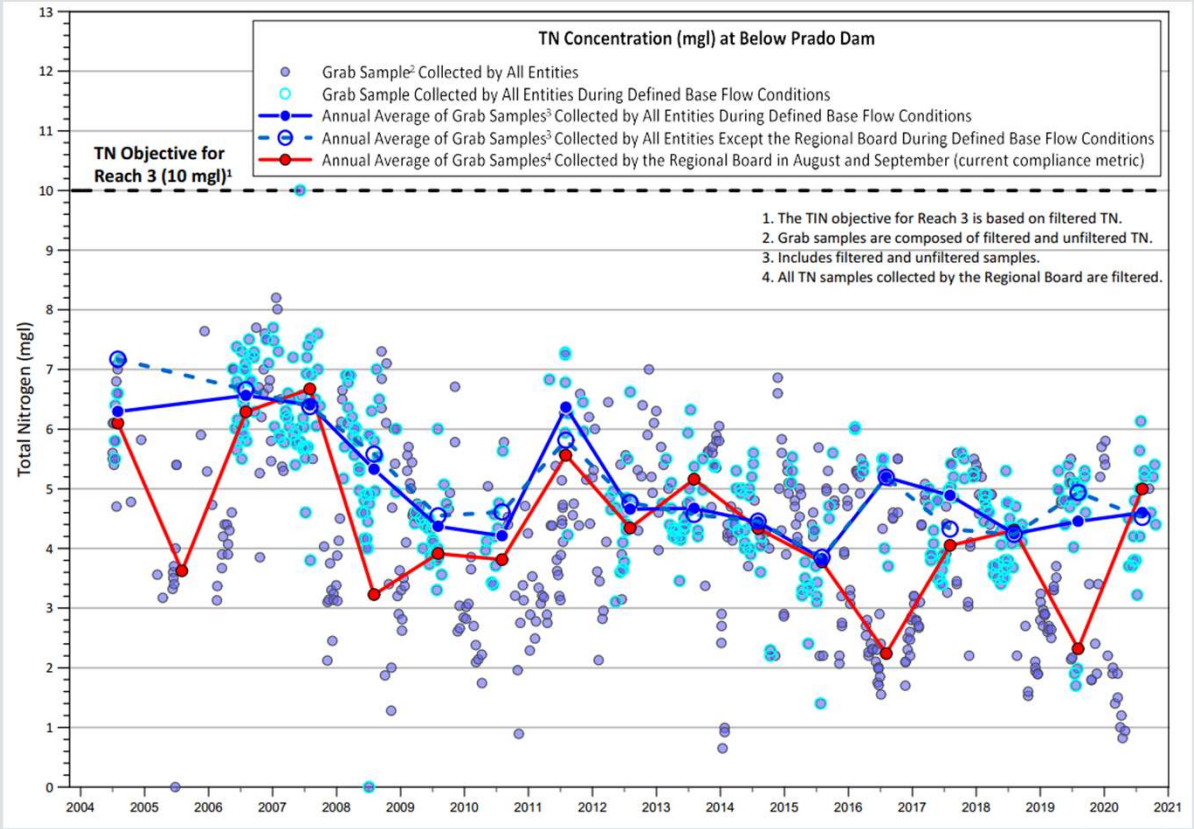
Option AB*: Define Base Flow conditions; and use data from **grab samples** and USGS **daily** EC **measurements** collected during Base Flow Conditions.

*Excluding Regional Board Samples

- Prepare Basin Plan Amendment to clarify the definition of Base Flow Conditions in Reach 3
- Annually, identify which days have Base Flow Conditions using the daily data (precipitation, dam water-level, non-trib.)
- Collect all grab sample data (USGS, OCWD) and USGS daily gage EC data
- Calculate daily EC from daily TDS
- Compile all TDS data for the Base Flow Conditions and evaluate compliance (annual average)

Recommendation for Monitoring and Assessment of Compliance with the Reach 3 TIN Objective:

Reach 3 TIN Objective = 10 mgl *
*Total nitrogen, filtered sample



Option A*: Define Base Flow conditions; and use data from **grab samples** collected during Base Flow Conditions:

*Excluding Regional Board Samples

- Prepare Basin Plan Amendment to clarify the definition of Base Flow Conditions in Reach 3, and to change the TN filtered requirement
- Annually, identify which days have Base Flow Conditions using the daily data (precipitation, dam water-level, non-trib.)
- Collect all grab sample data (USGS, OCWD)
- Compile all TIN data (calculated) for the Base Flow Conditions, and evaluate compliance (annual average)

Next Steps

- Prepare draft 2022 *Santa Ana River Surface Water Quality Work Plan* - draft to Task Force by June 15, 2022 – 3-week review period
- Prepare a Basin Plan Amendment:
  - Clarification on monitoring and assessment of compliance with the surface water objectives for Reaches 2-5
  - Potential updates related to recommended Options AB (TDS) and Option A (TIN) for Reach 3: 1) Characterization and definition of Base Flow Conditions in Reach 3; 2) removal of Regional Board Reach 3 monitoring; and 3) removal of the requirement for TN filtered sample.
- Task Force Meeting is mid to late June 2022, review the draft 2022 *Santa Ana River Surface Water Quality Work Plan*
- Final 2022 *Santa Ana River Surface Water Quality Work Plan* – to Task Force by July 21, 2022
- *August 1, 2022* – submit Final 2022 Work Plan to Regional Board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WE STRIVE TO BECOME OUR BEST

WE BELIEVE IN QUALITY

WE LISTEN

WE SOLVE HARD PROBLEMS

WE SEE THE BIGGER PICTURE

WE TAKE OWNERSHIP

WE COLLABORATE

WE HAVE FUN

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Task Force Planning Priorities - Task 1: Prepare Updated Surface Water Monitoring Program for TDS/N for the Santa Ana River Reaches, 2, 3 ,4 and 5

Overview of Recommended Surface Water Monitoring Plan

June 22, 2022

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2022 Santa Ana River Water Quality Work Plan

Tables of Contents:

1. Background
    - 2004 TDS/N Management Plan (SNMP); 2021 BPA; methods to prepare 2022 update; work plan objectives
2. Evaluation of the 2005-2020 Surface Water Monitoring Program
3. 2022 Surface Water Monitoring Program to assess compliance with Basin Plan TDS and Nitrogen objectives
4. Recommendation for Special Studies

2022 Santa Ana River Water Quality Work Plan

Objectives: Collect the Surface Water Data necessary to assess compliance with Basin Plan Objectives.

1. Compliance with Basin Plan Objectives is assessed in two ways under the Basin Plan SNMP:

   i. Annual assessment of current water quality data – are we in compliance today?
      - monitoring data
      - compliance metrics

   Sections 2 and 3

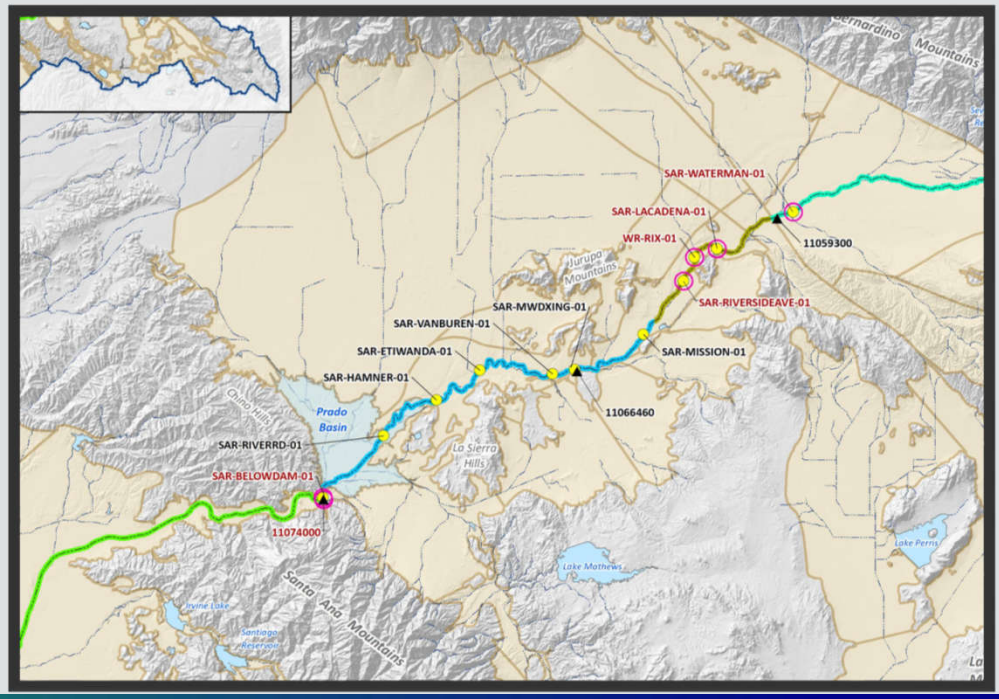
   ii. Predictive assessment of the wasteload allocation – will we comply in the future?
      - Wasteload Allocation Model (WLAM)
        - Calibrated based on historical data
        - Input future planning data (recycled water discharges, land use, climate conditions)

   Section 4

Section 2. Evaluation of the 2005-2020 Surface Water Monitoring Program

For each Reach, evaluated and described:

- the Basin Plan TDS/TIN objectives
- the Basin Plan description of the criteria and approach for assessing compliance with the objectives
- surface water data collected since 2004
- the metrics computed to assess compliance with objectives and data used to compute the metrics;
- the questions to be answered by the surface water monitoring data;
- the history of compliance with the Basin Plan objectives
- any data or information gaps to answer the monitoring program questions

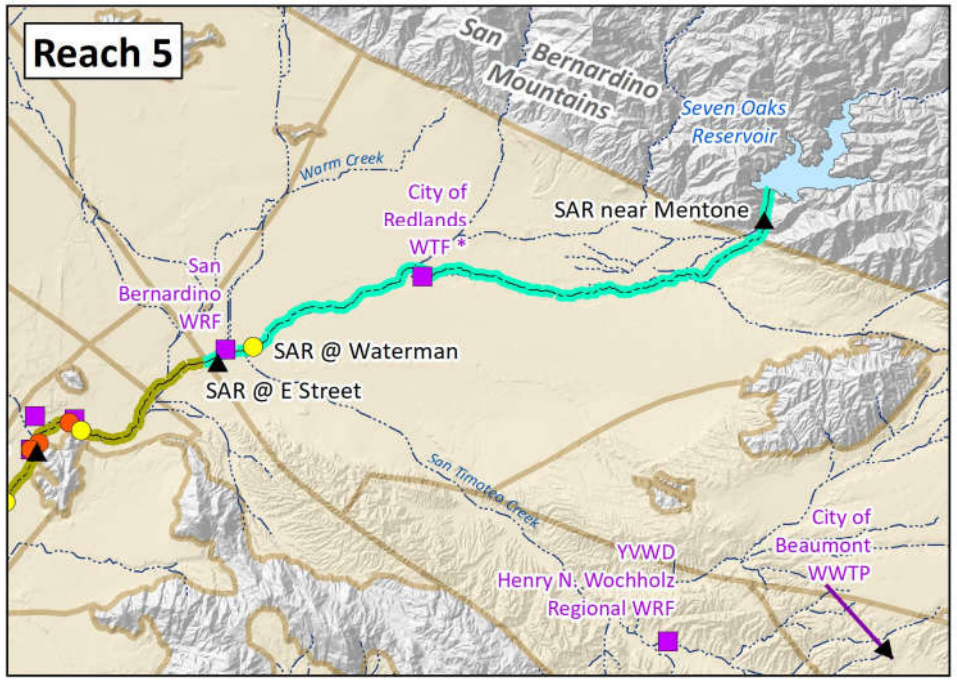


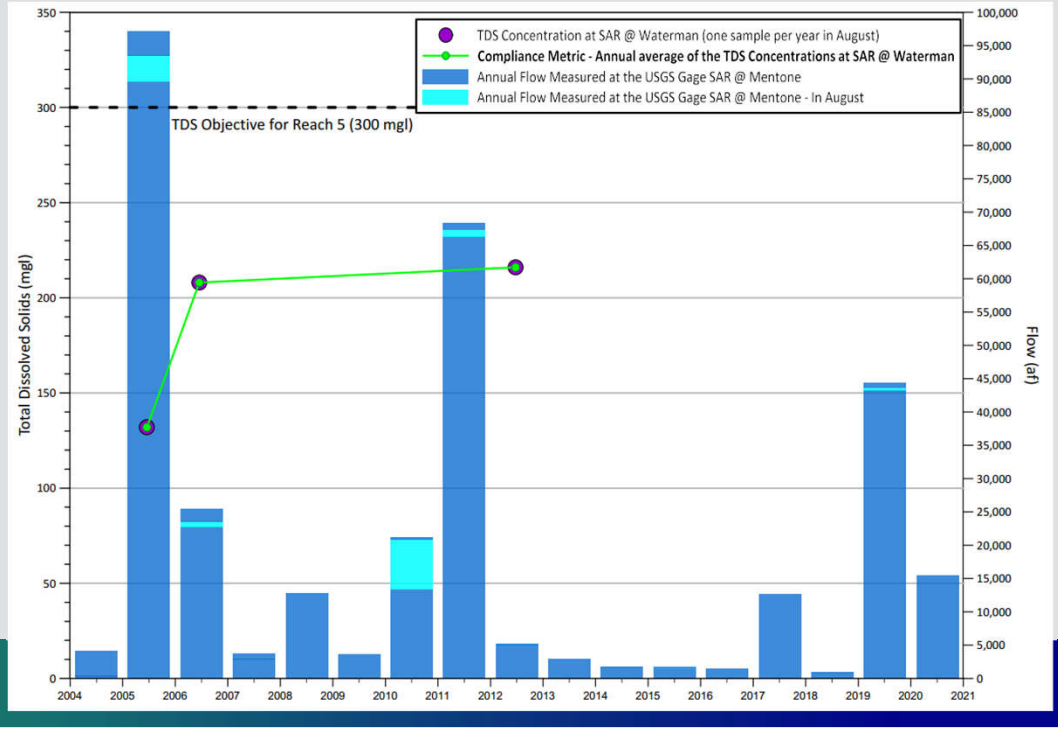
2022 Santa Ana River Water Quality Work Plan

Tables of Contents:

Reach 5 – Monitoring and Compliance from 2005 to 2020

Reach	TDS/TIN Objectives	Question Answered by the Monitoring Data	Monitoring Site	Data Collected	Frequency	Monitoring Entity	Compliance Metric
5	TDS = 300 mgl TIN = 5 mgl	What is the TDS and TIN concentration of the flow in Reach 5 that is recharged to Bunker Hill-B GMZ and that flows into Reach 4 and recharged to the Colton GMZ throughout the year?	SAR @ Waterman	WQ (Including TDS, TIN)	Annually	OCWD	Annual average TDS and TIN of all samples





Reach 5 – Monitoring and Compliance from 2005 to 2020

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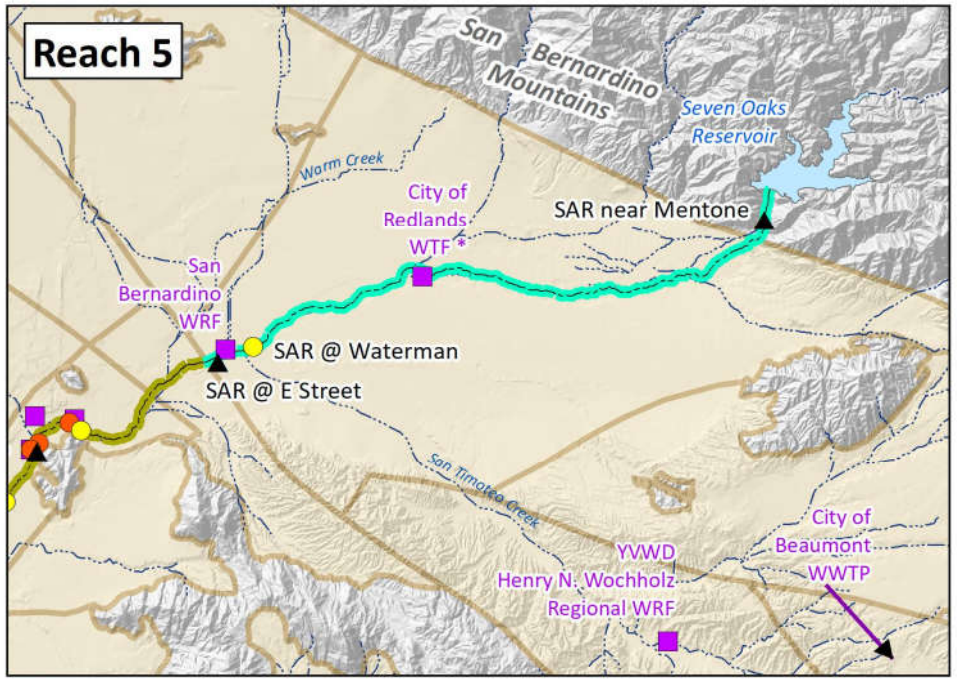
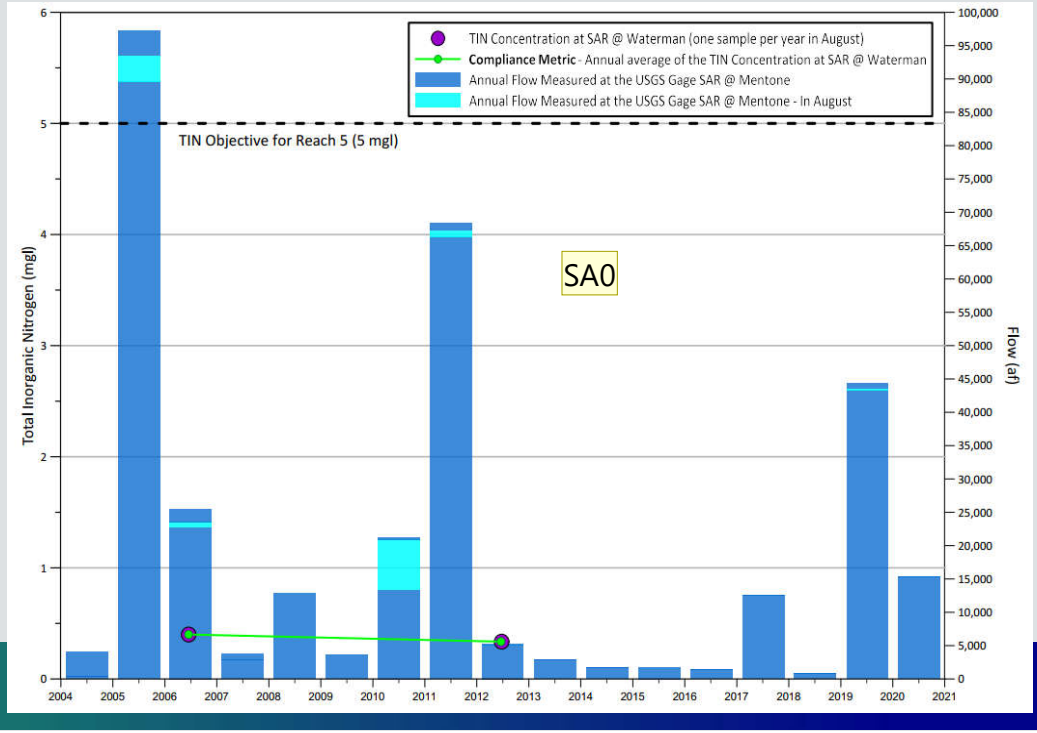




Slide 7

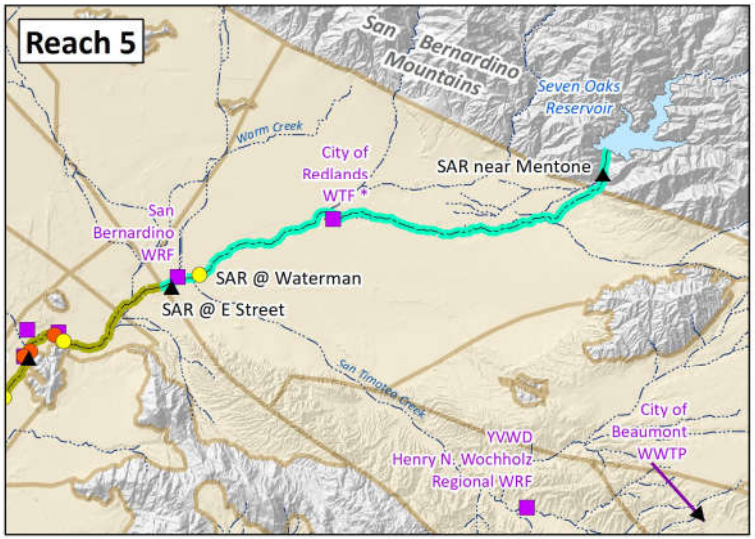
SA0 Drop in TIN plot

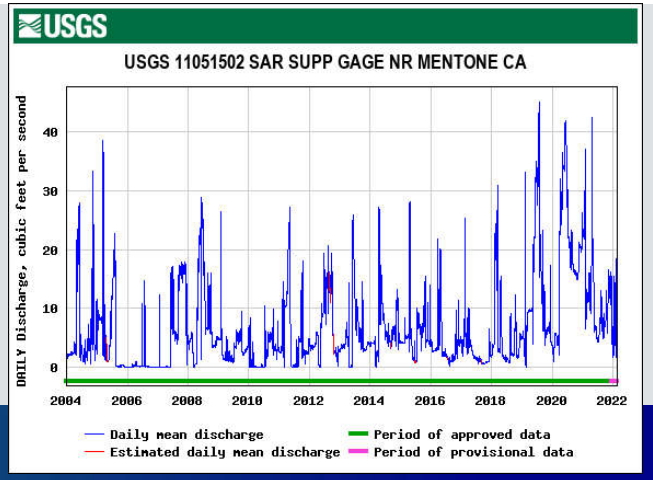
Samantha Adams, 2022-06-21T02:20:19.943

Reach 5 – Monitoring and Compliance from 2005 to 2020

Considerations, Data Gaps, and Uncertainties with Monitoring and Compliance:

- No description in the Basin Plan for monitoring or compliance assessment
- Since 2004, sampling has not occurred at *SAR @ Waterman* in 14 of the 17 years because no flow was present in August.
- Only know the quality of the flow in August, which is not representative of the recharge to Bunker Hill-B. One single sample per year is used to assess compliance. Exceedance of the objective based on one sample would be misleading.
- ISA0data upstream of *SAR @ Waterman* to characterize the quality of stream bed recharge to the Bunker Hill-B GMZ
- No data downstream of *SAR @ Waterman* to assess the influence of tributary flows and POTW discharges that flow into Reach 4 and that can recharge Colton GMZ.





Slide 8

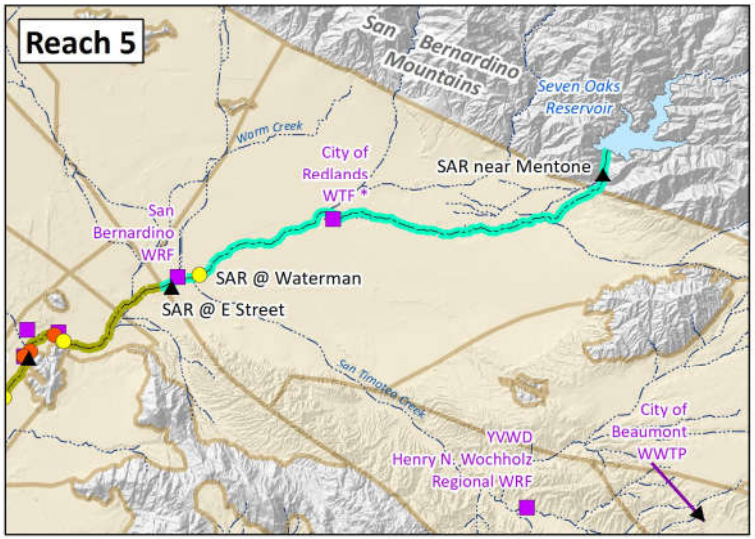
SA0 This is not a data gap. This is just a fact. Suggest to delete.
Samantha Adams, 2022-06-21T02:02:32.645

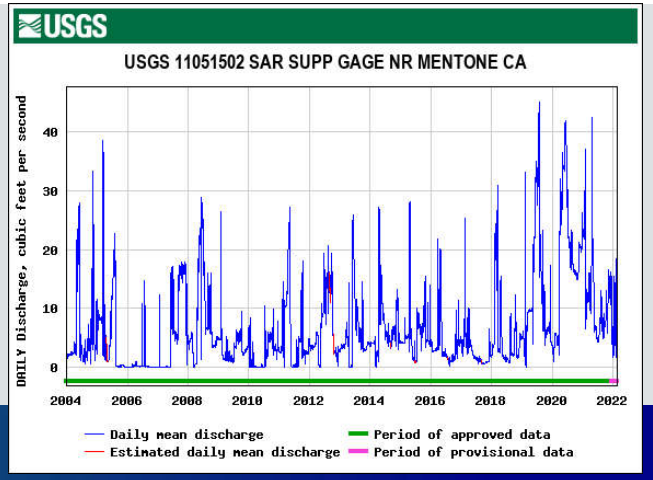
SA0 0 Fourth bullet, I mean on Reach 5 losing reach
Samantha Adams, 2022-06-21T13:01:45.227

Reach 5 – Monitoring and Compliance from 2005 to 2020

Recommendations for the 2022 Work Plan:

- Increase the frequency of sampling to better understand the variability of water quality throughout the year.
- Add sample locations upstream and downstream of *SAR @ Waterman* to more fully understand the quality of the river in Reach 5 that recharges to the Bunker Hill-B GMZ and the flows into Reach 4 overlying the Colton GMZ.
- Document compliance metric for annual assessment of compliance with TDS and TIN objectives*





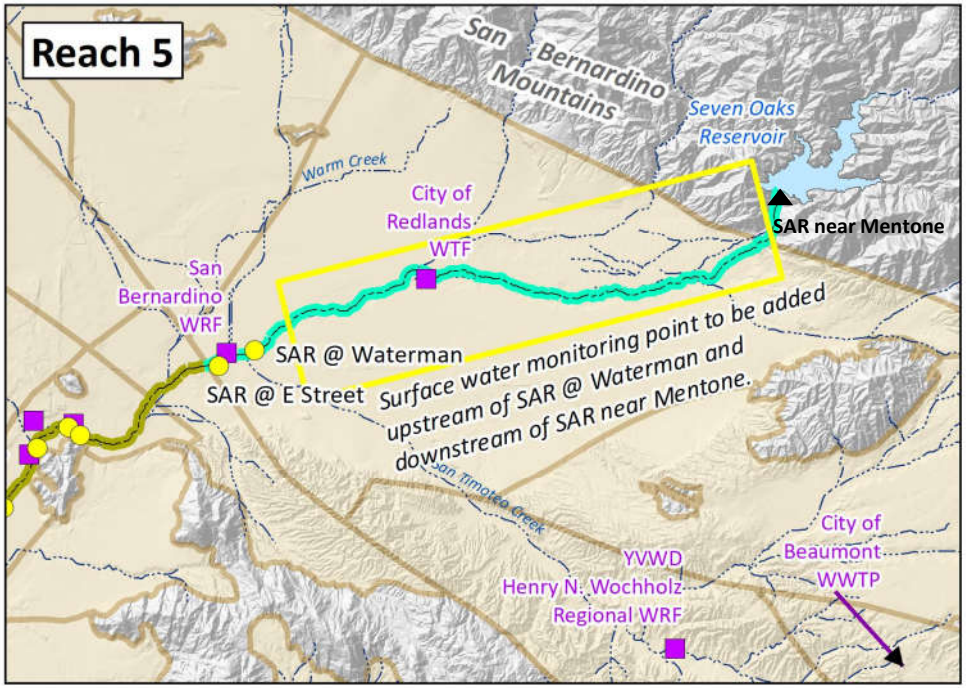
*Amend Basin Plan to Incorporate this into the SNMP Compliance Plan

Reach 5 – 2022 Work Plan

Site	Monitoring Performed	Monitoring Entity	Monitoring Frequency
New Site (TBD) – between SAR near Mentone and SAR @ Waterman	Water quality: TDS and TIN	Task Force (?)***	quarterly
SAR @ Waterman	Water quality: TDS and TIN	Task Force (?)***	quarterly
SAR @ E Street	Water quality: TDS and TIN	Task Force (?)***	quarterly

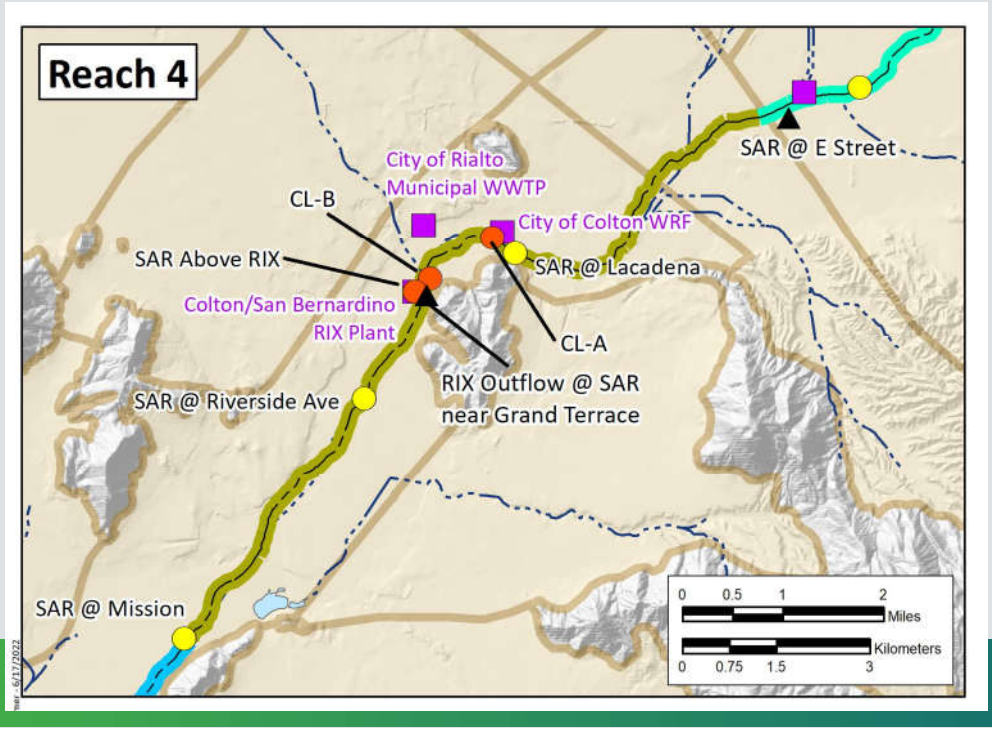
****For discussion on how to determine monitoring entity*

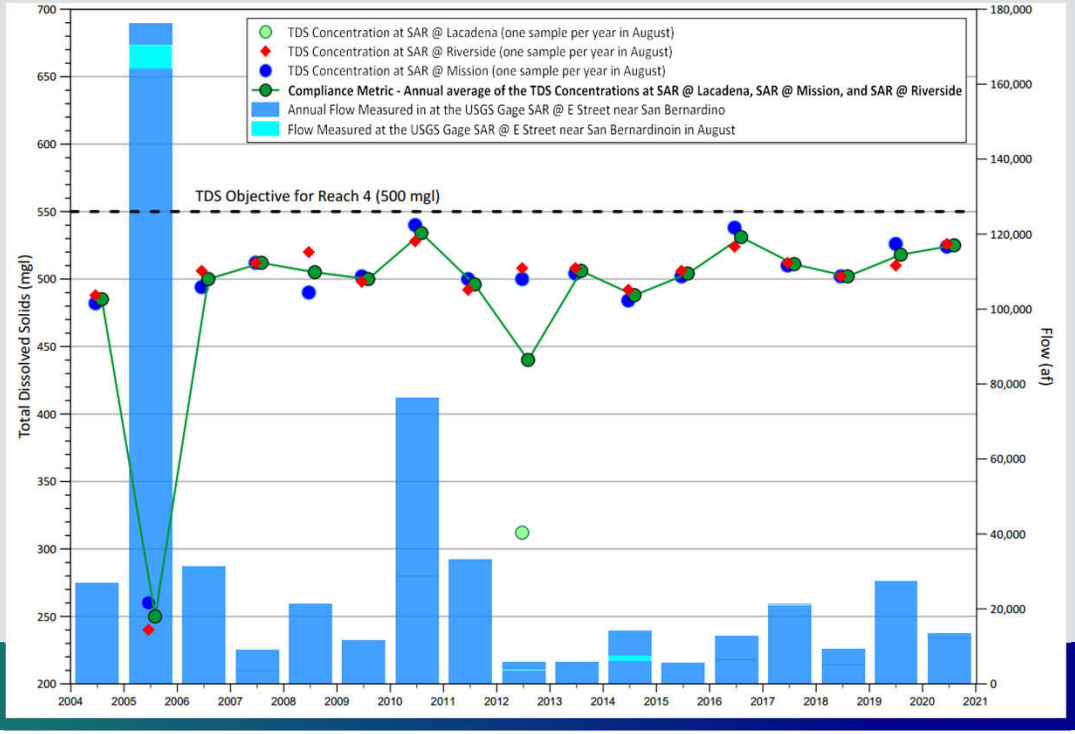
Compliance Metric: Annual Average TDS and TIN of all samples collected during the year



Reach 4 – Monitoring and Compliance from 2005 to 2020

Reach	TDS/TIN Objectives	Question Answered by the Monitoring Data	Monitoring Site	Data Collected	Frequency	Monitoring Entity	Compliance Metric
4	TDS = 550 mgl TIN = 10 mgl	What is the TDS and TIN concentration of the flow in Reach 4 that is recharged to Riverside-A GMZ throughout the year?	SAR @ Lacadena	TDS, TIN	Annually	OCWD	Annual average TDS and TIN of all samples
			SAR @ Riverside Ave	TDS, TIN	Annually	OCWD	
			SAR @ Mission	TDS, TIN	Annually	OCWD	
			CL-A	TDS, Nitrate-Nitrogen	Semi-Annually	San Bernardino County	
			CL-B	TDS, Nitrate-Nitrogen	Semi-Annually	San Bernardino County	





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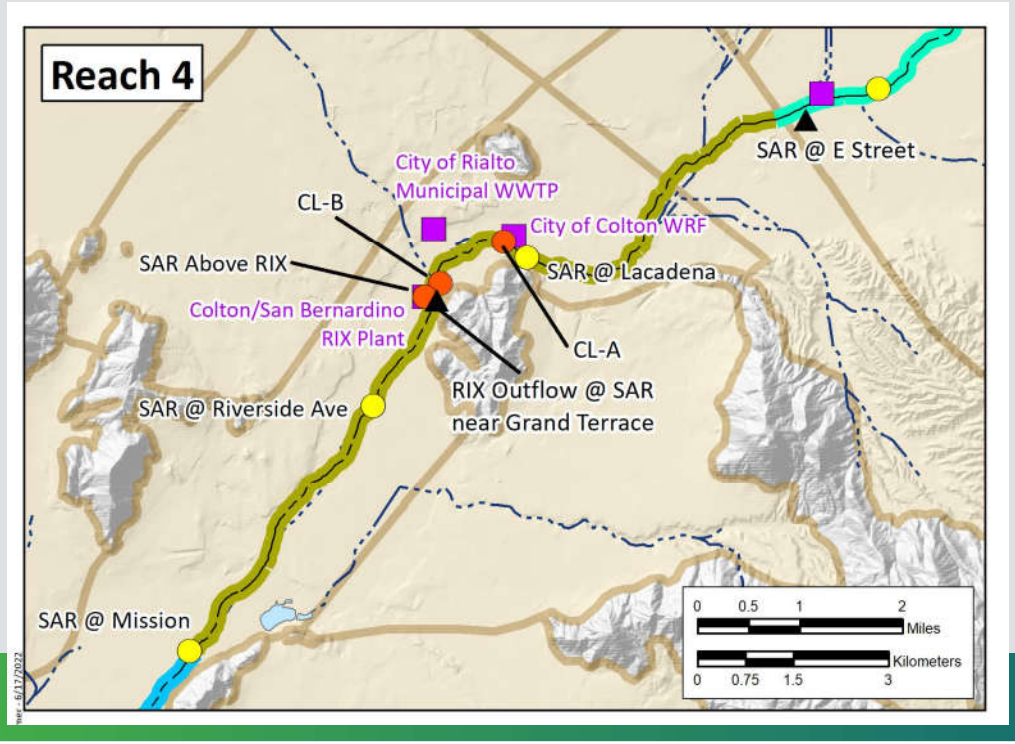
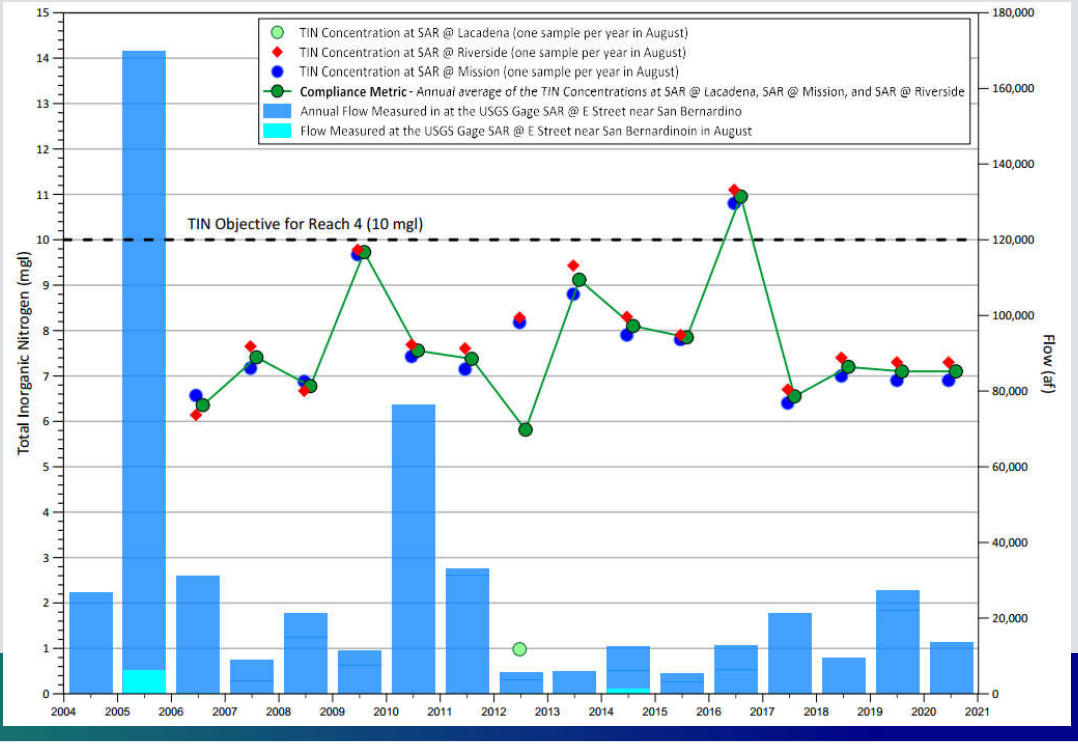
4	TDS = 550 mgl TIN = 10 mgl	What is the TDS and TIN concentration of the flow in Reach 4 that is recharged to Riverside-A GMZ throughout the year?	SAR @ Lacadena	TDS, TIN	Annually	OCWD	Annual average TDS and TIN of all samples
			SAR @ Riverside Ave	TDS, TIN	Annually	OCWD	
			SAR @ Mission	TDS, TIN	Annually	OCWD	
			CL-A	TDS, Nitrate-Nitrogen	Semi-Annually	San Bernardino County	
			CL-B	TDS, Nitrate-Nitrogen	Semi-Annually	San Bernardino County	

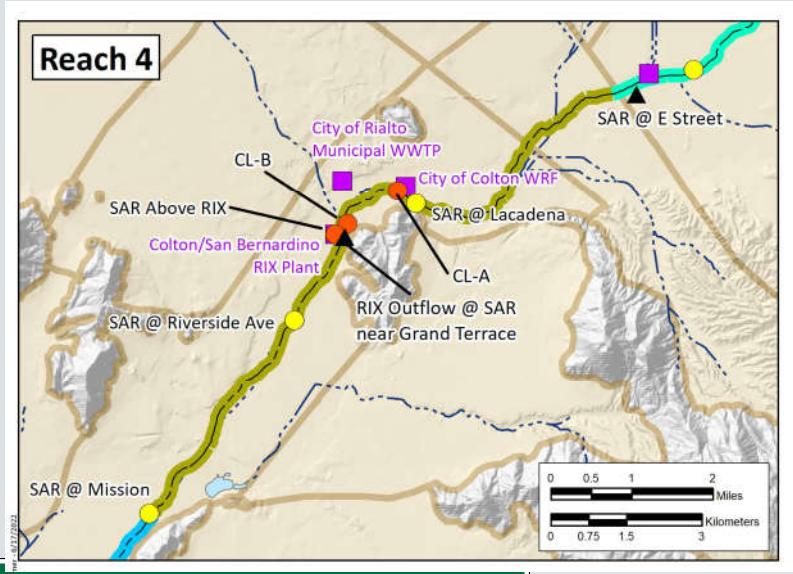


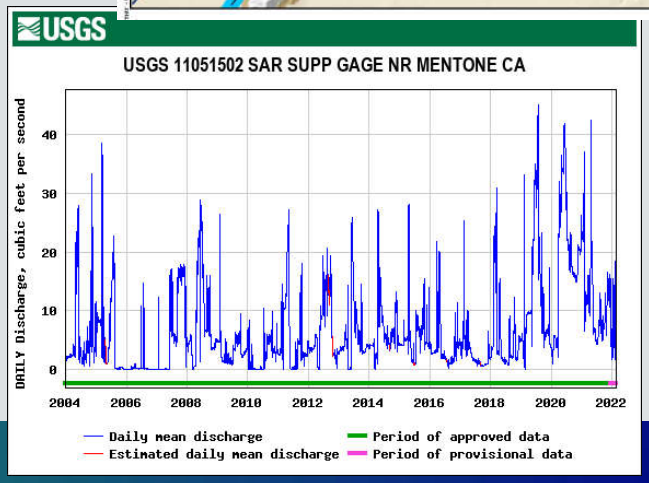


Reach 4 – Monitoring and Compliance from 2005 to 2020

Considerations, Data Gaps, and Uncertainties with Monitoring and Compliance:

- No description in the Basin Plan for monitoring and compliance
- Since 2004, sampling has not occurred at *SAR @ Lacadena* 16 of the 17 years because no surface water flow was present in August.
- Only know the quality of the flow in August at the two downstream locations SAR @ Riverside Ave and SAR @ Mission, which is not representative of the recharge to Riverside-A.
- One single sample event per year is used to assess compliance. Exceedance of the objective based on August would be misleading.

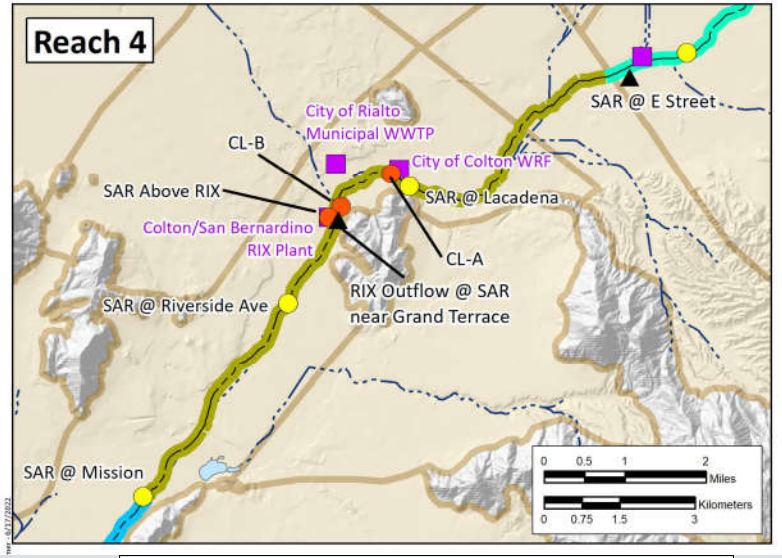


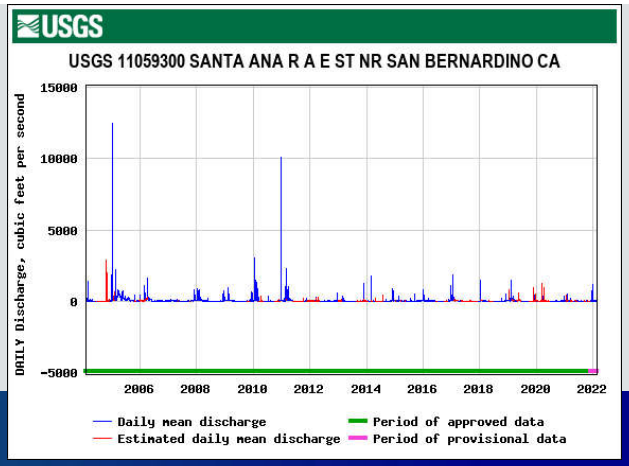


Reach 4 – Monitoring and Compliance from 2005 to 2020

Recommendations for the 2022 Work Plan:

- Increase the frequency of sampling at locations in Reach 4 to better understand the variability of water quality over high-flow and low-flow conditions throughout the year at all locations.
- Document compliance metric for annual assessment of compliance with TDS and TIN objectives*





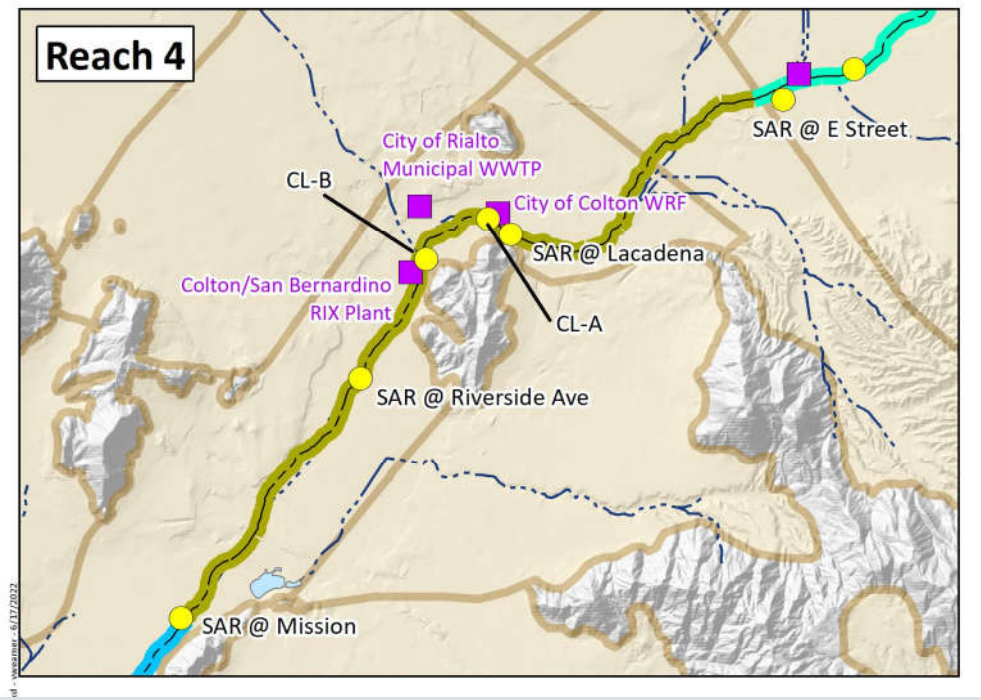
*Amend Basin Plan to Incorporate this into the SNMP Compliance Plan

Reach 4 – 2022 Work Plan

Site	Monitoring Performed	Monitoring Entity	Monitoring Frequency
SAR @ Lacadena	Water quality: TDS and TIN	Task Force (?)***	Quarterly
SAR @ Riverside Ave	Water quality: TDS and TIN	Task Force (?)***	Quarterly
SAR @ Mission	Water quality: TDS and TIN	Task Force (?)***	Quarterly
CL-A	Water quality: TDS and nitrate	County of San Bernadino	Semi-annual
CL-B	Water quality: TDS and nitrate	County of San Bernadino	Semi-annual

****For discussion on how to determine monitoring entity*

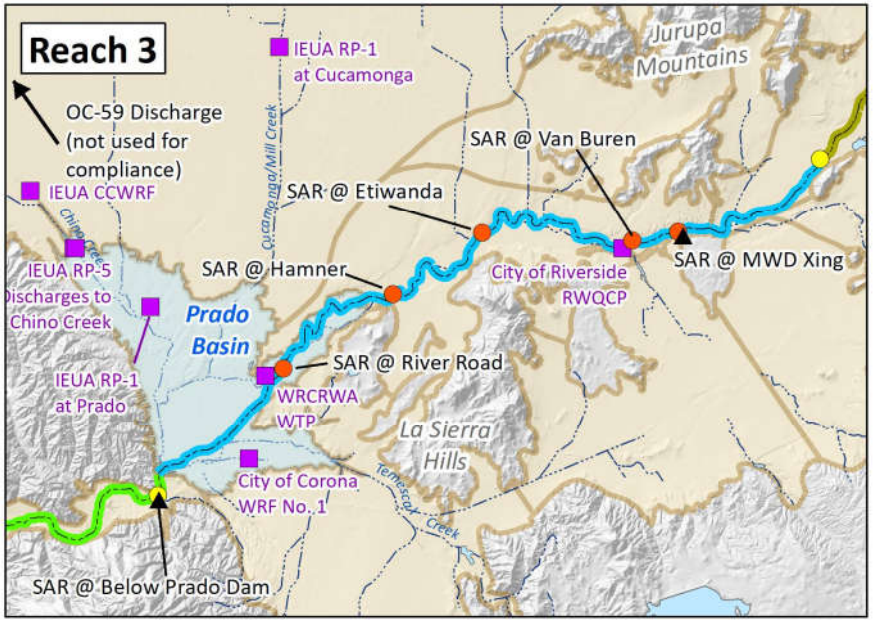
Compliance Metric: Annual Average TDS and TIN of all samples collected during the year

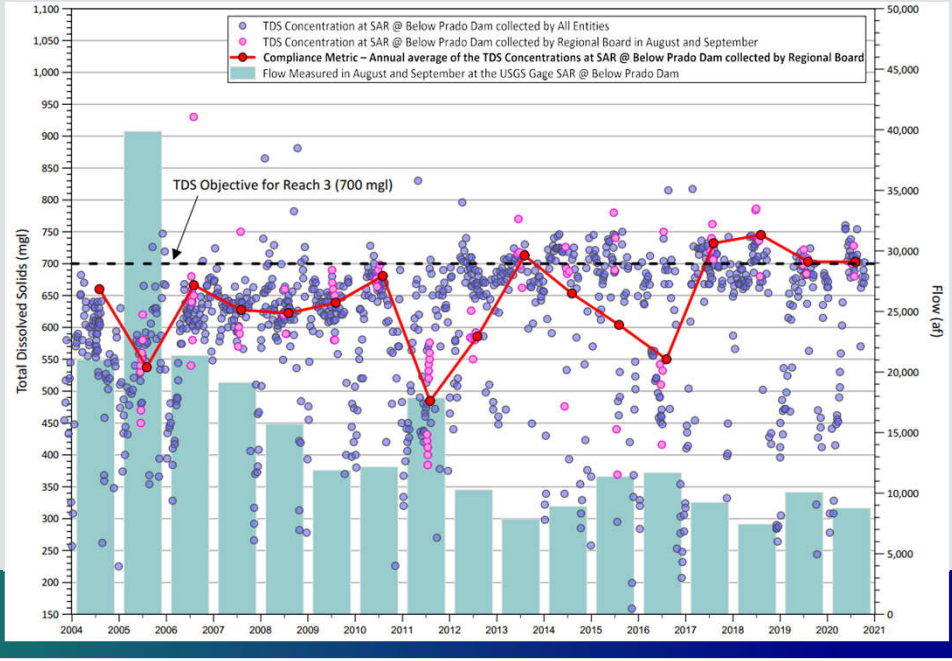


Reach 3 – Monitoring and Compliance from 2005 to 2020

* and weekly in August

Reach	TDS/TIN Objectives	Question Answered by the Monitoring Data	Monitoring Site	Data Collected	Frequency	Monitoring Entity	Compliance Metric
3	TDS = 700 mgl TIN = 10 mgl - Base Flow Objectives	What is the TDS and TIN of the base flow in Reach 3 that flows into Reach 2 and used for beneficial uses in the Orange County GMZ?	SAR @ Below Prado Dam	TDS, TIN	Monthly/Bi-weekly/Aug & Sept*	OCWD / USGS/Regional Board	Annual average TDS and TIN of all samples collected by Regional Board
			USGS Gage SAR @ Below Prado Dam	Flow, EC	Daily	USGS	
			SAR @ MWDXing	TDS, TIN	Annually/Quarterly	OCWD/CBWM	
			SAR @ Van Buren	TDS, TIN	Annually	OCWD	
			SAR @ Etiwanda	TDS, TIN	Annually/Quarterly	OCWD/CBWM	
			SAR @ Hamner	TDS, TIN	Annually	OCWD	
			SAR @ River Road	TDS, TIN	Annually	OCWD/CBWM	





Reach 3 – Monitoring and Compliance from 2005 to 2020

Reach	TDS/TIN Objectives	Question Answered by the Monitoring Data	Monitoring Site	Data Collected	Frequency	Monitoring Entity	Compliance Metric
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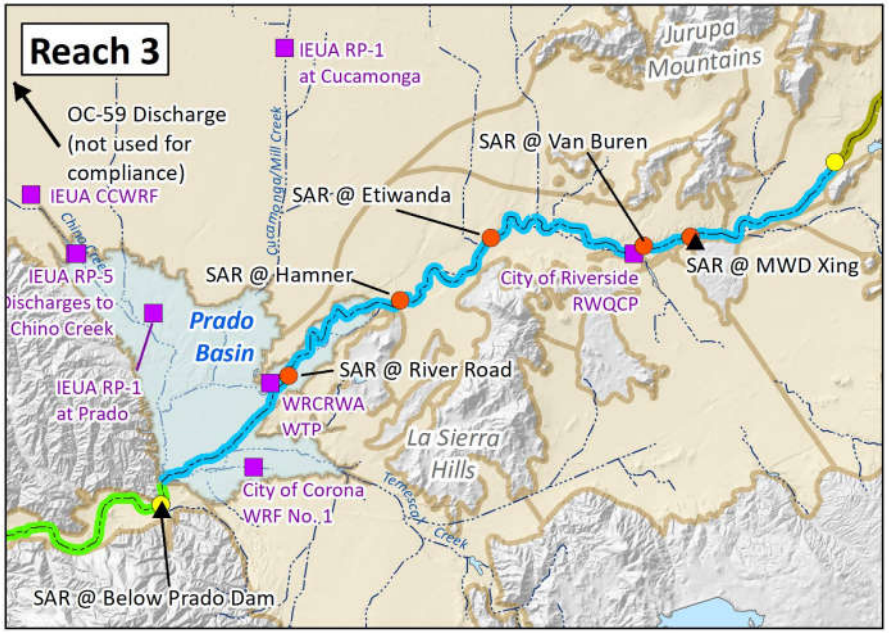
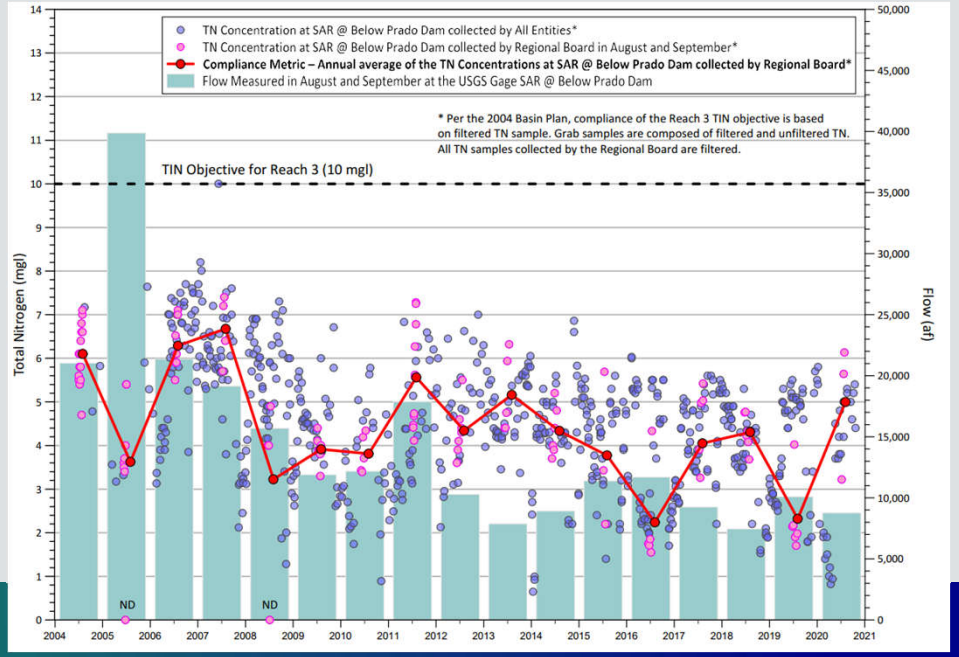
			USGS Gage SAR @ Below Prado Dam	Flow, EC	Daily	USGS	
			SAR @ MWDXing	TDS, TIN	Annually/Quarterly	OCWD/CBWM	
			SAR @ Van Buren	TDS, TIN	Annually	OCWD	
			SAR @ Etiwanda	TDS, TIN	Annually/Quarterly	OCWD/CBWM	
			SAR @ Hamner	TDS, TIN	Annually	OCWD	
			SAR @ River Road	TDS, TIN	Annually	OCWD/CBWM	

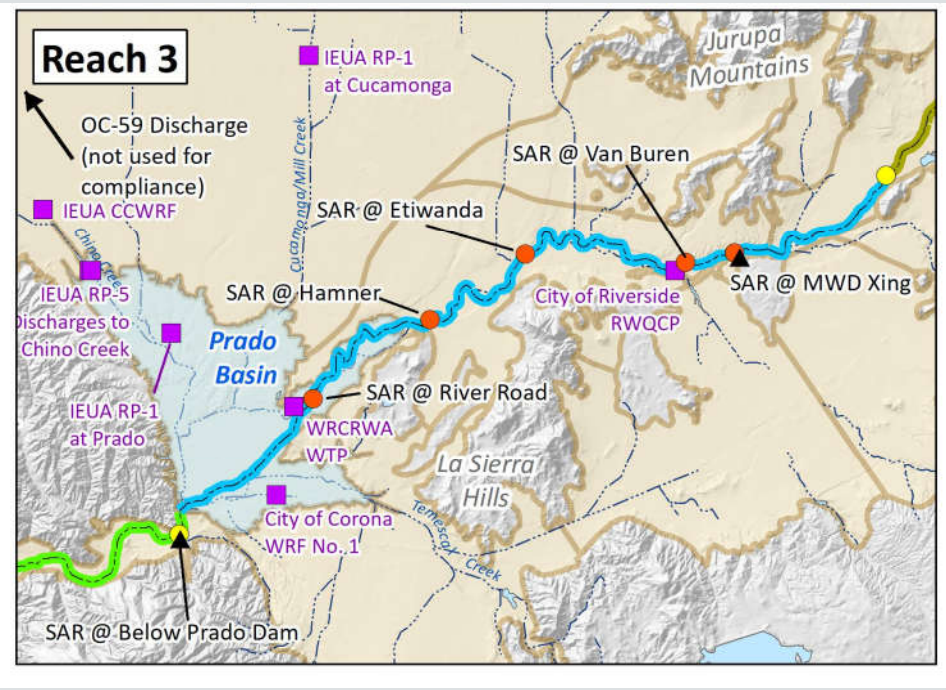




Reach 3 – Monitoring and Compliance from 2005 to 2020

Considerations with Monitoring and Compliance:

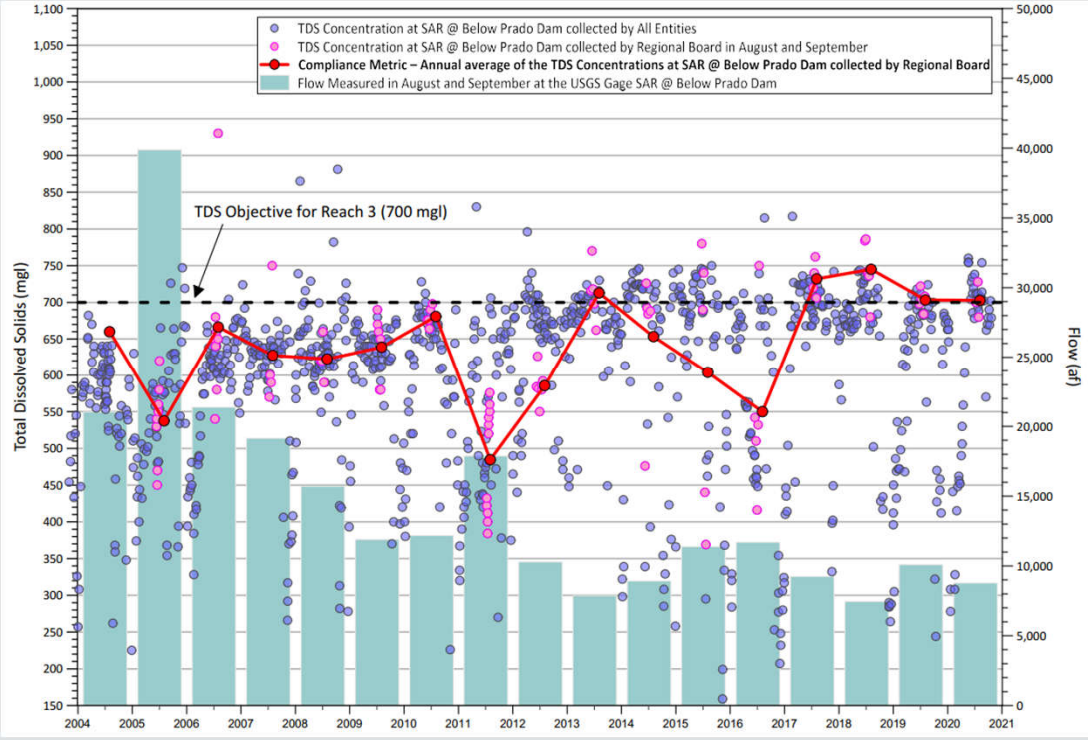
- The *SAR @ Below Prado Dam* location is the best suited location to characterize the quality of flow from Reach 3 into Reach 2 and there is sufficient monitoring of TDS/TIN at this location
- The compliance metric evaluation excludes good data collected at *SAR @ Below Prado Dam* and relies only on a small number of samples collected by the Regional Board in August and September. Excluded:
    - Grab samples data by OCWD
    - Grab samples data by USGS
    - Daily EC measurements at the USGS gage which can be used to create daily time history of TDS, as is done for Reach 2



Reach 3 – Monitoring and Compliance from 2005 to 2020

Considerations, Data Gaps, and Uncertainties with Monitoring and Compliance:

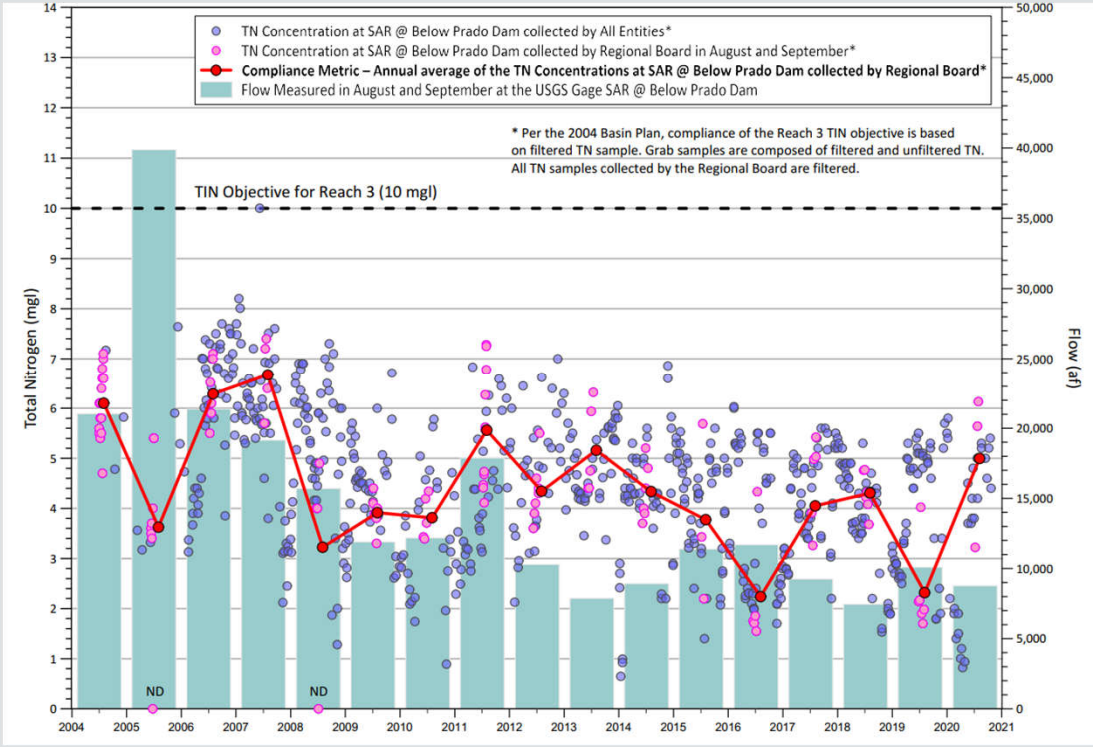
- The Basin Plan does not provide a clear definition of "base flow" conditions in Reach 3.
- Some "base flow" samples collected by the Regional Board in Aug/Sept occurred during conditions not indicative of base flow:
  - influenced by stormwater,
  - conservation pool behind Prado Dam,
  - presence of non-tributary discharge from OC-59
- Base flow conditions are occurring in more than the months of August and September, and likely occur at different times and durations from year to year based on climate conditions and other factors



Reach 3 – Monitoring and Compliance from 2005 to 2020

Considerations, Data Gaps, and Uncertainties with Monitoring and Compliance:

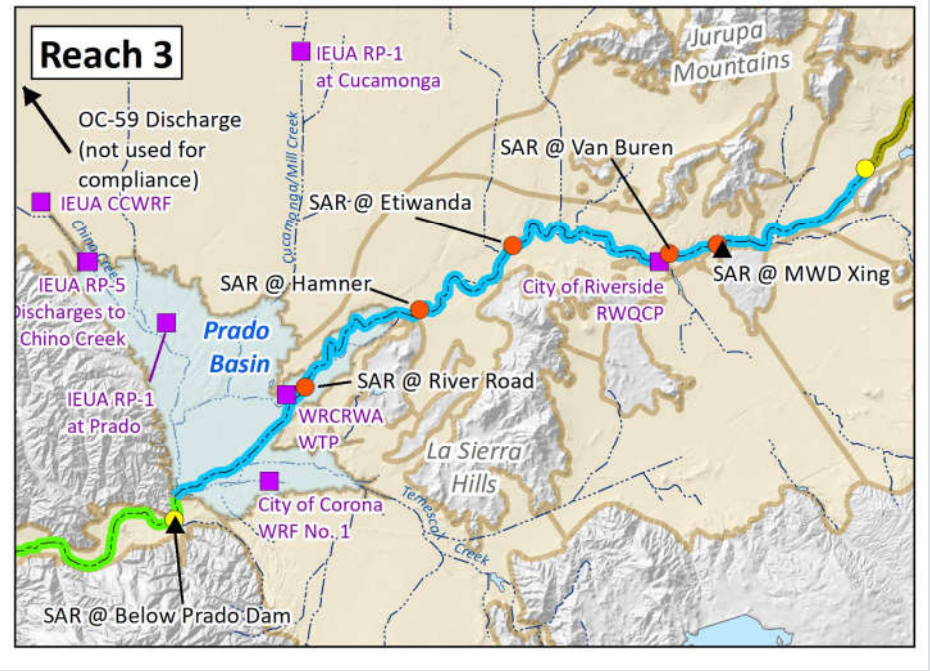
- Reach 3 is the only reach of the Santa Ana River that requires a filtered total nitrogen sample for compliance with the TIN objective?
  - Is it necessary to collect a filtered total nitrogen sample or can a TIN sample be collected instead?
  - The Basin Plan does not provide an explanation of intent of a filter total nitrogen sample.
  - Reported TIN and filtered total nitrogen results from the Regional Board samples are similar (within 1 mgl)
- Since 2004, no exceedance of Reach 3 TIN objectives → and decreasing trend, based on TN samples



Reach 3 – Monitoring and Compliance from 2005 to 2020

Recommendations for the 2022 Work Plan:

- Develop a clear definition of Reach 3 "base flow" conditions that enables use of more data*
- Use available precipitation data, USGS flow and ACOE reservoir levels at Prado Dam to assess base-flow conditions annually
- Use the available water quality data collected by USGS (daily calculated and grab samples) and OCWD during base flow conditions to assess compliance
- Eliminate Regional Board sampling requirement*
- Remove the requirement to collect filtered total nitrogen samples for compliance*



*Amend Basin Plan to Incorporate this into the SNMP Compliance Plan

Reach 3 – 2022 Work Plan

Site	Monitoring Performed	Monitoring Entity	Monitoring Frequency
USGS Gage at SAR @ Below Prado	Flow, EC	USGS	Daily
SAR @ Below Prado	Water quality: TDS and TIN	USGS OCWD	Bi-weekly Monthly
Prado Basin	Water level elevation	ACOE	Quarterly

Compliance Metric: Annual Average TDS and TIN of all samples collected ***during base flow conditions.***

- For TDS, use daily TDS record constructed from relationship between daily EC measured by USGS and periodic grab samples.
- For TIN, use TIN data, not filtered total nitrogen

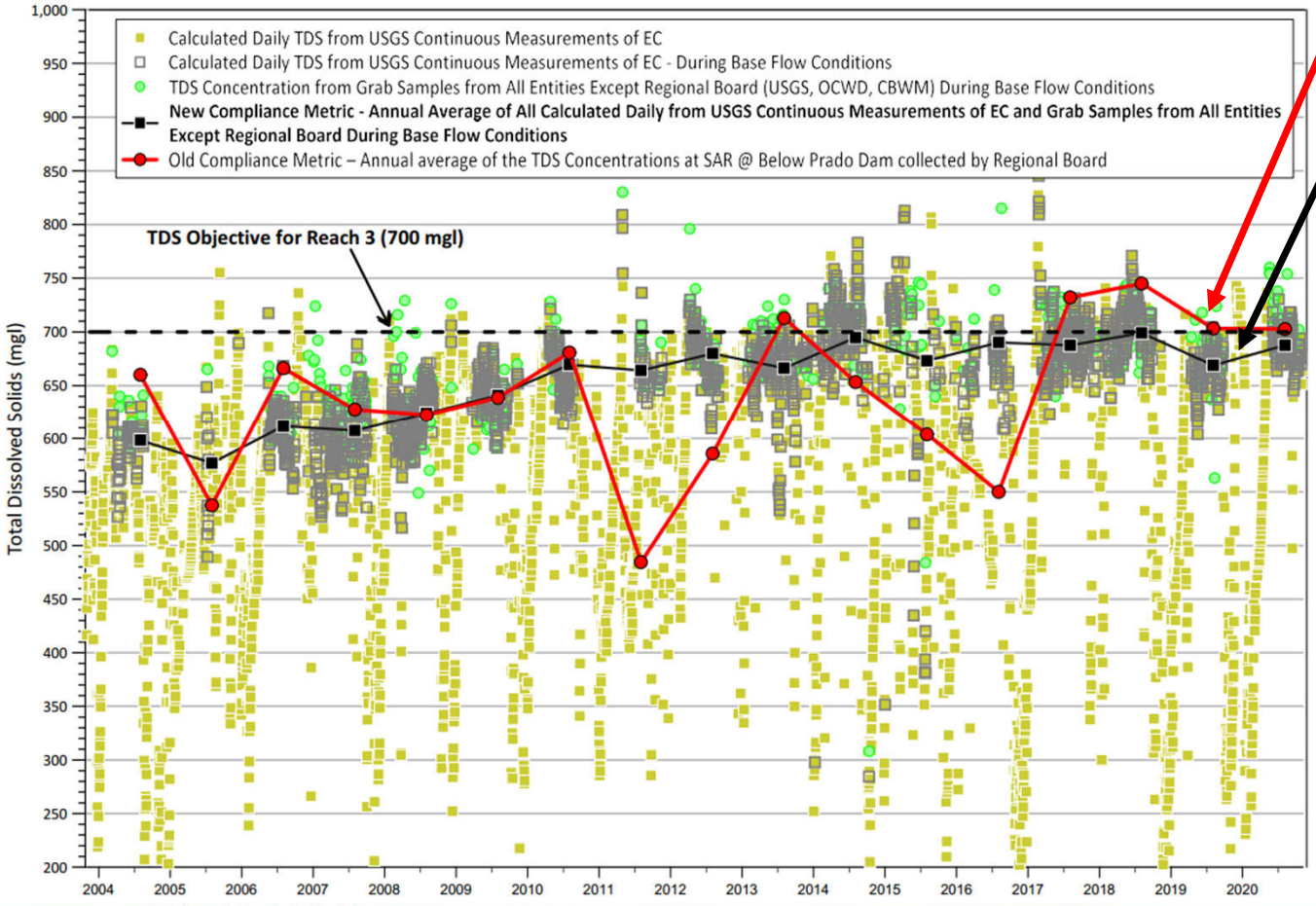
Proposed Definition of Base Flow Conditions in Reach 3:

"when there are no precipitation events and OC-59 discharge within the last four days, and the water-level elevation of the conservation pool behind Prado Dam is at or below the level that is considered empty."

****OCWD has proposed an alternative for consideration and discussion***

Reach 3 – 2022 Work Plan

Example from historical data of the new Reach 3 TDS monitoring and compliance



Old Compliance Metric

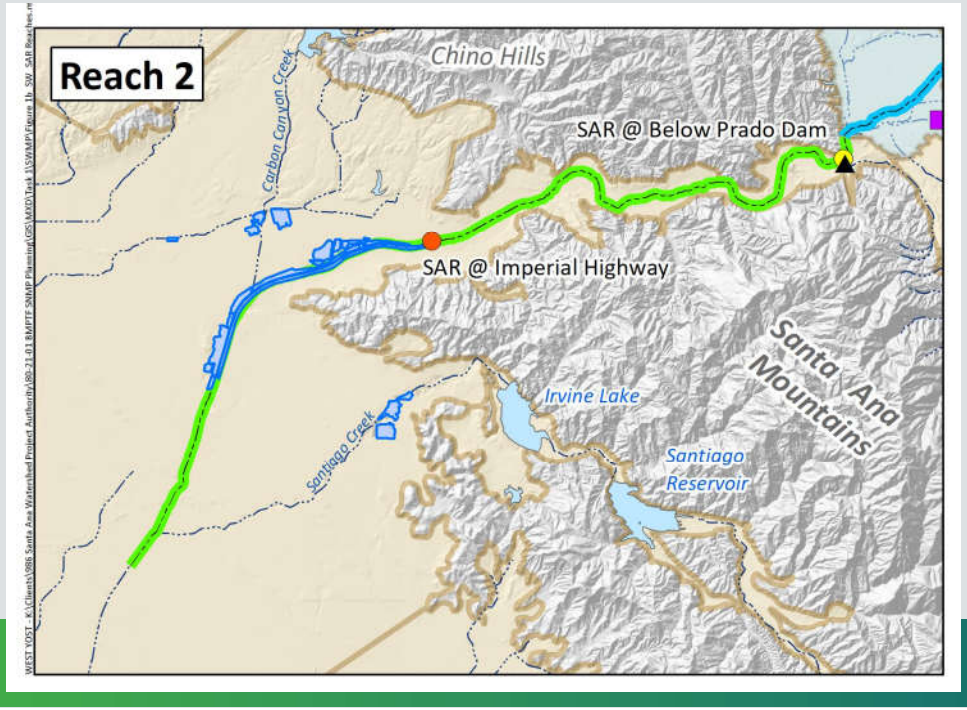
New Compliance Metric

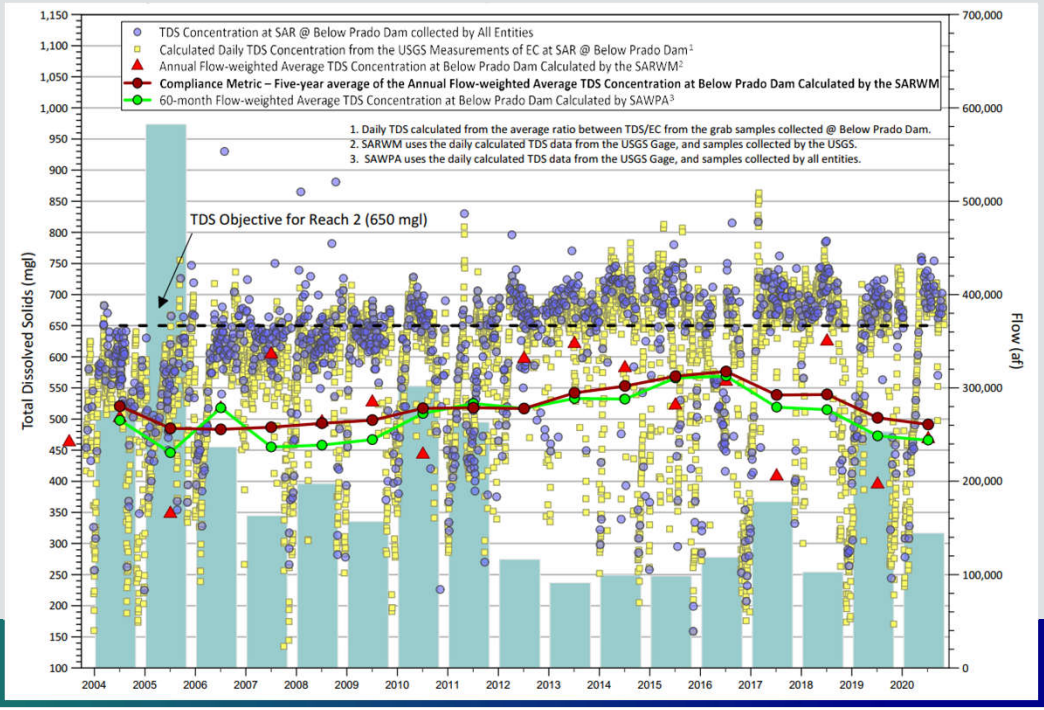
Steps:

1. Compile and evaluate the daily precipitation, water-level behind the dam, and OC-59 discharge → determine days with base flow conditions
2. Calculate daily TDS from daily EC
3. Compile all data for days that are base flow conditions from the daily TDS and all the grab samples collected by all Entries (no Regional Board)
4. Calculate metric - average of all base flow data

Reach 2 – Monitoring and Compliance from 2005 to 2020

Reach	TDS/TIN Objectives	Question Answered by the Monitoring Data	Monitoring Site	Method	Data Collected	Frequency	Monitoring Entity	Compliance Metric
2	TDS = 650 mgl TIN = None	What is the volume-weighted TDS and TIN concentration of the flow entering Reach 2 throughout the year?	SAR @ Below Prado Dam	Basin Plan Method	Annual Flow-weighted TDS concentration	Annual calculation	SARWM	The average of the five most recent SARWM reported annual flow-weighted TDS concentrations at Prado Dam
				Alternative Method	60-month Flow-weighted TDS concentration	Annual calculation	SAWPA	60-month Flow-weighted TDS concentration at Prado Dam





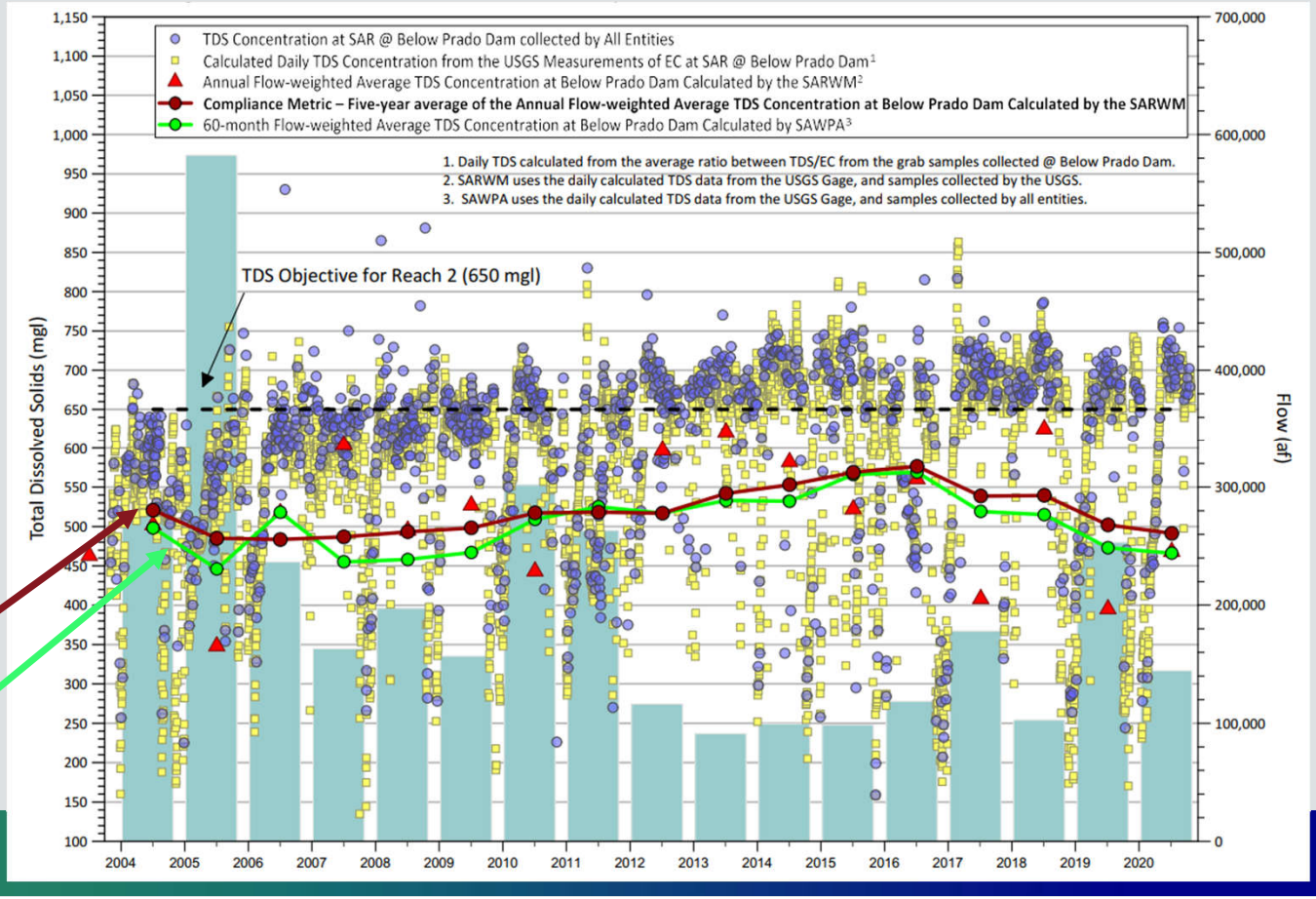
Reach 2 – Monitoring and Compliance from 2005 to 2020

Considerations, Data Gaps, and Uncertainties with Monitoring and Compliance:

- The Basin Plan compliance metrics are clearly defined
- The available data are appropriately used
- Is it necessary for SAWPA to perform and report on the alternative method (60-month volume-weighted TDS concentration) in addition to the compliance metric defined in the Basin Plan, which is computed by SARWM annually?

SARWM

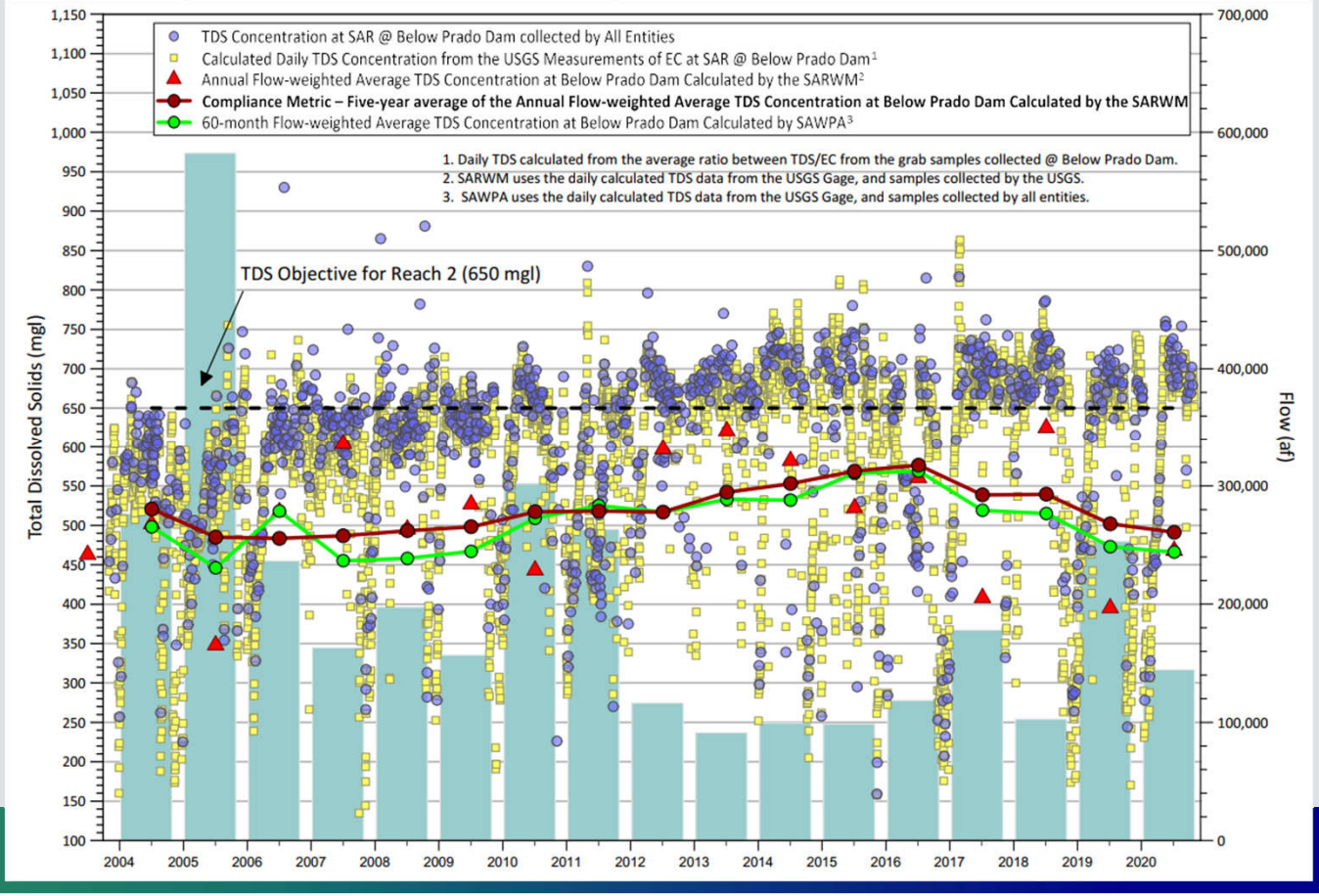
Task Force



Reach 2 – Monitoring and Compliance from 2005 to 2020

Recommendations for the 2022 Work Plan:

- Eliminate the annual reporting of the Task Force alternative method (60-month volume-weighted TDS concentration)
- No recommendations for improved monitoring.



What is left to Discuss to Finalize Sections 2 and 3?

- Proposed frequency and analyte list of sampling for expanded monitoring on Reaches 4 and 5:
  - Quarterly
  - TDS/TIN (calculated from nitrate-N, nitrite-N, and ammonia-N) or general minerals
- Proposed monitoring entity for new monitoring: Task Force
  - What does this mean? Flexible in implementation, Task Force responsible to ensure it is done. Monitoring could be physically done by:
    - member-agency staff
    - Task Force/SAWPA consultants

What is left to Discuss to Finalize Sections 2 and 3?

- Definition of Reach 3 base flow conditions
  - OCWD alternative method

Compliance Metric: Annual Average TDS and TIN of all samples collected ***during base flow conditions.***

- For TDS, use daily TDS record (?) constructed from relationship between daily EC measured by USGS and periodic grab samples.
- For TIN, use TIN data, not filtered total nitrogen

Proposed Definition of Base Flow Conditions in Reach 3:

"when there are no precipitation events and OC-59 discharge within the last four days, and the water-level elevation of the conservation pool behind Prado Dam is at or below the level that is considered empty."

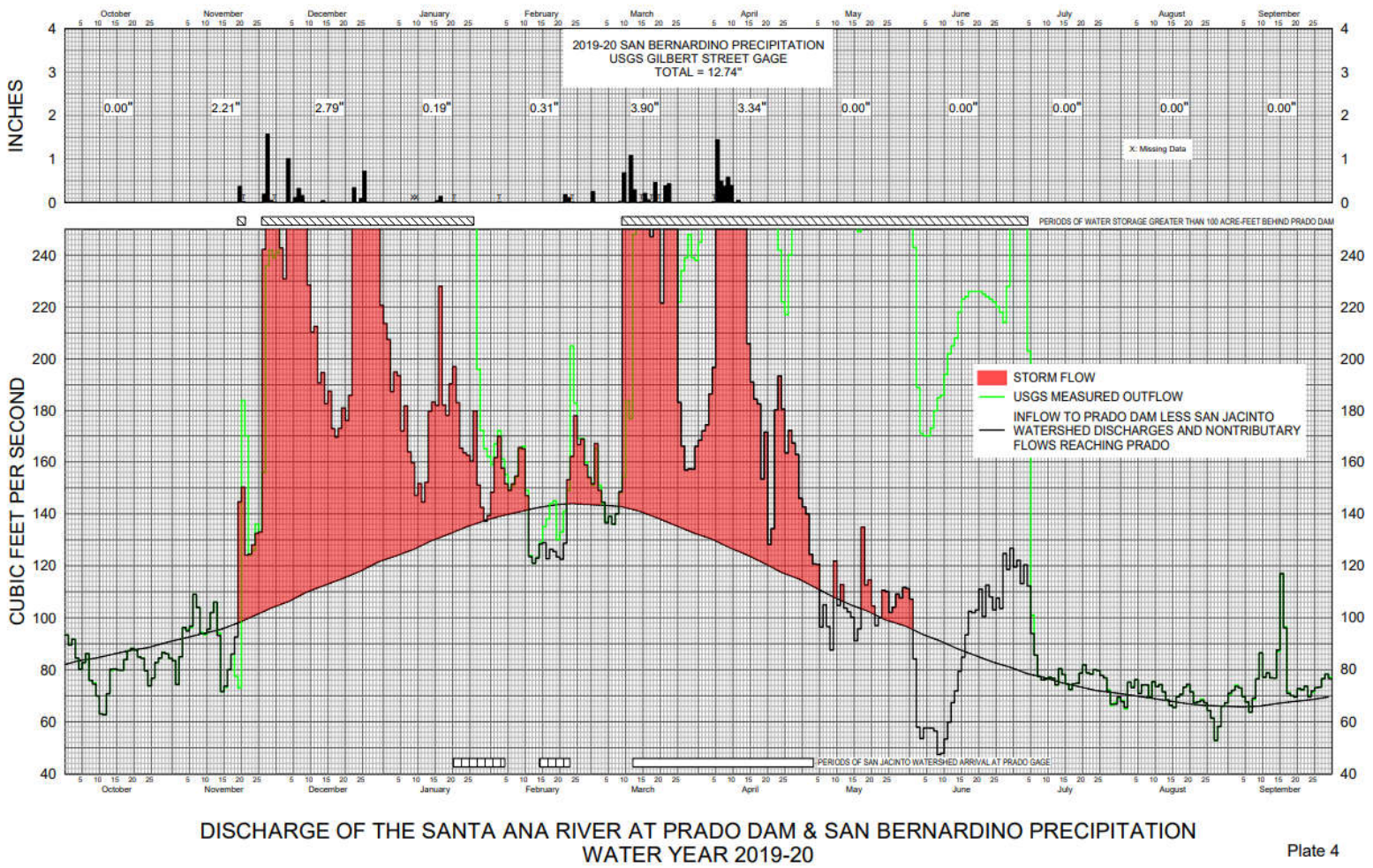
OCWD proposes:

- ***excluding the non-growing season period (November – February)***

- Looking into the use of the daily calculated TDS

What is left to Discuss to Finalize Sections 2 and 3?

Definition of Reach 3 base flow conditions



DISCHARGE OF THE SANTA ANA RIVER AT PRADO DAM & SAN BERNARDINO PRECIPITATION
WATER YEAR 2019-20

Plate 4

Plate 4 from the SARWM Annual; Report for FY 2019/2020

Outline

1. Background
2. Evaluation of the 2005-2020 Surface Water Monitoring Program
3. 2022 Surface Water Monitoring Program to assess compliance with Basin Plan TDS and Nitrogen objectives
4. Recommendation for Special Studies

Recommendation for Special Studies

- Basin Plan provides for additional studies beyond what is necessary to assess annual compliance
- Address data gaps identified by the Task Force, and investigated by West Yost, in the development and use of the WLAM
  - Recent TDS Exceedances in Reach 3
  - Understanding the Surface-Water/Groundwater Interaction in Reach 3 and Reach 4

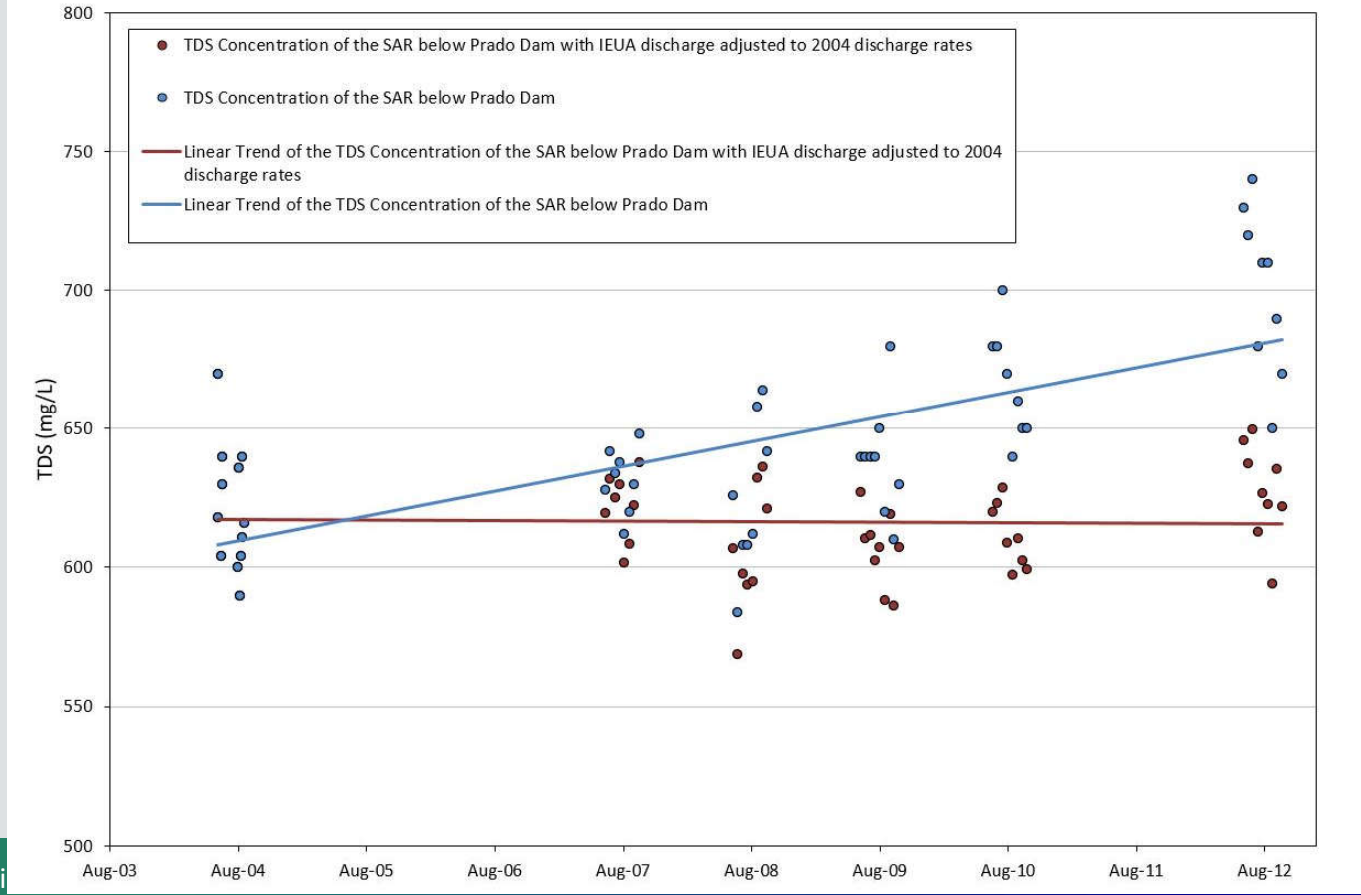
What is left to Discuss to Finalize Section 4?

- Sampling timing, frequency, duration
  - Quarterly sampling for two years
- Sampling locations
  - Reach 3, Reach 4, and major tributaries (~11 sites)
- Proposed monitoring entity for new surface water monitoring sites: Task Force
  - What does this mean? Flexible in implementation, Task Force responsible to ensure it is done. Monitoring could be physically done by:
    - Member-agency staff
    - Task Force/SAWPA consultants
- Report will include map and table with description of monitoring plan, including a more refined cost estimate

Recent TDS Exceedances in Reach 3

- Prior studies (2015) indicated that TDS concentrations were increasing due to decreasing POTW discharges tributary to the SAR
- Did not constrain the precise dynamics of the surface-water/groundwater interactions along Reach 3 and 4
- Difficult to identify potential strategies for maintaining compliance with Basin Plan Objectives

Figure 17
Influence of IEUA Discharge on the TDS Concentration of the Santa Ana River below Prado Dam

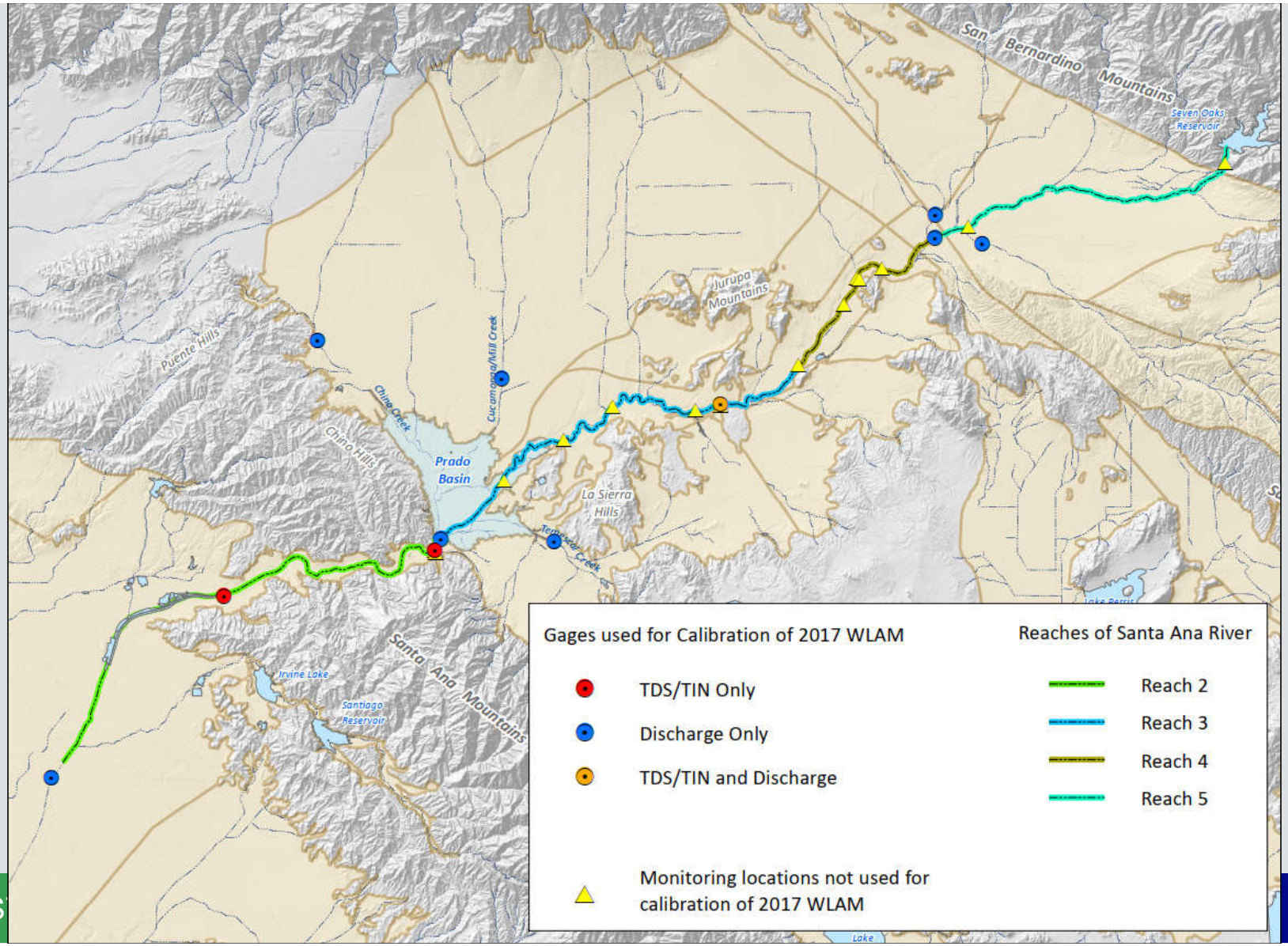


Understanding the Surface-Water/Groundwater Interaction in Reach 3 and Reach 4

- Sensitivity analysis performed during the development of the WLAM indicated high uncertainty in the representation of streambed infiltration and rising groundwater
- Multiple representations of the Santa Ana River can yield the same flow/quality at monitoring (calibration) points.

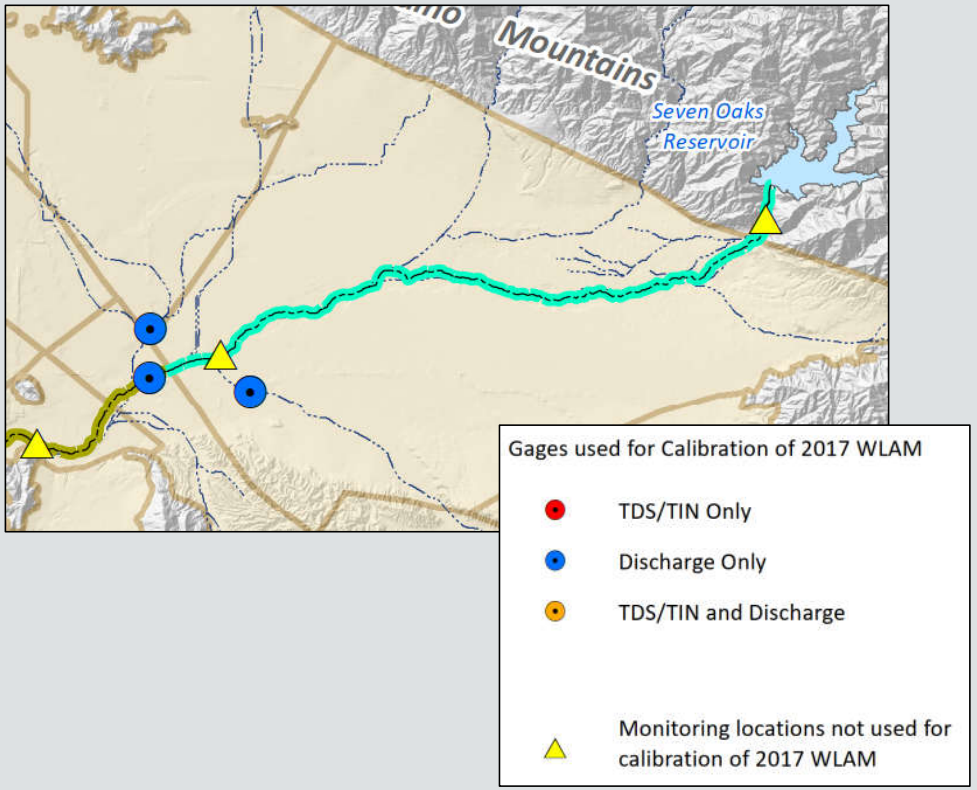
Understanding the Surface-Water/Groundwater Interaction in Reach 3 and Reach 4

- Unknown quantity and quality of streambed infiltration or rising water; insufficient to understand the quality/quantity of water infiltrating into the GMZs
- The models that simulate surface-water/groundwater interaction have results that disagree with the WLAM assumptions/results.
- Field data to understand these dynamics and represent them in a model is lacking.


San Bernardino Mountains
Seven Oaks Reservoir
Jurupa Mountains
Puente Hills
Chino Creek
Chino Hills
Cucamonga/Mill Creek
Prado Basin
La Sierra Hills
Temescal Creek
Santa Ana Mountains
Irvine Lake
Santiago Reservoir
Lake
Gages used for Calibration of 2017 WLAM
TDS/TIN Only
Discharge Only
TDS/TIN and Discharge
Monitoring locations not used for calibration of 2017 WLAM
Reaches of Santa Ana River
Reach 2
Reach 3
Reach 4
Reach 5

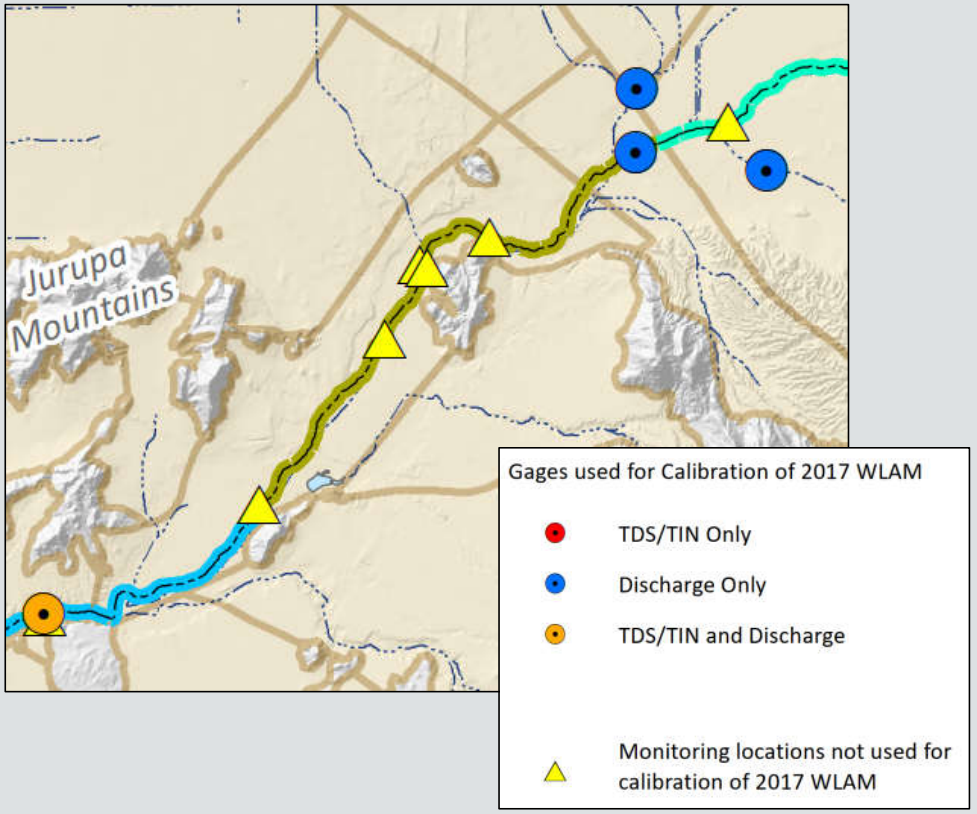
Data Gaps – Reach 5

- Uncertainty in TDS/N concentration of recharge to Bunker Hill-B because no measured data to compare simulated results



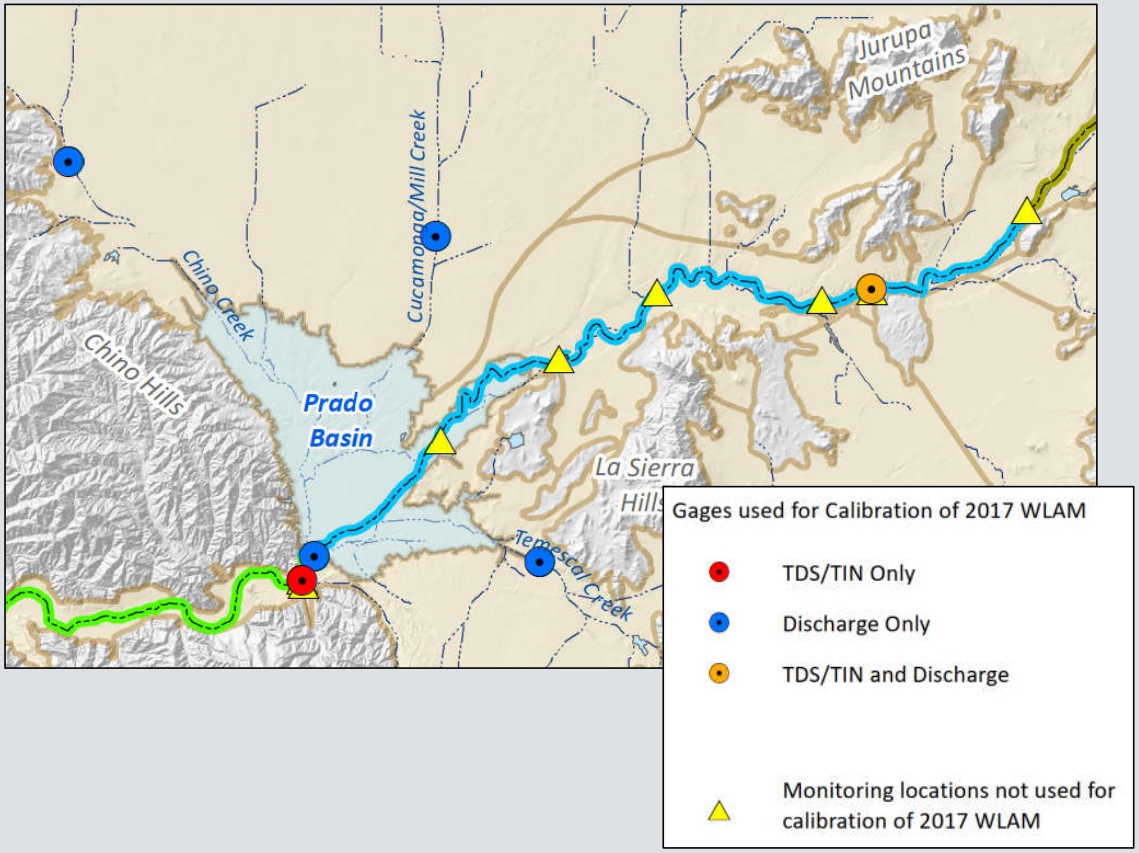
Data Gaps – Reach 4

- Uncertainty in magnitude and quality of streambed recharge in Riverside-A GMZ



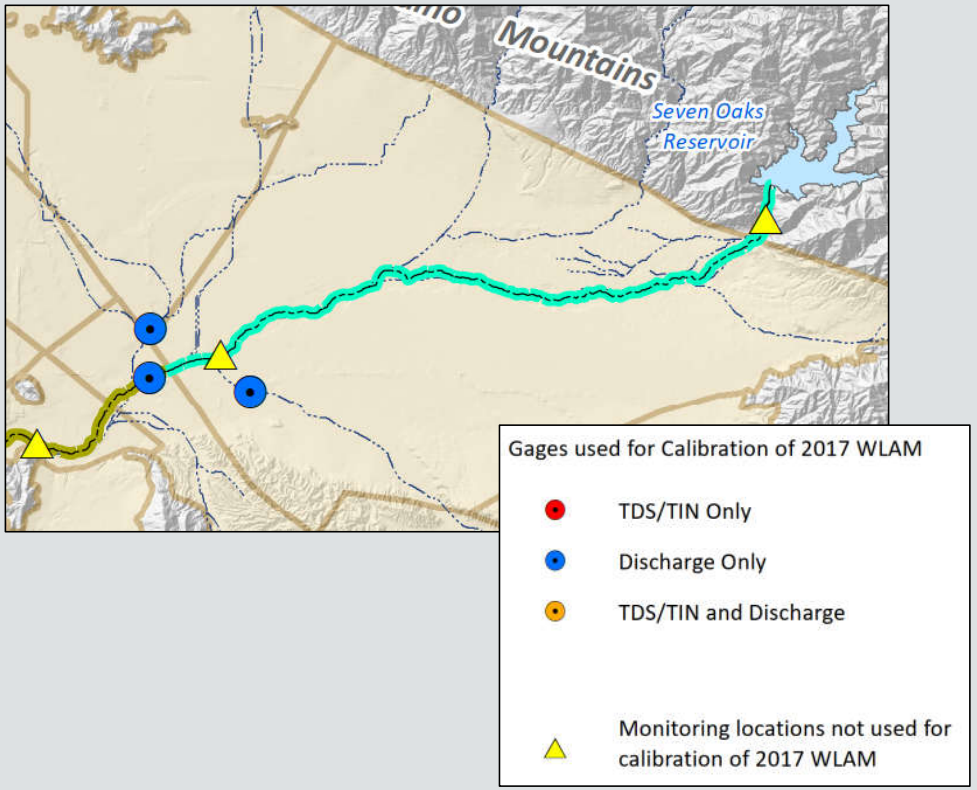
Data Gaps – Reach 3

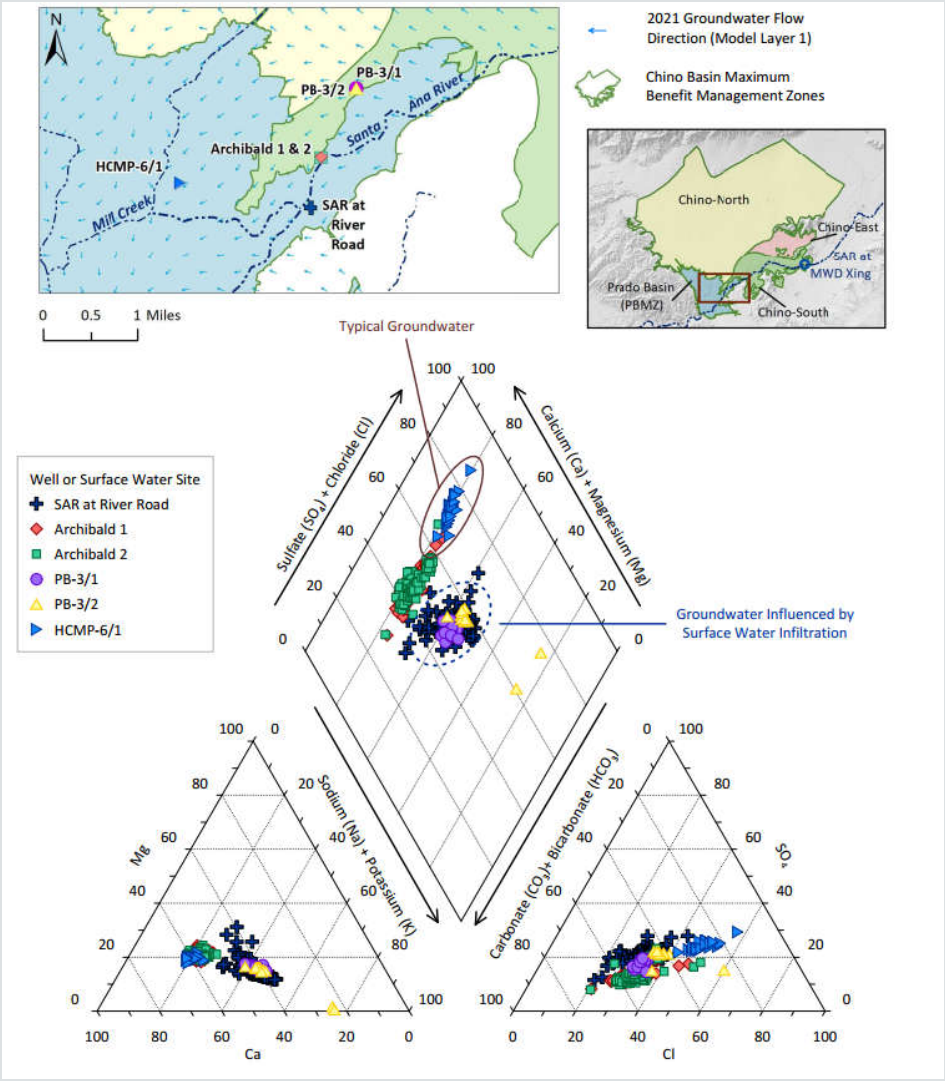
- Uncertainty in magnitude, quality, and location of rising groundwater and streambed recharge in Reach 3 and its tributaries



Recommended Monitoring Program to Support the Special Study – Reach 5

- Recommended monitoring to assess annual compliance with Reach 5 TDS/TIN objectives is sufficient to address data gaps



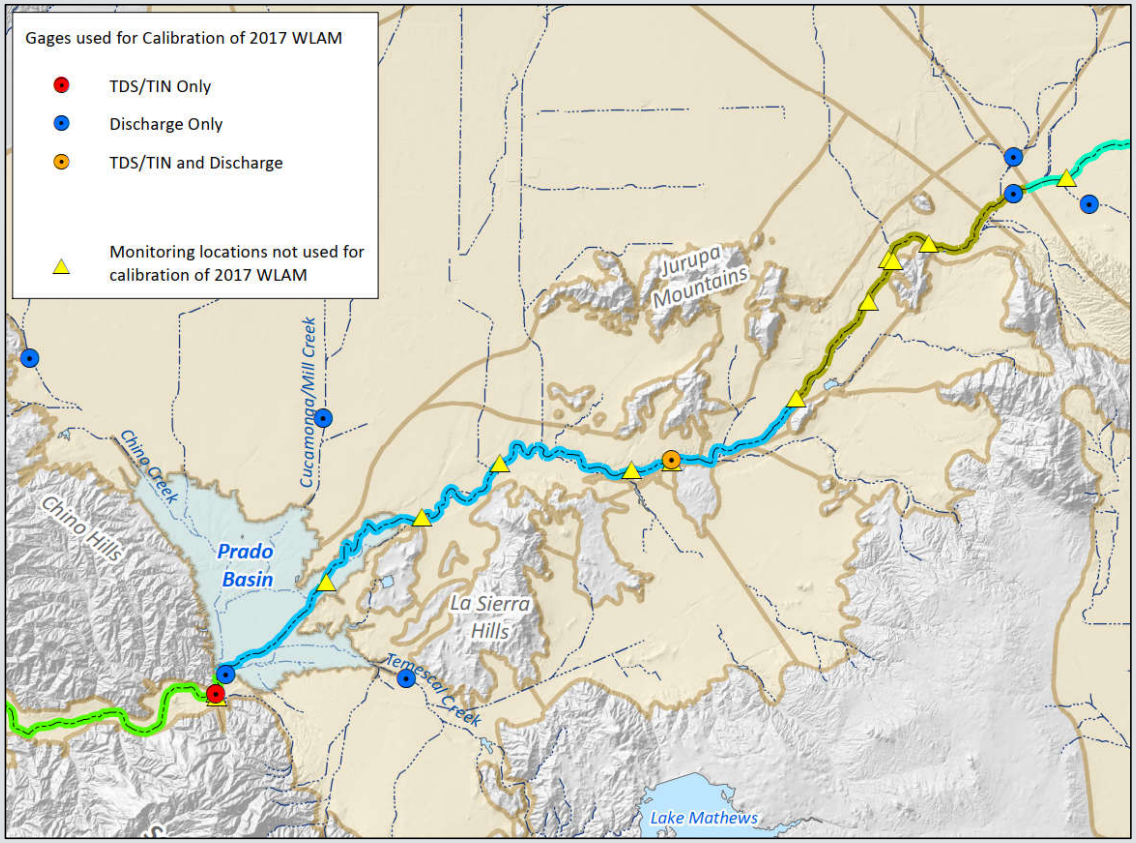


Recommended Monitoring Program to Support the Special Study – Reach 3 and 4

- Review available surface water and groundwater quality data from existing monitoring programs and determine applicability to address data gaps
  - Chino Basin Maximum Benefit monitoring

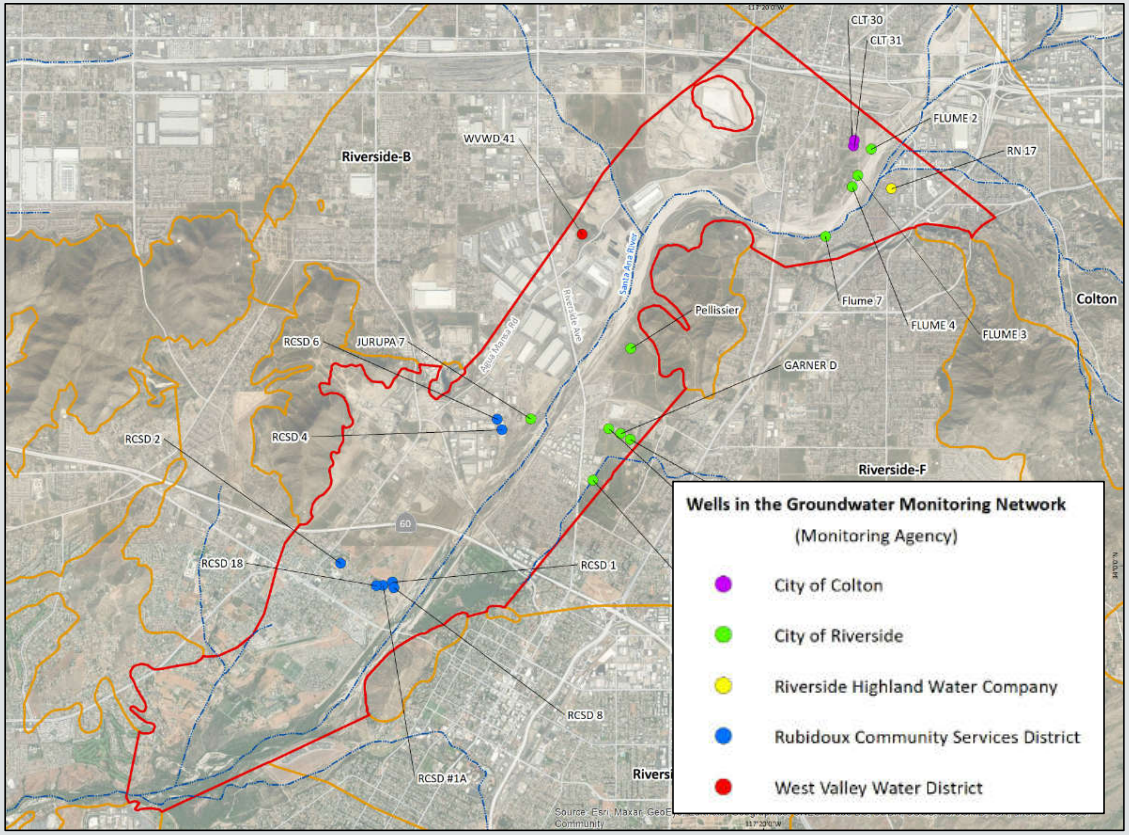
Recommended Monitoring Program to Support the Special Study – Reach 3 and 4

- Surface water monitoring:
  - Reach 3 – 4 locations
    - Includes Chino Basin Max Benefit monitoring
  - Reach 4 – 3 locations
  - 1 monitoring point in each major tributary to Reach 3
    - Chino Creek
    - Cucamonga/Mill Creek
    - Temescal Creek
    - Arlington Drain
  - Quarterly monitoring



Recommended Monitoring Program to Support the Special Study – Reach 3 and 4

- Groundwater monitoring:
  - Collect water quality data, levels if available
  - Leverage existing monitoring locations near SAR
    - Riverside-A GMZ monitoring
    - Chino Basin Max Benefit (near Etiwanda, River Road)
    - Near RIX
    - OCWD wells in Prado



Recommended Monitoring Program to Support the Special Study – Reach 3 and 4

- Groundwater monitoring:
  - Collect water quality data, levels if available
  - Leverage existing monitoring locations near SAR
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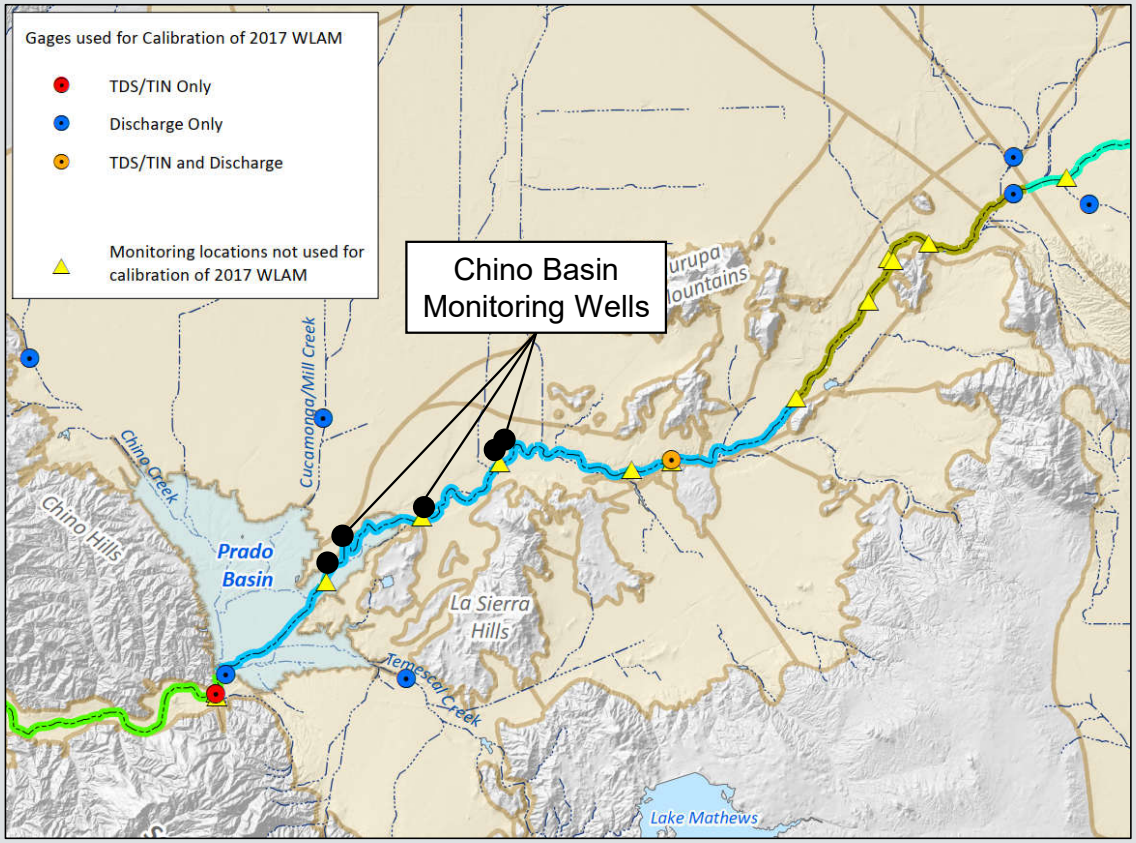
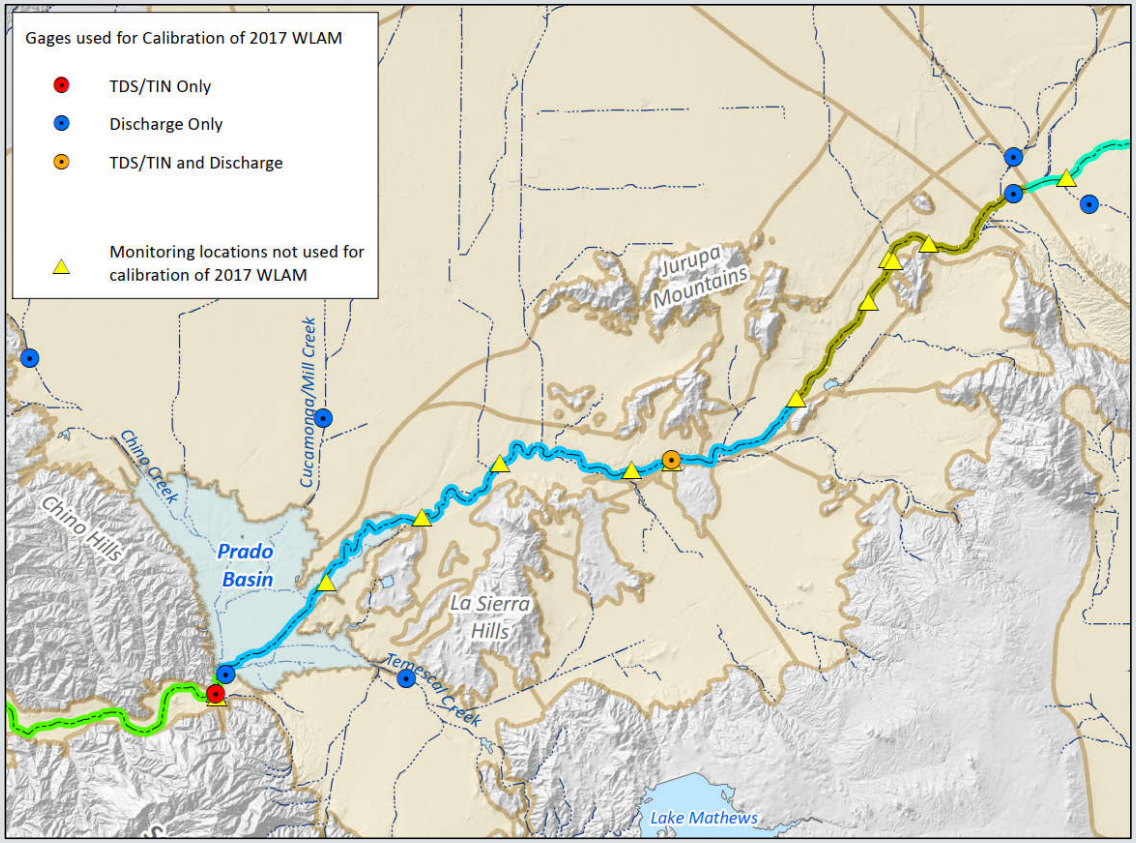
    - OCWD wells in Prado



Recommended Monitoring Program to Support the Special Study – Reach 3 and 4

- Groundwater levels (if available)
- Temperature
- TDS/TIN
- Major cations
- Carbonate
- Bicarbonate
- Chloride
- Sulfate

Used to calculate source water character (WCI, Piper, Stiff, etc.)



Recommended Monitoring Program to Support the Special Study

- Estimated cost of first year of monitoring: **$85,000 to $138,000**
- Assumptions:
  - Quarterly sampling at 11 surface water locations
  - Collecting and reviewing relevant monitoring data from outside agencies
  - Outside consultant
  - TM documenting analysis and recommendations
- Feedback?

What is left to Discuss to Finalize Section 4?

- Sampling timing, frequency, duration
  - Quarterly sampling for two years
- Sampling locations
  - Reach 3, Reach 4, and major tributaries (~11 sites)
- Proposed monitoring entity for new surface water monitoring sites: Task Force
  - What does this mean? Flexible in implementation, Task Force responsible to ensure it is done. Monitoring could be physically done by:
    - Member-agency staff
    - Task Force/SAWPA consultants
- Report will include map and table with description of monitoring plan, including a more refined cost estimate

Next Steps

- **Continue to receive feedback on the proposed surface water monitoring program**
  - Send feedback to Veva Weamer vweamer@westyost.com or Garrett Rapp grapp@westyost.com
- **Next Task Force Meeting** – further discussion on base flow
- **Prepare Draft Report of the 2022 Santa Ana River Water Quality Work Plan**

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Task Force Planning Priorities - Task 1: Prepare Updated Surface Water Monitoring Program for TDS/N for the Santa Ana River Reaches, 2, 3 ,4 and 5

Recommended Surface Water Monitoring Plan – Reach 3 TDS Compliance Metric and Special Studies for Reach 3 & 4

July 26, 2022

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2022 Santa Ana River Water Quality Work Plan

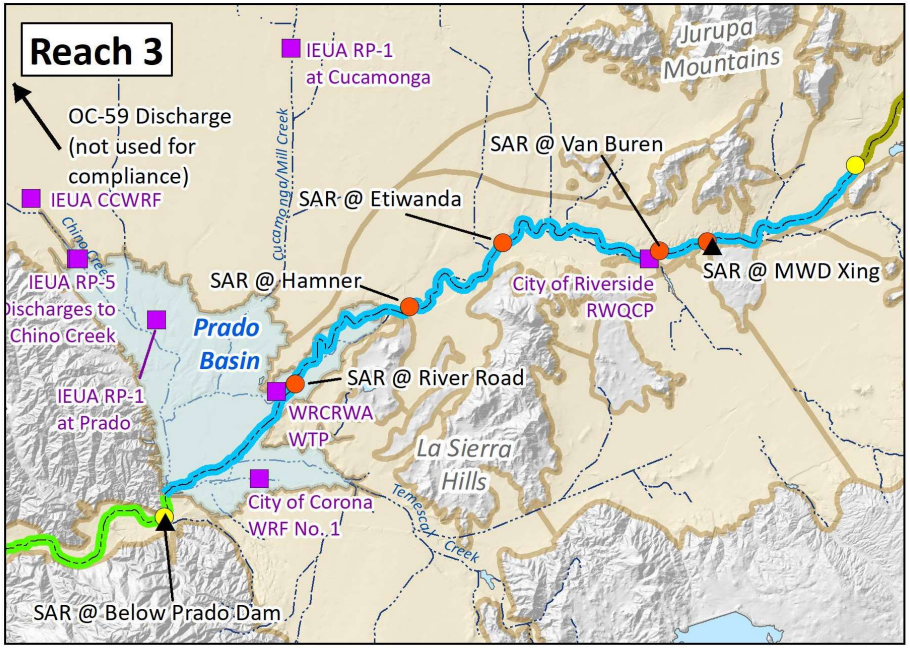
Tables of Contents:

1. Background
2. Evaluation of the 2005-2020 Surface Water Monitoring Program
3. 2022 Surface Water Monitoring Program to Assess Compliance with Basin Plan TDS and Nitrogen Objectives
4. Recommendation for Special Studies

Reach 3 – Monitoring and Compliance

Recommendations for the 2022 Work Plan:

- Develop a clear definition of Reach 3 “base flow” conditions that enables use of more data*
- Use available precipitation data, USGS flow and ACOE reservoir levels at Prado Dam to assess base-flow conditions annually
- Use the available water quality data collected by USGS (daily calculated and grab samples) and OCWD during base flow conditions to assess compliance
- Eliminate Regional Board sampling requirement*
- Remove the requirement to collect filtered total nitrogen samples for compliance*



*Amend Basin Plan to Incorporate this into the SNMP Compliance Plan

Reach 3 – 2022 Work Plan

Site	Monitoring Performed	Monitoring Entity	Monitoring Frequency
USGS Gage at SAR @ Below Prado	Flow, EC	USGS	Daily
SAR @ Below Prado	Water quality: TDS and TIN	USGS	Bi-weekly
		OCWD	Monthly
Prado Basin	Water level elevation	ACOE	Quarterly

(This is called Option AB on subsequent slide)

Compliance Metric: Annual Average TDS and TIN of all samples collected ***during base flow conditions.***

- For TDS, use daily TDS record constructed from relationship between daily EC measured by USGS and periodic grab samples.
- For TIN, use TIN data, not filtered total nitrogen

Proposed Definition of Base Flow Conditions in Reach 3:

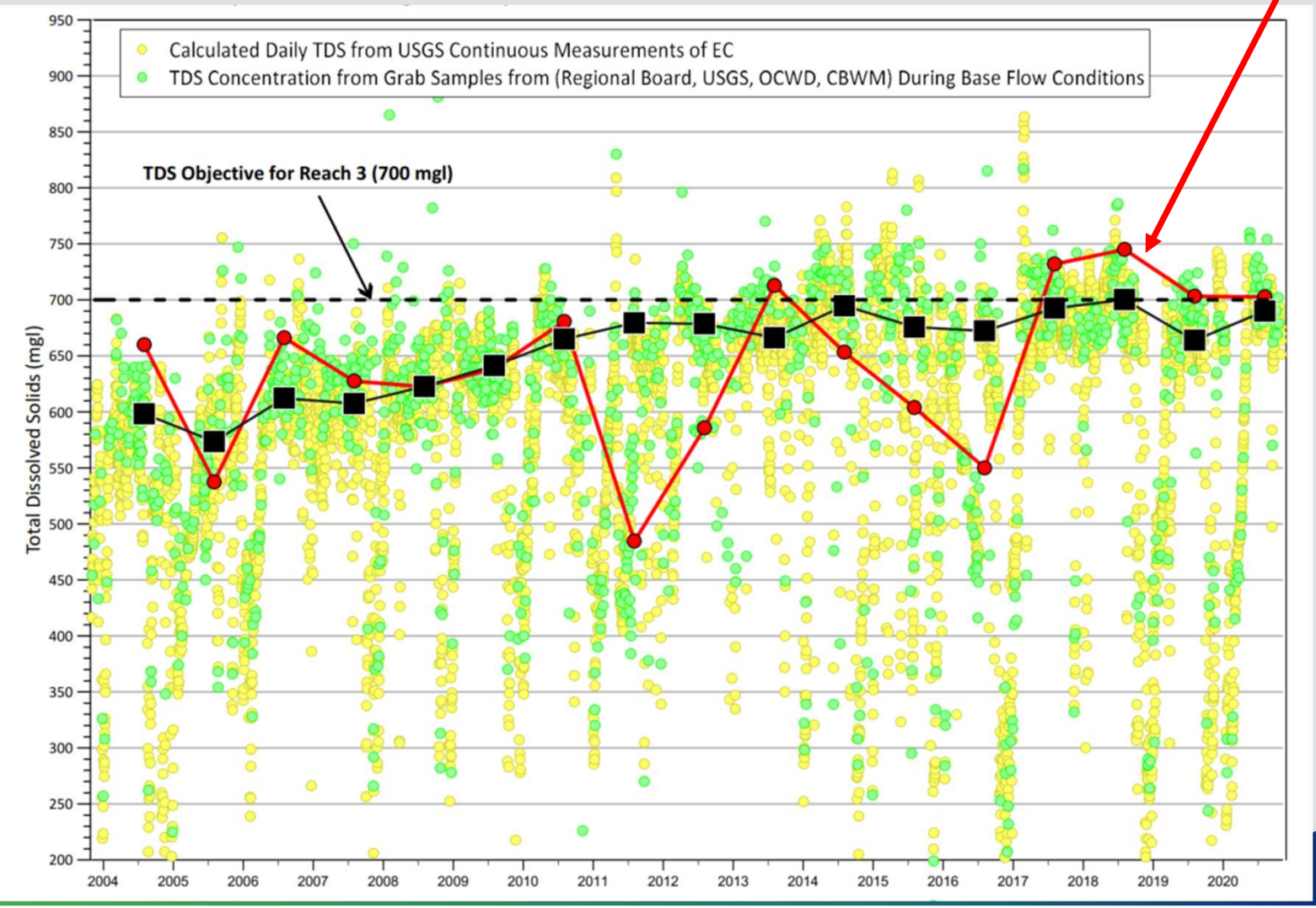
"when there are no precipitation events and OC-59 discharge within the last four days, and the water-level elevation of the conservation pool behind Prado Dam is at or below the level that is considered empty."

OCWD proposed:

- ***Also excluding November – February which is the non-growing season for riparian vegetation in Prado Basin, and higher rising groundwater***

- Looking into the use of the daily calculated TDS

Reach 3 TDS Compliance Metric Options That Use data during Base Flow Conditions



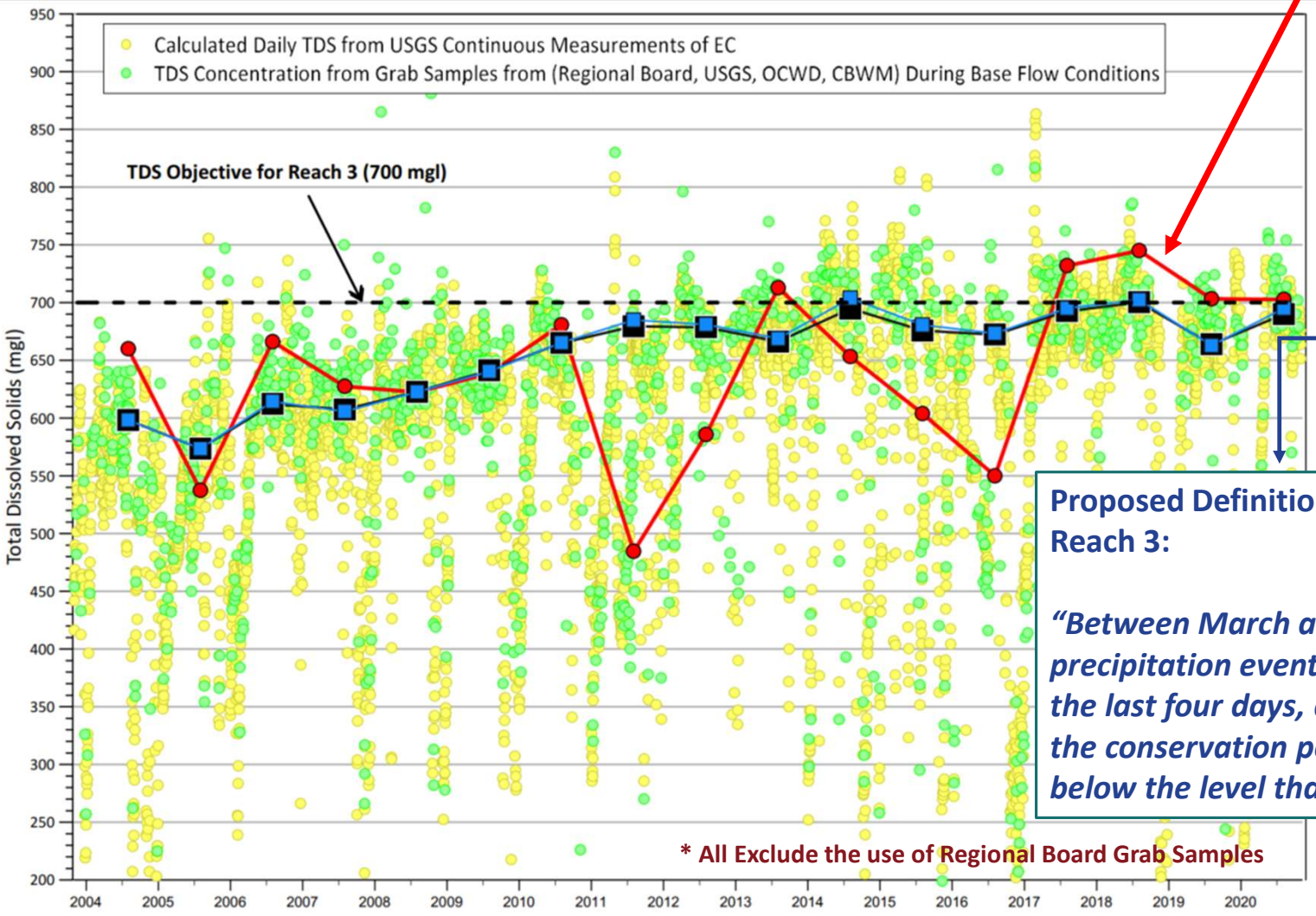
Old Compliance Metric

Proposed New Compliance Metric Options: *

- Option AB –TDS for Base Flow Conditions (Grab Samples and Calculated Daily)

*** All Exclude the use of Regional Board Grab Samples**

Reach 3 TDS Compliance Metric Options That Use data during Base Flow Conditions



Old Compliance Metric

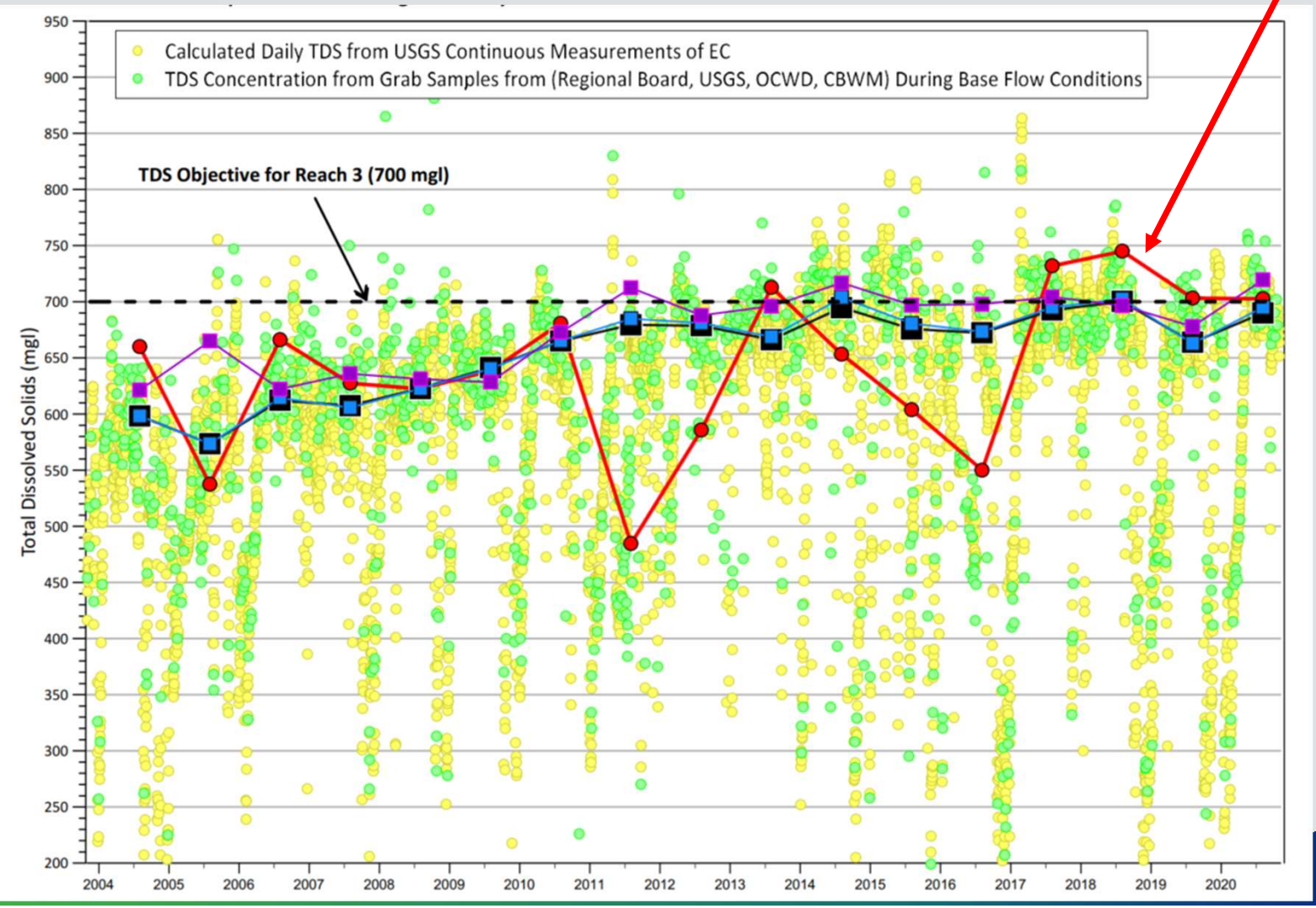
Proposed New Compliance Metric Options: *

- Option AB –TDS for Base Flow Conditions (Grab Samples and Calculated Daily)
- Option Xa –TDS for Base Flow Conditions Excluding Nov – Feb (Grab Samples and Calculated Daily)

Proposed Definition of Base Flow Conditions in Reach 3:

"Between March and October when there are no precipitation events and OC-59 discharge within the last four days, and the water-level elevation of the conservation pool behind Prado Dam is at or below the level that is considered empty."

Reach 3 TDS Compliance Metric Options That Use data during Base Flow Conditions



Old Compliance Metric

Proposed New Compliance Metric Options: *

- Option AB –TDS for Base Flow Conditions (Grab Samples and Calculated Daily)
- Option Xa –TDS for Base Flow Conditions Excluding Nov – Feb (Grab Samples and Calculated Daily)
- Option Xb –TDS for Base Flow Conditions Exclusive of Nov– Feb (Grab Samples only; **no Calculated Daily**)

*** All Exclude the use of Regional Board Grab Samples**

What is left to Discuss to Finalize Sections 3?

- The use of the total filtered sample for compliance with the Reach 3 TIN objective
  - Its intended purpose ?
  - Continue to use or not for Reach 3?
  - Use for other reaches?

2022 Santa Ana River Water Quality Work Plan Outline

1. Background
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3. 2022 Surface Water Monitoring Program to assess compliance with Basin Plan TDS and Nitrogen objectives
4. Recommendation for Special Studies

Recommendation for Special Studies

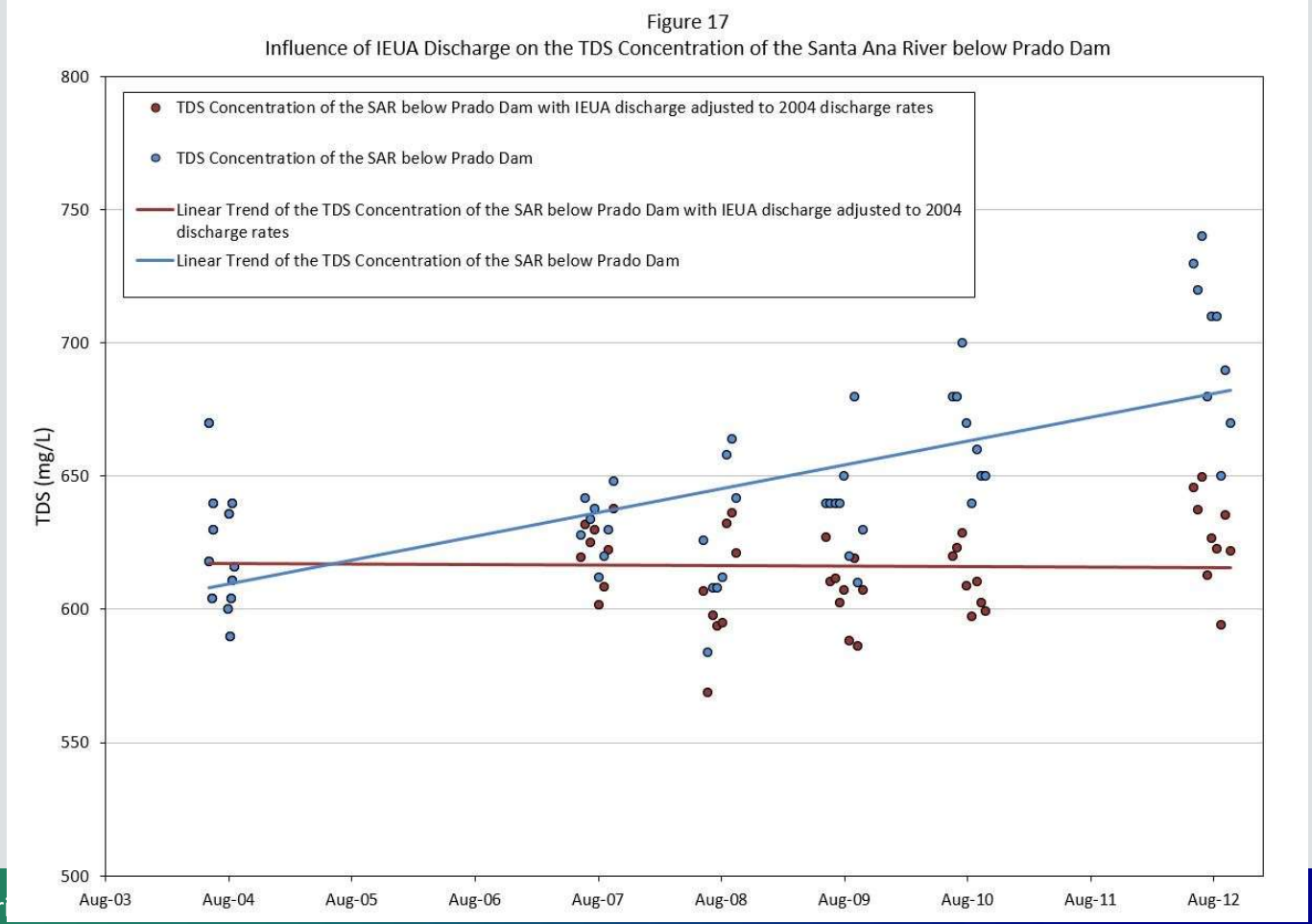
- Basin Plan provides for additional studies beyond what is necessary to assess annual compliance with Basin Plan objectives
- Address data gaps identified by the Task Force, and investigated by West Yost, in the development and use of the WLAM
  - Recent TDS Exceedances in SAR Reach 3
  - Understanding the surface-water/groundwater interaction in SAR Reach 3 and Reach 4
- **Research Objective:** ***Improve the ability of the WLAM to predict future TDS/TIN conditions in the Santa Ana River***

What Feedback is Needed to Finalize Section 4 on the Special Study Recommendation?

- Proposed monitoring program details:
  - Sampling timing, frequency, duration
  - Sampling locations
  - Constituents
  - Proposed monitoring entity for new surface water monitoring sites: Task Force
- Report will include map and table with description of monitoring plan, including a more refined cost estimate that accounts for Task Force feedback

Recent TDS Exceedances in Reach 3

- Prior studies (2015) indicated that TDS concentrations were increasing due to decreasing POTW discharges tributary to the SAR
- The available data was insufficient to understand the precise dynamics of the surface-water/groundwater interactions along Reach 3 and 4
- Lack of understanding is a barrier to identify potential strategies for maintaining compliance with Basin Plan Objectives

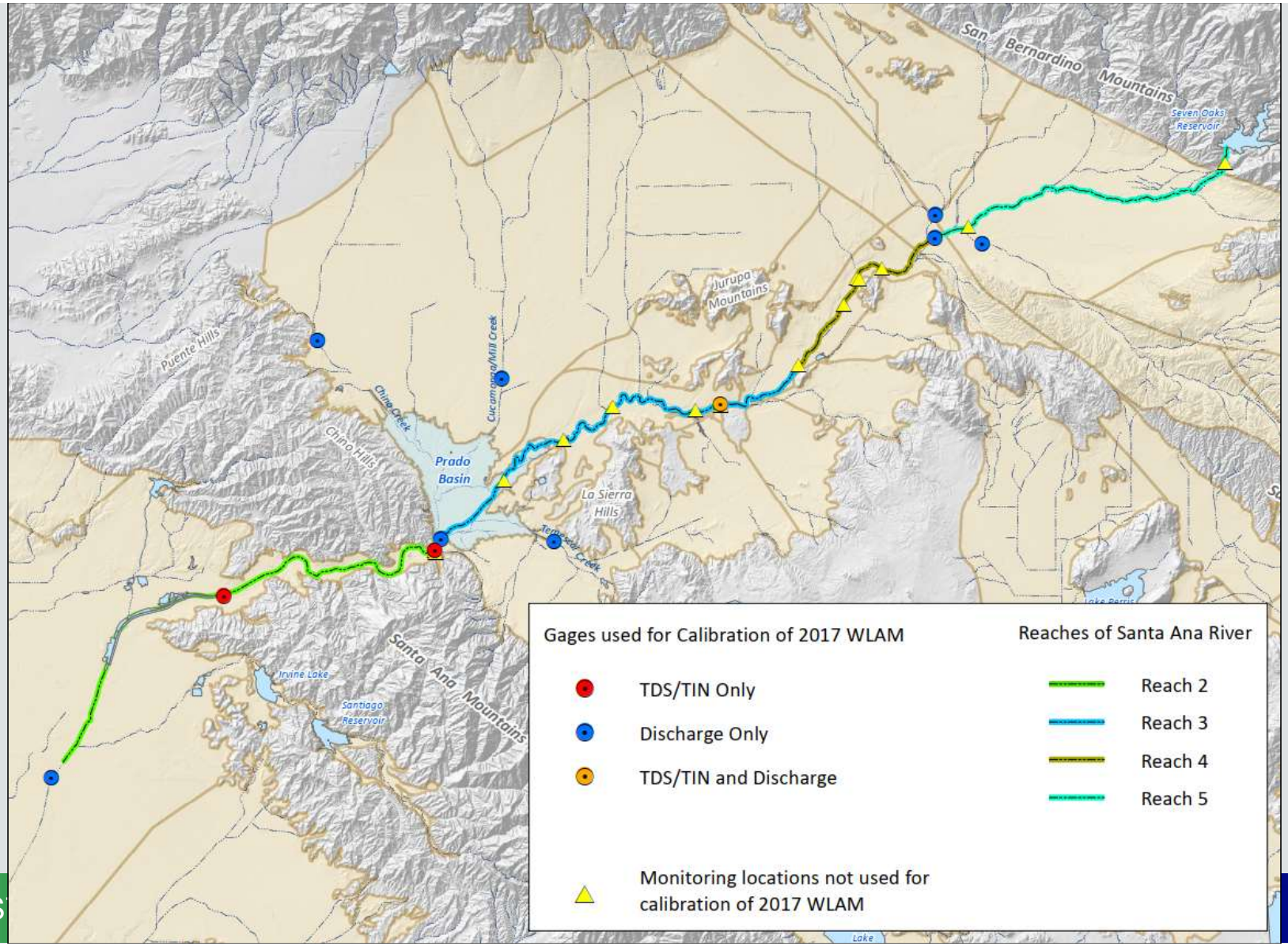


Understanding the Surface-Water/Groundwater Interaction in Reach 3 and Reach 4

- Sensitivity analysis performed during the development of the 2017 WLAM indicated high uncertainty in the representation of streambed infiltration and rising groundwater in Reaches 3 and 4.
- Multiple representations of the surface-water/groundwater interactions within reaches of the Santa Ana River can produce simulated flow/quality at model calibration points that are representative of observed flow/quality.

Understanding the Surface-Water/Groundwater Interaction in Reach 3 and Reach 4

- The location, quantity, and quality of streambed infiltration and rising water is not known and thus there is insufficient information to accurately characterize the quality/quantity of water infiltrating into the GMZs overlying Reaches 3 and 4.
- Regional models that simulate surface-water/groundwater interaction (e.g., ISARM, CVM) produce results that are different than the WLAM assumptions/results.
- Field data to understand surface-water/groundwater dynamics and represent them accurately in a model is lacking.


San Bernardino Mountains
Seven Oaks Reservoir
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Gages used for Calibration of 2017 WLAM
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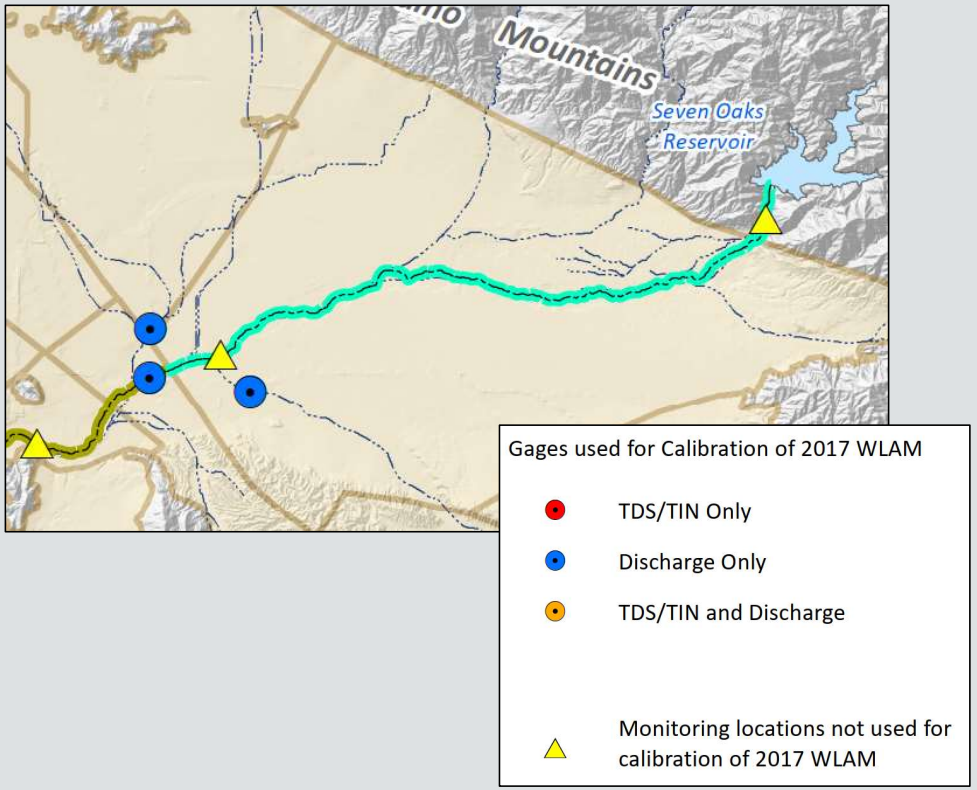
TDS/TIN and Discharge
Monitoring locations not used for calibration of 2017 WLAM
Reaches of Santa Ana River
Reach 2
Reach 3
Reach 4
Reach 5

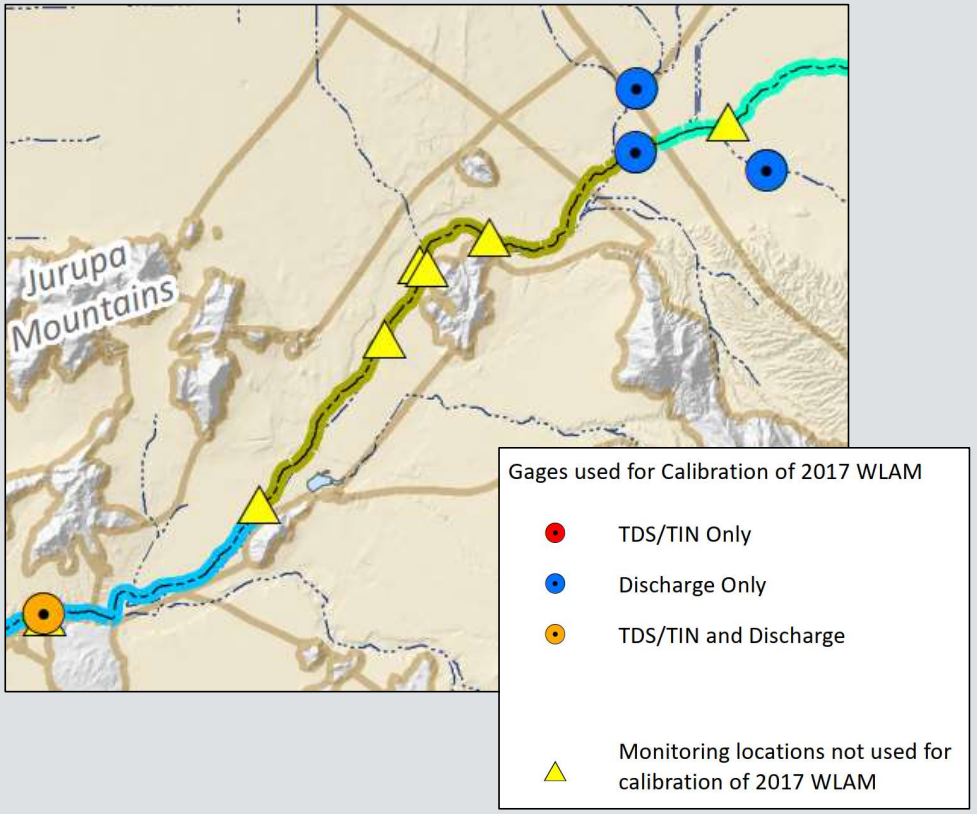
Data Gaps – Reach 5

- Uncertainty in TDS/N concentration of recharge to Bunker Hill-B because no measured data to compare to simulated results from the WLAM



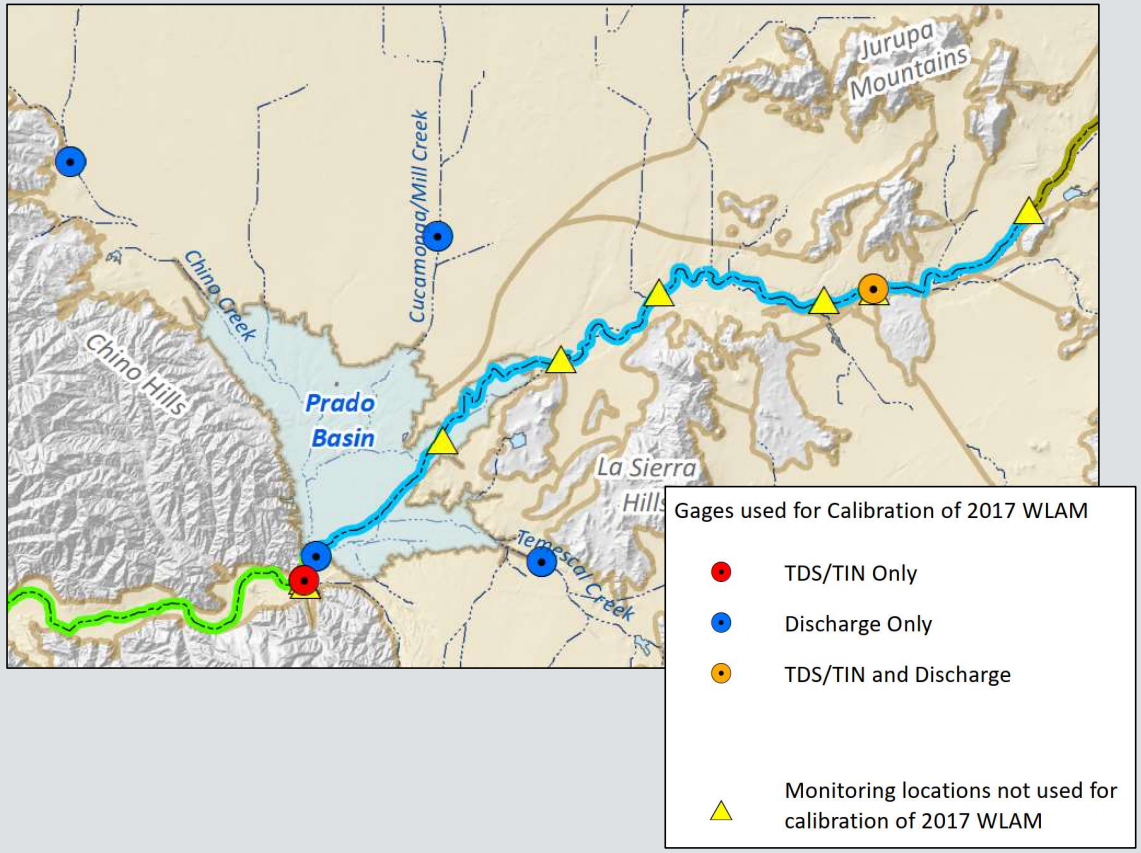
Data Gaps – Reach 4

- Uncertainty in the magnitude and quality of streambed recharge in Riverside-A GMZ



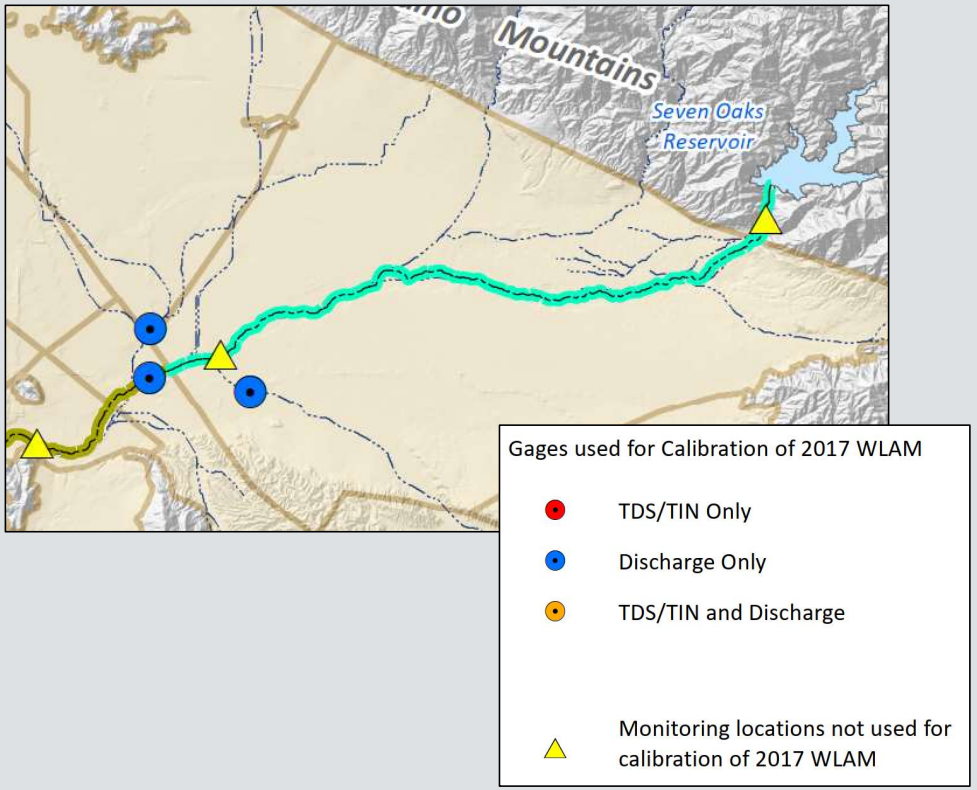
Data Gaps – Reach 3

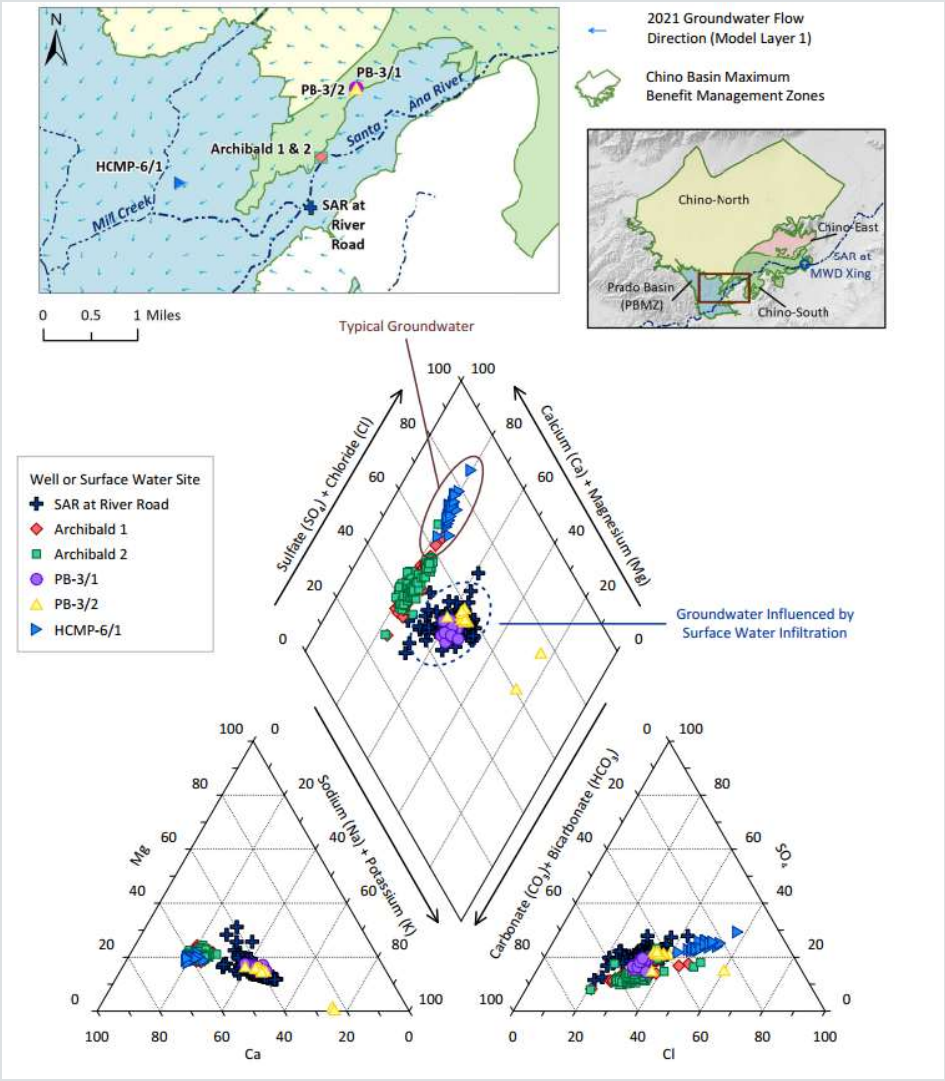
- Uncertainty in the magnitude, quality, and location of rising groundwater and streambed recharge in Reach 3 and its tributaries



Recommended Monitoring Program to Support the Special Study – Reach 5

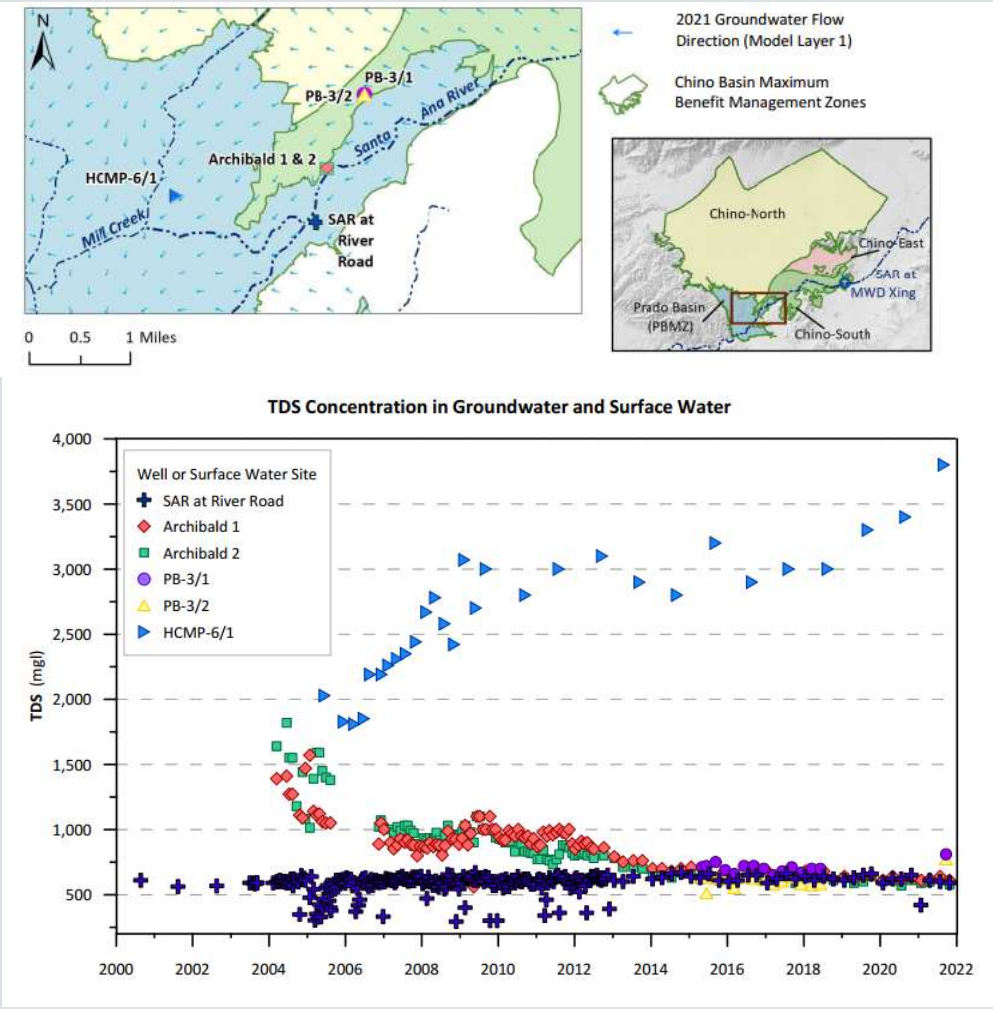
- The recommended monitoring to improve the annual assessment of compliance with the Reach 5 TDS/TIN objectives is sufficient to address data gaps
- No additional monitoring for the Special Study is proposed





Recommended Monitoring Program to Support the Special Study – Reach 3 and 4

- Review available surface water and groundwater quality data from existing monitoring programs and determine applicability to address data gaps
- Chino Basin Maximum Benefit monitoring
  - Surface and groundwater monitoring
  - Used to assess surface-water/groundwater interactions

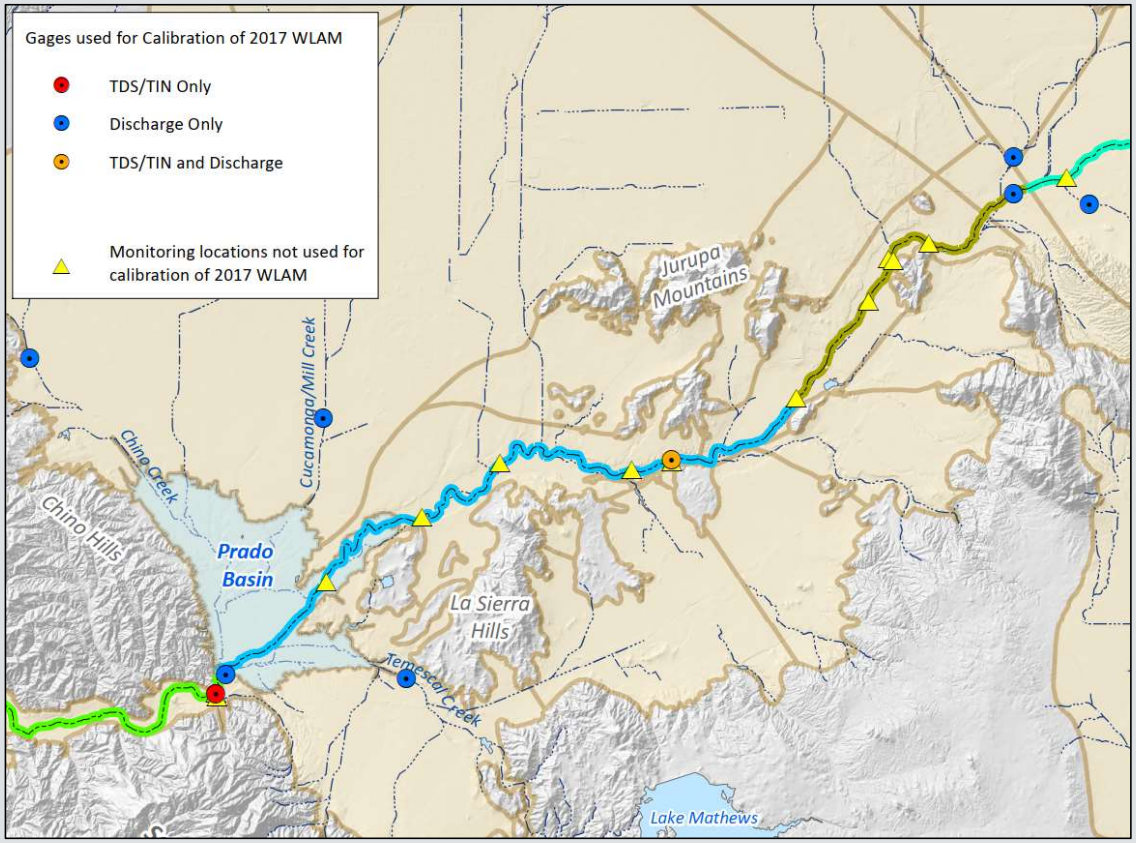


Recommended Monitoring Program to Support the Special Study – Reach 3 and 4

- Changes in cultural conditions change surface-water/groundwater interactions
  - Chino Basin Desalters
- Quarterly sampling adequately captures trends

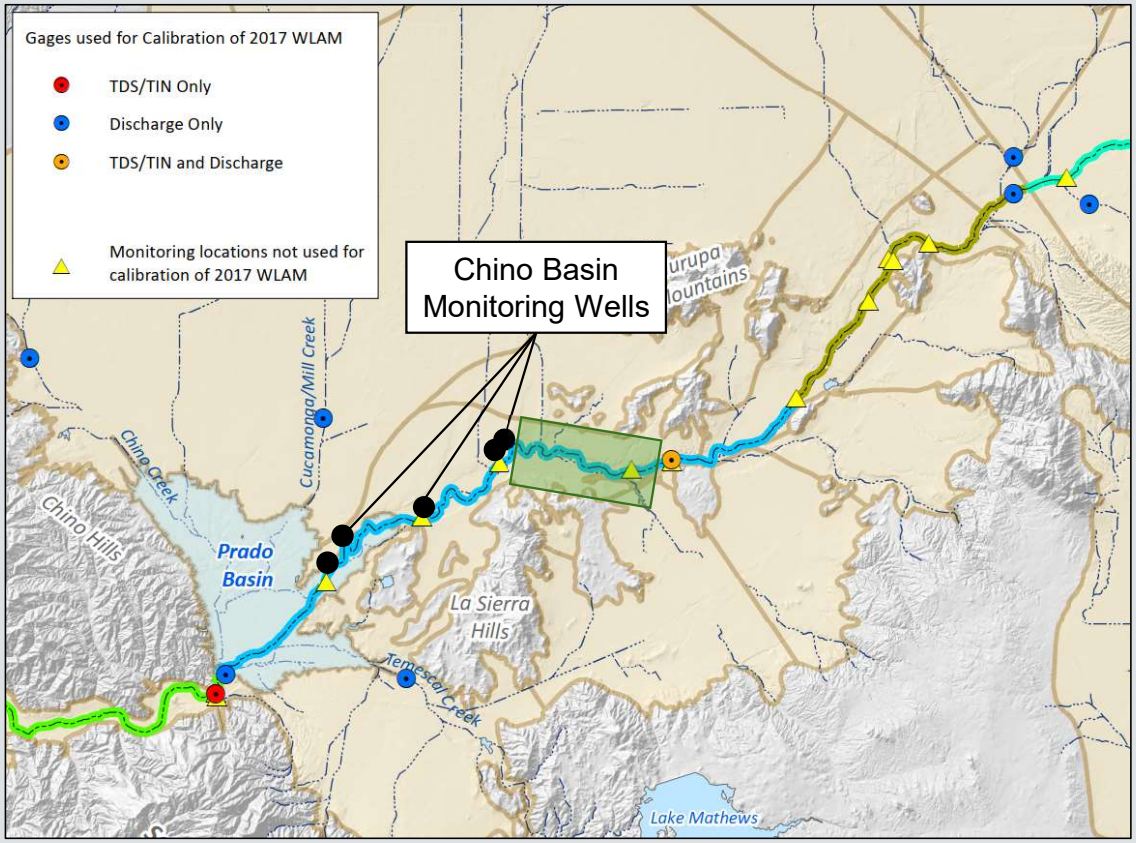
Recommended Monitoring Program to Support the Special Study – Reach 3 and 4

- Quarterly surface water monitoring:
  - 3 monitoring points in SAR overlying Riverside-A GMZ
  - 4 monitoring points in SAR overlying Chino South GMZ
  - 1 monitoring point in each major tributary to Prado Basin
    - Chino Creek
    - Cucamonga/Mill Creek
    - Temescal Creek
    - Arlington Drain



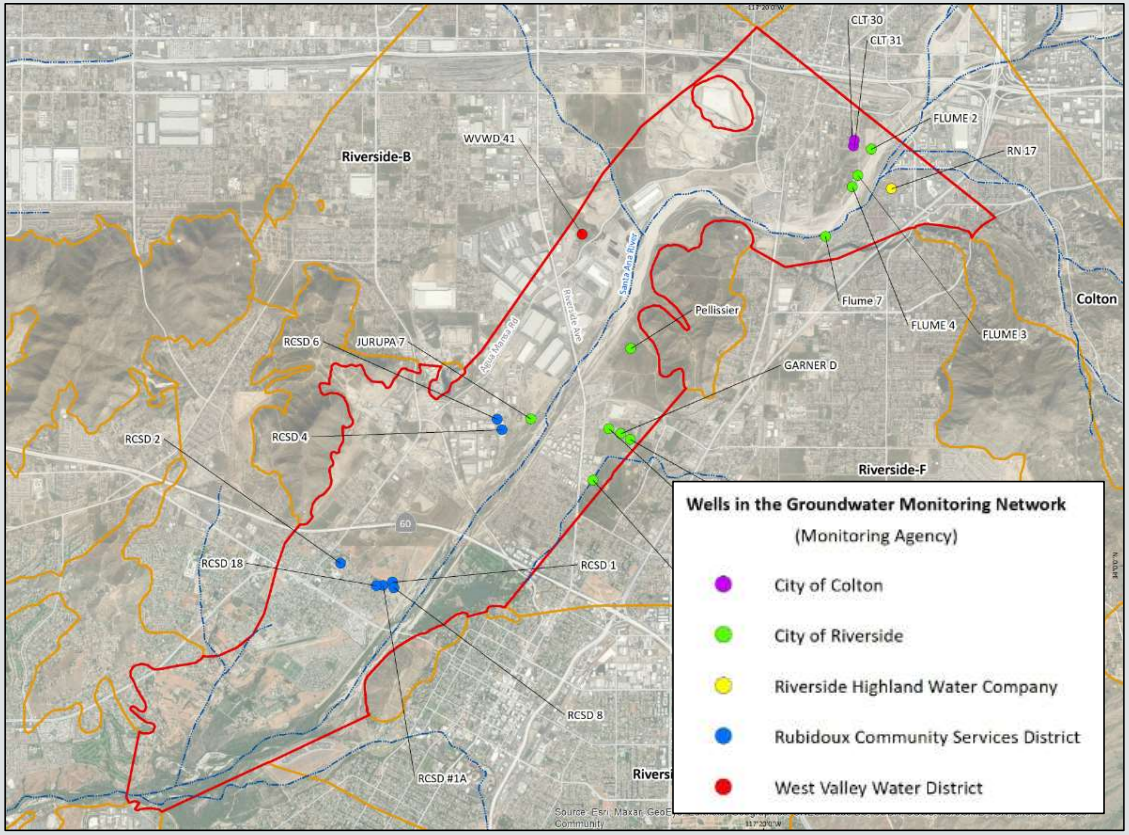
Recommended Monitoring Program to Support the Special Study – Chino South GMZ (Reach 3)

- Groundwater monitoring:
  - Collect existing water quality and groundwater level data
  - Leverage existing monitoring in Chino Basin Max Benefit Program
  - One new monitoring location between Riverside Narrows and Etiwanda



Recommended Monitoring Program to Support the Special Study – Riverside-A GMZ (Reach 3/4)

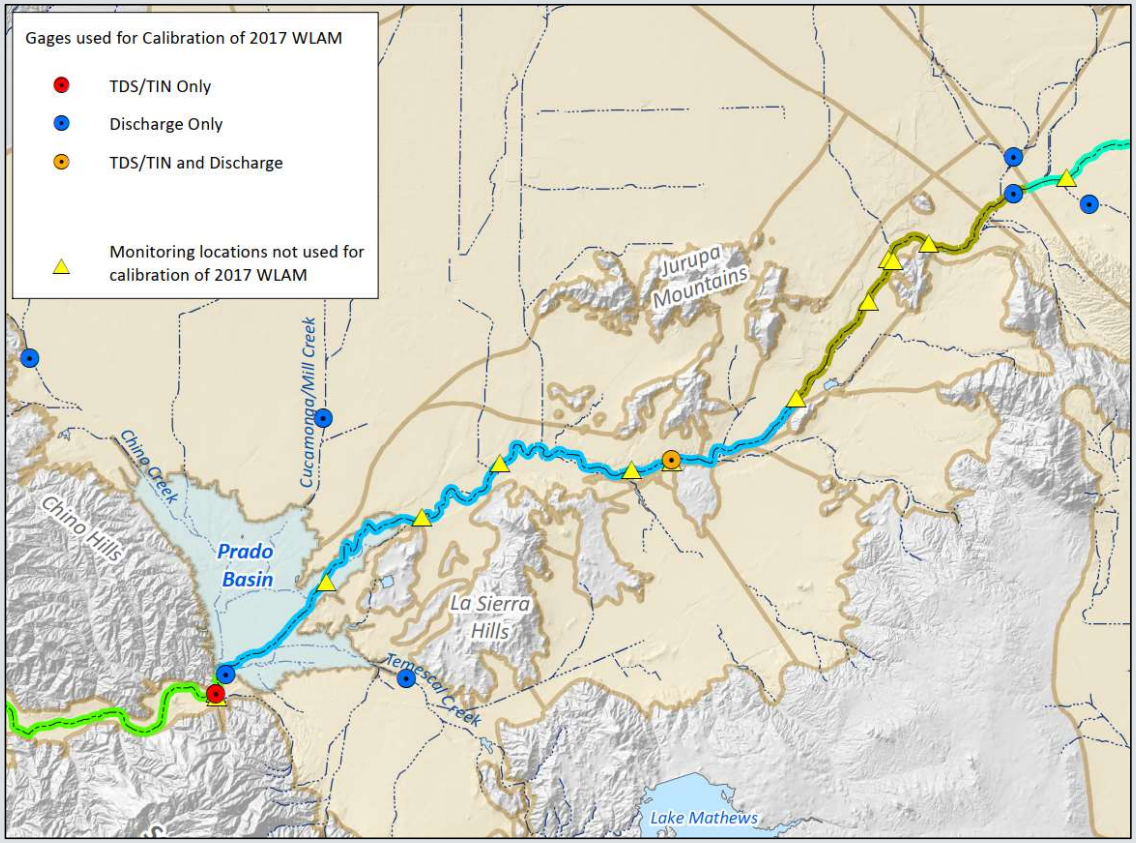
- Groundwater monitoring:
  - Collect existing water quality and groundwater level data
  - Quarterly monitoring in Riverside-A for wells near proposed surface water monitoring sites



Recommended Monitoring Program to Support the Special Study – Reach 3 and 4

- Water quality parameters:
  - Temperature
  - TDS/TIN
  - Major cations
  - Carbonate
  - Bicarbonate
  - Chloride
  - Sulfate

Used to calculate source water character (WCI, Piper, Stiff, etc.)



Recommended Monitoring Program to Support the Special Study

- Estimated cost of first year of monitoring: **$130,000**
- Assumptions:
  - Quarterly sampling at surface water and groundwater sites
  - Collecting and reviewing relevant monitoring data from outside agencies
  - Outside consultant performs all work
  - TM documenting analysis and recommendations
  - No QAPP required for Special Study monitoring

Research Objective for Special Study

- ***<u>Research Objective</u>: Improve the ability of the WLAM to predict future TDS/TIN conditions in the Santa Ana River***
- The proposed monitoring will provide:
  - Surface water data to better constrain the TDS/TIN concentration of the streambed recharge
  - Groundwater data to better constrain the location and concentration of rising groundwater in Reaches 3 and 4

What Feedback is Needed to Finalize Section 4 on the Special Study Recommendation?

- Sampling timing, frequency, duration
  - Quarterly sampling for two years
- Sampling locations
  - Reach 3, Reach 4, and major tributaries
  - Groundwater wells
- Constituents
  - TDS/TIN, cations, anions, temperature, groundwater levels
- Proposed monitoring entity will be reported as the Task Force
  - Need to determine entity physically responsible for monitoring:
    - Member-agency staff
    - Task Force/SAWPA consultants

Next Steps

- **Continue to receive feedback on the proposed surface water monitoring program**
  - Send feedback to Veva Weamer vweamer@westyost.com or Garrett Rapp grapp@westyost.com
- **Next Task Force Meeting** – further discussion on base flow
- **Prepare Draft Report of the 2022 Santa Ana River Water Quality Work Plan**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Task Force Planning Priorities - Task 1: Prepare Updated Surface Water Monitoring Program for TDS/N for the Santa Ana River Reaches, 2, 3 ,4 and 5

Update on Recommended Surface Water Monitoring Plan

August 30, 2022

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Section 3 - Surface Water Monitoring Program to Assess Compliance with Basin Plan TDS and Nitrogen Objective. Remaining items to discuss:

- **Reach 3:** Filtered Total Nitrogen requirement for TIN Objective
- **Reach 2:** Use of the 5-year average of SARWM volume-weighted method vs. 60-month volume-weighted method
- **Reach 2 and 3:** The ability to upload calculated TDS from EC measurements to CEDEN

Reach 3 Filtered Total Nitrogen requirement for TIN Objective

Reach 3 Recommendations for the 2022 Work Plan:

- Remove the requirement to collect filtered total nitrogen samples for compliance*

  **Amend Basin Plan to Incorporate this into the SNMP Compliance Plan*

Table 4-1 in Basin Plan for the Santa Ana River Basin:

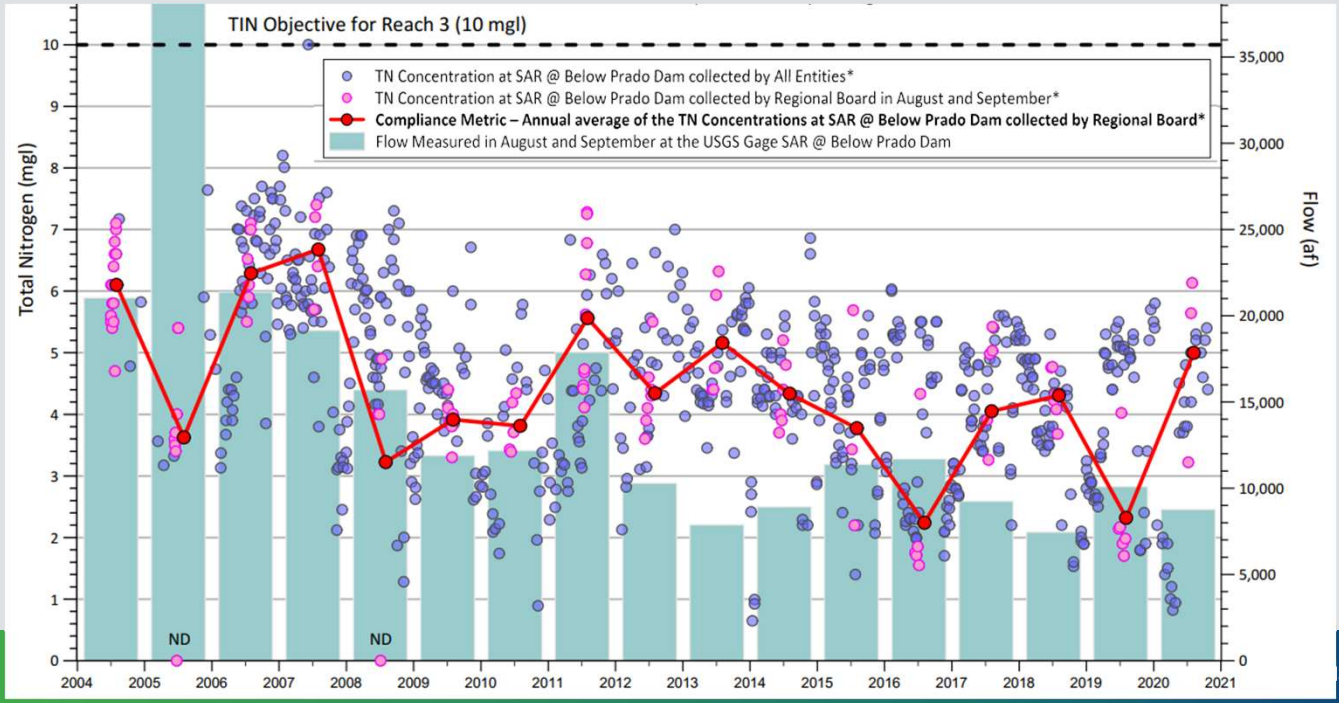
INLAND SURFACE STREAMS	WATER QUALITY OBJECTIVES (mg/L)							Hydrologic Unit	
	Total Dissolved Solids	Hardness	Sodium	Chloride	Total Inorganic Nitrogen	Sulfate	Chemical Oxygen Demand	Primary	Secondary
UPPER SANTA ANA RIVER BASIN									
Santa Ana River									
Reach 3 – Prado Dam to MissionBlvd. in Riverside – Base Flow[2]	700	350	110	140	10[3]	150	30	801.21	801.27, 801.25
Reach 4 – Mission Blvd. in Riverside to San Jacinto Fault in San Bernardino	550	---	---	---	10	---	30	801.27	801.44
38 at Upper Powerhouse to Headwaters	110	100	25	5	1	15	5	801.58	

[2] Additional Objectives: Boron: 0.75 mg/l

[3] Total nitrogen, filtered sample

Reach 3 Filtered Total Nitrogen requirement for TIN Objective

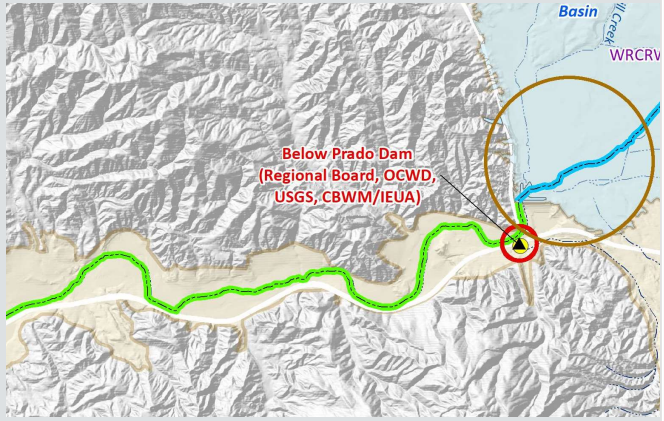
ST_ID	Station_Name	StaType	Sample_Date	Parameter	Result	Unit	Data_Source
1129614	Below Prado Dam	Surface	9/1/2020	Total Inorganic Nitrogen	2.2	mg/L	Regional Water Quality Control Board
1129614	Below Prado Dam	Surface	9/1/2020	Total Nitrogen (filtered)	3.2	mg/L	Regional Water Quality Control Board
1129614	Below Prado Dam	Surface	9/16/2020	Total Inorganic Nitrogen	4.3	mg/L	Regional Water Quality Control Board
1129614	Below Prado Dam	Surface	9/16/2020	Total Nitrogen (filtered)	5.6	mg/L	Regional Water Quality Control Board
1129614	Below Prado Dam	Surface	9/22/2020	Total Inorganic Nitrogen	4.9	mg/L	Regional Water Quality Control Board
1129614	Below Prado Dam	Surface	9/22/2020	Total Nitrogen (filtered)	6.1	mg/L	Regional Water Quality Control Board



- TN filtered sample is conservative
- 2004-2020 TN filtered metric well below the 10 mgl objective for TIN
- Feedback on the removal of the TN filtered requirement for Reach 3

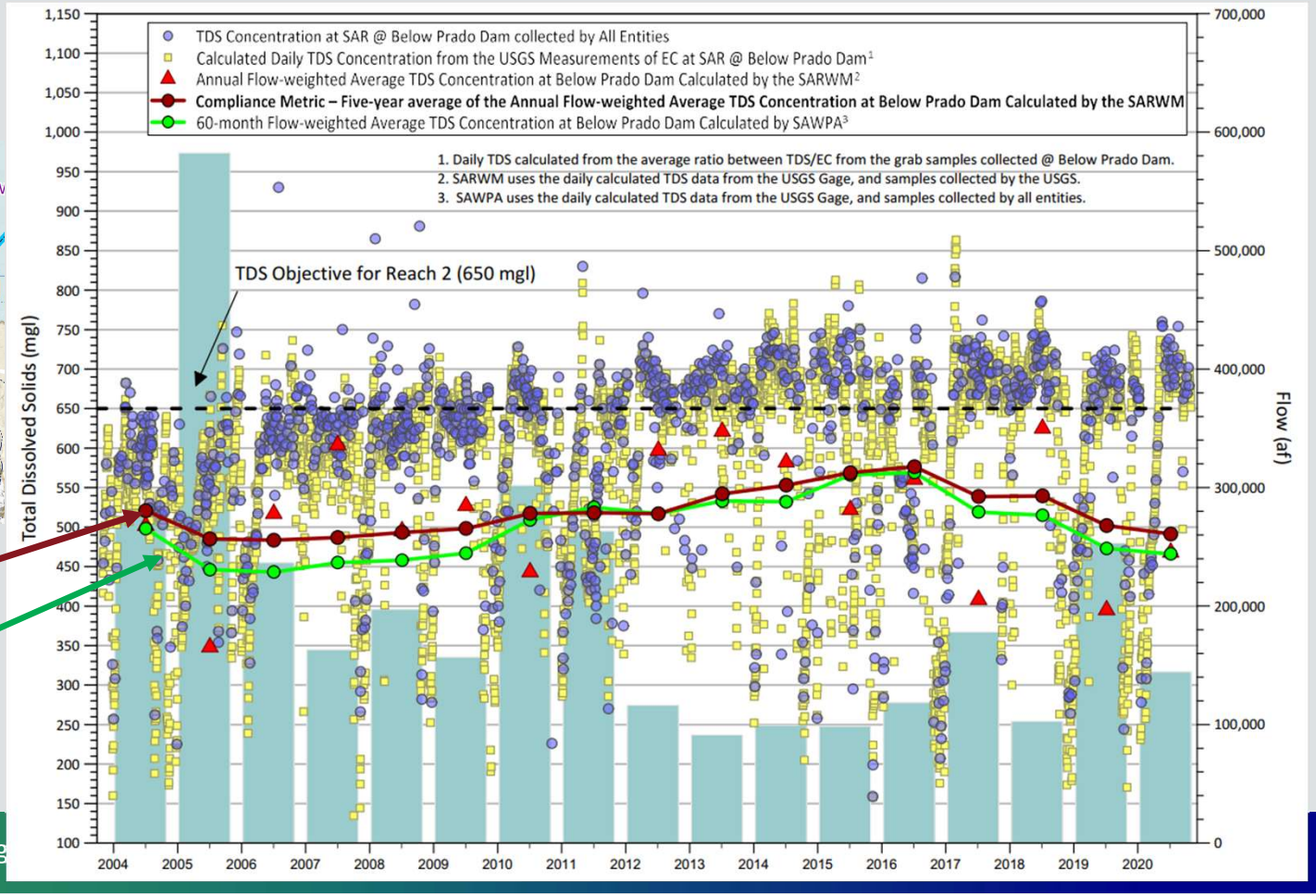
Use of the 5-year average of SARWM volume-weighted calculation (Basin Plan Method) vs. 60-month volume-weighted method (Alternative 60-month Method)

Reach 2 - TDS Objective – Volume-weighted metric



Basin Plan Method
(5-yr Avg of SARWM Annual Calc)

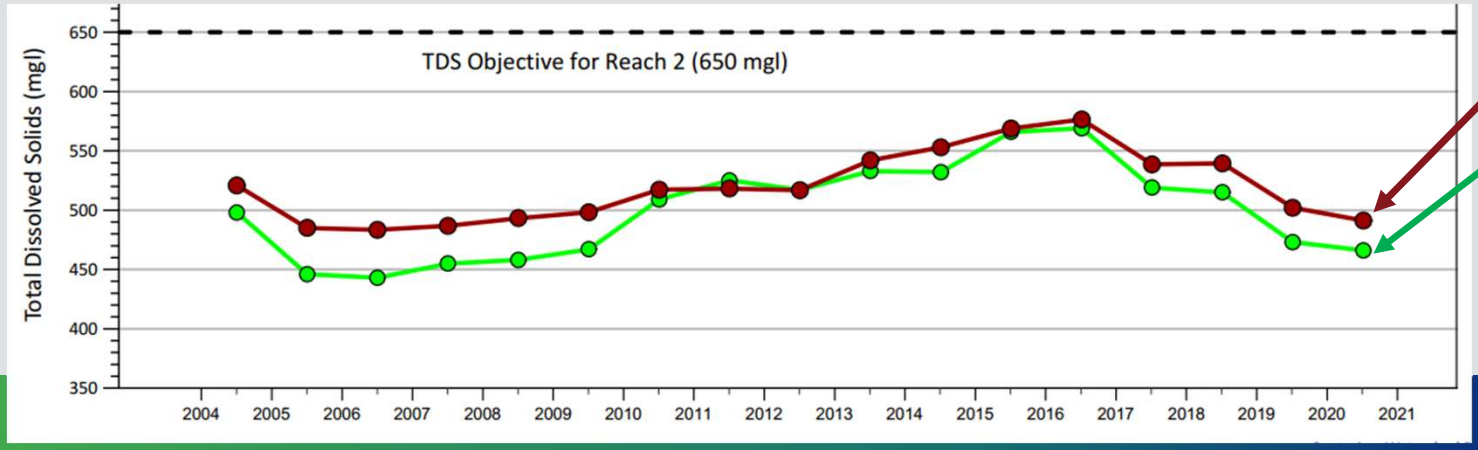
Alternative Method
(60-month Avg)



Reach 2: Use of the 5-year average of SARWM volume-weighted calculation (Basin Plan Method) vs. 60-month volume-weighted method (Alternative 60-month Method)

Table 2. Difference between the Two Methods used to Calculate the Five-year Volume-Weighted TDS Concentration at Below Prado Dam for Reach 2

Method	Year Type	Source of Grab Sample Data Used to Calculate a TDS and EC Relationship	Type of Calculation used to Determine Relationship between TDS and EC, to calculate a daily TDS	Calculation Type
Described in the Basin Plan	Water Year	USGS	Average Ratio (EC/TDS) TDS = (EC X 0.6087)	Arithmetic Mean of five different annual volume-weighted averages
Alternative	Calendar Year	USGS, OCWD, Regional Board	Linear Regression Model TDS = (EC X 0.5746) + 41.25 R^2 = .92	Five-year (60-month) volume-weighted average



5-yr Avg of Annual SARWM

60-Month Avg

Reach 2: Use of the 5-year average of SARWM volume-weighted calculation (Basin Plan Method) vs. 60-month volume-weighted method (Alternative 60-month Method)

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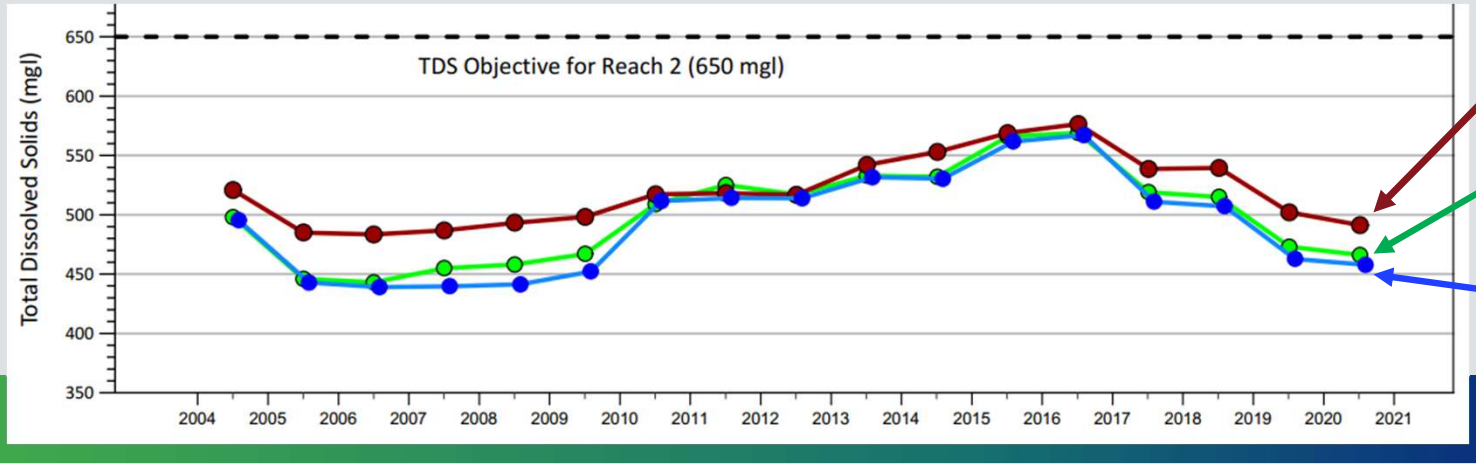
Difference between using the linear regression and TDS/EC Ratio to calculate TDS → **minimal difference.**



Reach 2: Use of the 5-year average of SARWM volume-weighted calculation (Basin Plan Method) vs. 60-month volume-weighted method (Alternative 60-month Method)

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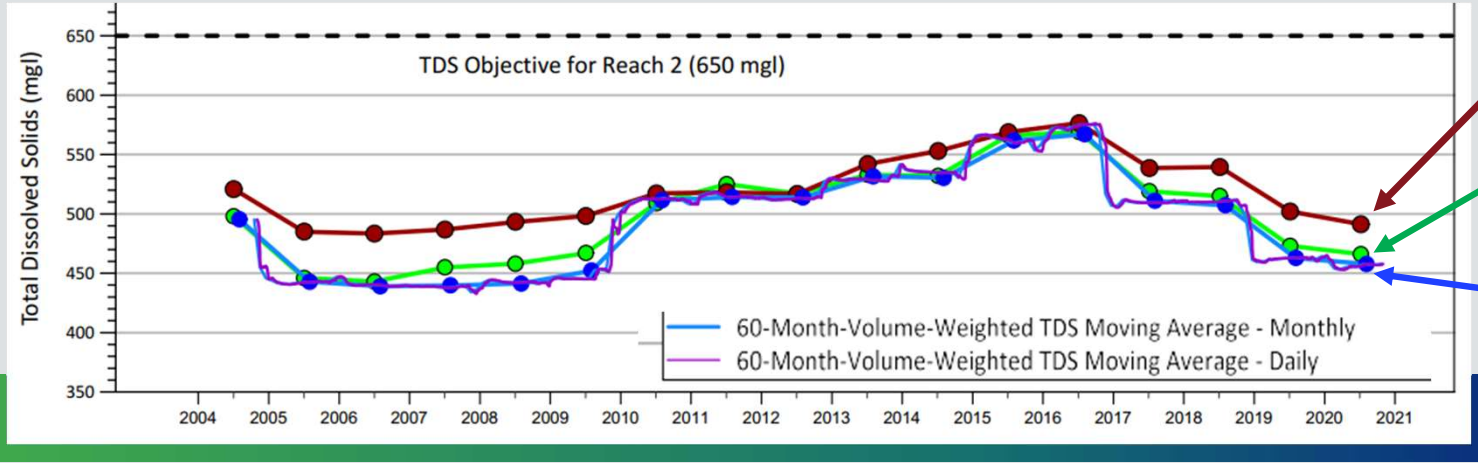
Alternative	Calendar Year	USGS, OCWD, Regional Board	Linear Regression Model TDS = (EC X 0.5746) + 41.25 R^2 = .92	Five-year (60-month) volume-weighted average

Using the 60-month method allows for evaluating running averages for various frequencies



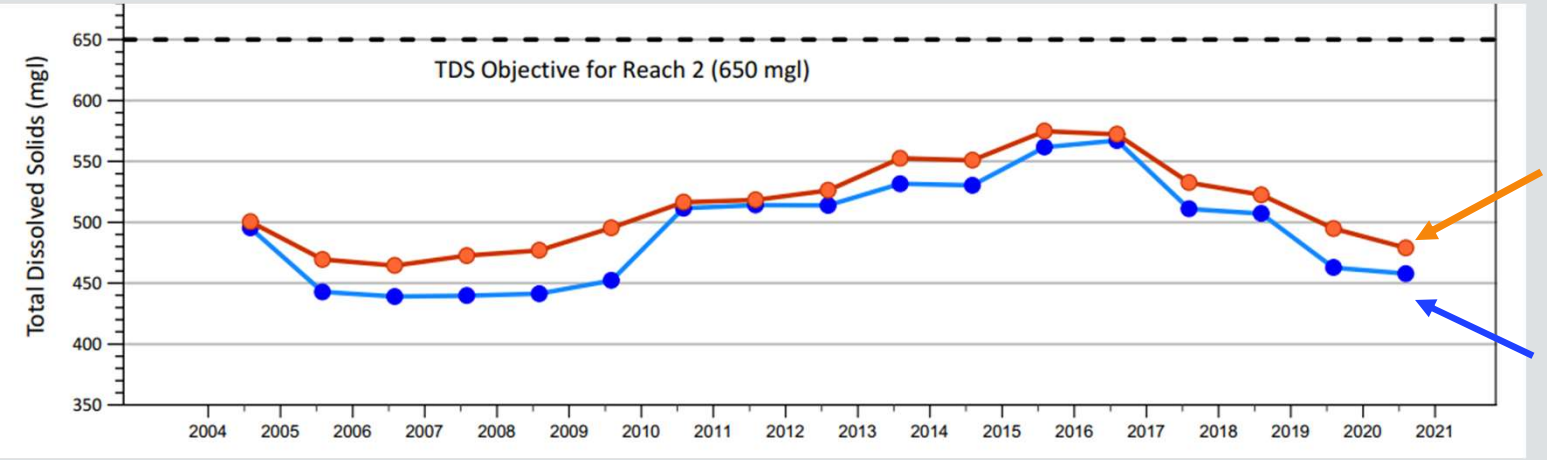
5-yr Avg of Annual SARWM

60-Month Avg – Using Linear Regression

60-Month Avg - Using TDS/EC Ratio

Reach 2: Use of the 5-year average of SARWM volume-weighted calculation (Basin Plan Method) vs. 60-month volume-weighted method (Alternative 60-Method)

Demonstration of difference between averaging period methods, using the exact same data set:



Average of five Annual Volume-Weighted Average Calculations

60-Month Volume-Weighted Average

What is left to Discuss to Complete 2022 Santa Ana River Water Quality Work Plan

- Method for Reach 2: Use of the 5-year average of annual SARWM volume-weighted averages **vs**. 60-month volume-weighted average.

- If use 60-month volume-weighted average, which method should be used to calculate the daily TDS from EC measurements
  - Average TDS/EC Ratio
  - Linear Regression Equation
  - Should be consistent with that used for Reach 3 TDS objective compliance

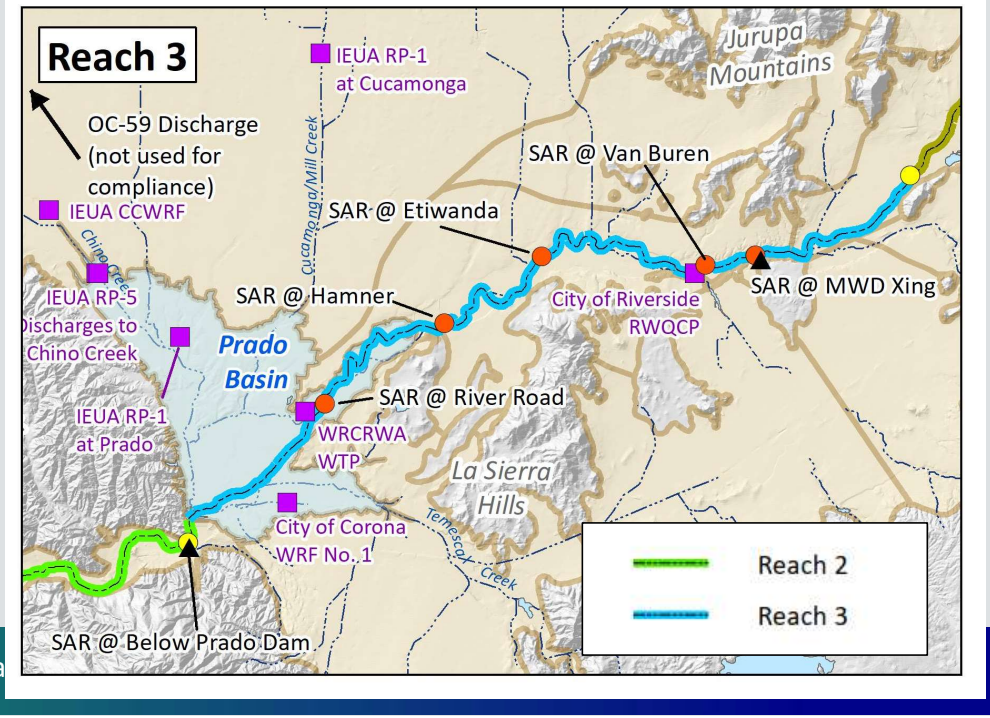
- Changing the filtered TN requirement to TIN for compliance with the Reach 3 TIN Objective

Upload to CEDEN of Daily Calculated TDS Data from the Daily EC Measurements

- We are proposing to use the daily calculated TDS concentrations from the daily EC measurements at the Below Prado Dam USGS gage for both Reach 2 & 3

- Possible to use the Daily TDS – The EC data would need to be uploaded into CEDEN as EC and then the Regional Board would need to calculate the TDS.

- Basin Plan must include a clear description of the calculate methods



Next Steps

- **Prepare Draft Report of the 2022 Santa Ana River Water Quality Work Plan**
  - Draft in early October 2022
  - 21-day review period by the Task Force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