CHINO BASIN WATERMASTER
Partners in Basin Management

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

PETER KAVOUNAS, P.E.
General Manager

SHIVAJI DESHMUKH, P.E.
General Manager

April 15, 2022

Regional Water Quality Control Board, Santa Ana Region
Attention: Jayne Joy
3737 Main Street, Suite 500
Riverside, California 92501-3348

Subject: Transmittal of the Chino Basin 2021 Maximum Benefit Annual Report

Dear Ms. Joy,

The Chino Basin Watermaster (Watermaster) and Inland Empire Utilities Agency (IEUA) hereby submit the Chino Basin Maximum Benefit Annual Report for 2021. This Annual Report is in partial fulfillment of the maximum benefit commitments made by Watermaster and the IEUA as discussed in Resolution No. R8-2004-0001 and its attachment: *Resolution Amending the Water Quality Control Plan for the Santa Ana River Basin to Incorporate an Updated Total Dissolved Solids (TDS) and Nitrogen Management Plan for the Santa Ana Region Including Revised Groundwater Subbasin Boundaries, Revised TDS and Nitrate-Nitrogen Quality Objectives for Groundwater, Revised TDS and Nitrogen Wasteload Allocations, and Revised Reach Designations, TDS and Nitrogen Objectives and Beneficial Uses for Specific Surface Waters.* Table 5-8a in the attachment to the Resolution identifies the Chino Basin Maximum Benefit Commitments which are specific projects and requirements that must be implemented to demonstrate that water quality consistent with maximum benefit to the people of the state will be maintained. This Annual Report describes the status of compliance with each commitment and the work performed during 2021.

If you have any questions, please do not hesitate to call.

Sincerely,

Chino Basin Watermaster

Peter Kavounas, P.E.
General Manager

Inland Empire Utilities Agency

Shivaji Deshmukh

Shivaji Deshmukh, P.E.
General Manager

FINAL REPORT | APRIL 2022

Chino Basin Optimum Basin Management Program 2021 Maximum Benefit Annual Report

PREPARED FOR

Chino Basin Watermaster and the
Inland Empire Utilities Agency

PREPARED BY

WEST YOST
Water. Engineered.

Chino Basin Optimum Basin Management Program 2021 Maximum Benefit Annual Report

Prepared for

Chino Basin Watermaster and the Inland Empire Utilities Agency

Project No. 941-80-21-64

4/15/2022

Project Manager: Veva Weamer

Date

4/15/2022

QA/QC Review: Samantha Adams

Date

WEST YOST
Water. Engineered.

FINAL REPORT | APRIL 2022

Table of Contents

1.0 Introduction 1

1.1 Investigations of the Relationship between Groundwater Production and Santa Ana River Discharge in the Southern Chino Basin 1

1.2 The OBMP and the 2004 Basin Plan Amendment 4

1.3 Maximum Benefit Implementation Plan for Salt Management: Maximum-Benefit Commitments 7

1.4 Purpose and Report Organization 8

2.0 Maximum-Benefit Commitment Compliance...9

2.1 Hydraulic Control.. 9
- 2.1.1 Hydraulic Control Monitoring Program 9
- 2.1.2 Hydraulic Control Monitoring Program Objectives and Methods....................................... 14
- 2.1.3 Current Status of Hydraulic Control.. 15
- 2.1.4 Future Projection of Hydraulic Control.. 16
- 2.1.5 Mitigation Plan for Temporary Loss of Hydraulic Control 18

2.2 Chino Basin Desalters 21
- 2.2.1 Annual Performance Reporting on the Chino Basin Desalters 24

2.3 Recycled Water Recharge and Quality 31
- 2.3.1 Recycled Water Recharge 31
- 2.3.2 Recycled Water Quality 39

2.4 Ambient Groundwater Quality... 50

3.0 Data Collected in 2021...53

3.1 Groundwater Monitoring Program 53
- 3.1.1 Groundwater-Level Monitoring Program 53
- 3.1.2 Groundwater-Quality Monitoring Program... 55

3.2 Surface-Water Quality Monitoring Program 57

4.0 Influence of Rising Groundwater on the Santa Ana River 59

4.1 Surface-Water Discharge Accounting.. 59

4.2 Analysis of Surface and Groundwater Interactions from Monitoring Data 62

4.3 Surface-Water Quality at Prado Dam 67

5.0 References 70

Table of Contents

LIST OF TABLES

Table 2-1. Status of Compliance with the Chino Basin Maximum-Benefit Commitments 10

Table 2-2. Annual and Total Pumping and Removal of TDS and Nitrate by Desalter Well from 2004 to 2021 26

Table 2-3a. Quarterly and Cumulative TDS Budget from the Operations of the OBMP Projects from 2004 through 2021 27

Table 2-3b. Quarterly and Cumulative Nitrate Budget from the Operations of the OBMP Projects from 2004 through 2021 28

Table 2-3. Annual Groundwater Recharge by Water Type at Chino Basin Facilities - 2005 to 2021 31

Table 2-4. Monthly Calculation of the Five-Year, Volume-Weighted TDS and Nitrate Concentrations of Recharge Water Sources to the Chino Basin(a) - 2005 to 2021 32

Table 2-5. Monthly and 12-Month Running Average of the IEUA Agency-Wide Effluent TIN and TDS Concentrations – 2005 to 2021 40

Table 3-1. Analyte List for the Groundwater-Quality Monitoring Program 55

Table 3-2. Analyte List for the Surface-Water Quality Monitoring Program 58

Table 4-1. Water Budget for the Chino Basin for the Calibration and Planning Periods and Estimated Net Rising Groundwater 60

LIST OF FIGURES

Figure 1-1. Chino Basin Management Zones – Antidegradation and Maximum-Benefit Objectives for TDS and Nitrate 3

Figure 1-2. Cumulative Distribution of State Water Project TDS Concentrations at Silverwood Lake Reservoir - 1980 to 2021 6

Figure 2-1. State of Hydraulic Control in Spring 2020 – Shallow Aquifer System 17

Figure 2-2. State of Hydraulic Control - July 2030 19

Figure 2-3. Historical and Projected Groundwater Discharge from the Chino-North GMZ to Prado Basin MZ - 2000 to 2050 20

Figure 2-4. Agriculture and Chino Basin Desalter Wells - Annual Pumping 2000 to 2021 23

Figure 2-5a. Quarterly TDS Loading and Export and Cumulative Net TDS Loading 29

Figure 2-5b. Quarterly Nitrate Loading and Export and Cumulative Net Nitrate Loading 30

Figure 2-6. Chino Basin Recharge Basins - Existing Facilities by Recharge Type as of 2021 36

Figure 2-7a. Volume and TDS Concentrations of Recharge Water Sources in the Chino Basin - 2005 to 2021 37

Figure 2-7b. Volume and Nitrate Concentrations of Recharge Water Sources in the Chino Basin - 2005 to 2021 38

Figure 2-8. Monthly and 12-Month Running Average of the IEUA Agency-Wide Effluent TDS and TIN Concentrations - 2005 to 2021 47

Figure 2-9. The IEUA Agency-Wide TDS Compliance Metric Compared to Monthly SWP Water - TDS Concentrations - 2005 to 2021 49

Figure 2-10a. Trends in Ambient Water Quality – Determination for Total Dissolved Solids by Groundwater Management Zone 51

Figure 2-10b. Trends in Ambient Water Quality – Determination for Nitrate by Groundwater Management Zone 52

Figure 3-1. Groundwater-Level Monitoring Program 54

Figure 3-2. Groundwater and Surface-Water Quality Monitoring Program 56

Figure 4-1. Net Annual Rising Groundwater Contribution to Surface Discharge in the Santa Ana River between Riverside Narrows and Prado Dam - 1978 to 2021 61

Figure 4-2a. Groundwater and Surface Water Interactions – Santa Ana River Near Etiwanda 65

Figure 4-2b. Groundwater and Surface Water Interactions – Santa Ana River Near River Road 66

Figure 4-3. TDS and Components of Discharge of the Santa Ana River at Prado Dam - Water Year 1971 to 2021 69

LIST OF APPENDICES

Appendix A. Quarterly Pumping and Export of TDS and Nitrate by the Chino Basin Desalters from 2004 to 2021 (Digital)

Appendix B. The IEUA Five-Year, Volume-Weighted TDS and TIN Computations for Managed Aquifer Recharge

Appendix C. 2021 Maximum Benefit Digital Database

LIST OF ACRONYMS AND ABBREVIATIONS

afy	Acre-Feet Per Year
Basin Plan	Water Quality Control Plan for the Santa Ana River Basin
CCWF	Chino Creek Well Field
CDA	Chino Basin Desalter Authority
Chino-North GMZ	Chino-North Groundwater Management Zone
DTSC	California Department of Toxic Substance Control
ET	Evapotranspiration
GMZ	Groundwater Management Zone

GWQMP	Groundwater Quality Monitoring Program
HCMP	Hydraulic Control Monitoring Program
IEUA	Inland Empire Utilities Agency
maximum benefit SNMP	Maximum Benefit Salt and Nutrient Plan
MCL	Maximum contaminant level
mgd	Million Gallons Per Day
mgl	Milligrams Per Liter
MWD	Metropolitan Water District of Southern California
NAWQA	National Water Quality Assessment
OBMP	Optimum Basin Management Program
PBHSP	Prado Basin Habitat Sustainability Program
PBMZ	Prado Basin Management Zone
Regional Board	California Regional Water Quality Control Board, Sant Ana Region
SARWC	Santa Ana River Water Company
SARWM	Santa Ana River Watermaster
SOB	State of the Basin Report
SWP	State Water Project
TCE	Trichloroethene
TDS	Total Dissolved Solids
TIN	Total Inorganic Nitrogen
TKN	Total Kjeldahl Nitrogen
USGS	United States Geological Survey
VOC	Volatile Organic Compound
Watermaster	Chino Basin Watermaster
WEI	Wildermuth Environmental, Inc.

1.0 INTRODUCTION

This 2021 Maximum Benefit Annual Report was prepared by the Chino Basin Watermaster (Watermaster) and the Inland Empire Utilities Agency (IEUA) pursuant to the Chino Basin Maximum Benefit salt and nutrient management plan (maximum benefit SNMP), as described in the Water Quality Control Plan for the Santa Ana River Basin (Basin Plan))[1].

This introductory section provides background on: 1) the relationship between groundwater production in the Chino Basin and the Santa Ana River discharge, 2) the Chino Basin Optimum Basin Management Program (OBMP) and the OBMP Implementation Plan, 3) the establishment of the alternative, maximum-benefit groundwater-quality objectives for the Chino Basin to create assimilative for recycled water use, and 4) the commitments made by Watermaster and the IEUA when the California Regional Water Quality Control Board, Santa Ana Region (Regional Board) amended the Basin Plan to include the maximum benefit SNMP for regulatory purposes. This Annual Report describes the status of compliance with the maximum-benefit commitments and the work performed during calendar year 2021.

1.1 Investigations of the Relationship between Groundwater Production and Santa Ana River Discharge in the Southern Chino Basin

Figure 1-1 is a map of the Chino Basin. Groundwater generally flows from the forebay regions in the north and east toward the Prado Basin, where rising groundwater becomes surface water in the Santa Ana River and its tributaries. Recent and past studies have provided insight into the influence of groundwater pumping in the southern Chino Basin on the Safe Yield of the Basin, and on the discharge of rising groundwater to the Prado Basin and the Santa Ana River. Several studies, as discussed below, have quantified the impacts of groundwater pumping at the Chino Basin Desalter well field on groundwater discharge to the Prado Basin and the Santa Ana River. Groundwater pumping from the Chino Basin Desalter well fields was intended to the replace agricultural pumping in the southern Chino Basin as agriculture lands are developed into housing and urban developments[2] to maintain the yield of the Basin and prevent discharge of poor-quality rising groundwater from the Basin to the Santa Ana River. The Chino Basin Desalters are operated by the Chino Basin Desalter Authority[3] (CDA).

The desalter well fields were first described in *Nitrogen and TDS Studies, Upper Santa Ana Watershed* (James M. Montgomery, Consulting Engineers, Inc., 1991). This study matched desalter production to meet future potable demands in the southern Chino Basin through 2015. Well fields were sited to maximize the interception of rising groundwater discharge from the north and to induce streambed infiltration in the Santa Ana River. The decrease in rising groundwater and increase in streambed infiltration were projected to account for 45 to 65 percent of total desalter pumping.

A design study for the Chino Basin Desalter well field provided estimates of the volume of rising groundwater discharge that would be intercepted by the desalter wells (Wildermuth Environmental, Inc. [WEI], 1993). This study used a detailed model of the southern Chino Basin to evaluate the hydraulic impacts of desalter pumping on rising groundwater discharge and groundwater levels at nearby wells.

---

[1] https://www.waterboards.ca.gov/santaana/water_issues/programs/basin_plan/

[2] The 2000 OBMP indicated that agricultural pumping would decrease by 40,000 afy.

[3] https://www.chinodesalter.org/

This study showed the relationship of intercepting rising groundwater discharge at the well field locations and well pumping capacity. The fraction of total desalter well pumping composed of decreased rising groundwater discharge and increased streambed infiltration was estimated to range from 40 to 50 percent.

A subsequent analysis, consistent with the OBMP Implementation Plan and the Peace II Agreement, projected the increase in streambed infiltration to be about 20 percent of desalter pumping due to Watermaster's basin re-operation[4] plan alone (WEI, 2009d). This projection was made using the 2007 Chino Basin Model to evaluate the then-current and projected groundwater pumping at the Chino Basin Desalter wells through 2060, as envisioned in the Peace II Agreement project description.

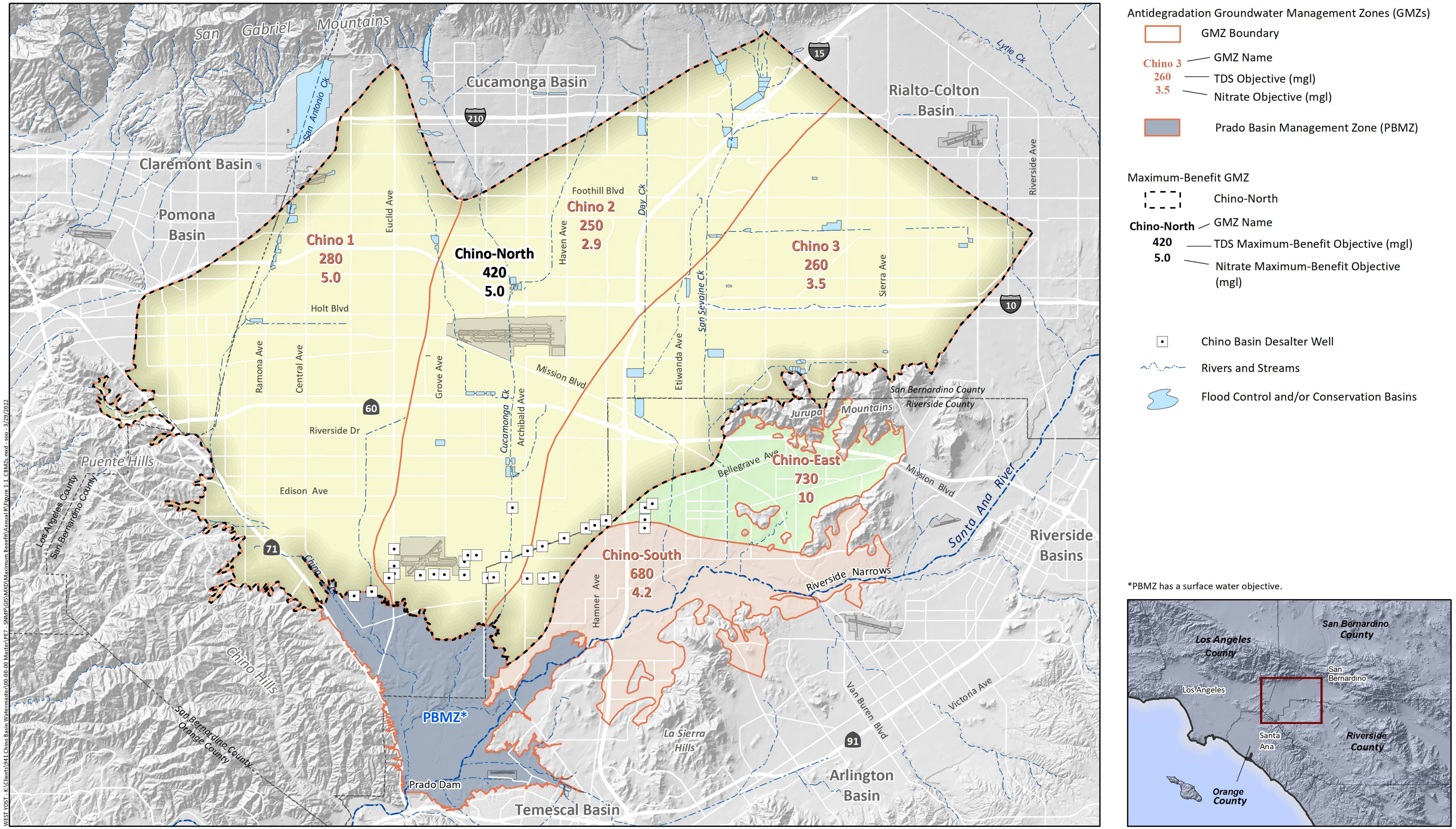
In 2011, the Watermaster initiated the process to recalculate the Safe Yield, which included an update and recalibration of its groundwater model. The 2013 Chino Basin Model was used to 1) estimate the historical volumes of rising groundwater discharge to the Santa Ana River and the streambed infiltration in the Santa Ana River for the period 1961 through 2011; and 2) project the volumes of groundwater discharge and streambed infiltration through 2050 (WEI, 2015c). The projected New Yield[5] from Santa Ana River recharge estimated by the 2013 Chino Basin Model was 61 percent of desalter well pumping in fiscal year 2011 and decreased to about 49 percent of total future desalter well pumping through fiscal year 2030. This New Yield induced by pumping at the desalter wells and Chino Basin re-operation is consistent with the planning estimates described in the previous studies.

These studies demonstrate that the yield of the Chino Basin is enhanced by increasing groundwater pumping in the southern portion of the Basin. These studies also indicated that the Chino Basin Desalter and re--operation authorized in the Peace II Agreement and approved by the Court will 1) capture groundwater flowing south from the forebay regions of the Chino Basin; and 2) reduce the outflow of high-salinity groundwater to the Santa Ana River, thereby providing greater protection of downstream beneficial uses.

---

[4] Re-operation as defined in Peace II Agreement "means the controlled overdraft of the Basin by the managed withdrawal of groundwater Production for the Desalters and the potential increase in the cumulative un-replenished Production from 200,000 acre-feet authorized by paragraph 3 of the Engineering Appendix Exhibit I to the Judgement, to 600,000 acre-feet for the express purpose of securing and maintaining Hydraulic Control as a component of the Physical Solution."

[5] New Yield as defined in the Peace Agreement "means proven increases in yield in quantities greater than historical amounts from sources of supply including, but not limited to, […] operations of the Desalters […] and other management activities implemented and operational after June 1, 2000." The net Santa Ana River recharge in fiscal year 2000 is the baseline from which to measure New Yield from Santa Ana River recharge in all subsequent years.



*PBMZ has a surface water objective.

WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PE7 - SNMP\GIS\MXD\Maximum Benefit\Annual R\Figure 1-1_CBMZs.mxd - sou - 3/29/2022

Prepared by:

WEST YOST
Water. Engineered.

Prepared for:

Chino Basin Watermaster and
the Inland Empire Utilities Agency
2021 Maximum Benefit
Annual Report

Chino Basin Management Zones
Antidegradation and Maximum-Benefit Objectives for TDS and Nitrate

Figure 1-1

1.2 The OBMP and the 2004 Basin Plan Amendment

The Chino Basin OBMP (WEI, 1999) was developed by Watermaster and the parties to the 1978 Chino Basin Judgment (Chino Basin Municipal Water District v. City of Chino et al.) pursuant to a February 19, 1998 court ruling. The OBMP maps a strategy that provides for the enhanced yield of the Chino Basin and reliable water supplies for the development expected to occur within the Basin. The goals of the OBMP are to: enhance basin water supplies, protect and enhance water quality, enhance the management of the Basin, and equitably finance the OBMP. The OBMP Implementation Plan is the court-ordered governing document for achieving the goals defined in the OBMP. The OBMP Implementation Plan is a comprehensive, long-range water management plan for the Chino Basin and includes the use of recycled water for direct reuse and artificial groundwater recharge. It also includes: the capture of increased quantities of high-quality storm water, recharge of imported water when its total dissolved solids (TDS) concentrations are low; improving the water supply by desalting poor-quality groundwater; supporting regulatory efforts to improve water quality in the Basin; and the implementation of management activities that will result in the reduced outflow of poor-quality (high salinity) groundwater to the Santa Ana River and the Orange County Basin to protect downstream beneficial uses and water quality.

The 1995 Basin Plan contained restrictions on the use of recycled water for irrigation and groundwater recharge. In particular, it contained TDS objectives ranging from 220 to 330 milligrams per liter (mgl) over a significant portion of the Chino Basin. The ambient TDS concentrations in these areas exceeded the objectives, which meant that no assimilative capacity existed for the discharge or recharge of high-TDS water sources over the Basin. Therefore, the use of the IEUA’s recycled water (which had a TDS concentration of about 490 mgl at the time) for irrigation and groundwater recharge—one of the key elements of the OBMP Implementation Plan—would require mitigation even though recycled water reuse would not materially impact future TDS concentrations or impair the beneficial uses of the Chino Basin.

In 1995, in part because of these considerations, the Regional Board initiated a collaborative study with 22 water supply and wastewater agencies, including Watermaster and the IEUA, to devise a new TDS and nitrogen management plan for the Santa Ana Watershed. This study culminated in the Regional Board’s adoption of a Basin Plan amendment in January 2004 ([2004 Basin Plan amendment], Regional Board, 2004) . The 2004 Basin Plan amendment included revised: groundwater subbasin boundaries, termed “groundwater management zones” (GMZs); TDS and nitrate (as nitrogen, hereafter nitrate) objectives for the GMZs; TDS and nitrogen wasteload allocations; surface water reach designations; and TDS and nitrate objectives and beneficial uses for specific surface waters. The technical work supporting the 2004 Basin Plan amendment was directed by the total inorganic nitrogen (TIN)/TDS Task Force and is summarized in *TIN/TDS Phase 2A: Tasks 1 through 5, TIN/TDS Study of the Santa Ana Watershed* (WEI, 2000).

The new TDS and nitrate objectives for the GMZs in the Santa Ana River Basin were established to ensure that water quality is maintained pursuant to the State’s Antidegradation Policy (State Board Resolution No. 68-16). These objectives were termed “antidegradation” objectives. Figure 1-1 shows the antidegradation objectives for the five Chino Basin GMZs[6]: Chino-1, Chino-2, Chino-3, Chino-East, and Chino-South. Note that the antidegradation TDS objectives for Chino-1, Chino-2, and Chino-3 are low (250 to 280 mgl) and would restrict recycled water reuse and artificial recharge, as well as the recharge of imported water when its TDS concentration is above the objectives, without mitigation. Figure 1-2 is a

---

[6] Note that the Prado Basin Management Zone is regulated by the Regional Board as a surface water management zone and does not have groundwater objectives assigned.

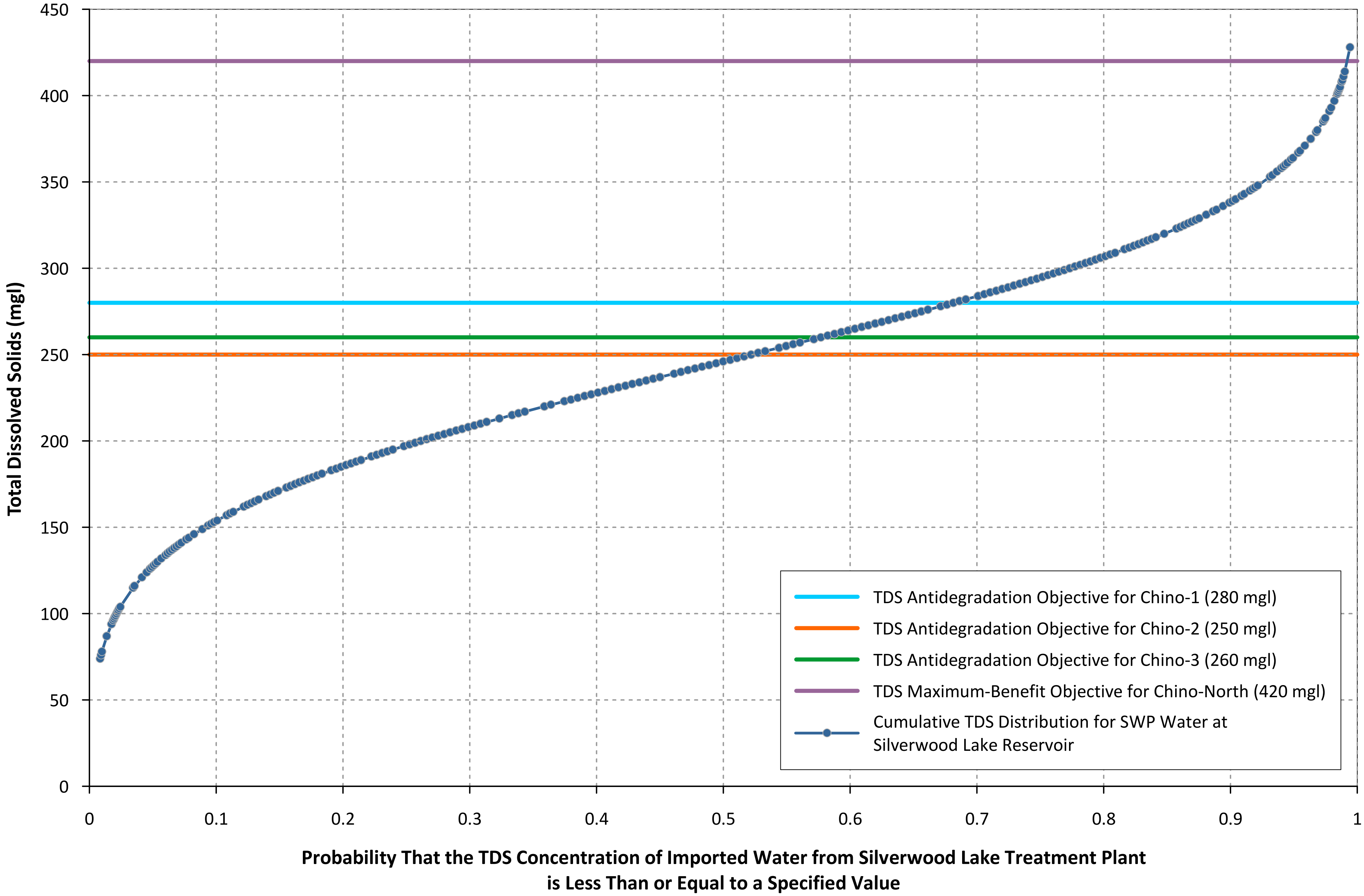
cumulative distribution plot that shows the percent of time that the TDS concentration of imported State Water Project (SWP) water at Silverwood Lake[7] has been less than or equal to the TDS antidegradation objectives for these three GMZs based on the observed TDS concentrations from 1980 through 2021, a period of 41 years. Since 1980, the TDS concentrations of SWP water have been less than the antidegradation objectives in the Chino-1, -2, and -3 GMZs about 67, 51, and 57 percent of the time, respectively.

To address this issue, Watermaster and the IEUA proposed, and the Regional Board approved, alternative "maximum-benefit" TDS and nitrate objectives for a new GMZ, the Chino-North GMZ (Chino-North), that combined the Chino-1, Chino-2, and Chino-3 GMZs into one single management unit, as shown in Figure 1-1. All of the groundwater recharge activities that would occur as part of the OBMP Implementation Plan are within boundary of Chino-North. The TDS and nitrate maximum-benefit objectives established for Chino-North are 420 and 5 mgl, respectively. The maximum-benefit TDS objective was higher than the then-current ambient TDS concentration of 300 mgl, thus creating 120 mgl of assimilative capacity for TDS and allowing for recycled water reuse and recharge, and imported water recharge, without the immediate need for mitigation. The TDS concentration of SWP water is projected be less than the 420 mgl maximum-benefit objective 99 percent of the time, as shown in Figure 1-2.

The maximum-benefit objectives were established based on demonstrations by Watermaster and the IEUA that the State Board's antidegradation requirements were satisfied. Watermaster and IEUA demonstrated that: the beneficial uses of the Chino Basin would continue to be protected and water quality consistent with maximum benefit to the people of the State of California would be maintained. Other factors consistent with California Water Code Section 13241—such as economics, the need to use recycled water, and the need to develop housing in the area—were also considered in establishing the maximum-benefit objectives.

---

[7] Silverwood Lake in the San Bernardino Mountains is a reservoir on the east branch of the SWP that supplies the IEUA region with SWP water deliveries from the Metropolitan Water District of Southern California (MWD) via the Devil Canyon Power Plant Afterbay and Upper Feeder Pipeline.



K:Chino Basin Watermaster\PE7\GRAPHER\GR\MaxBen\AnnualR\Figure1-2-SO 3/30/2022

Prepared by:

WEST YOST
Water. Engineered

Prepared for:

Chino Basin Watermaster and
The Inland Empire Utilities Agency
2021 Maximum Benefit
Annual Report

Cumulative Distribution of
State Water Project TDS Concentrations
Silverwood Lake Reservoir - 1980 to 2021

Figure 1-2

1.3 Maximum Benefit Implementation Plan for Salt Management: Maximum-Benefit Commitments

The application of the maximum-benefit objectives is contingent upon the implementation of specific projects and programs by Watermaster and the IEUA. These projects and programs, termed the "Chino Basin maximum-benefit commitments," are described in the Maximum Benefit Implementation Plan for Salt Management in Chapter 5 of the Basin Plan and are listed in Table 5-8a therein (Regional Board, 2016). These commitments include:

1. The implementation of a surface-water monitoring program.
2. The implementation of a groundwater monitoring program.
3. The expansion of the Chino-I Desalter to a capacity of 10 million gallons per day (mgd) and the construction of the Chino-II Desalter with a design capacity of 10 mgd.
4. The additional expansion of desalter capacity (to 40 mgd) pursuant to the OBMP and the Peace Agreement, the timing for which is tied to the IEUA's agency-wide effluent concentration)[8]
5. The completion of the groundwater recharge facilities included in the 2001 Watermaster Recharge Master Plan.
6. The management of recycled water quality to ensure that the IEUA agency-wide, 12-month running average volume-weighted effluent TDS concentration does not equal or exceed 550 mgl and the TIN concentration does not equal or exceed 8 mgl.
7. The management of basin-wide, volume-weighted TDS and nitrate concentrations in artificial recharge to less than or equal to the maximum-benefit objectives on a five-year volume-weighted basis.
8. The achievement and maintenance of the "hydraulic control" of groundwater outflow from the Chino Basin, specifically from the Chino-North GMZ, in order to protect Santa Ana River water quality and downstream beneficial uses.
9. The determination of ambient TDS and nitrate concentrations of Chino Basin groundwater every three years.

If these maximum-benefit commitments are not met, the antidegradation objectives would apply for regulatory purposes. The application of the antidegradation objectives would result in a finding of no assimilative capacity for TDS and nitrate in the Chino-1, Chino-2, and Chino-3 GMZs and the Regional Board would require mitigation for both recycled water and imported SWP water discharges to Chino-North that exceed the antidegradation objectives. Furthermore, the Regional Board would require that Watermaster and the IEUA mitigate the effects of discharges of recycled and imported SWP water that took place in excess of the antidegradation objectives under the maximum-benefit objectives retroactively to January 2004. The mitigation for past discharges would be required to be completed

---

[8] The expansion to provide an additional 20 mgd of desalter pumping capacity was initially required to occur when the 12-month running average for the IEUA agency-wide effluent TDS concentration exceeded 545 mgl for three consecutive months. The expansion has occurred even though this water quality condition has never been triggered and has instead been driven by the implementation of the Peace II Agreement and achieving hydraulic control.

within a ten-year period following the Regional Board's finding that the maximum-benefit commitments were not met.

1.4 Purpose and Report Organization

This remainder of this report describes the status of compliance with the maximum-benefit commitments listed above and is organized as follows:

- ***Section 2.0*** – *Maximum-Benefit Commitment Compliance*. This section describes the status of compliance with each of the maximum-benefit commitments.
- ***Section 3.0*** – *Data Collected in 2021.* This section describes the data collected in 2021 as part of the maximum-benefit monitoring program.
- ***Section 4.0*** *–Influence of Rising Groundwater on the Santa Ana River.* This section characterizes the influence of rising groundwater on the flow and quality of the Santa Ana River between the Riverside Narrows and Prado Dam.
- ***Section 5.0*** – *References.* This section provides the references consulted in performing the analyses described herein and in writing this report.

2.0 MAXIMUM-BENEFIT COMMITMENT COMPLIANCE

Table 2-1 lists the status of compliance for each of the nine maximum-benefit commitments outlined in the Maximum Benefit Implementation Plan for Salt Management in Chapter 5 of the Basin Plan (Regional Board 2016) as of December 31, 2021. A discussion of ongoing activities related to commitment compliance is provided below. For this discussion, the commitments are grouped together into four main topics: hydraulic control, Chino Basin Desalters, recycled water recharge and quality, and the recomputation of ambient groundwater quality.

2.1 Hydraulic Control

The Regional Board requires that Watermaster and the IEUA achieve and maintain “hydraulic control” of groundwater outflow from Chino-North (Commitment number 8). The Basin Plan defines hydraulic control as: “[…] eliminating groundwater discharge from the Chino Basin to the Santa Ana River or controlling the discharge to *de minimis* levels […].” In practice, Watermaster and the IEUA use a more measurable definition of hydraulic control: eliminating groundwater discharge from Chino-North to the Prado Basin Management Zone (PBMZ) or controlling the discharge to *de minimis* levels. In a letter from the Regional Board to Watermaster and the IEUA, dated October 12, 2011, the Regional Board defined the *de minimis* discharge of groundwater from Chino-North to the PBMZ as an amount less than 1,000 acre-feet per year (afy). (Regional Board, 2011).

Commitment number 8 requires the achievement and maintenance of hydraulic control and a plan to mitigate the loss or temporary loss of hydraulic control (see Table 2-1). The monitoring data collected in compliance with Commitments number 1 and number 2 are used, in part, demonstrate the occurrence and maintenance of hydraulic control.

2.1.1 Hydraulic Control Monitoring Program

The surface-water and groundwater monitoring programs implemented for Commitments number 1 and number 2 are designed, in part[9], to collect the data necessary to determine the state of hydraulic control and are referred to collectively as the Hydraulic Control Monitoring Program (HCMP). In May 2004, Watermaster and the IEUA submitted a surface-water and groundwater monitoring program work plan to the Regional Board entitled *Final Hydraulic Control Monitoring Program Work Plan for the Optimum Basin Management Program* (2004 Work Plan [WEI, 2004b]). The Regional Board adopted Resolution R8--2005--0064, approving the 2004 Work Plan, and required Watermaster and the IEUA to implement the HCMP.

---

[9] The groundwater monitoring program also supports the recomputation of ambient water quality and several of Watermaster’s OBMP activities.

Table 2-1. Status of Compliance with the Chino Basin Maximum-Benefit Commitments

Description of Commitment	Compliance Date (as soon as possible, but no later than)	Status of Compliance
1. Surface Water Monitoring Program(a)		
a. Submit draft Monitoring Program to Regional Board	a. January 23, 2005	a. Draft work plan submitted to the Regional Board on January 23, 2005
b. Implement Monitoring Program	b. Within 30 days from the date of RegionalBoard approval of the monitoring plan.	b. Monitoring plan initiated prior to Regional Board approval
c. Submit Draft Revised MonitoringProgram to Regional Board	c. 15 days from 2012 Basin PlanAmendment (BPA) approval.	c. Draft work plan submitted to the Regional Board on February 16, 2012, six days after 2012 BPA approval
d. Implement Revised Monitoring Program	d. Upon Regional Board approval.	d. Revised monitoring program began in December 2012 after the BPA was approved by the Office of Administrative Law on December 6, 2012
e. Submit Draft Revised Monitoring Program(s) (subsequent to that requiredin "c", above) to Regional Board	e. Upon notification of the need to do so from the Regional Board Executive Officerand in accordance with the schedule prescribed by the Executive Officer.	e. No revisions requested by the Regional Board
f. Implement Revised MonitoringProgram(s)	f. Upon Regional Board approval.	f. N/A
g. Annual data report submittal	g. April 15th	g. All annual reports submitted by April 15 of eachyear since 2006
2. Groundwater Monitoring Program(a)		
a. Submit Draft Monitoring Program to Regional Board	a. January 23, 2005	a. Draft monitoring plan submitted to Regional Boardon January 23, 2005
b. Implement Monitoring Program	b. Within 30 days from the date of RegionalBoard approval of the monitoring plan.	b. Monitoring program initiated prior to RegionalBoard approval
c. Plan and schedule for demonstrating hydraulic control	c. By December 31, 2013	c. Plan and schedule for demonstrating hydraulic control submitted in the 2014 Work Plan to the Regional Board on December 23, 2013
d. Implement hydraulic control demonstration	d. Upon Regional Board approval.	d. Hydraulic control demonstration reported in all annual reports
e. Submit Draft Revised Monitoring Program(s) (subsequent to that requiredin "a", above) to Regional Board	e. Upon notification of the need to do so from the Regional Board Executive Officer and in accordance with the schedule prescribed by the Executive Officer.	e. No revisions requested by Regional Board
f. Implement revised monitoring plans (s)	f. Upon Regional Board approval.	f. N/A
g. Annual data report submittal	g. April 15th	g. All annual reports submitted by April 15 ofeach year
3. Chino Desalters		
a. Chino-I Desalter expansion to 10 mgd	a. Prior to the recharge of recycled water.	a. Chino-I Desalter expansion to a pumping capacity of 14 mgd (15,700 afy) was completed in April 2005and operation began in October 2005; recycled water recharge began in July 2005
b. Chino-II Desalter construction to 10 mgd capacity	b. Recharge of recycled water allowed once award of contract and notice to proceed issued for construction of desalter treatment plant.	b. Contract for Chino-II Desalter awarded in early 2005; construction was completed to a pumping capacity of 10 mgd (11,00 afy), and the facility wentonline in June 2006
4. Submittal of future desalters plan and schedule		
	Plan due: October 1, 2005 Trigger for construction: when the IEUA agency-wide 12-month running average effluent TDS concentration exceeds 545 mgl for three consecutive months. Implement plan and schedule upon Regional Board approval.	Starting in 2005, several plans for desalter expansion to achieve hydraulic control and meet the pumping capacity of 40,000 afy pursuant to the Peace II Agreement were submitted to the Regional Board. Although the IEUA recycled water effluent has never reached 545 mgl as a 12-month average, the Chino Desalter Authority proceeded to expand the capacity of the desalters to ensure the attainment of hydraulic control. In June 2020, the CDA facilities reached a pumping capacity of 40,000 afy.
5. Recharge facilities (17) built and inoperation		
	June 30, 2005	Watermaster and the IEUA partnered with the San Bernardino County Flood Control District and the Chino Basin Water Conservation District for completion of the Chino Basin Facilities Improvement Program to construct and/or improve eighteen recharge sites. There are currently 17 basins in the Chino Basin Groundwater Recharge Program.

6. Submittal of IEUA wastewater quality improvement plan and schedule		
	60 days after agency-wide, 12-month running average effluent concentration equals or exceeds 545 mgl for TDS for three consecutive months or equals or exceeds 8mgl for TIN in any month. Implement plan and schedule upon approval by Regional Board.	These thresholds have not been triggered; therefore, a wastewater quality improvement plan has not been submitted (See Table 2-5, and Figure 2-8 of this report). Due to the drought conditions and water conservation measures, the effluent TDS concentration reached a historical-high of 534 mgl in 2015, which was only 11 mgl below the 545 mgl action limit. To account for impacts of drought and water conservation measures on the effluent TDS concentration, a technical investigation was initiated in 2017 to evaluate the potential water quality impacts of updating the compliance metric to allow for a longer-term averaging period. The technical study was completed in December 2021 and Watermaster and the IEUA are preparing a regulatory compliance proposal to request a longer-term averaging period. The proposal is expected to be finalized around April 2022.
7. Recycled water will be blended with other recharge sources such that the volume-weighted, 5-year running average TDS and nitrate-nitrogen concentrations of recharge are equal to or less than the maximum benefit water quality objectives.		
	Compliance must be achieved by the end of the 5th year after initiation of recycled water recharge operations.	
a. Submit a report that documents the location, amount of recharge, and TDS and nitrogen quality of storm water recharge before the OBMP recharge improvements were constructed and what is projected to occur after the recharge improvements are completed.	a. Prior to initiation of recycled water recharge.	a. No documentation of water quality data or quantity for storm water prior to OBMP initiation exists. Storm water has been monitored for flow, TDS, and nitrogen since 2005 in accordance with water recharge permits.
b. Submit documentation of the amount and TDS and nitrogen quality of all sources of recharge and recharge locations. For storm water recharge used for blending, submit documentation that the recharge is the result of OBMP enhanced recharge facilities.	b. Annually, by April 15th, after initiation of construction of basins/other facilities to support enhanced storm water recharge.	b. The volume-weighted, 5-year running average TDS and nitrate-nitrogen concentrations of Chino Basin recharge are less than the maximum-benefit water quality objectives (See Table 2-3, and Figures 2-6a and 2-6b of this report).
8. Hydraulic Control Failure		
a. Plan and schedule to correct loss of hydraulic control	a. 60 days from Regional Board finding that hydraulic control is not being maintained	a. There has been no finding that hydraulic control is not being maintained to trigger preparation of a plan and schedule.
b. Achievement and maintenance of hydraulic control.	b. In accordance with plan and schedule approved by the Regional Board	b. Hydraulic control has been achieved at and to the east of Chino-I Desalter Well 20. Groundwater model estimates published in 2014 indicate that a total production of 1,529 afy at the CCWF will achieve hydraulic control west of Chino-I Desalter Well 5 to de minimis levels (<1,000 afy of groundwater flow past the CCWF to the PBMZ). In 2016, the CCWF began full operation to achieve hydraulic control. Production at the CCWF has decreased below 1,529 afy since 2017 due to the detection of 1,2,3-TCP concentration above the MCL at CCWF Well I-17. In 2020, Watermaster used the groundwater model to estimate the historical (2004-2018) and projected (2019-2050) groundwater discharge past the CCWF under revised pumping conditions at the CCWF. The results indicate that both the estimated historical and projected discharge past the CCWF area is below the *de minimis threshold* (1,000 afy). The model assumes an average pumping 992 afy at the CCWF from fiscal year 2019 through the remainder of the planning period. Watermaster is working with the Regional Board to update the definition of de minimis threshold at CCWF to maintain hydraulic control based on the new model results.

Table 2-1. Status of Compliance with the Chino Basin Maximum-Benefit Commitments

Description of Commitment	Compliance Date (as soon as possible, but no later than)	Status of Compliance
c. Mitigation plan for temporary failure toachieve/maintain hydraulic control	c. The original plan by January 23, 2005 and updated plan by June 30, 2022.	c. The original mitigation plan was submitted to the Regional Board on March 3, 2005. Due to the revised pumping conditions at the CCWF, the Regional Board requested Watermaster and the IEUA to develop an updated plan to establish new metrics to assess compliance with *de minimis* outflow requirements and to develop an updated mitigation plan should water quality or other concerns lead to a broad reduction in desalter pumping. The plan is due to the Regional Board by June 30, 2022.
9. Ambient Groundwater Quality Determination		
	July 1, 2005 and every three years thereafter	Watermaster and the IEUA have participated in the regional triennial ambient water quality determination as requested by SAWPA. Watermaster and the IEUA provide their fair share of funds and substantial groundwater data for this effort.

(a) The commitments related to surface water and groundwater monitoring were revised by a Basin Plan amendment approved by the Regional Board on February 10, 2012. The commitments and status of compliance shown in this table reflect the amended commitments for surface water and groundwater monitoring.

afy = acre-feet per year

mgd = million gallons per day mgl = milligrams per liter

TDS = Total dissolved solids

The initial design of the HCMP included multiple lines of evidence to demonstrate hydraulic control. The multiple lines of evidence were:

- Collect and analyze groundwater-elevation data to determine the direction of groundwater flow in the southern part of the Chino Basin and whether pumping at the Chino Basin Desalter well fields is completely capturing all groundwater that would otherwise discharge out of Chino-North and into the PBMZ.
- Collect and analyze the chemistry of basin-wide groundwater and the Santa Ana River to 1) track the migration, or lack thereof, of the South Archibald volatile organic compound (VOC) plume beyond the Chino Basin Desalter well fields; and 2) identify the source of groundwater in the area of the Chino Basin between the Santa Ana River and the Chino Basin Desalter well fields.
- Collect and analyze surface-water quality data and surface-water discharge measurements to determine if groundwater from the Chino Basin is rising as surface water and contributing to flow in the Santa Ana River or if the River is recharging the Basin.
- Use Watermaster's numerical groundwater-flow model to corroborate the results and interpretations of the first three lines of evidence.

Watermaster and the IEUA executed the surface-water and groundwater-monitoring program pursuant to the 2004 Work Plan from 2004 through 2011 and concluded that 1) hydraulic control had been achieved to the east of Chino-I Desalter Well 5, 2) hydraulic control had not yet been achieved to the west of Chino I Desalter Well 5, and 3) the impact of rising groundwater discharge from Chino-North on surface- water quality in the Santa Ana River at Prado Dam has been de minimis (WEI, 2007b; 2008b; 2009a; 2010; 2011a; and 2012b). In 2010, the CDA began construction of the Chino Creek Well Field (CCWF), which was designed to achieve hydraulic control to the west of Chino-I Desalter Well 5 (see also Section 2.1.3 and Figure 2-1 of this report). Watermaster and the IEUA also concluded that the data collected as part of the surface-water monitoring program were not necessary to determine the state of hydraulic control and began the process of working with the Regional Board to modify the surface-water and groundwater--monitoring program and maximum-benefit commitments accordingly (WEI, 2011a and 2012b).

On February 10, 2012, the Regional Board adopted an amendment to the Basin Plan to remove all references to specific monitoring locations and sampling frequencies for the groundwater and surface-water monitoring programs and, in their place, required that Watermaster and the IEUA submit 1) an updated surface-water monitoring program by February 25, 2012 and 2) a revised groundwater monitoring program and schedule for achieving hydraulic control by December 31, 2013. Pursuant to 1), Watermaster and the IEUA submitted the *2012 Hydraulic Control Monitoring Program Work Plan* (2012 Work Plan) to the Regional Board on February 25, 2012 (WEI, 2012a). The 2012 Work Plan was adopted by the Regional Board on March 16, 2012 (Regional Board, 2012).[10] Pursuant to 2), Watermaster and the IEUA submitted the *2014 Maximum Benefit Monitoring Work Plan* (2014 Work Plan) to the Regional Board on December 23, 2013 (WEI, 2013c).[11] The 2014 Work Plan was approved by the Regional Board on April 25, 2014 (Regional Board, 2014b).

---

[10] The 2012 Basin Plan amendment was approved by the Office of Administrative Law on December 6, 2012, and at that time, the revised surface-water monitoring program (2012 Work Plan) was implemented.

[11] The name was changed from the Hydraulic Control Monitoring Program Work Plan to the Maximum Benefit Monitoring Program Work Plan to clarify that the 2014 Work Plan (and its predecessor) contains the monitoring and

Each year, the data collected pursuant to the 2014 Work Plan is summarized and included in the Chino Basin Maximum Benefit Annual Report (see Section 3.0 of this report).

2.1.2 Hydraulic Control Monitoring Program Objectives and Methods

The 2014 Work Plan describes the following as the ongoing questions to be answered by the HCMP:

1. Will hydraulic control of groundwater from Chino-North be maintained east of Chino--I Desalter Well 5?
2. Will the CCWF continue to reduce groundwater discharge from Chino-North to the PBMZ past the desalter well field west of Chino-I Desalter Well 5 to the *de minimis* threshold of 1,000 afy or less?
3. Will the impact of groundwater discharge from Chino-North to the PBMZ that becomes rising groundwater on the surface-water quality in the Santa Ana River remain *de minimis*?

Watermaster and the IEUA use the following methods to answer these questions:

Method to Address Question 1: The groundwater-level monitoring program and periodic groundwater modeling will continue to be used to define the capture zone created by the Chino Basin Desalter well field east of Chino-I Desalter Well 5. These methods will be sufficient to demonstrate hydraulic control in this area in the future.

Watermaster prepares a State of the Basin (SOB) Report every two years. The SOB Report includes a spring groundwater-elevation contour map of the southern portion of Chino Basin, showing the capture zone of the Chino Basin Desalter well field, and a characterization of the state of hydraulic control based on the groundwater-elevation contours. The most up-to-date hydraulic control findings in the SOB Report will be referenced in the Chino Basin Maximum Benefit Annual Report (see Section 2.1.3 of this report).

Watermaster recalibrates and runs its groundwater-flow model at least every five years to assess: the physical impacts of the implementation of the OBMP and Peace II Agreement, the state of hydraulic control, the balance of recharge and discharge, the cumulative impact of water rights transfers among the parties, and safe yield. The most up-to-date modeling assessment of the then-current and projected state of hydraulic control will be referenced each year in the Maximum Benefit Annual Report (see Section 2.1.3of this report).

Method to Address Question 2: The operation of the CCWF is intended to achieve hydraulic control and reduce groundwater discharge west of Chino-I Desalter Well 5 to the *de minimis* threshold of 1,000 afy or less. The 2013 Chino Basin Model estimated that the amount of groundwater discharge from Chino-North to the PBMZ in the absence of the CCWF was about 2,400 afy (WEI, 2014a). The model was used to estimate the discharge once the CCWF wells are in operation. The results indicated that with planned pumping at the CCWF of 1,529 afy, the groundwater discharge from Chino-North to the PBMZ would decrease to about 900 afy by 2016, which is less than the *de minimis* threshold.

---

data collection strategy for complying with both the maximum-benefit monitoring directives of demonstrating hydraulic control and computing ambient water quality.

At least every five years, historical production, and groundwater-level data for the CCWF and other wells will be used to recalibrate the Chino Basin Model. The model will be used to calculate annual groundwater discharge past the CCWF since the start of CCWF operations and to estimate future groundwater discharge past the CCWF based on projected groundwater pumping in the Basin. The most up-to-date modeling assessment of the then-current and projected groundwater discharge past the CCWF will be referenced each year in the Maximum Benefit Annual Report (see Section 2.1.4 of this report).

Method to Address Question 3: The monitoring data from HCMP has demonstrated that the historical and current impacts of rising groundwater discharge from Chino-North to the PBMZ on the surface-water quality of the Santa Ana River at Prado Dam is *de minimis*. Groundwater modeling shows that pumping at the CCWF will further decrease the volume of groundwater discharge from Chino-North that becomes rising groundwater in the PBMZ and thereby further reduces the impact on Santa Ana River water quality.

A 2015 mass-balance analysis estimated the impact of groundwater discharge from Chino-North to the PBMZ through the CCWF on the volume-weighted TDS concentration of the Santa Ana River at Prado Dam (WEI, 2016). The mass-balance analysis estimated that without the CCWF, rising groundwater from Chino-North would increase the TDS concentration of the Santa Ana River at Prado Dam by approximately 8 mgl (a one and a half percent increase) relative to full hydraulic control in this area. The operation of the CCWF to the *de minimis* threshold reduces the impact to a 4 mgl increase (a half percent increase) relative to full hydraulic control in this area (WEI, 2016).

Continued analysis of Santa Ana River flow and quality at Below Prado Dam will help determine the nature of the impact of groundwater discharge from Chino-North that becomes rising groundwater in the PBMZ. The impact of groundwater discharge from Chino-North to the PBMZ on Reach 2 of the Santa Ana River will be characterized each year in the Chino Basin Maximum Benefit Annual Report (see Section 4.2.2 of this report).

2.1.3 Current Status of Hydraulic Control

Figure 2-1 shows the most current characterization of the state of hydraulic control based on groundwater-elevation contours for spring 2020 from the 2020 SOB Report (West Yost, 2021a). The spring 2020 groundwater-elevation contours show a regional depression in groundwater elevation at and east of Chino-I Desalter Well I-20, demonstrating that groundwater flowing from Chino-North to the PBMZ is being captured by the desalter wells in this area. This characterization of the state of hydraulic control is consistent with past characterizations in the 2017 through 2021 Annual Reports (WEI 2017; 2018; 2019; 2020; West Yost 2021b). Prior to 2017, complete hydraulic control had been achieved at and east of Chino-I Desalter Well 5 (WEI, 2007b; 2008b; 2009a; 2010; 2011a; 2012b; 2013a; 2014b; 2015a; and 2016).

For the area west of Chino-I Desalter Well 5, the operation of the CCWF is intended to achieve hydraulic control to *de minimis* levels (<1,000 afy). In February 2016, the CCWF commenced full-scale operation with production at Wells I-16, I-17, I-20, and I-21 and, by definition, hydraulic control was determined to have been achieved in this area. In 2021, the CCWF wells produced a total of about 1,127 af which is less than the amount previously characterized (1,529 afy) to be necessary to ensure *de minimis* outflows. Production at the CCWF has decreased since 2017 as a result of the new maximum contaminant level (MCL) for 1,2,3-Tricholoropropane (1,2,3-TCP), which required the CDA to temporarily shut down operation of CCWF Well I-17[12]. In 2020, Watermaster's groundwater model was used to estimate the historical (2004-2018) and projected (2019-2050) volume of groundwater discharge past the CCWF

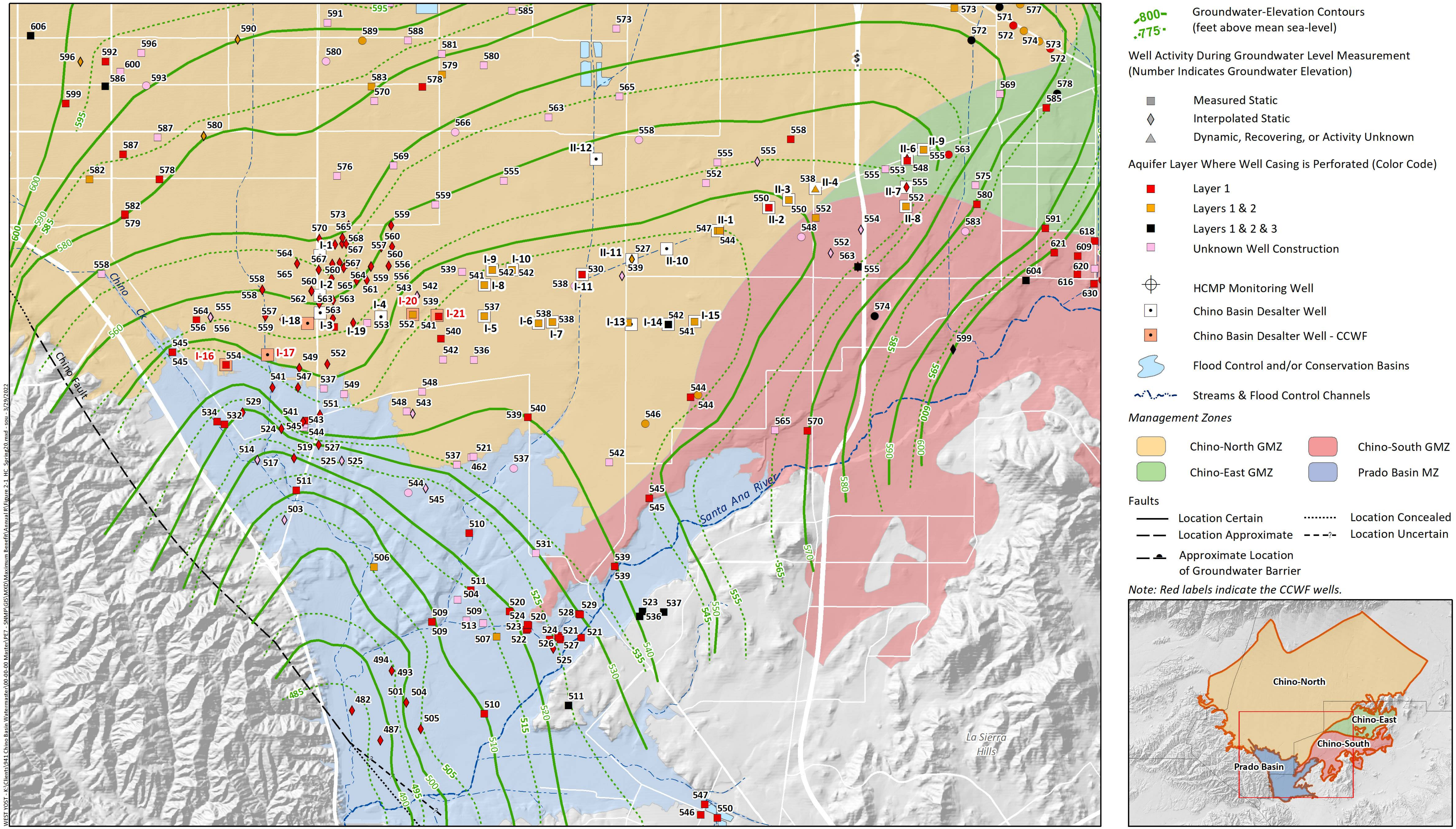
---

[12] 1,2,3-TCP concentrations in groundwater samples from CCWF Well I-17 exceed the MCL.

(WEI, 2020) under revised pumping conditions at the CCWF. The model-results indicate that both the estimated historical and projected discharge past the CCWF area is always below the *de minimis* threshold level of 1,000 afy (see Section 2.1.4). The model assumes an annual average pumping volume at the CCWF of 992 af from fiscal year 2019 through the remainder of the planning period. Watermaster and the IEUA are working with the Regional Board to update the definition of the minimum pumping required at the CCWF to maintain *de minimis* outflow past the CCWF to maintain hydraulic control based on new modeling results. This is part of the updated mitigation plan for the temporary loss of hydraulic control described in Section 2.1.5.

2.1.4 Future Projection of Hydraulic Control

In 2020, Watermaster completed its five-year update and recalibration of the Chino Basin Model to recalculate the Safe Yield of the Chino Basin (WEI, 2020). As part of the 2020 Safe Yield recalculation, the future state of hydraulic control was estimated using the updated Chino Basin Model. A planning scenario was developed to recalculate Safe Yield based on the recent planning work reported in the *2018 StorageFramework Investigation* (WEI, 2019a) and the *2020 Storage Management Plan* (WEI, 2020). This scenario, referred to herein as 2020 SYR1 is based on the water demands and water supply plans provided by the Watermaster Parties, planning hydrology that incorporates climate change impacts on precipitation and evapotranspiration (ET), and assumptions regarding cultural conditions and future groundwater replenishment. The projected state of hydraulic control was estimated with the Chino Basin Model by simulating the Chino Basin's response to the 2020 SYR1 scenario. The attainment of hydraulic control is assessed using model-predicted groundwater elevation data to evaluate whether all groundwater north of the desalter wells is captured by the Chino Basin Desalter well field (total hydraulic containment standard) or that groundwater discharge through the Chino Basin Desalter well field is, in aggregate, less than 1,000 afy (*de minimis* standard).



WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PE7 - SNMP\GIS\MXD\Maximum Benefit Annual R\Figure 2-1_HC_Spring20.mxd - sou - 3/29/2022

Prepared by:

WEST YOST
Water. Engineered.

0 1 2 Miles
0 2 4 Km

Prepared for:

Chino Basin Watermaster and
the Inland Empire Utilities Agency
2021 Maximum Benefit
Annual Report

Chino Basin Watermaster
Partners in Basin Management

State of Hydraulic Control
Spring 2020

Figure 2-1

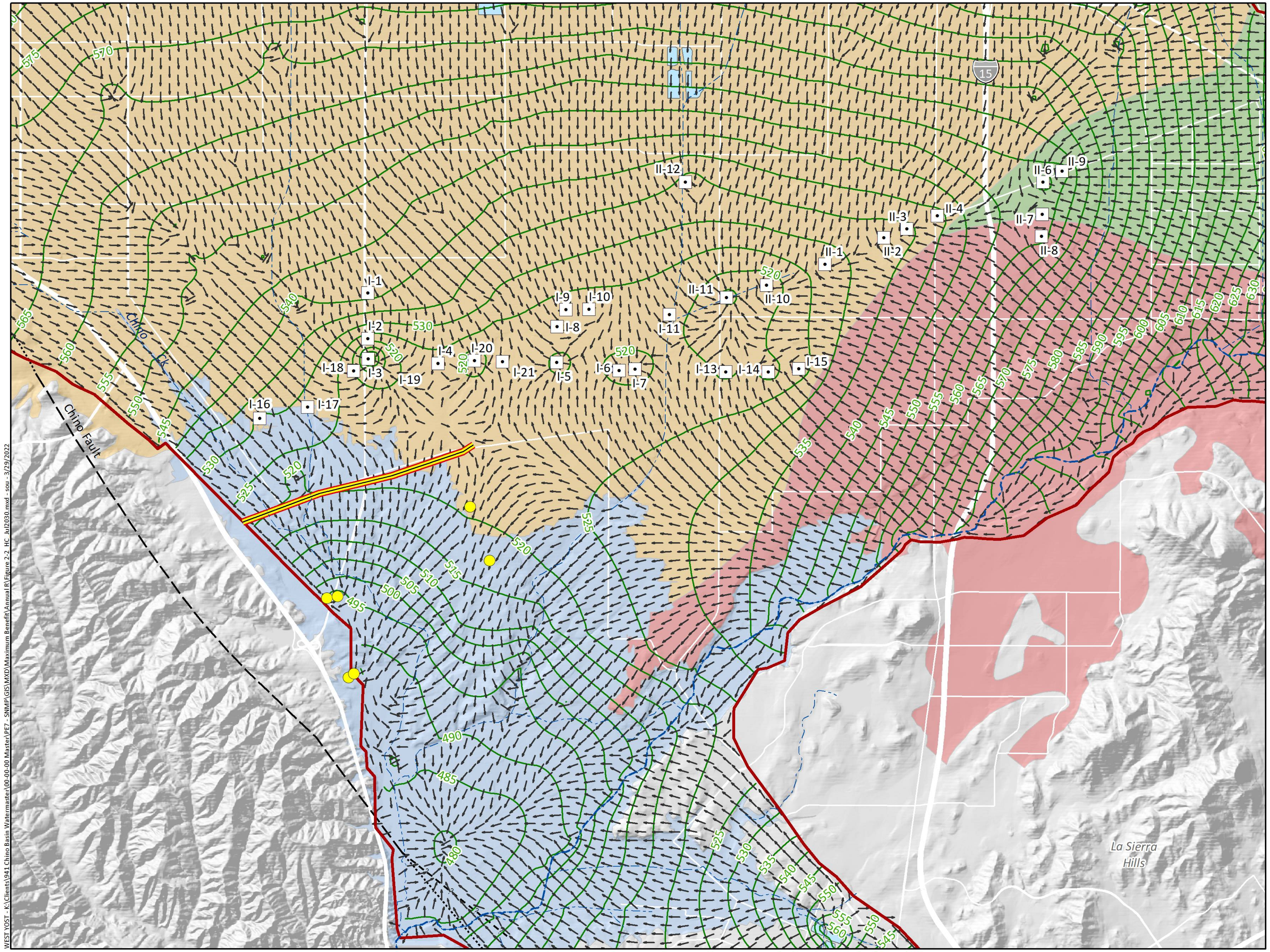
Figure 2-2 shows the model-projected state of hydraulic control in 2030 for the 2020 SYR1 scenario. The figure includes groundwater-elevation contours for model layer 1 and groundwater flow direction projected for July 2030. The model-estimated groundwater elevations and flow directions show full hydraulic containment of Chino-North groundwater at and east of Chino-I Well I-20, and groundwater discharge from the Chino-North to the PBMZ and Santa Ana River is projected to not be fully contained by the Chino Basin Desalter well field west of Well I-20.

The volume of groundwater discharge to the west of Well I-20 was estimated through the analysis of model projected discharges across a “line of control” approximately perpendicular to the groundwater flow direction past the CCWF (WEI, 2020). Figure 2-2 shows the location of the line of control. Figure 2-3 is a time-history chart that shows the historical and projected volume of groundwater discharge across the line of control (2004 to 2050). Over this period, the groundwater discharge across the line of control ranges from 380 to 740 afy, averages 490 afy, and is always less than the *de minimis* discharge threshold of 1,000 afy. Additionally, as shown in Figure 2-2, there are several active private pumping wells downgradient of the line of control that further reduce rising groundwater outflow to the PBMZ. As describe above in Section 2.1.3, Watermaster is working with the Regional Board to formally update the definition of the minimum pumping required at the CCWF to maintain outflow from the Chino-North to *de minimis* levels. This is part of the updated mitigation plan for the temporary loss of hydraulic control described in Section 2.1.5.

2.1.5 Mitigation Plan for Temporary Loss of Hydraulic Control

Part of Commitment number 8 is the development of mitigation plan for the temporary loss of hydraulic control. Watermaster and the IEUA prepared and submitted the initial mitigation plan to the Regional Board on March 3, 2005 (2005 mitigation plan). In a September 2021 letter, the Regional Board requested that this mitigation plan be updated to assure that Watermaster and the IEUA are prepared to both quantify and mitigate any impacts from the loss of hydraulic control due to challenges that could result in reduced CDA pumping such as the reduced pumping at the CCWF when 1,2,3-TCP was detected above the MCL at CCWF Well I-17 (Regional Board, 2021). Furthermore, the 2005 mitigation plan was designed based on outdated information such as outdated CDA operations and planning. The updated mitigation plan will be submitted to the Regional Board by June 30, 2022 and will include: an updated plan and schedule for the mitigation of any temporary loss of hydraulic control, a proposed definition of the required minimum CCWF pumping to maintain outflows to the PBMZ to de minimis levels (see Section 2.1.3 of this report), and a proposed definition of operational flexibility around the 40,000 afy requirement for the aggregate pumping at CDA facilities (see Section 2.2 of this report).

The September 2021 letter from the Regional Board also requested new annual performance reporting on the Chino Basin Desalters, which can be included in the Annual Reports. The requested annual performance report of the Chino Basin Desalter has been incorporated into this Annual Report and is described in Section 2.2.1.



WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PE7 - SNMP\GIS\MXD\Maximum Benefit\Annual R\Figure 2-2_HC_Jul2030.mxd - sou - 3/29/2022

800 2030 Model-Estimated Groundwater Elevation Contours - Model Layer 1 *(feet above mean sea-level)*

← 2030 Model-Estimated Groundwater Flow Directions - Model Layer 1

Line of Control for Assessment of Hydraulic Control

● Private Wells Assumed Active Downgradient of the Line of Control

⊡ Chino Basin Desalter Well

Groundwater Flow Model Boundary

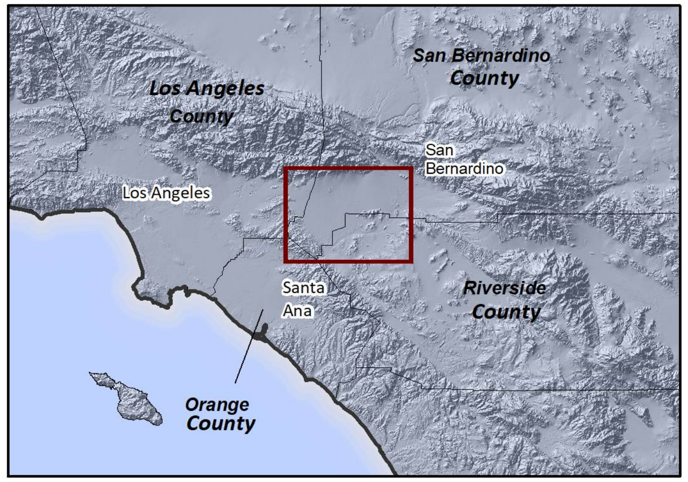
Flood Control and/or Conservation Basins

Streams & Flood Control Channels

Management Zones

🟧	Chino-North GMZ	🟥	Chino-South GMZ
🟩	Chino-East GMZ	🟦	Prado Basin MZ

(Figure 7-14 of the 2020 Safe Yield Recalculation - May 2020)



Prepared by:

WEST YOST
Water. Engineered.

0 1 2 Miles
0 2 4 Km

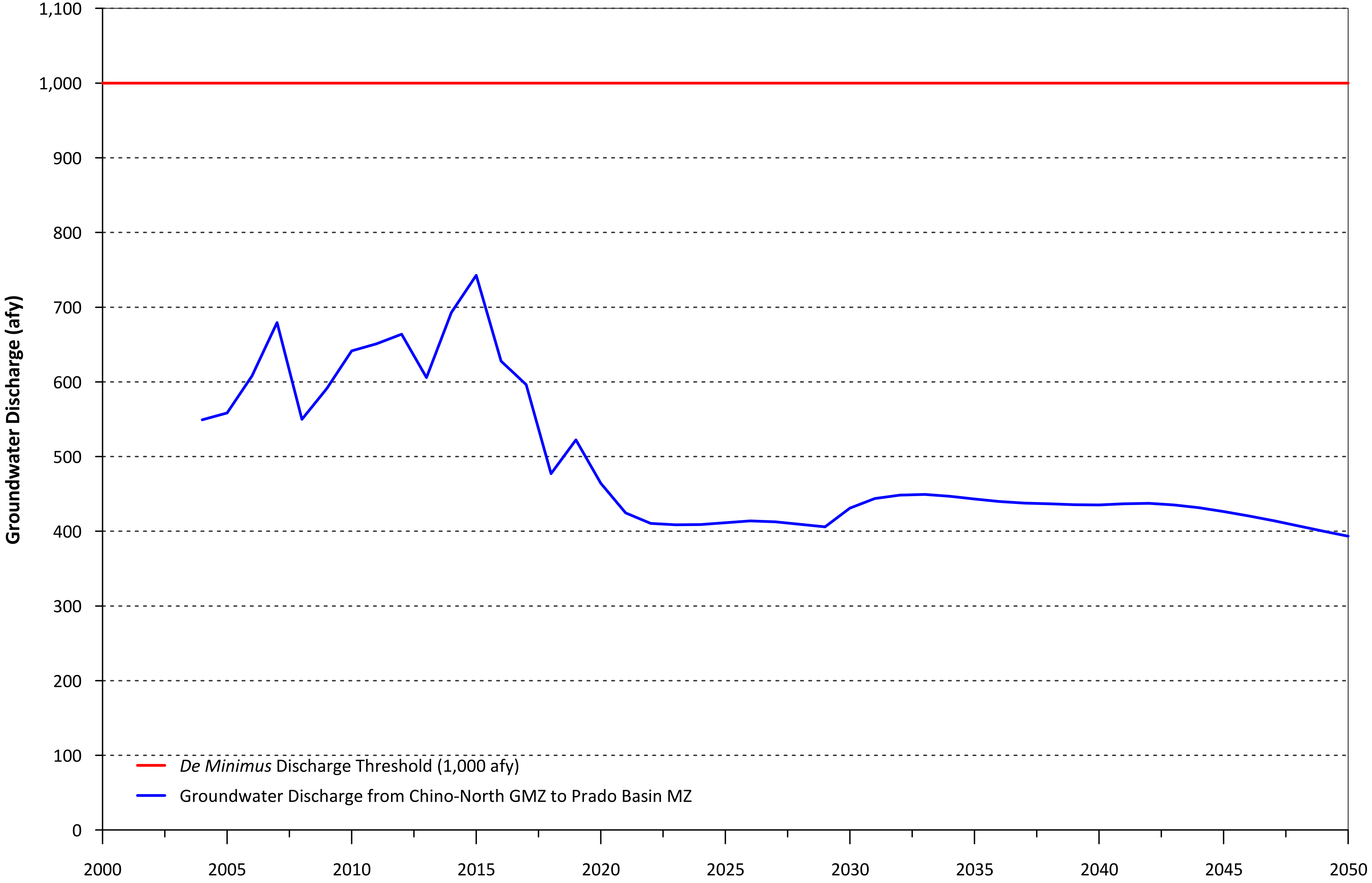
Prepared for:

Chino Basin Watermaster and
the Inland Empire Utilities Agency
2021 Maximum Benefit
Annual Report

Model-estimated State of Hydraulic Control

July 2030 - Scenario 2020 SYR1

Figure 2-2



K:Chino Basin Watermaster\PE7\GRAPHER\GR\MaxBen\AnnualR\Figure2-3_SO 3/30/2022

(Figure 7-15 from the Safe Yield Recalculation Report - May 2020)

Prepared by:

WEST YOST
Water. Engineered

Prepared for:

Chino Basin Watermaster and
The Inland Empire Utilities Agency
2021 Maximum Benefit
Annual Report

Historical and Projected Groundwater Discharge from the Chino-North GMZ to Prado Basin MZ
2005 to 2050

Figure 2-3

2.2 Chino Basin Desalters

The operation of the Chino Basin Desalters is fundamental to the maximum benefit requirement of achieving hydraulic control to protect the water quality of the Santa Ana River and manage TDS and nitrate loading from the use and recharge of recycled and imported waters. The desalter operations are also essential for maximizing the yield of the Chino Basin and minimizing the loss of stored water. The first Chino Basin Desalter, Chino-I, began operation in late 2000 and had an original design capacity of 8 mgd (8,960 afy). Commitments number 3 and number 4 are related to the Chino Basin Desalters.

Commitment number 3 required the expansion of Chino-I Desalter and the construction of Chino--II Desalter. In 2005, the Chino-I Desalter was expanded to a capacity of 14 mgd (15,680 afy), and a contract was awarded for the construction of the Chino-II Desalter. The Chino-II Desalter began operation in June 2006 with a capacity of 15 mgd (16,800 afy), bringing the total Chino Basin Desalter capacity to 29 mgd (32,480 afy).

Commitment number 4 requires the submittal of plans to construct the additional wells and facilities needed to achieve the ultimate capacity defined in the OBMP Implementation Plan, to maintain hydraulic control once agricultural pumping ceases in the southern end of the Basin, and to ensure the offset of TDS and nitrate consistent with the maximum benefit proposal. The Basin Plan requires that the construction of the desalter expansion begin once the IEUA effluent compliance metric (the 12-month running average of the IEUA volume-weighted agency-wide recycled water effluent TDS concentration) equals or exceeds 545 mgl for three consecutive months. Although the IEUA effluent compliance metric has never reached 545 mgl, the CDA proceeded to expand the capacity of the desalters to ensure the attainment of hydraulic control.

The CCWF wells (I-16, I-17, I-18, I-20, and I-21) were constructed between September 2011 and May 2012[13] in the southwestern portion of the Chino Basin to achieve hydraulic control to the west of Well I-5 (see Section 2.1.1 of this report). The well locations are shown in Figure 2-4. Pumping commenced at CCWF Wells I-16 and I-17 in mid-2014 and Wells I-20 and I-21 in February 2016. The combined pumping capacity of these four wells is about 1,529 afy (1.4 mgd). Due to the presence of VOCs at Well I-18, the CDA has not produced groundwater at this well since its construction. And as previously noted in Section 2.1.3, Well I-17 has been offline since 2017 due to the detection of 1,2,3-TCP concentrations above the new CA Primary MCL. The VOC concentrations (including 1,2,3-TCP) at CCWF Well I-17 and I-18 are associated with the Chino Airport plume. Additionally, Chino-I Desalter Wells I-1, I-2, I-3, and I-4 in the vicinity of the CCWF were also taken out of service starting in 2018 due to the presence of 1,2,3-TCP and trichloroethene (TCE) associated with the Chino Airport plume and other contaminants. Implementation of a remedial action plan for cleanup of the Chino Airport plume is underway that includes the utilization of CCWF Wells I-16, I-17, I-18, and potentially I-20 and I-21, and Chino-I Desalter Wells I-1, I-2, I-3, and I--4, as part of a pump-and-treat system, along with ten extraction well clusters constructed by the County of San Bernardino, who is the identified responsible party for the plume. Groundwater pumped from the CCWF, Chino-I Desalter wells, and County wells will be treated at the Chino-I Desalter facility using new and existing treatment infrastructure. It is anticipated that pumping at CCWF Wells I-17 and I-18 will commence in July 2022 as part of this pump and treat system.

In a letter dated January 23, 2014, the Regional Board required that Watermaster and the IEUA submit a plan detailing how hydraulic control will be sustained in the future as agricultural pumping in the southern

---

[13] Proposed CCWF Well I-19 was not constructed because the projected pumping estimates during borehole testing were too low to warrant construction.

region of Chino Basin continues to decrease and how the Chino Basin Desalters will achieve the required total groundwater production level of 40,000 afy[14]. Watermaster and the IEUA coordinated with the CDA to develop a plan to achieve 40,000 afy of desalter well pumping and submitted a final plan to the Regional Board on June 30, 2015 (Watermaster & IEUA, 2015). The plan included the construction and operation of three new wells for the Chino-II Desalter (II-10, II-11, and II-12). Due to the proximity of these wells to the South Archibald TCE plume, the CDA has been collaborating with the responsible parties of the plume to integrate these wells into the remedial solution to address groundwater cleanup of the plume while maintaining hydraulic control[15]. The plan included the construction of a dedicated pipeline to convey groundwater produced from these wells to the Chino-II Desalter facility which will remove VOCs via air stripping. The construction of Wells II-10 and II-11 was completed in September 2015, and pumping initiated in September 2018 and July 2018, respectively. The construction of Well II-12 was completed in November 2020. In 2021, the equipping of Well II-12 and construction of the dedicated raw water pipeline were completed, and pumping commenced at Well II-12 in August 2021.

Figure 2-4 shows the location of the Chino Basin Desalter wells and two bar charts of annual pumping at the desalter wells since 2000. The top chart shows pumping separated by Chino-I, Chino-II, and CCWF wells. In June 2020, the CDA facilities reached the pumping capacity necessary to meet the 40,000 afy required for hydraulic control and replacing the lost agriculture pumping in the southern Chino Basin. This pumping capacity was achieved without the inclusion of Well II-12, which was part of the final expansion plan designed to meet the 40,000 afy. In 2021, total pumping by the Chino Basin Desalter wells was approximately 40,560 af. Watermaster, IEUA, and the CDA are working with the Regional Board on a definition of operational flexibility around the 40,000 afy requirement for the aggregate pumping at CDA facilities. This is part of the work to update the mitigation plan for the temporary loss of hydraulic control described in Section 2.1.5. Also included in the top chart in Figure 2-4 is the cumulative export of TDS and nitrate mass from the groundwater basin via pumping at the Chino Basin Desalter wells since they began operation in 2000[16]. Since 2000, the Chino Basin Desalters have pumped about 537,725 af of high--TDS/nitrate water and exported about 564,000 tons of TDS and 24,000 tons of nitrate from the Chino Basin. In 2021, the desalters exported 48,803 and 2,046 tons of TDS and nitrate, respectively.

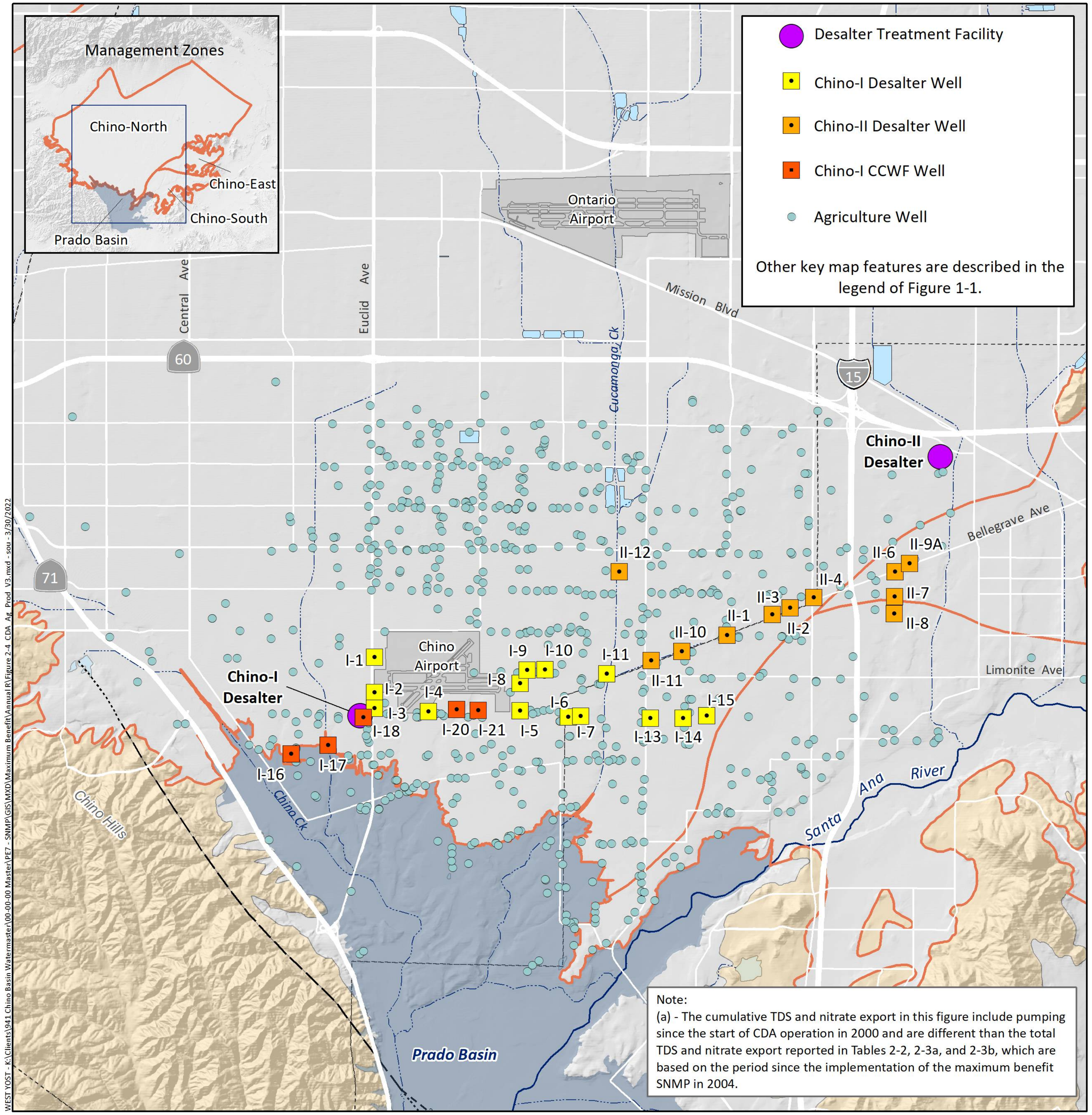
The bottom chart in Figure 2-4 shows the annual aggregate pumping at the desalter wells and agricultural wells in southern Chino Basin since 2000. This chart demonstrates how the Chino Basin Desalter well pumping is replacing the lost agriculture pumping in the southern Chino Basin.

---

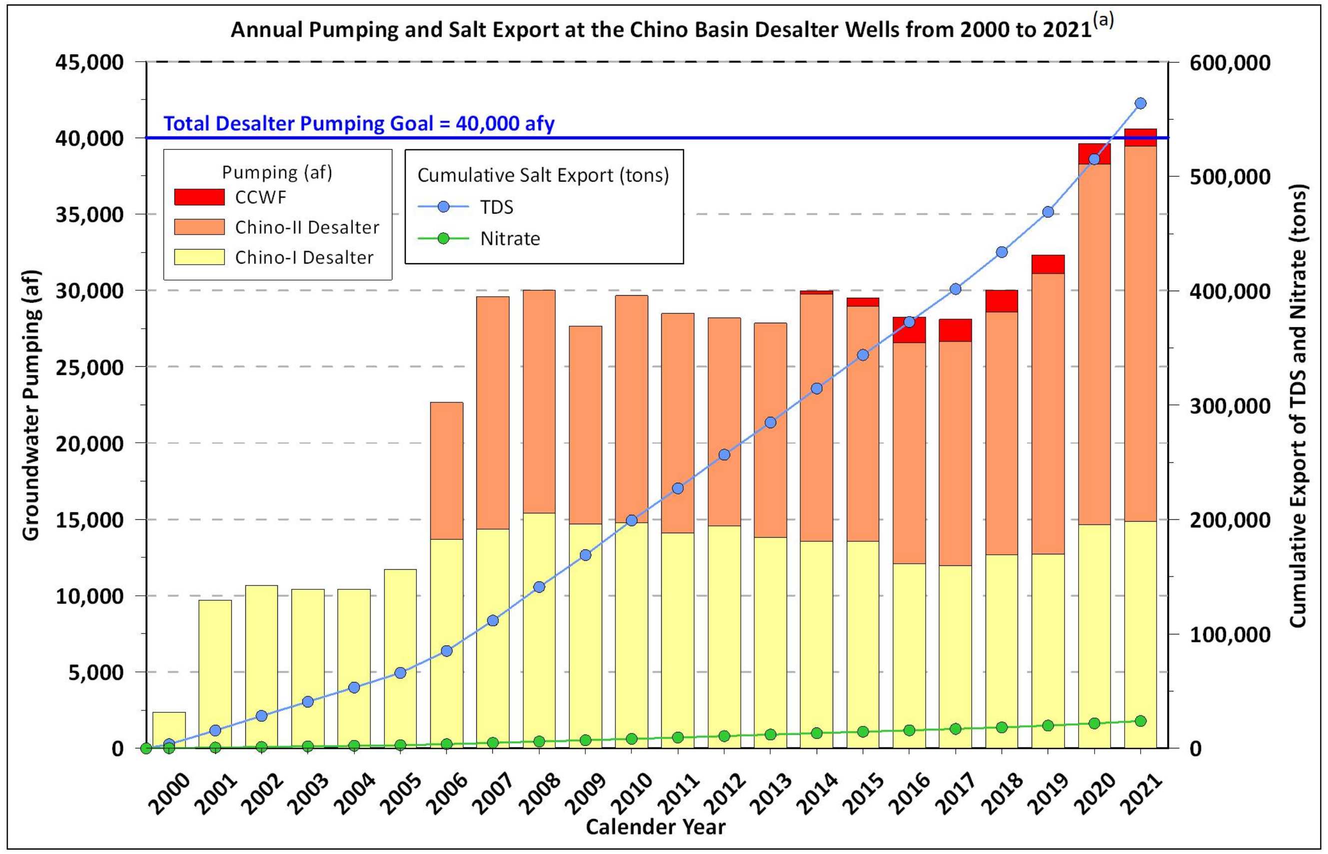
[14] As articulated in the OBMP Implementation Plan, the Peace Agreement, and the Peace II Agreement, Watermaster and the IEUA are required to expand desalter well pumping to about 40,000 afy to replace the agricultural pumping that is lost in the southern portion of the basin.

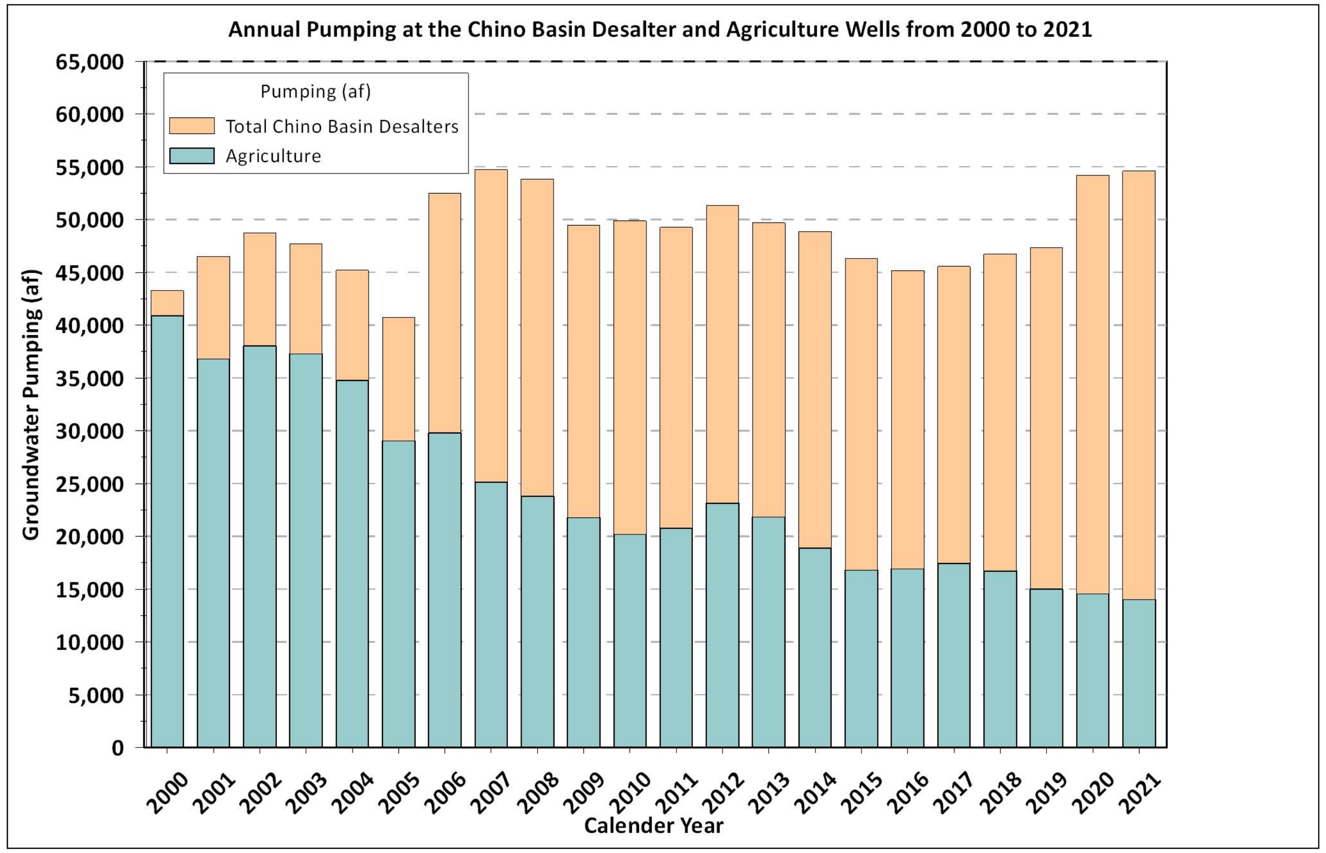
[15] In June 2013, the CDA entered into a Memorandum of Understanding with CDA Sponsor Agencies (Western Municipal Water District, City of Ontario, and Jurupa Community Service District), the IEUA, and the City of Upland, regarding the South Archibald TCE Plume cleanup. The CDA is working with this group and the "Airport Parties" (former industrial companies on the Ontario Airport property and the United States Army and Air Force) to find a mutually agreeable and beneficial solution to mitigate the TCE contamination.

[16] Note that this cumulative total is different than the total salt export reported in Section 2.2.1 below for the CDA annual performance reporting required by the Regional Board. Pursuant to the September 2021 letter, the Regional Board is only interested in the cumulative loading and export since the start of the maximum benefit SNMP in January 2004.



Note:
(a) - The cumulative TDS and nitrate export in this figure include pumping since the start of CDA operation in 2000 and are different than the total TDS and nitrate export reported in Tables 2-2, 2-3a, and 2-3b, which are based on the period since the implementation of the maximum benefit SNMP in 2004.


Annual Pumping and Salt Export at the Chino Basin Desalter Wells from 2000 to 2021[a]


Annual Pumping at the Chino Basin Desalter and Agriculture Wells from 2000 to 2021

WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PE7 - SNMP\GIS\MXD\Maximum Benefit\Annual R\Figure 2-4_CDA_Ag_Prod_V3.mxd - sou - 3/30/2022

Prepared by:

WEST YOST
Water. Engineered.

0 2 Miles
0 4 Km

Prepared for:

Chino Basin Watermaster and
the Inland Empire Utilities Agency
2021 Maximum Benefit
Annual Report

Chino Basin Desalter Wells
Annual Pumping 2000 to 2021

Figure 2-4

2.2.1 Annual Performance Reporting on the Chino Basin Desalters

The Regional Board previously required the CDA to provide quarterly reporting on the status of the final Chino Basin Desalters expansion to achieve 40,000 afy. In 2021, the Regional Board terminated this quarterly reporting requirement and requested the CDA, Watermaster, and the IEUA to provide annual performance reporting on the Chino Basin Desalters. This request was included in the September 2021 letter from the Regional Board which also requested the update to the mitigation plan for the temporary loss of hydraulic control (see Section 2.1.5 of this report). Pursuant to the September 2021 letter, the new annual performance reporting on the Chino Basin Desalters can be included in the maximum benefit annual reports, and must include the quarterly and cumulative: 1) groundwater pumping and TDS and nitrate mass removed from each desalter well from 2004 to present and 2) the TDS and nitrate budget (salt budget) from 2004 to present from the operation of the OBMP projects including: recycled water reuse; recharge of recycled, imported, and storm waters; and pumping of the Chino Basin Desalter wells.

Table 2-2 summarizes the annual and total Chino Basin Desalter pumping and mass of TDS and nitrate export by the desalter wells since the implementation of the maximum benefit program in 2004.[17] The quarterly calculations of Chino Basin Desalter pumping and mass of TDS and nitrate export by well since 2004 are provided in Appendix A.

Tables 2-3a and 2-3b show the quarterly and cumulative TDS and nitrate budgets (loading and export) and net loading to the Chino Basin from the operation of the OBMP projects. Specifically, Tables 2-3a and 2--3b show the quarterly volume (af), volume-weighted concentration (mgl), and mass (tons) for each loading and export activity. Salt loadings are shown as positive values to represent salts added to the Basin while salt exports are shown as negative values to represent salts removed from the Basin. The total TDS or nitrate loadings in tons are provided in column m, and the TDS or nitrate exports in tons are provided in column p. The net TDS or nitrate loadings in column q are the sum of the quarterly loading and export (column m plus column p). A positive net loading demonstrates that more salt is loaded to the Basin than is exported from the Basin, and a negative net loading demonstrates that more salt is exported from the Basin than is loaded to the Basin.

Figure 2-5a and Figure 2-5b plots the quarterly salt loading, export, and cumulative net loading, for TDS and nitrate, respectively, since the implementation of the maximum benefit program in 2004 through 2021.

Table 2-3a and Figure 2-5a show that for TDS:

- The quarterly loading from OBMP activities has ranged from 930 to 8,900 tons and averaged 4,830 tons.
- The quarterly export from CDA operations has ranged from negative 2,730 to negative 13,520 tons and averaged negative 7,270 tons.
- The quarterly net loading operations has ranged from 1,810 to negative 7,880 tons and averaged negative 2,440 tons.

---

[17] Note that the total TDS and nitrate mass export in Section 2.2.1 include CDA pumping since 2004 and are different than the cumulative TDS and nitrate export reported in Section 2.2, which are based on the entire period of operation of the Desalters since 2000. For the annual performance reporting required by the Regional Board, the period of interest in the cumulative loading and export is the period since the start of the maximum benefit SNMP in January 2004.

- For the period of analysis, the quarterly net TDS loading was always negative except for:
    - 2005 (quarter 2 and 4) and 2006 (quarter 1 and 4) due to high volumes of imported water and storm water recharge and limited CDA pumping.
    - 2011 (quarter 3) and 2017 (quarter 2 through 4) due to high volume of imported water recharge
- The cumulative net TDS loading since the implementation of the maximum benefit program in 2004 through 2021 was negative 175,535 tons, which demonstrate that more TDS was exported from the Chino Basin through the operation of the Chino Basin Desalters compared to TDS loaded to the Basin from the recycled water reuse and recharge of recycled, imported, and storm waters.

Table 2-3b and Figure 2-5b show that for nitrate:

- The quarterly loading from OBMP activities has ranged from 9 to 92 tons and averaged 45 tons.
- The quarterly export from CDA operations has ranged from negative 110 to negative 536 tons and averaged negative 307 tons.
- The quarterly net loading operations has ranged from negative 75 to negative 488 tons and averaged negative 263 tons.
- The cumulative net nitrate loading since the implementation of the maximum benefit program in 2004 through 2021 was negative 18,917 tons, which demonstrate that more nitrate was exported from the Chino Basin through the operation of the Chino Basin Desalters compared to nitrate loaded to the Basin from the recycled water reuse and recharge of recycled, imported, and storm water

Table 2-2. Annual and Total Pumping and Removal of TDS and Nitrate by Desalter Well from 2004 to 2021																				
Desalter Facility	Well Name		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
Chino-I	I-1	Volume (af)	630	632	664	482	618	595	588	560	567	541	479	515	493	585	548	1	0	0	8,499
		TDS (tons)	221	227	214	170	222	205	216	239	220	210	187	193	186	221	205	1	0	0	3,136
		Nitrate (tons)	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4	0	0	0	62
Chino-I	I-2	Volume (af)	265	211	168	202	218	249	246	222	237	233	219	222	232	52	7	0	0	0	2,981
		TDS (tons)	95	70	49	63	70	80	78	83	94	95	91	91	101	23	4	0	0	0	1,087
		Nitrate (tons)	1	1	1	1	1	1	1	2	2	2	2	2	3	1	0	0	0	0	22
Chino-I	I-3	Volume (af)	0	565	836	810	856	804	775	775	769	711	670	412	32	49	0	0	0	0	8,063
		TDS (tons)	0	235	386	392	394	374	353	408	426	404	403	242	32	44	0	0	0	0	4,093
		Nitrate (tons)	0	4	9	9	9	8	8	11	12	12	12	8	2	2	0	0	0	0	106
Chino-I	I-4	Volume (af)	611	527	462	408	339	196	315	254	245	215	186	150	149	95	173	0	0	0	4,328
		TDS (tons)	322	293	264	263	262	247	371	235	241	217	196	144	139	93	153	0	0	0	3,441
		Nitrate (tons)	12	12	13	12	14	12	22	15	14	13	11	8	8	5	8	0	0	0	179
Chino-I	I-5	Volume (af)	2,006	1,670	417	214	483	150	1,236	945	1,806	1,318	1,310	1,400	441	707	920	1,242	1,907	1,931	20,104
		TDS (tons)	3,533	2,944	710	367	850	253	2,056	1,608	3,019	2,208	2,177	2,300	767	1,119	1,760	2,337	3,761	3,853	35,622
		Nitrate (tons)	155	138	36	17	39	11	98	80	142	105	96	108	37	53	79	106	171	180	1,652
Chino-I	I-6	Volume (af)	471	123	327	560	407	408	257	20	452	426	365	248	105	94	214	255	301	337	5,370
		TDS (tons)	553	146	408	744	591	631	419	32	682	667	605	399	168	150	399	454	509	542	8,099
		Nitrate (tons)	25	7	19	37	30	34	22	2	36	37	35	24	10	8	23	27	28	30	434
Chino-I	I-7	Volume (af)	487	301	421	408	352	341	253	17	508	381	329	259	134	154	217	248	359	234	5,403
		TDS (tons)	517	374	513	508	447	433	375	26	691	572	524	398	218	298	459	405	561	328	7,648
		Nitrate (tons)	23	14	27	27	24	25	20	2	39	34	32	24	13	19	26	22	30	18	419
Chino-I	I-8	Volume (af)	1,688	875	106	368	432	152	494	1,001	1,311	1,117	727	911	1,195	769	974	1,002	1,345	1,170	15,637
		TDS (tons)	2,666	1,452	238	717	796	296	894	1,620	2,109	1,778	1,141	1,379	1,809	1,044	1,587	1,603	2,342	1,868	25,339
		Nitrate (tons)	130	68	12	38	38	14	40	81	114	85	64	64	83	49	75	77	111	92	1,236
Chino-I	I-9	Volume (af)	1,029	1,210	463	647	1,113	847	1,668	1,183	1,350	1,124	1,056	1,226	1,229	713	1,127	1,189	1,605	1,757	20,537
		TDS (tons)	1,665	1,983	802	1,247	1,924	1,441	2,781	2,027	2,337	1,907	1,803	2,026	1,994	1,090	1,979	2,062	2,890	3,137	35,095
		Nitrate (tons)	69	84	38	63	100	78	153	124	137	105	96	102	96	56	93	103	139	154	1,789
Chino-I	I-10	Volume (af)	1,546	1,217	879	1,320	1,601	1,278	1,697	1,657	1,910	1,688	1,578	1,527	1,497	1,156	1,172	1,537	1,677	1,483	26,422
		TDS (tons)	1,640	1,387	1,086	1,680	2,170	2,002	2,589	2,614	3,134	3,020	2,617	2,529	2,397	1,801	1,991	2,505	2,783	2,441	40,385
		Nitrate (tons)	47	47	38	64	89	51	112	122	153	136	127	124	114	87	90	113	123	110	1,749
Chino-I	I-11	Volume (af)	1,677	1,358	1,237	1,537	1,326	1,026	742	852	823	193	1,282	1,242	623	637	768	1,613	1,644	1,806	20,388
		TDS (tons)	1,275	1,075	1,140	1,596	1,413	1,154	847	1,058	986	192	1,543	1,534	727	843	1,166	2,286	2,355	2,361	23,552
		Nitrate (tons)	47	43	49	70	64	50	36	42	44	8	61	63	31	38	51	103	102	105	1,005
Chino-I	I-13	Volume (af)	0	1,396	2,775	1,925	1,373	2,717	2,465	1,952	1,568	1,234	1,368	1,708	1,078	1,318	1,482	1,309	1,366	767	27,801
		TDS (tons)	0	986	2,665	1,891	1,226	2,530	2,334	1,840	1,448	1,065	1,123	1,498	934	902	1,226	1,164	1,395	790	25,020
		Nitrate (tons)	0	53	131	92	57	83	112	83	69	53	53	73	44	42	56	56	69	43	1,170
Chino-I	I-14	Volume (af)	0	1,360	3,428	3,269	3,266	2,850	979	2,364	103	2,798	2,406	3,098	3,231	3,003	2,748	2,333	2,555	2,083	41,875
		TDS (tons)	0	1,284	3,147	3,190	3,490	3,116	1,051	2,832	119	3,429	3,125	4,003	4,175	3,950	3,911	3,278	4,146	3,554	51,799
		Nitrate (tons)	0	58	147	155	175	158	45	130	6	189	171	219	222	213	193	171	187	156	2,596
Chino-I	I-15	Volume (af)	0	246	1,491	2,188	3,039	3,096	3,080	2,313	2,928	1,850	1,575	661	1,661	2,545	2,325	2,003	1,880	3,280	36,162
		TDS (tons)	0	301	2,012	2,600	3,462	3,568	3,632	2,599	3,204	2,076	1,983	820	2,216	3,399	3,544	3,271	3,696	6,373	48,755
		Nitrate (tons)	0	13	101	136	170	173	164	113	144	106	99	43	117	177	172	165	174	278	2,345

Table 2-2. Annual and Total Pumping and Removal of TDS and Nitrate by Desalter Well from 2004 to 2021

Desalter Facility	Well Name		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
Chino-I	I-16	Volume (af)	0	0	0	0	0	0	0	0	0	0	199	308	177	247	297	252	302	210	1,991
		TDS (tons)	0	0	0	0	0	0	0	0	0	0	234	341	199	274	329	271	322	224	2,194
		Nitrate (tons)	0	0	0	0	0	0	0	0	0	0	8	11	7	10	12	10	13	9	81
Chino-I	I-17	Volume (af)	0	0	0	0	0	0	0	0	0	0	9	227	258	0	0	0	0	0	494
		TDS (tons)	0	0	0	0	0	0	0	0	0	0	12	254	295	0	0	0	0	0	561
		Nitrate (tons)	0	0	0	0	0	0	0	0	0	0	0	8	12	0	0	0	0	0	20
Chino-I	I-20	Volume (af)	0	0	0	0	0	0	0	0	0	0	0	0	646	651	620	419	601	557	3,494
		TDS (tons)	0	0	0	0	0	0	0	0	0	0	0	0	1,071	998	1,006	660	939	823	5,497
		Nitrate (tons)	0	0	0	0	0	0	0	0	0	0	0	0	65	55	48	33	48	41	291
Chino-I	I-21	Volume (af)	0	0	0	0	0	0	0	0	0	0	0	0	584	579	503	555	423	360	3,004
		TDS (tons)	0	0	0	0	0	0	0	0	0	0	0	0	895	902	879	885	693	614	4,868
		Nitrate (tons)	0	0	0	0	0	0	0	0	0	0	0	0	37	37	35	33	26	23	190
Chino-II	II-1	Volume (af)	0	0	2,546	3,069	1,870	1,357	2,639	909	1,833	3,002	3,221	3,194	2,699	2,369	2,468	967	2,669	2,379	37,191
		TDS (tons)	0	0	1,680	2,202	1,340	906	1,714	598	1,201	2,182	2,355	2,263	1,763	1,580	1,756	630	1,889	1,832	25,890
		Nitrate (tons)	0	0	67	86	51	33	63	22	51	89	97	95	78	68	76	28	91	86	1,081
Chino-II	II-2	Volume (af)	0	0	2,129	3,109	2,744	3,050	2,922	2,883	2,179	2,360	2,741	2,715	2,623	2,236	2,358	551	1,534	2,498	38,631
		TDS (tons)	0	0	1,373	1,874	1,730	2,213	2,753	2,196	1,605	1,812	2,097	1,998	1,945	1,688	1,990	436	1,212	2,262	29,183
		Nitrate (tons)	0	0	52	66	55	67	70	70	55	61	70	72	70	61	71	17	47	79	982
Chino-II	II-3	Volume (af)	0	0	2,110	3,232	2,763	944	1,390	3,105	3,128	3,016	2,916	2,946	2,931	2,792	2,729	2,703	2,744	1,409	40,857
		TDS (tons)	0	0	1,199	2,001	1,696	534	805	1,961	2,141	2,209	2,050	2,071	1,869	1,787	1,951	2,043	2,060	1,125	27,503
		Nitrate (tons)	0	0	53	83	69	19	31	70	80	78	72	71	63	56	59	66	71	37	977
Chino-II	II-4	Volume (af)	0	0	2,075	2,706	161	0	2,820	2,884	2,015	2,463	3,057	3,031	1,440	2,478	2,618	2,621	2,680	2,651	35,700
		TDS (tons)	0	0	1,187	1,819	103	0	1,853	1,688	1,222	1,470	1,687	1,689	740	1,258	1,365	1,368	1,443	1,434	20,325
		Nitrate (tons)	0	0	45	75	5	0	72	63	44	50	59	53	19	33	35	35	36	33	659
Chino-II	II-6	Volume (af)	0	0	0	1,394	2,155	2,715	2,208	2,284	2,441	2,032	1,960	1,785	2,511	2,447	2,421	2,156	2,532	1,491	32,533
		TDS (tons)	0	0	0	1,159	1,795	2,274	1,840	1,845	2,089	1,718	1,568	1,461	2,062	2,007	1,923	1,700	1,859	849	26,150
		Nitrate (tons)	0	0	0	44	78	102	79	72	75	58	60	57	77	75	70	69	75	31	1,022
Chino-II	II-7	Volume (af)	0	0	19	833	1,839	2,011	718	361	0	276	902	526	1,203	1,082	1,066	1,304	1,401	1,408	14,948
		TDS (tons)	0	0	18	809	1,701	1,887	673	280	0	211	844	534	1,116	967	982	1,229	1,279	1,233	13,763
		Nitrate (tons)	0	0	0	19	42	47	17	5	0	3	14	10	22	19	18	26	28	25	295
Chino-II	II-8	Volume (af)	0	0	107	124	1,730	1,895	1,612	1,522	1,633	822	1,409	1,143	1,044	956	984	1,609	1,630	1,554	19,774
		TDS (tons)	0	0	132	143	1,882	2,122	1,772	1,535	1,686	768	1,309	1,030	933	827	910	1,483	1,565	1,574	19,672
		Nitrate (tons)	0	0	3	3	34	47	36	27	31	12	20	17	13	12	12	21	26	28	344
Chino-II	II-9A	Volume (af)	0	0	0	782	1,338	987	551	417	389	52	3	45	35	959	55	4	1,717	2,510	9,844
		TDS (tons)	0	0	0	1,039	1,838	1,656	910	686	687	91	5	73	59	1,599	95	6	2,559	3,599	14,902
		Nitrate (tons)	0	0	0	42	69	65	29	22	23	3	0	2	2	51	3	0	92	124	527
Chino-II	II-10	Volume (af)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	390	3,707	4,246	3,560	11,903
		TDS (tons)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	196	2,460	3,401	2,820	8,877
		Nitrate (tons)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	115	166	135	424
Chino-II	II-11	Volume (af)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	815	2,750	2,492	4,776	10,833
		TDS (tons)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	536	2,540	2,538	5,016	10,630
		Nitrate (tons)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	117	110	223	473

Table 2-2. Annual and Total Pumping and Removal of TDS and Nitrate by Desalter Well from 2004 to 2021

Desalter Facility	Well Name		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
Chino-II	II-12	Volume (af)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	353	353
		TDS (tons)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	154	154
		Nitrate (tons)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4
Total		Volume (af)	10,410	11,692	22,659	29,590	30,021	27,668	29,654	28,482	28,197	27,853	29,969	29,501	28,249	28,673	29,997	32,332	39,609	40,564	505,120
		TDS (tons)	12,487	12,758	19,222	26,475	29,403	27,925	30,313	28,012	29,339	28,299	29,680	29,270	28,811	28,865	32,301	35,077	46,199	48,804	523,231(a)
		Nitrate (tons)	514	548	844	1,145	1,217	1,082	1,235	1,161	1,275	1,244	1,265	1,265	1,248	1,230	1,338	1,513	1,964	2,047	22,135(a)

Note:

(a) The total TDS and nitrate mass export in this table include CDA pumping since 2004 and are different than the cumulative TDS and nitrate export reported in Figure 2-4, which are based on the entire period of operation of the Desalters since 2000. Pursuant to the September 2021 letter from the Regional Board, the period of interest in the CDA cumulative export is the period since the start of the maximum benefit SNMP in January 2004.

Table 2-3a. Quarterly and Cumulative TDS Budget from the Operations of the OBMP Projects from 2004 through 2021.

Calendar Year Quarter				TDS Loading										TDS Export				
	TDS Loading from the Direct Use of Recycled Water			TDS Loading from Recycled Water Recharge			TDS Loading from Imported Water Recharge[a]			TDS Loading from Storm Water Recharge				TDS Export from CDA Pumping				
	Direct Use Volume (af)	Volume-wtd TDS (mgl)	Loading (tons)	Recharge Volume (af)	Volume-Wtd TDS (mgl)	Loading (tons)	Recharge Volume (af)	Volume-Wtd TDS (mgl)	Loading (tons)	Recharge Volume (af)	Volume-Wtd TDS (mgl)	Loading (tons)	Total Loading (tons)	Pumping Volume (af)	Volume-Wtd TDS (mgl)	Export[b] (tons)	Net TDS Loading (tons)	Cumulative Net TDS Loading (tons)
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m) = (c) + (f) + (i) + (l)	(n)	(o)	(p)	(q) = (m) + (p)	(r)
2004 Q1	759	475	490	0		0	1,140	285	441	0		0	931	2,701	875	(3,210)	(2,279)	(2,279)
2004 Q2	1,445	475	932	49	485	32	1,789	242	587	5,500	129	964	2,515	2,623	882	(3,142)	(627)	(2,906)
2004 Q3	1,384	501	942	135	494	91	3,564	234	1,134	0		0	2,166	2,478	920	(3,098)	(932)	(3,838)
2004 Q4	996	501	678	23	474	15	2,832	253	974	4,284	129	751	2,417	2,608	857	(3,036)	(619)	(4,457)
2005 Q1	635	501	433	0		0	117	261	41	9,276	129	1,625	2,099	2,424	955	(3,144)	(1,045)	(5,502)
2005 Q2	1,210	501	823	0		0	5,746	253	1,973	4,088	129	716	3,512	2,344	859	(2,733)	779	(4,722)
2005 Q3	1,468	473	944	541	456	335	6,655	189	1,705	1,084	129	190	3,173	3,219	746	(3,264)	(91)	(4,814)
2005 Q4	1,212	473	779	327	460	204	9,498	213	2,748	1,886	129	330	4,062	3,706	719	(3,617)	445	(4,369)
2006 Q1	773	473	497	362	464	228	9,058	225	2,772	5,590	150	1,138	4,635	3,118	667	(2,826)	1,808	(2,560)
2006 Q2	1,472	473	946	73	486	48	9,357	150	1,906	4,380	115	684	3,584	6,499	626	(5,522)	(1,938)	(4,498)
2006 Q3	2,290	484	1,505	1,688	441	1,012	12,174	165	2,723	594	115	93	5,333	6,496	608	(5,364)	(31)	(4,529)
2006 Q4	2,090	483	1,372	576	440	344	16,838	166	3,804	1,288	115	201	5,722	6,546	620	(5,510)	211	(4,318)
2007 Q1	1,333	483	876	407	447	247	3,944	281	1,505	1,883	115	294	2,922	6,829	613	(5,689)	(2,767)	(7,085)
2007 Q2	2,538	483	1,667	322	477	209	4	256	1	980	115	153	2,030	7,206	649	(6,354)	(4,324)	(11,409)
2007 Q3	2,658	514	1,856	362	484	238	0		0	511	329	229	2,322	7,948	687	(7,420)	(5,097)	(16,506)
2007 Q4	2,027	514	1,414	531	510	368	0		0	2,700	287	1,054	2,836	7,607	679	(7,013)	(4,177)	(20,683)
2008 Q1	1,293	514	902	557	486	368	0		0	6,128	96	800	2,070	7,051	728	(6,973)	(4,903)	(25,586)
2008 Q2	2,462	514	1,718	890	490	593	0		0	866	284	334	2,645	7,516	773	(7,893)	(5,248)	(30,834)
2008 Q3	3,103	500	2,106	622	476	402	0		0	356	380	184	2,692	7,943	711	(7,668)	(4,976)	(35,810)
2008 Q4	2,607	500	1,769	712	472	456	0		0	3,218	309	1,350	3,575	7,512	673	(6,869)	(3,294)	(39,104)
2009 Q1	1,663	500	1,129	590	460	369	0		0	3,600	81	398	1,896	6,971	732	(6,935)	(5,039)	(44,143)
2009 Q2	3,166	500	2,148	760	481	496	0		0	338	274	126	2,771	6,587	752	(6,730)	(3,960)	(48,103)
2009 Q3	4,076	496	2,744	586	461	367	0		0	328	321	143	3,254	7,387	740	(7,425)	(4,172)	(52,274)
2009 Q4	3,456	495	2,324	2,580	455	1,596	20	266	7	3,954	159	854	4,781	6,724	748	(6,835)	(2,054)	(54,328)
2010 Q1	2,205	495	1,483	1,252	445	757	6	233	2	8,498	85	987	3,228	7,323	756	(7,523)	(4,295)	(58,623)
2010 Q2	4,198	495	2,823	2,792	438	1,661	4,974	229	1,547	1,493	211	429	6,460	7,423	793	(7,997)	(1,538)	(60,160)
2010 Q3	4,419	484	2,903	2,302	448	1,402	0		0	537	283	206	4,511	7,495	753	(7,670)	(3,158)	(63,319)
2010 Q4	3,380	483	2,218	1,958	446	1,187	0		0	8,862	216	2,602	6,008	7,413	707	(7,123)	(1,115)	(64,434)
2011 Q1	2,157	483	1,415	1,073	421	614	0		0	6,764	210	1,926	3,955	6,708	708	(6,450)	(2,495)	(66,928)
2011 Q2	4,106	483	2,694	2,732	419	1,557	9,465	143	1,843	889	192	231	6,325	7,428	709	(7,152)	(827)	(67,755)
2011 Q3	4,797	488	3,177	1,831	416	1,034	23,366	138	4,390	509	295	204	8,805	7,392	749	(7,519)	1,286	(66,470)
2011 Q4	3,886	488	2,574	2,442	415	1,376	83	136	15	2,600	156	552	4,518	6,954	729	(6,891)	(2,373)	(68,842)
2012 Q1	2,480	488	1,643	1,871	434	1,103	0		0	4,209	73	416	3,162	6,949	741	(6,994)	(3,832)	(72,674)
2012 Q2	4,721	488	3,127	2,490	459	1,553	0		0	1,953	305	810	5,489	7,116	752	(7,267)	(1,778)	(74,453)
2012 Q3	5,198	508	3,584	1,350	440	807	0		0	556	388	293	4,685	7,211	770	(7,542)	(2,857)	(77,310)
2012 Q4	4,080	507	2,810	2,112	458	1,314	0		0	2,654	306	1,103	5,227	6,921	802	(7,536)	(2,309)	(79,619)
2013 Q1	2,603	507	1,793	3,778	464	2,380	0		0	1,741	72	170	4,343	6,100	718	(5,950)	(1,606)	(81,225)
2013 Q2	4,956	507	3,413	3,239	475	2,091	0		0	320	281	122	5,626	6,865	763	(7,112)	(1,486)	(82,711)
2013 Q3	5,983	524	4,262	3,255	472	2,086	0		0	318	383	165	6,513	7,493	780	(7,938)	(1,425)	(84,136)
2013 Q4	4,926	524	3,508	4,122	482	2,696	0		0	1,050	287	409	6,612	7,394	727	(7,299)	(687)	(84,822)
2014 Q1	3,143	524	2,238	2,627	487	1,737	713	308	299	2,135	172	499	4,773	7,193	719	(7,026)	(2,253)	(87,075)
2014 Q2	5,983	524	4,261	3,589	494	2,409	83	303	34	796	328	355	7,058	7,202	728	(7,123)	(65)	(87,140)
2014 Q3	5,978	550	4,468	2,544	493	1,703	0	310	0	425	359	207	6,378	7,837	717	(7,636)	(1,258)	(88,398)
2014 Q4	4,426	550	3,308	2,237	533	1,619	0		0	4,810	181	1,179	6,106	7,737	751	(7,895)	(1,789)	(90,187)
2015 Q1	2,824	550	2,111	2,700	515	1,890	0		0	1,744	150	355	4,355	6,994	739	(7,025)	(2,670)	(92,857)
2015 Q2	5,376	550	4,018	3,359	501	2,286	0		0	1,022	177	246	6,549	7,454	726	(7,351)	(801)	(93,658)
2015 Q3	4,958	526	3,545	2,580	481	1,684	0		0	1,859	311	786	6,015	7,692	738	(7,713)	(1,697)	(95,356)
2015 Q4	3,473	526	2,479	3,417	473	2,196	0		0	2,144	208	606	5,282	7,360	718	(7,182)	(1,901)	(97,256)
2016 Q1	2,216	526	1,582	3,252	477	2,106	0		0	4,396	64	380	4,068	6,451	740	(6,485)	(2,417)	(99,674)
2016 Q2	4,218	526	3,011	3,973	488	2,635	0		0	837	291	331	5,977	6,688	776	(7,053)	(1,076)	(100,750)
2016 Q3	4,580	499	3,101	3,448	472	2,213	0		0	194	295	78	5,392	7,751	750	(7,899)	(2,507)	(103,257)
2016 Q4	3,567	499	2,415	3,637	463	2,287	4,260	267	1,547	4,385	145	863	7,112	7,361	737	(7,373)	(261)	(103,518)
2017 Q1	2,276	499	1,541	2,571	450	1,571	760		0	6,694	86	777	3,889	6,536	728	(6,465)	(2,576)	(106,094)
2017 Q2	4,332	499	2,934	4,268	437	2,533	8,129	119	1,310	302	245	100	6,877	6,637	724	(6,525)	352	(105,741)
2017 Q3	6,983	468	4,435	3,191	417	1,807	18,362	101	2,527	313	305	130	8,899	7,817	813	(8,634)	265	(105,476)
2017 Q4	4,044	453	2,486	4,332	417	2,452	12,250	159	2,640	138	280	52	7,630	7,633	698	(7,242)	388	(105,088)
2018 Q1	2,534	485	1,668	1,978	455	1,222	4,994	244	1,657	3,775	166	849	5,396	7,323	759	(7,552)	(2,155)	(107,243)
2018 Q2	4,094	505	2,807	3,711	468	2,362	652	254	225	268	168	61	5,455	7,315	796	(7,907)	(2,452)	(109,695)
2018 Q3	4,189	499	2,837	3,879	453	2,387	58	226	18	161	394	86	5,328	7,121	854	(8,264)	(2,936)	(112,631)
2018 Q4	2,092	502	1,428	2,942	468	1,870	287		0	2,547	247	853	4,151	8,238	766	(8,571)	(4,420)	(117,051)
2019 Q1	649	482	425	1,159	457	720	455	254	157	9,188	153	1,909	3,211	7,783	755	(7,980)	(4,769)	(121,820)
2019 Q2	2,627	486	1,736	3,165	447	1,920	6,602	205	1,835	966	218	285	5,777	8,091	792	(8,699)	(2,922)	(124,742)
2019 Q3	5,974	474	3,849	3,115	419	1,771	12,433	149	2,522	117	384	61	8,204	7,871	863	(9,230)	(1,027)	(125,769)
2019 Q4	3,252	469	2,070	3,721	427	2,157	6,210	188	1,586	4,190	288	1,637	7,450	8,566	788	(9,168)	(1,718)	(127,487)
2020 Q1	1,960	471	1,255	2,740	440	1,637	484	212	139	3,033	107	440	3,472	9,127	850	(10,540)	(7,069)	(134,556)
2020 Q2	3,146	500	2,138	3,378	456	2,093	1,026	235	328	2,627	233	833	5,391	10,065	859	(11,748)	(6,357)	(140,912)

Table 2-3a. Quarterly and Cumulative TDS Budget from the Operations of the OBMP Projects from 2004 through 2021.

Calendar Year Quarter				TDS Loading										TDS Export				
	TDS Loading from the Direct Use of Recycled Water			TDS Loading from Recycled Water Recharge			TDS Loading from Imported Water Recharge(a)			TDS Loading from Storm Water Recharge				TDS Export from CDA Pumping				
	Direct Use Volume (af)	Volume-wtd TDS (mgl)	Loading (tons)	Recharge Volume (af)	Volume-Wtd TDS (mgl)	Loading (tons)	Recharge Volume (af)	Volume-Wtd TDS (mgl)	Loading (tons)	Recharge Volume (af)	Volume-Wtd TDS (mgl)	Loading (tons)	Total Loading (tons)	Pumping Volume (af)	Volume-Wtd TDS (mgl)	Export(b) (tons)	Net TDS Loading (tons)	Cumulative Net TDS Loading (tons)
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m) = (c) + (f) + (i) + (l)	(n)	(o)	(p)	(q) = (m) + (p)	(r)
2020 Q3	6,788	506	4,666	4,221	452	2,590	106	241	35	46	334	21	7,312	10,215	916	(12,707)	(5,396)	(146,308)
2020 Q4	3,193	485	2,105	5,171	443	3,112	2,021	245	673	1,558	303	640	6,531	10,202	809	(11,204)	(4,673)	(150,981)
2021 Q1	2,405	486	1,586	2,567	462	1,611	100	270	37	3,048	162	672	3,905	9,470	865	(11,133)	(7,227)	(158,208)
2021 Q2	4,950	499	3,353	3,769	465	2,380	2	275	1	413	250	140	7,327	10,269	934	(13,031)	(5,704)	(163,912)
2021 Q3	7,069	501	4,806	4,201	465	2,655	201	301	82	360	290	142	5,640	10,594	940	(13,520)	(7,881)	(171,793)
2021 Q4	4,174	487	2,760	4,219	458	2,625	71	282	27	5,773	251	1,964	7,377	10,231	800	(11,119)	(3,742)	(175,535)
Total	237,687		161,841	156,951(c)		97,873	200,887(c)		47,799	176,047(c)		40,775	347,696	505,049		(523,231)(d)	(175,535)	

Notes:

(a) The imported water available to Chino Basin, State Water Project water, is considered the alternative water supply that would be used if recycled water was not permitted for recharge and reuse

(b) Exports are shown as negative values to represent salt removed from the Chino Basin.

(c) Total recharge volumes for recycled water, imported water, and storm water in this table include groundwater recharge from 2004 to 2021. These total volumes differ from the volumes in Table 2-3 of this Annual Report which only includes groundwater recharge since the implementation of the Chino Basin Recycled Water Groundwater Recharge Program in 2005 to 2021.

(d) The total TDS and nitrate mass export in this table include CDA pumping since 2004 and are different than the cumulative TDS and nitrate export reported in Figure 2-4, which are based on the entire period of operation of the Desalters since 2000. Pursuant to the September 2021 letter from the Regional Board, the period of interest in the salt loading and export is the period since the start of the maximum benefit SNMP in January 2004.

(Red Text) Indicates negative values.

Table 2-3b. Quarterly and Cumulative Nitrate Budget from the Operations of the OBMP Projects from 2004 through 2021.

Calendar Year Quarter	Nitrate Loading													Nitrate Export			Net Nitrate Loading (tons)	Cumulative Net Nitrate Loading (tons)
	Nitrate Loading from the Direct Use of Recycled Water			Nitrate Loading from Recycled Water Recharge			Nitrate Loading from Imported Water Recharge[(a)]			Nitrate Loading from Storm Water Recharge				Nitrate Export from CDA Pumping				
	Direct Use Volume (af)	Volume-wtd Nitrate (mgl)	Loading (tons)	Recharge Volume (af)	Volume-Wtd Nitrate (mgl)	Loading (tons)	Recharge Volume (af)	Volume-Wtd Nitrate (mgl)	Loading (tons)	Recharge Volume (af)	Volume-Wtd Nitrate (mgl)	Loading (tons)	Total Loading (mgl)	Pumping Volume (af)	Volume-Wtd Nitrate (mgl)	Export[(b)] (tons)		
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m) = (c) + (f) + (i) + (l)	(n)	(o)	(p)	(q) = (m) + (p)	(r)
2004 Q1	759	7.5	7.8	0		0.0	1,140	0.9	1.4	0		0.0	9.1	2,701	34	(123.8)	(114.7)	(114.7)
2004 Q2	1,445	7.5	14.8	49	2.8	0.2	1,789	0.8	1.9	5,500	2.9	21.9	38.8	2,623	36	(127.0)	(88.1)	(202.8)
2004 Q3	1,384	6.9	13.0	135	1.6	0.3	3,564	0.5	2.2	0		0.0	15.5	2,478	40	(134.0)	(118.5)	(321.3)
2004 Q4	996	6.9	9.4	23	4.0	0.1	2,832	0.6	2.2	4,284	2.9	17.1	28.8	2,608	37	(129.7)	(100.9)	(422.2)
2005 Q1	635	6.9	6.0	0		0.0	117	1.3	0.2	9,276	2.9	37.0	43.2	2,424	40	(131.8)	(88.6)	(510.8)
2005 Q2	1,210	6.9	11.4	0		0.0	5,746	1.0	7.6	4,088	2.9	16.3	35.3	2,344	35	(110.6)	(75.2)	(586.0)
2005 Q3	1,468	6.4	12.8	541	3.4	2.5	6,655	0.5	4.5	1,084	2.9	4.3	24.1	3,219	31	(136.2)	(112.1)	(698.1)
2005 Q4	1,212	6.4	10.5	327	3.2	1.4	9,498	0.5	5.9	1,886	2.9	7.5	25.4	3,706	34	(169.1)	(143.7)	(841.8)
2006 Q1	773	6.4	6.7	362	5.8	2.8	9,058	0.8	9.7	5,590	0.9	7.1	26.4	3,118	33	(141.5)	(115.1)	(957.0)
2006 Q2	1,472	6.4	12.8	73	5.2	0.5	9,357	0.5	5.7	4,380	0.8	4.6	23.6	6,499	27	(235.8)	(212.2)	(1,169.1)
2006 Q3	2,290	6.3	19.7	1,688	4.1	9.3	12,174	0.3	5.7	594	0.8	0.6	35.4	6,496	25	(222.9)	(187.5)	(1,356.6)
2006 Q4	2,090	6.3	18.0	576	5.4	4.2	16,838	0.5	11.9	1,288	1.3	2.3	36.4	6,546	27	(243.6)	(207.2)	(1,563.8)
2007 Q1	1,333	6.3	11.5	407	5.3	2.9	3,944	0.7	4.0	1,883	2.5	6.4	24.7	6,829	27	(253.3)	(228.6)	(1,792.3)
2007 Q2	2,538	6.3	21.8	322	5.6	2.5	4	0.8	0.0	980	2.5	3.3	27.6	7,206	27	(267.8)	(240.2)	(2,032.6)
2007 Q3	2,658	6.4	23.1	362	5.1	2.5	0		0.0	511	0.9	0.6	26.2	7,948	29	(312.9)	(286.6)	(2,319.2)
2007 Q4	2,027	6.4	17.5	531	5.5	4.0	0		0.0	2,700	1.1	3.9	25.4	7,607	30	(311.1)	(285.7)	(2,604.9)
2008 Q1	1,293	6.4	11.2	557	4.9	3.7	0		0.0	6,128	1.2	10.3	25.2	7,051	30	(284.8)	(259.6)	(2,864.5)
2008 Q2	2,462	6.4	21.3	890	6.5	7.9	0		0.0	866	1.0	1.2	30.3	7,516	31	(317.4)	(287.0)	(3,151.5)
2008 Q3	3,103	6.4	26.8	622	6.7	5.6	0		0.0	356	0.6	0.3	32.8	7,943	29	(309.1)	(276.3)	(3,427.8)
2008 Q4	2,607	6.4	22.5	712	7.0	6.7	0		0.0	3,218	0.7	3.2	32.5	7,512	30	(305.9)	(273.4)	(3,701.2)
2009 Q1	1,663	6.4	14.4	590	5.2	4.2	0		0.0	3,600	0.7	3.4	22.0	6,971	28	(260.9)	(238.9)	(3,940.0)
2009 Q2	3,166	6.4	27.4	760	5.0	5.2	0		0.0	338	0.5	0.2	32.8	6,587	29	(259.9)	(227.1)	(4,167.1)
2009 Q3	4,076	4.9	27.3	586	3.9	3.1	0		0.0	328	0.3	0.1	30.5	7,387	30	(297.8)	(267.3)	(4,434.5)
2009 Q4	3,456	4.9	23.0	2,580	4.0	14.1	20	0.4	0.0	3,954	1.3	6.7	43.9	6,724	29	(263.8)	(219.9)	(4,654.4)
2010 Q1	2,205	4.9	14.7	1,252	4.6	7.8	6	0.8	0.0	8,498	1.1	12.2	34.7	7,323	30	(298.5)	(263.8)	(4,918.2)
2010 Q2	4,198	4.9	28.0	2,792	4.2	15.8	4,974	0.8	5.2	1,493	1.0	2.0	51.1	7,423	31	(308.1)	(257.0)	(5,175.3)
2010 Q3	4,419	5.3	31.9	2,302	4.4	13.9	0		0.0	537	0.7	0.5	46.4	7,495	31	(320.1)	(273.7)	(5,449.0)
2010 Q4	3,380	5.3	24.5	1,958	5.5	14.5	0		0.0	8,862	0.7	8.7	47.7	7,413	31	(308.0)	(260.3)	(5,709.3)
2011 Q1	2,157	5.3	15.6	1,073	6.0	8.8	0		0.0	6,764	1.2	11.3	35.7	6,708	31	(285.0)	(249.3)	(5,958.5)
2011 Q2	4,106	5.3	29.7	2,732	4.8	17.8	9,465	0.4	4.8	889	1.5	1.8	54.2	7,428	27	(270.6)	(216.4)	(6,175.0)
2011 Q3	4,797	5.9	38.2	1,831	4.3	10.8	23,366	0.4	12.0	509	0.6	0.4	61.3	7,392	31	(308.1)	(246.7)	(6,421.7)
2011 Q4	3,886	5.9	31.0	2,442	5.5	18.3	83	0.3	0.0	2,600	1.0	3.5	52.8	6,954	32	(297.6)	(244.8)	(6,666.5)
2012 Q1	2,480	5.9	19.8	1,871	5.8	14.7	0		0.0	4,209	0.7	4.1	38.5	6,949	31	(293.7)	(255.1)	(6,921.6)
2012 Q2	4,721	5.9	37.7	2,490	4.9	16.7	0		0.0	1,953	1.3	3.4	57.8	7,116	33	(317.8)	(260.0)	(7,181.6)
2012 Q3	5,198	5.3	37.1	1,350	4.5	8.3	0		0.0	556	1.0	0.7	46.1	7,211	34	(329.7)	(283.6)	(7,465.2)
2012 Q4	4,080	5.3	29.1	2,112	5.3	15.2	0		0.0	2,654	2.1	7.4	51.7	6,921	35	(333.6)	(282.0)	(7,747.1)
2013 Q1	2,603	5.3	18.6	3,778	6.2	32.0	0		0.0	1,741	0.7	1.7	52.2	6,100	32	(262.5)	(210.3)	(7,957.4)
2013 Q2	4,956	5.3	35.3	3,239	5.6	24.7	0		0.0	320	0.1	0.0	60.1	6,865	34	(313.9)	(253.8)	(8,211.2)
2013 Q3	5,983	5.8	47.2	3,255	5.2	23.2	0		0.0	318	0.6	0.3	70.7	7,493	34	(344.1)	(273.4)	(8,484.6)
2013 Q4	4,926	5.8	38.9	4,122	6.2	34.5	0		0.0	1,050	1.5	2.2	75.5	7,394	32	(323.6)	(248.1)	(8,732.7)
2014 Q1	3,143	5.8	24.8	2,627	6.0	21.5	713	0.7	0.7	2,135	1.1	3.1	50.1	7,193	31	(306.5)	(256.4)	(8,989.1)
2014 Q2	5,983	5.8	47.2	3,589	5.0	24.5	83	0.7	0.1	796	0.9	1.0	72.8	7,202	31	(305.5)	(232.6)	(9,221.7)
2014 Q3	5,978	5.6	45.3	2,544	4.6	15.7	0		0.0	425	1.0	0.6	61.7	7,837	30	(324.3)	(262.7)	(9,484.4)
2014 Q4	4,426	5.6	33.6	2,237	4.9	14.7	0		0.0	4,810	0.6	4.0	52.4	7,737	31	(329.2)	(276.9)	(9,761.3)
2015 Q1	2,824	5.6	21.4	2,700	6.0	21.8	0		0.0	1,744	1.5	3.6	46.8	6,994	32	(303.1)	(256.2)	(10,017.5)
2015 Q2	5,376	5.6	40.8	3,359	5.5	25.2	0		0.0	1,022	1.5	2.1	68.1	7,454	31	(314.8)	(246.7)	(10,264.2)
2015 Q3	4,958	5.6	37.7	2,580	4.9	17.3	0		0.0	1,859	0.7	1.8	56.8	7,692	31	(326.2)	(269.4)	(10,533.6)
2015 Q4	3,473	5.6	26.4	3,417	5.7	26.5	0		0.0	2,144	0.7	2.0	54.9	7,360	32	(320.4)	(265.5)	(10,799.1)
2016 Q1	2,216	5.6	16.8	3,252	6.3	27.8	0		0.0	4,396	0.7	4.2	48.9	6,451	35	(304.9)	(256.0)	(11,055.1)
2016 Q2	4,218	5.6	32.0	3,973	4.9	26.4	0		0.0	837	2.4	2.7	61.2	6,688	33	(303.5)	(242.4)	(11,297.5)
2016 Q3	4,580	5.4	33.5	3,448	5.8	27.3	0		0.0	194	1.7	0.4	61.3	7,751	31	(328.8)	(267.6)	(11,565.1)
2016 Q4	3,567	5.4	26.1	3,637	5.7	28.3	4,260	0.2	1.1	4,385	1.7	10.1	65.6	7,361	31	(310.5)	(244.9)	(11,810.0)
2017 Q1	2,276	5.4	16.7	2,571	5.4	19.0	760		0.0	6,694	0.5	4.8	40.4	6,536	32	(285.8)	(245.3)	(12,055.3)
2017 Q2	4,332	5.4	31.7	4,268	4.5	26.1	8,129	0.3	3.7	302	0.5	0.2	61.8	6,637	30	(274.6)	(212.8)	(12,268.1)
2017 Q3	6,983	6.2	58.7	3,191	6.3	27.4	18,362	0.2	6.0	313	0.6	0.2	92.4	7,817	33	(351.7)	(259.3)	(12,527.4)
2017 Q4	4,044	6.1	33.5	4,332	5.7	33.3	12,250	0.4	6.5	138	1.2	0.2	73.6	7,633	31	(318.2)	(244.6)	(12,772.0)
2018 Q1	2,534	5.2	17.8	1,978	4.5	12.2	4,994	0.6	4.4	3,775	1.6	8.4	42.7	7,323	32	(319.5)	(276.8)	(13,048.8)
2018 Q2	4,094	4.7	26.3	3,711	4.0	20.3	652	0.4	0.4	268	1.1	0.4	47.3	7,315	33	(332.4)	(285.1)	(13,333.9)
2018 Q3	4,189	4.9	27.9	3,879	4.2	22.2	58	0.1	0.0	161	0.4	0.1	50.2	7,121	34	(325.3)	(275.1)	(13,609.0)
2018 Q4	2,092	4.9	14.0	2,942	4.0	16.2	287		0.0	2,547	0.6	2.1	32.3	8,238	32	(360.4)	(328.2)	(13,937.2)
2019 Q1	649	5.1	4.5	1,159	4.4	7.0	455	0.4	0.2	9,188	0.2	2.5	14.2	7,783	33	(352.6)	(338.4)	(14,275.5)
2019 Q2	2,627	3.9	13.9	3,165	3.5	15.1	6,602	0.3	2.8	966	0.4	0.5	32.4	8,091	34	(369.3)	(337.0)	(14,612.5)
2019 Q3	5,974	3.7	30.1	3,115	3.6	15.1	12,433	0.2	3.9	117	2.7	0.4	49.5	7,871	36	(390.1)	(340.6)	(14,953.1)
2019 Q4	3,252	4.4	19.6	3,721	4.4	22.0	6,210	0.1	1.2	4,190	2.8	15.9	58.8	8,566	34	(401.1)	(342.3)	(15,295.4)
2020 Q1	1,960	5.1	13.7	2,740	5.0	18.8	484	0.5	0.3	3,033	0.7	2.8	35.6	9,127	35	(432.3)	(396.7)	(15,692.2)
2020 Q2	3,146	4.6	19.5	3,378	4.5	20.6	1,026	0.5	0.6	2,627	0.8	2.7	43.5	10,065	36	(495.1)	(451.6)	(16,143.8)

Table 2-3b. Quarterly and Cumulative Nitrate Budget from the Operations of the OBMP Projects from 2004 through 2021.

Calendar Year Quarter	Nitrate Loading													Nitrate Export			Net Nitrate Loading (tons)	Cumulative Net Nitrate Loading (tons)
	Nitrate Loading from the Direct Use of Recycled Water			Nitrate Loading from Recycled Water Recharge			Nitrate Loading from Imported Water Recharge[a]			Nitrate Loading from Storm Water Recharge			Total Loading (mgl)	Nitrate Export from CDA Pumping				
	Direct Use Volume (af)	Volume-wtd Nitrate (mgl)	Loading (tons)	Recharge Volume (af)	Volume-Wtd Nitrate (mgl)	Loading (tons)	Recharge Volume (af)	Volume-Wtd Nitrate (mgl)	Loading (tons)	Recharge Volume (af)	Volume-Wtd Nitrate (mgl)	Loading (tons)		Pumping Volume (af)	Volume-Wtd Nitrate (mgl)	Export[b] (tons)		
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m) = (c) + (f) + (i) + (l)	(n)	(o)	(p)	(q) = (m) + (p)	(r)
2020 Q3	6,788	4.4	40.4	4,221	3.7	21.0	106	0.2	0.0	46	0.6	0.0	61.5	10,215	37	(513.8)	(452.3)	(16,596.1)
2020 Q4	3,193	4.1	17.7	5,171	3.7	26.1	2,021	0.2	0.6	1,558	0.5	1.1	45.5	10,202	38	(522.7)	(477.2)	(17,073.3)
2021 Q1	2,405	3.9	12.9	2,567	3.5	12.3	100	0.9	0.1	3,048	0.3	1.3	26.6	9,470	37	(477.0)	(450.4)	(17,523.7)
2021 Q2	4,950	4.2	28.0	3,769	3.8	19.4	2	1.8	0.0	413	0.4	0.2	47.6	10,269	38	(536.0)	(488.3)	(18,012.0)
2021 Q3	7,069	4.1	39.8	4,201	3.8	21.7	201	1.4	0.4	360	2.5	1.2	63.1	10,594	37	(525.9)	(462.9)	(18,474.8)
2021 Q4	4,174	4.1	23.3	4,219	3.9	22.5	71	1.5	0.1	5,773	2.5	19.8	65.8	10,231	37	(507.7)	(441.9)	(18,916.7)
Total	237,687		1,743.8	156,951[c]		1,036.4	200,887[c]		118.4	176,047[c]		319.2	3,217.9	505,049		(22,135)[d]	(18,916.7)	

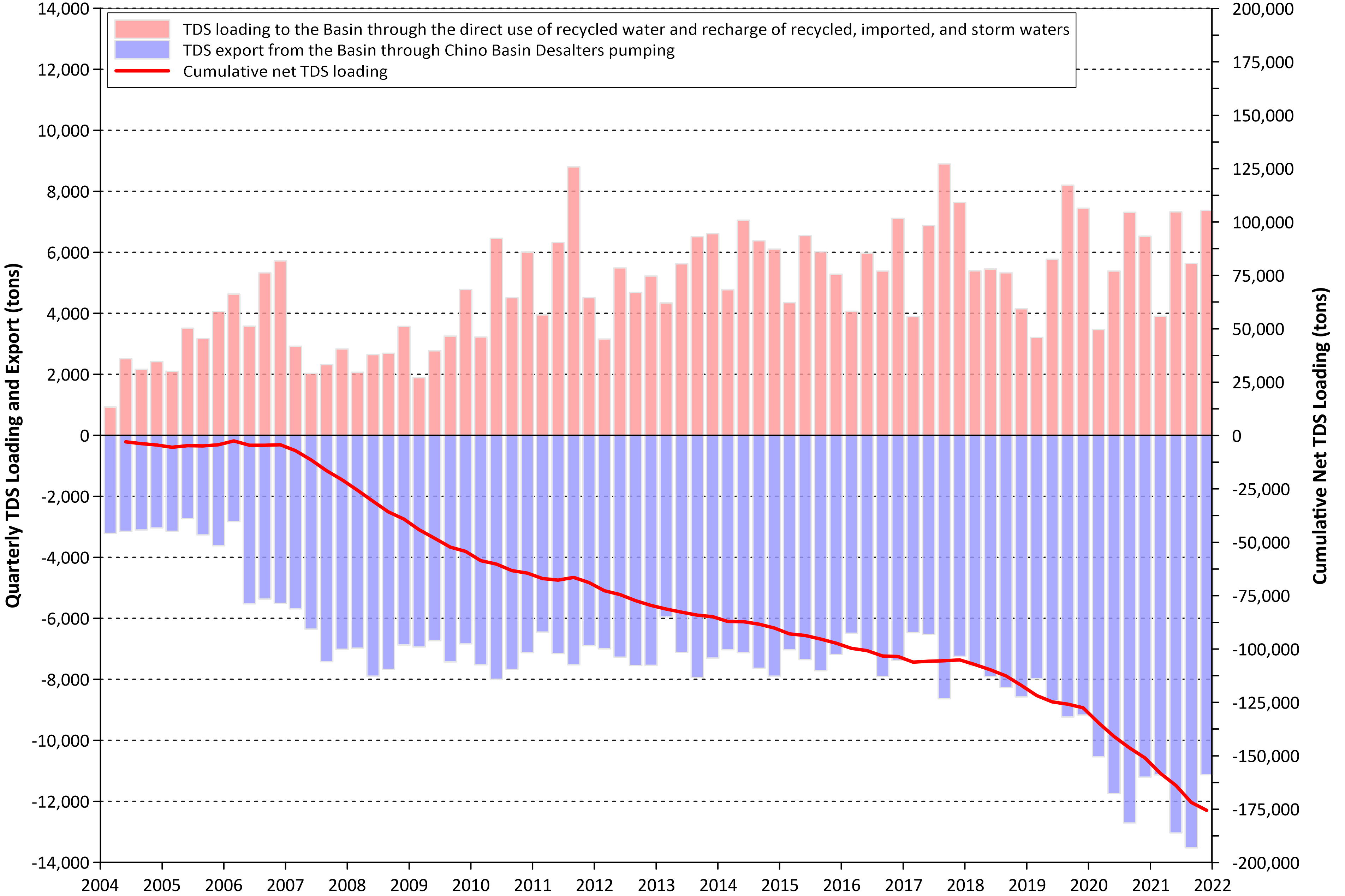
Notes:

(a) The imported water available to Chino Basin, State Water Project water, is considered the alternative water supply that would be used if recycled water was not permitted for recharge and reuse

(b) Exports are shown as negative values to represent salt removed from the Chino Basin.

(c) Total recharge volumes for recycled water, imported water, and storm water in this table include groundwater recharge from 2004 to 2021. These total volumes differ from the volumes in Table 2-3 of this Annual Report which only includes groundwater recharge since the implementation of the Chino Basin Recycled Water Groundwater Recharge Program in 2005 to 2021.

(d) The total TDS and nitrate mass export in this table include CDA pumping since 2004 and are different than the cumulative TDS and nitrate export reported in Figure 2-4, which are based on the entire period of operation of the Desalters since 2000. Pursuant to the September 2021 letter from the Regional Board, the period of interest in the salt loading and export is the period since the start of the maximum benefit SNMP in January 2004.



K:Chino Basin Watermaster\PE7\GRAPHER\GR\MaxBen\AnnualR\Figure2-5a_SO 3/30/2022

Prepared by:

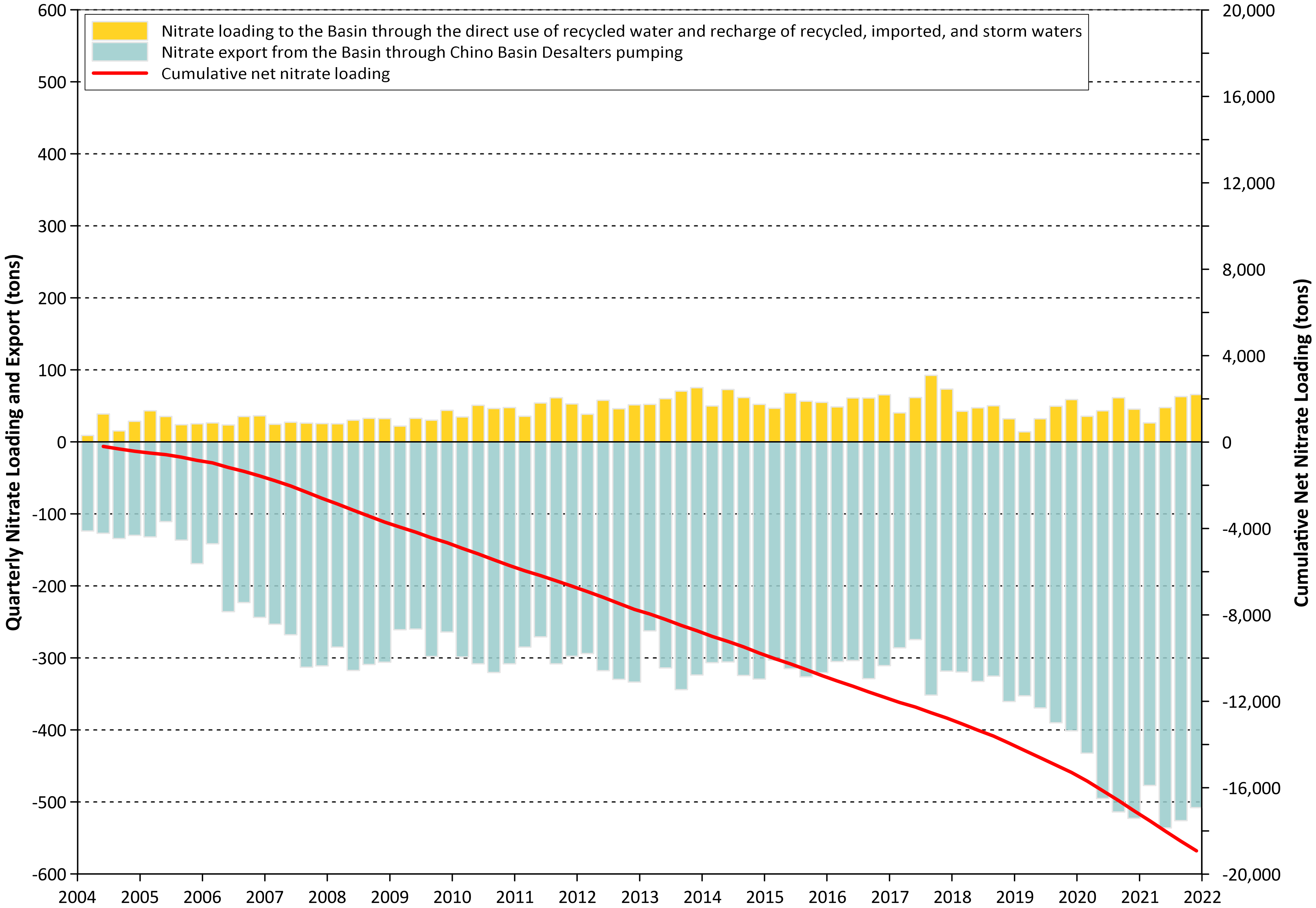
WEST YOST
Water. Engineered

Prepared for:

Chino Basin Watermaster and
The Inland Empire Utilities Agency
2021 Maximum Benefit
Annual Report

Quarterly TDS Loading and Export and
Cumulative Net TDS Loading from OBMP Projects
2004 to 2021

Figure 2-5a



K:Chino Basin Watermaster\PE7\GRAPHER\GR\MaxBen\AnnualR\Figure2-5b_SO 3/30/2022

Prepared by:

WEST YOST
Water. Engineered

Prepared for:

Chino Basin Watermaster and
The Inland Empire Utilities Agency
2021 Maximum Benefit
Annual Report

Quarterly Nitrate Loading and Export and Cumulative Net Nitrate Loading from OBMP Projects
2004 to 2021

Figure 2-5b

2.3 Recycled Water Recharge and Quality

2.3.1 Recycled Water Recharge

The recharge of recycled water, imported water, and storm water is an integral part of the OBMP Implementation Plan, and is necessary to maximize the use of the water resources of the Chino Basin. The IEUA, Watermaster, Chino Basin Water Conservation District, and San Bernardino County Flood Control District are partners in the implementation of the Chino Basin Recycled Water Groundwater Recharge Program. The IEUA manages the recharge program and performs recycled water recharge operations pursuant to Regional Board Orders R8-2007-0039 and R8-2009-0057. As required by these orders, the IEUA and Watermaster submit quarterly and annual reports to the Regional Board on the Chino Basin recharge activities. Figure 2- is a map of existing recharge facilities in the Chino Basin used for imported, storm, and recycled water recharge. Table 2-3 summarizes the total annual recharge, by water type, from July 2005 (commencement of the Chino Basin Recycled Water Groundwater Recharge Program) through December 2021. Since July 2005, a total of 514,569 af of water has been recharged in the Chino Basin as a result of the OBMP and maximum benefit SNMP.

Table 2-3. Annual Groundwater Recharge by Water Type at Chino Basin Facilities - 2005 to 2021

Calendar Year	Imported water, af	Storm water, af	Recycled Water, af	Total, af
2005	22,015	16,334	868	39,217
2006	47,426	11,852	2,699	61,977
2007	3,948	6,074	1,622	11,644
2008	0	10,568	2,781	13,349
2009	20	8,220	4,516	12,756
2010	4,980	19,390	8,304	32,674
2011	32,913	10,762	8,078	51,753
2012	0	9,372	7,823	17,195
2013	0	3,429	14,394	17,823
2014	795	8,166	10,997	19,958
2015	0	6,769	12,056	18,825
2016	4,260	9,812	14,310	28,382
2017	39,502	7,447	14,362	61,310
2018	5,990	6,751	12,510	25,251
2019	25,700	14,460	11,160	51,321
2020	3,637	7,265	15,509	26,411
2021	375	9,593	14,756	24,723
Total	**191,562**	**166,263**	**156,744**	**514,569**

Commitment number 7 requires that the use of recycled water for artificial recharge be limited to the amount that can be blended on a volume-weighted basis with other sources of recharge to achieve five-year running-average concentrations of no more than the maximum-benefit objectives (420 mgl for TDS and 5 mgl for nitrate). Recycled water recharge began in July 2005; thus, the first five-year period for which the metric was computed was July 2005 through June 2010. This metric is computed monthly. Table 2-4 summarizes the five-year running-average volume-weighted TDS and nitrate concentrations of the combined recharge sources. The monthly recharge and water-quality data used to compute the five-year running-average TDS and nitrate metrics are plotted in Figures 2-7a and 2-7b, respectively. A table of the monthly data used to compute these metrics, by recharge source, is included as Appendix B to this report.

Table 2-4. Monthly Calculation of the Five-Year, Volume-Weighted TDS and Nitrate Concentrations of Recharge Water Sources to the Chino Basin[(a)] - 2005 to 2021

Five-Year Period	TDS, mgl	Nitrate, mgl
Jul 2005 - Jun 2010	203	1.1
Aug 2005 - Jul 2010	205	1.1
Sep 2005 - Aug 2010	207	1.1
Oct 2005 - Sep 2010	208	1.1
Nov 2005 - Oct 2010	210	1.1
Dec 2005 - Nov 2010	211	1.2
Jan 2006 - Dec 2010	213	1.1
Feb 2006 - Jan 2011	212	1.2
Mar 2006 - Feb 2011	214	1.2
Apr 2006 - Mar 2011	216	1.2
May 2006 - Apr 2011	221	1.3
Jun 2006 - May 2011	222	1.3
Jul 2006 - Jun 2011	222	1.3
Aug 2005 - Jul 2011	218	1.2
Sep 2006 - Aug 2011	215	1.2
Oct 2006 - Sep 2011	213	1.2
Nov 2006 - Oct 2011	217	1.3
Dec 2006 - Nov 2011	220	1.3
Jan 2007 - Dec 2011	218	1.4
Feb 2007 - Jan 2012	218	1.4
Mar 2007 - Feb 2012	218	1.4
Apr 2007 - Mar 2012	216	1.4
May 2007 - Apr 2012	215	1.4
Jun 2007 - May 2012	217	1.4
Jul 2007 - Jun 2012	220	1.4
Aug 2007 - Jul 2012	221	1.4
Sep 2007 - Aug 2012	221	1.4
Oct 2007 - Sep 2012	222	1.4
Nov 2007 - Oct 2012	222	1.4
Dec 2007 - Nov 2012	223	1.4
Jan 2008 - Dec 2012	224	1.5
Feb 2008 - Jan 2013	231	1.6

Table 2-4. Monthly Calculation of the Five-Year, Volume-Weighted TDS and Nitrate Concentrations of Recharge Water Sources to the Chino Basin[(a)] - 2005 to 2021

Five-Year Period	TDS, mgl	Nitrate, mgl
Mar 2008 - Feb 2013	233	1.6
Apr 2008 - Mar 2013	235	1.6
May 2008 - Apr 2013	236	1.6
Jun 2008 - May 2013	237	1.6
Jul 2008 - Jun 2013	239	1.7
Aug 2008 - Jul 2013	240	1.7
Sep 2008 - Aug 2013	241	1.7
Oct 2008 - Sep 2013	243	1.7
Nov 2008 - Oct 2013	245	1.7
Dec 2008 - Nov 2013	247	1.7
Jan 2009 - Dec 2013	251	1.8
Feb 2009 - Jan 2014	253	1.8
Mar 2009 - Feb 2014	257	1.8
Apr 2009 - Mar 2014	259	1.9
May 2009 - Apr 2014	261	1.9
Jun 2009 - May 2014	263	1.9
Jul 2009 - Jun 2014	264	1.9
Aug 2009 - Jul 2014	265	1.9
Sep 2009 - Aug 2014	266	1.9
Oct 2009 - Sep 2014	268	1.9
Nov 2009 - Oct 2014	269	1.9
Dec 2009 - Nov 2014	269	1.9
Jan 2010 - Dec 2014	266	1.9
Feb 2010 - Jan 2015	273	2.0
Mar 2010 - Feb 2015	279	2.0
Apr 2010 - Mar 2015	280	2.0
May 2010 - Apr 2015	283	2.0
Jun 2010 - May 2015	283	2.1
Jul 2010 - Jun 2015	285	2.1
Aug 2010 - Jul 2015	286	2.1
Sep 2010 - Aug 2015	286	2.1
Oct 2010 - Sep 2015	287	2.1
Nov 2010 - Oct 2015	287	2.1
Dec 2010 - Nov 2015	289	2.1
Jan 2011 - Dec 2015	291	2.2
Feb 2011 - Jan 2016	288	2.2

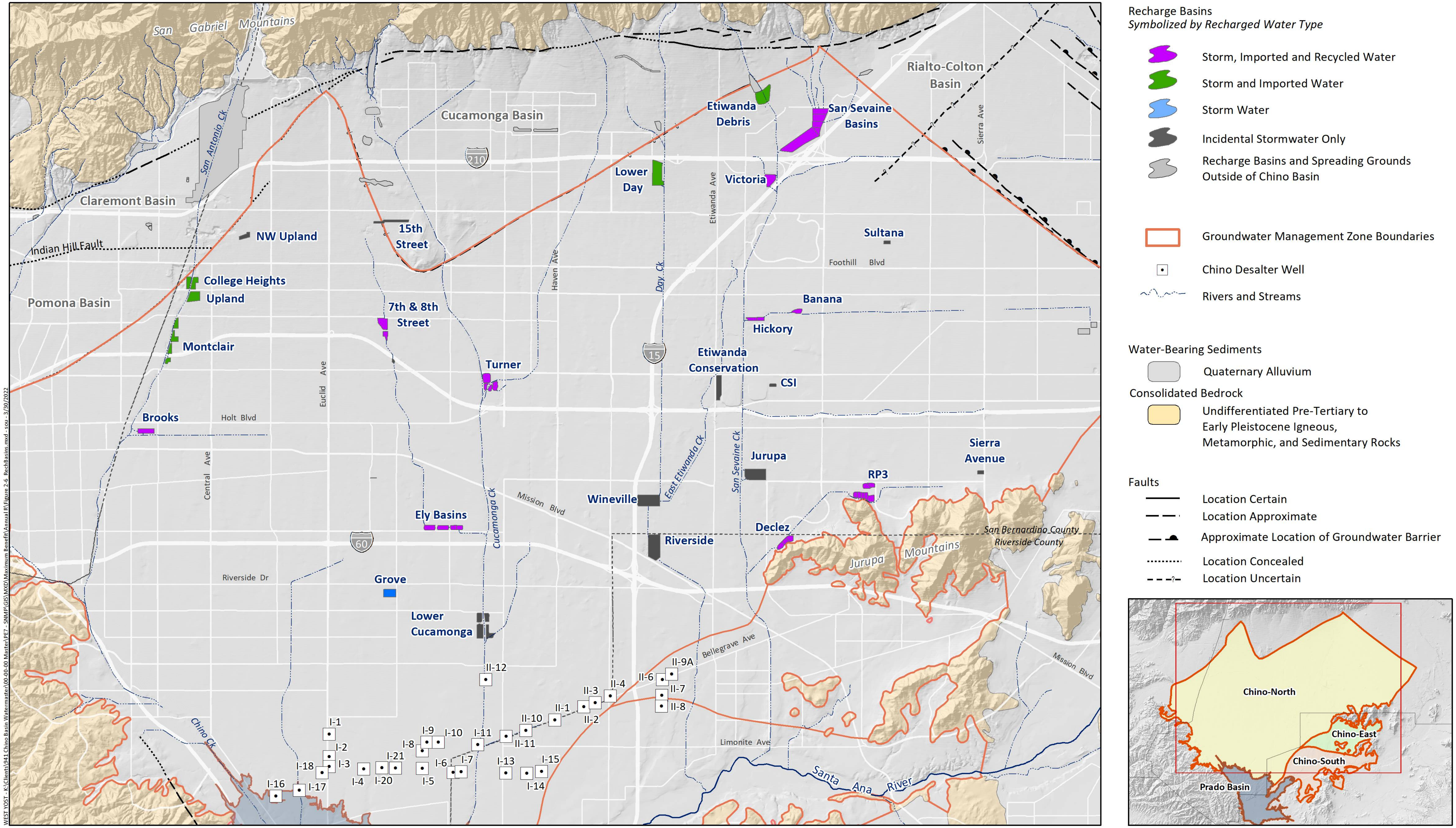
Table 2-4. Monthly Calculation of the Five-Year, Volume-Weighted TDS and Nitrate Concentrations of Recharge Water Sources to the Chino Basin[(a)] - 2005 to 2021

Five-Year Period	TDS, mgl	Nitrate, mgl
Mar 2011 - Feb 2016	290	2.2
Apr 2011 - Mar 2016	292	2.2
May 2011 - Apr 2016	293	2.2
Jun 2011 - May 2016	300	2.3
Jul 2011 - Jun 2016	310	2.4
Aug 2011 - Jul 2016	323	2.6
Sep 2011 - Aug 2016	338	2.8
Oct 2011 - Sep 2016	354	3.0
Nov 2011 - Oct 2016	349	2.9
Dec 2011 - Nov 2016	352	2.9
Jan 2012 - Dec 2016	345	2.8
Feb 2012 - Jan 2017	336	2.7
Mar 2012 - Feb 2017	334	2.7
Apr 2012 - Mar 2017	340	2.8
May 2012 - Apr 2017	342	2.8
Jun 2012 - May 2017	342	2.8
Jul 2012 - Jun 2017	328	2.6
Aug 2012 - Jul 2017	314	2.5
Sep 2012 - Aug 2017	302	2.4
Oct 2012 - Sep 2017	298	2.3
Nov 2012 - Oct 2017	292	2.3
Dec 2012 - Nov 2017	290	2.3
Jan 2013 - Dec 2017	289	2.2
Feb 2013 - Jan 2018	287	2.1
Mar 2013 - Feb 2018	287	2.1
Apr 2013 - Mar 2018	283	2.1
May 2013 - Apr 2018	283	2.1
Jun 2013 - May 2018	283	2.1
Jul 2013 - Jun 2018	283	2.1
Aug 2013 - Jul 2018	284	2.1
Sep 2013 - Aug 2018	284	2.1
Oct 2013 - Sep 2018	284	2.1
Nov 2013 - Oct 2018	283	2.1
Dec 2013 - Nov 2018	282	2.0
Jan 2014 - Dec 2018	281	2.0
Feb 2014 - Jan 2019	278	2.0

Table 2-4. Monthly Calculation of the Five-Year, Volume-Weighted TDS and Nitrate Concentrations of Recharge Water Sources to the Chino Basin[(a)] - 2005 to 2021

Five-Year Period	TDS, mgl	Nitrate, mgl
Mar 2014 - Feb 2019	275	1.9
Apr 2014 - Mar 2019	273	1.9
May 2014 - Apr 2019	271	1.9
Jun 2014 - May 2019	270	1.8
Jul 2014 - Jun 2019	269	1.8
Aug 2014 - Jul 2019	266	1.8
Sep 2014 - Aug 2019	262	1.7
Oct 2014 - Sep 2019	260	1.7
Nov 2014 - Oct 2019	258	1.7
Dec 2014 - Nov 2019	260	1.7
Jan 2015 - Dec 2019	262	1.7
Feb 2015 - Jan 2020	261	1.7
Mar 2015 - Feb 2020	261	1.7
Apr 2015 - Mar 2020	259	1.6
May 2015 - Apr 2020	257	1.6
Jun 2015 - May 2020	258	1.6
Jul 2015 - Jun 2020	258	1.6
Aug 2015 - Jul 2020	258	1.6
Sep 2015 - Aug 2020	258	1.6
Oct 2015 - Sep 2020	259	1.6
Nov 2015 - Oct 2020	259	1.6
Dec 2015 - Nov 2020	260	1.6
Jan 2016 - Dec 2020	260	1.6
Feb 2015 - Jan 2021	261	1.6
Mar 2015 - Feb 2021	261	1.6
Apr 2015 - Mar 2021	262	1.6
May 2015 - Apr 2021	262	1.5
Jun 2015 - May 2021	261	1.5
Jul 2015 - Jun 2021	261	1.5
Aug 2015 - Jul 2021	261	1.5
Sep 2015 - Aug 2021	262	1.5
Oct 2015 - Sep 2021	262	1.5
Nov 2015 - Oct 2021	264	1.5
Dec 2015 - Nov 2021	265	1.5
Jan 2016 - Dec 2021	264	1.5

(a) See Appendix B for more details.



WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PE7 - SNMP\GIS\MXD\Maximum Benefit\Annual R\Figure 2-6_RechBasins.mxd - sou - 3/30/2022

Prepared by:

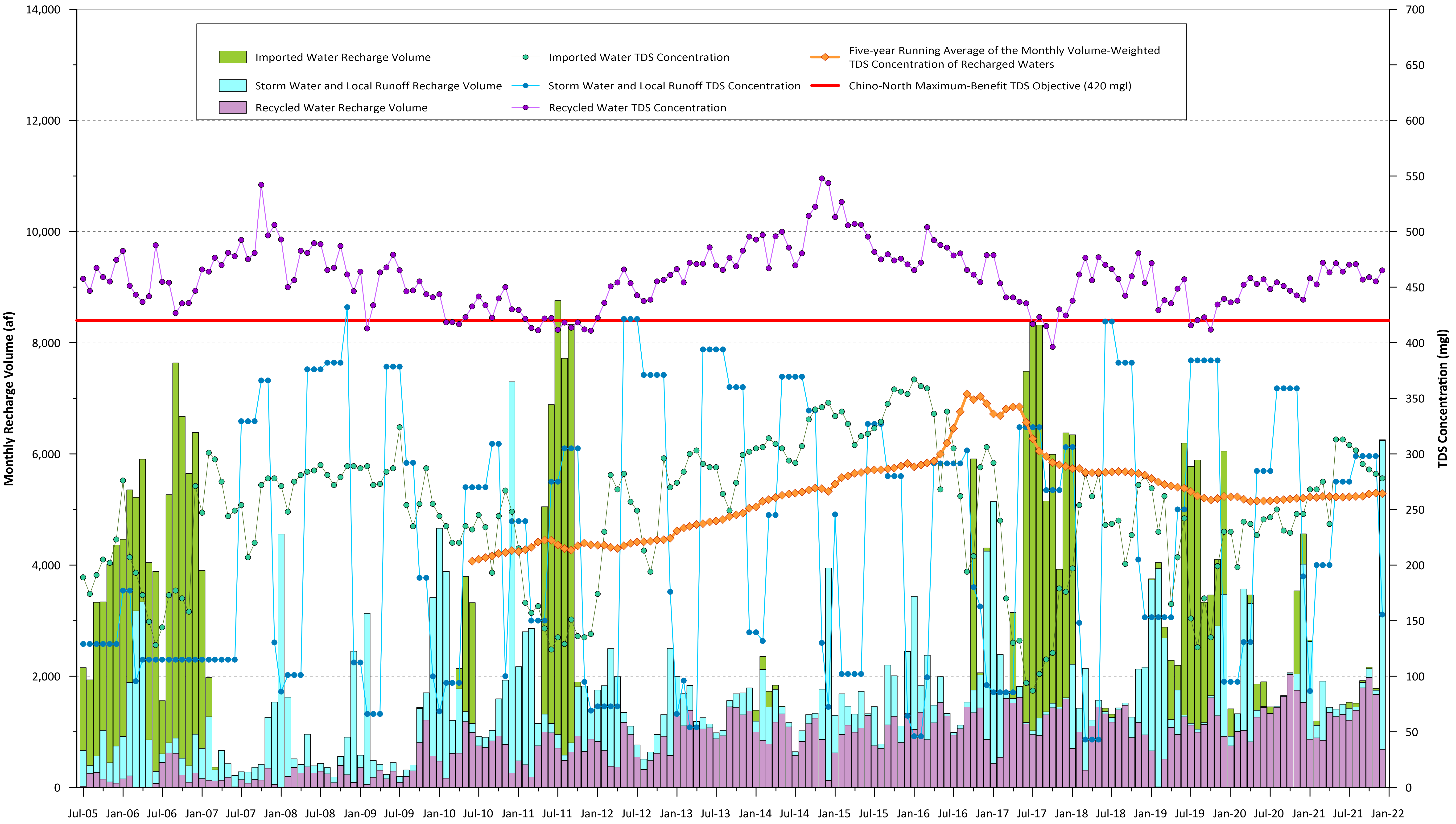
WEST YOST
Water. Engineered.

Prepared for:

Chino Basin Watermaster and
the Inland Empire Utilities Agency
2021 Maximum Benefit
Annual Report

Chino Basin Recharge Basins
Existing Facilities by Recharge Type as of 2021

Figure 2-6



Prepared by:

WEST YOST
Water. Engineered

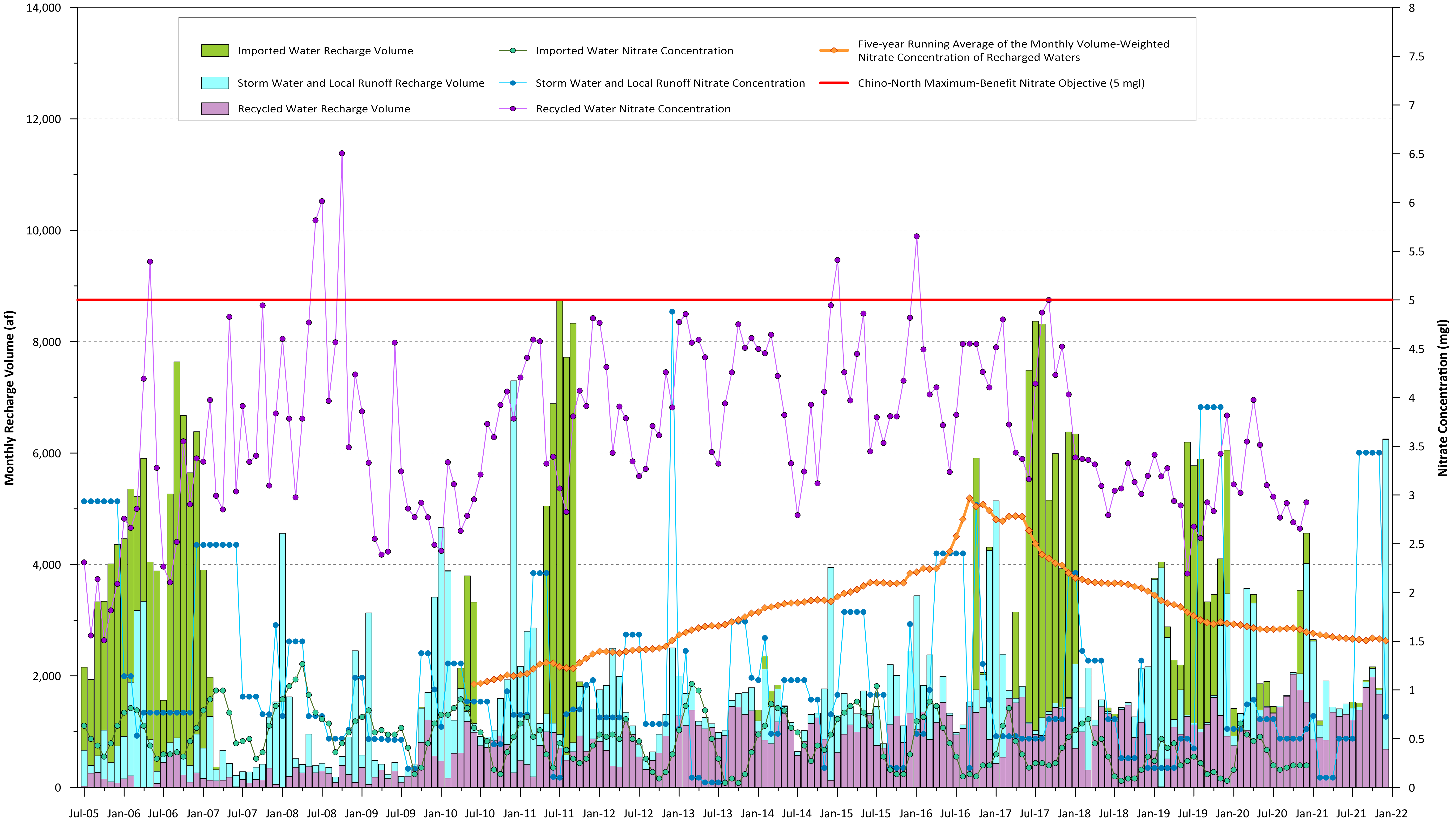
K:Chino Basin Watermaster\PE7\GRAPHER\GR\MaxBen\AnnualR\Figure2-7a_SO 3/30/2022

Prepared for:

Chino Basin Watermaster and
The Inland Empire Utilities Agency
2021 Maximum Benefit
Annual Report

Volume and TDS Concentrations of
Recharge Water Sources in Chino Basin
2005 to 2021

Figure 2-7a



Prepared by:

WEST YOST
Water. Engineered

K:Chino Basin Watermaster\PE7\GRAPHER\GR\MaxBen\AnnualR\Figure2-7b_SO 3/30/2022

Prepared for:

Chino Basin Watermaster and
The Inland Empire Utilities Agency
2021 Maximum Benefit
Annual Report

Volume and Nitrate Concentrations of Recharge Water Sources in Chino Basin
2005 to 2021

Figure 2-7b

The five-year running-average, volume-weighted TDS and nitrate concentrations have not exceeded the maximum-benefit objectives for TDS or nitrate. Since June 2010, the five-year running average, volume-weighted TDS concentrations of the managed recharge ranged from 203 mgl to 354 mgl, averaged about 264 mgl, and was 264 mgl as of December 2021. Over the same period, the five-year running average, volume-weighted nitrate ranged from 1.1 mgl to about 3 mgl, averaged about 1.8 mgl, and was 1.5 mgl as of December 2021. The maximum five-year running average, volume-weighted TDS and nitrate concentrations were observed in September 2016 when the preceding five-year period had almost no imported water recharge.

Prior to 2016, the TDS concentration metric was increasing monotonically at a rate of about 1.3 mgl per month, primarily driven by the increasing proportion of recycled water recharge relative to imported and storm waters. Between May and September 2016, that rate increased to about 12 mgl per month, reflecting the loss of the last significant period of imported water recharge (May and September of 2011) from the 5-year period used for the metric calculation. The TDS concentration metric decreased from September 2016 through April 2020 and stabilized through December 2021. This trend is due to the increase in imported water and storm water recharge that occurred from October 2016 through January 2018, March 2019 through December 2019, and November 2020 through December 2020; and the increase in storm water recharge during water year 2019 and December 2021. A similar trend was observed for the nitrate concentration metric, as shown in Figure 2-7b. These observations demonstrate the importance of periodic imported water recharge and large storm events to complying with the long-term TDS metric contained in the maximum benefit commitments.

2.3.2 Recycled Water Quality

As described in the Basin Plan, the IEUA wastewater effluent TDS and TIN permit limits are an important component of the maximum benefit demonstration and provide a controlling point for the management of TDS and nitrate concentrations in the Chino Basin. The TDS and TIN permit limits for the IEUA are 550 mgl and 8 mgl, respectively. Compliance with these limits is based on the volume-weighted, 12-month running average of the agency-wide effluent for all IEUA wastewater treatment facilities. The volume-weighted, 12-month running average of the IEUA agency-wide effluent is referred to as the “effluent compliance metric”. Commitment number 6 requires that the IEUA submit a plan and schedule to the Regional Board for the implementation of measures to ensure that the effluent compliance metric does not exceed the permit limits when the TDS effluent compliance metric exceeds 545 mgl for three consecutive months or the TIN effluent compliance metric exceeds 8 mgl in any one month (action limits). The plan must be submitted within 60 days of a finding that one of these “action limits” has been exceeded. The plan and schedule must be implemented upon Regional Board approval. The effluent compliance metric is calculated and reported by the IEUA in the Chino Basin Recycled Water Groundwater Recharge Program Quarterly Monitoring Reports.

Table 2-5 and Figure 2-8 show the monthly, volume-weighted IEUA agency-wide effluent TDS and TIN concentrations and the calculated effluent compliance metric for 2005 through 2021. Since the initiation of recycled water recharge in July 2005, the TDS and TIN effluent compliance metrics have ranged between 456 and 534 mgl and 3.8 and 7.6 mgl, respectively, and have never exceeded the permit limits[18].

---

[18] The agency-wide 12-month running average TIN limit in the NPDES permit was decreased from 10 mgl to 8 mgl, effective July 8, 2006. This decreased limit was anticipated; therefore, secondary treatment at all facilities was optimized to attain lower TIN. The 12-Month Running Average TIN has not been above the limit of 8 mgl since the recycled water recharge program began in July 2005.

During 2021, the TDS and TIN effluent compliance metrics ranged between 486 and 494 mgl and 4.2 and 4.4 mgl, respectively.

Table 2-5. Monthly and 12-Month Running Average of the IEUA Agency-Wide Effluent TIN and TDS Concentrations – 2005 to 2021

Month	TIN, mgl		TDS, mgl	
	Monthly	12-Month Running Average[(a)]	Monthly	12-Month Running Average
Jan 2005	7.3	8.4	492	486
Feb 2005	8.4	8.4	496	487
Mar 2005	7.5	8.4	516	488
Apr 2005	6.9	8.2	534	491
May 2005	6.7	8.0	513	492
Jun 2005	7.0	8.0	507	492
Jul 2005	5.4	7.8	466	492
Aug 2005	5.9	7.7	452	490
Sep 2005	5.4	7.4	469	491
Oct 2005	5.5	7.1	468	491
Nov 2005	5.5	6.7	467	490
Dec 2005	8.4	6.7	481	488
Jan 2006	9.9	6.9	491	488
Feb 2006	9.0	6.9	467	486
Mar 2006	8.8	7.1	471	482
Apr 2006	7.8	7.1	464	476
May 2006	8.3	7.2	454	471
Jun 2006	6.5	7.2	466	468
Jul 2006	6.8	7.3	472	469
Aug 2006	5.9	7.3	475	470
Sep 2006	6.5	7.4	465	470
Oct 2006	6.4	7.6	457	469
Nov 2006	6.9	7.6	456	468
Dec 2006	7.1	7.5	470	467
Jan 2007	7.7	7.3	488	467
Feb 2007	6.2	7.1	481	468
Mar 2007	6.7	6.9	490	470
Apr 2007	5.6	6.7	491	472
May 2007	5.6	6.5	489	475
Jun 2007	6.0	6.5	495	477
Jul 2007	5.1	6.3	492	479

Table 2-5. Monthly and 12-Month Running Average of the IEUA Agency-Wide Effluent TIN and TDS Concentrations – 2005 to 2021

Month	TIN, mgl		TDS, mgl	
	Monthly	12-Month Running Average[(a)]	Monthly	12-Month Running Average
Aug 2007	5.2	6.3	478	479
Sep 2007	5.9	6.2	478	480
Oct 2007	6.0	6.2	517	485
Nov 2007	7.6	6.2	514	490
Dec 2007	7.4	6.3	522	495
Jan 2008	6.8	6.2	511	481
Feb 2008	6.4	6.2	492	483
Mar 2008	6.6	6.2	515	484
Apr 2008	6.7	6.3	519	487
May 2008	7.2	6.4	502	489
Jun 2008	6.8	6.5	490	490
Jul 2008	6.1	6.6	499	491
Aug 2008	5.8	6.6	514	492
Sep 2008	8.3	6.8	510	494
Oct 2008	7.0	6.9	503	496
Nov 2008	5.7	6.7	496	498
Dec 2008	6.3	6.7	494	504
Jan 2009	6.5	6.6	497	503
Feb 2009	7.8	6.7	463	500
Mar 2009	6.9	6.8	496	499
Apr 2009	6.6	6.8	509	498
May 2009	5.8	6.6	501	498
Jun 2009	5.4	6.5	505	499
Jul 2009	5.0	6.4	512	499
Aug 2009	4.5	6.3	499	497
Sep 2009	4.0	6.0	498	497
Oct 2009	4.6	5.8	500	497
Nov 2009	4.8	5.7	489	497
Dec 2009	5.5	5.6	494	497
Jan 2010	5.7	5.6	493	496
Feb 2010	6.2	5.4	489	498
Mar 2010	6.4	5.4	482	497
Apr 2010	5.7	5.3	473	494
May 2010	5.2	5.3	471	492

Table 2-5. Monthly and 12-Month Running Average of the IEUA Agency-Wide Effluent TIN and TDS Concentrations – 2005 to 2021

Month	TIN, mgl		TDS, mgl	
	Monthly	12-Month Running Average[(a)]	Monthly	12-Month Running Average
Jun 2010	5.0	5.2	478	490
Jul 2010	5.1	5.2	477	487
Aug 2010	4.6	5.2	477	485
Sep 2010	3.7	5.2	476	483
Oct 2010	5.5	5.3	478	481
Nov 2010	5.7	5.3	479	481
Dec 2010	5.0	5.3	472	479
Jan 2011	6.4	5.4	474	477
Feb 2011	6.9	5.4	455	474
Mar 2011	6.4	5.4	468	473
Apr 2011	6.5	5.5	460	472
May 2011	6.0	5.6	462	471
Jun 2011	5.7	5.6	464	470
Jul 2011	4.3	5.5	454	468
Aug 2011	4.4	5.5	457	467
Sep 2011	5.8	5.7	457	465
Oct 2011	5.2	5.7	457	463
Nov 2011	5.9	5.7	453	461
Dec 2011	6.3	5.8	454	460
Jan 2012	6.4	5.8	465	459
Feb 2012	6.7	5.8	476	461
Mar 2012	6.7	5.8	497	463
Apr 2012	7.4	5.9	496	466
May 2012	6.4	5.9	493	469
Jun 2012	5.8	5.9	482	470
Jul 2012	5.4	6.0	477	472
Aug 2012	4.8	6.1	463	473
Sep 2012	5.1	6.0	472	474
Oct 2012	4.9	6.0	486	476
Nov 2012	6.1	6.0	485	479
Dec 2012	6.0	6.0	492	482
Jan 2013	6.1	5.9	495	484
Feb 2013	6.8	5.9	490	486
Mar 2013	6.1	5.9	493	485

Table 2-5. Monthly and 12-Month Running Average of the IEUA Agency-Wide Effluent TIN and TDS Concentrations – 2005 to 2021

Month	TIN, mgl		TDS, mgl	
	Monthly	12-Month Running Average[(a)]	Monthly	12-Month Running Average
Apr 2013	6.4	5.8	501	486
May 2013	6.4	5.8	503	487
Jun 2013	5.8	5.8	502	488
Jul 2013	5.6	5.8	496	490
Aug 2013	6.9	6.0	496	493
Sep 2013	7.3	6.2	499	495
Oct 2013	7.4	6.4	496	496
Nov 2013	6.7	6.4	507	497
Dec 2013	7.6	6.6	511	499
Jan 2014	5.9	6.6	510	500
Feb 2014	6.1	6.5	509	502
Mar 2014	5.5	6.5	497	502
Apr 2014	5.2	6.4	517	504
May 2014	5.2	6.3	524	505
Jun 2014	4.4	6.1	506	506
Jul 2014	3.5	6.0	494	505
Aug 2014	3.5	5.7	508	506
Sep 2014	4.1	5.4	524	508
Oct 2014	4.9	5.2	541	512
Nov 2014	5.9	5.1	571	518
Dec 2014	6.2	5.0	565	522
Jan 2015	7.9	5.2	546	525
Feb 2015	7.4	5.3	560	529
Mar 2015	6.2	5.4	528	532
Apr 2015	5.2	5.4	531	533
May 2015	6.1	5.4	520	533
Jun 2015	4.6	5.4	515	534
Jul 2015	5.2	5.6	500	534
Aug 2015	4.7	5.7	503	534
Sep 2015	4.8	5.7	508	532
Oct 2015	5.2	5.8	506	529
Nov 2015	5.4	5.7	505	524
Dec 2015	6.2	5.7	503	519
Jan 2016	7.3	5.7	504	515

Table 2-5. Monthly and 12-Month Running Average of the IEUA Agency-Wide Effluent TIN and TDS Concentrations – 2005 to 2021

Month	TIN, mgl		TDS, mgl	
	Monthly	12-Month Running Average[(a)]	Monthly	12-Month Running Average
Feb 2016	6.5	5.6	495	510
Mar 2016	5.9	5.6	521	509
Apr 2016	5.8	5.6	514	508
May 2016	5.7	5.6	514	507
Jun 2016	5.3	5.7	519	508
Jul 2016	6.2	5.7	514	509
Aug 2016	6.5	5.9	502	509
Sep 2016	6.4	6.0	492	507
Oct 2016	5.8	6.1	491	506
Nov 2016	5.5	6.1	489	505
Dec 2016	5.8	6.0	495	504
Jan 2017	6.5	6.0	495	504
Feb 2017	6.7	6.0	489	503
Mar 2017	5.3	5.9	469	499
Apr 2017	5.8	6.0	468	495
May 2017	5.7	6.0	464	491
Jun 2017	5.5	6.0	461	486
Jul 2017	6.8	6.0	447	480
Aug 2017	6.0	6.0	446	476
Sep 2017	5.7	5.9	440	471
Oct 2017	6.1	6.0	428	466
Nov 2017	6.5	6.0	455	463
Dec 2017	6.8	6.0	444	459
Jan 2018	5.3	6.0	464	456
Feb 2018	5.3	5.9	488	456
Mar 2018	4.4	5.8	504	459
Apr 2018	5	5.8	485	460
May 2018	4.8	5.7	495	463
Jun 2018	4.7	5.6	490	465
Jul 2018	4.6	5.4	484	468
Aug 2018	4.3	5.3	478	471
Sep 2018	5.2	5.3	467	473
Oct 2018	4.7	5.1	496	479
Nov 2018	5.9	5.1	505	483

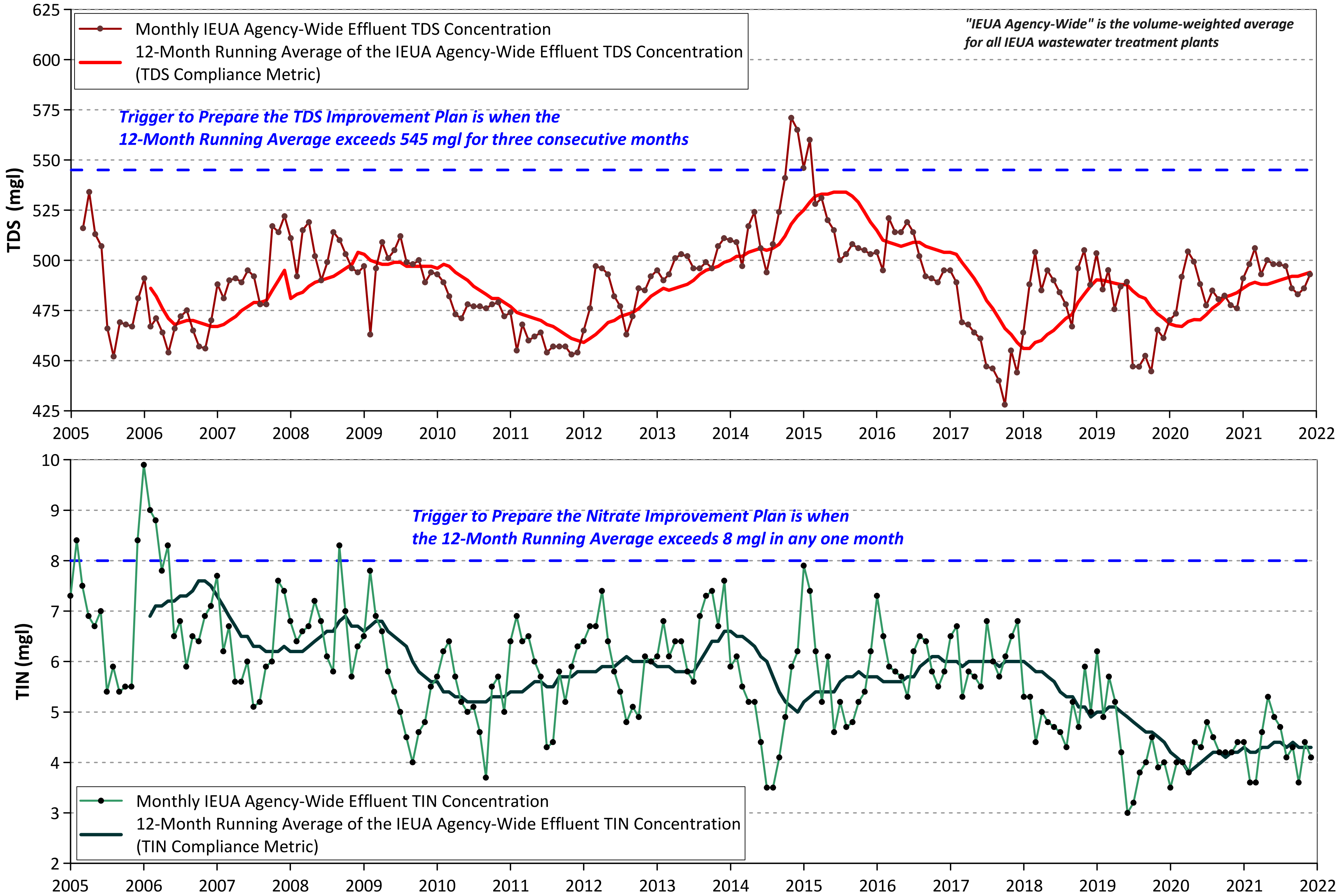
Table 2-5. Monthly and 12-Month Running Average of the IEUA Agency-Wide Effluent TIN and TDS Concentrations – 2005 to 2021

Month	TIN, mgl		TDS, mgl	
	Monthly	12-Month Running Average[a]	Monthly	12-Month Running Average
Dec 2018	5	4.9	488	487
Jan 2019	6.2	5.0	503	490
Feb 2019	4.9	5.0	485	490
Mar 2019	5.7	5.1	495	489
Apr 2019	5.2	5.1	476	489
May 2019	4.2	5.0	487	488
Jun 2019	3	4.9	489	488
Jul 2019	3.2	4.8	447	485
Aug 2019	3.8	4.7	447	482
Sep 2019	4	4.6	452	481
Oct 2019	4.5	4.6	445	477
Nov 2019	3.9	4.5	465	473
Dec 2019	4	4.4	461	471
Jan 2020	3.5	4.2	470	468
Feb 2020	4	4.1	473	467
Mar 2020	4	4.0	492	467
Apr 2020	3.8	3.8	504	469
May 2020	4.4	3.9	499	470
Jun 2020	4.3	4.0	488	470
Jul 2020	4.8	4.1	477	473
Aug 2020	4.5	4.2	485	476
Sep 2020	4.2	4.2	481	478
Oct 2020	4.2	4.1	482	482
Nov 2020	4.2	4.2	478	483
Dec 2020	4.4	4.2	476	484
Jan 2021	4.4	4.3	491	486
Feb 2021	3.6	4.2	498	488
Mar 2021	3.6	4.2	506	489
Apr 2021	4.6	4.3	493	488
May 2021	5.3	4.3	500	488
Jun 2021	4.9	4.4	498	489
Jul 2021	4.7	4.4	498	490
Aug 2021	4.1	4.3	497	491
Sep 2021	4.3	4.4	486	492

Table 2-5. Monthly and 12-Month Running Average of the IEUA Agency-Wide Effluent TIN and TDS Concentrations – 2005 to 2021

Month	TIN, mgl		TDS, mgl	
	Monthly	12-Month Running Average[a]	Monthly	12-Month Running Average
Oct 2021	3.6	4.3	483	492
Nov 2021	4.4	4.3	486	493
Dec 2021	4.1	4.3	493	494

(a) The Agency-wide 12-month running average TIN limit in the NPDES permit was decreased from 10 mgl to 8 mgl, effective July 8, 2006. This decreased limit was anticipated; therefore, secondary treatment at all facilities was optimized to attain lower TIN. The 12-Month Running Average TIN has not been above the limit of 8 mgl since the recycled water recharge program began in July 2005.



Prepared by:

WEST YOST
Water. Engineered

K:Chino Basin Watermaster\PE7\GRAPHER\
GR\MaxBen\AnnualR\Figure1-2-SO 3/30/2022

Prepared for:

Chino Basin Watermaster and
The Inland Empire Utilities Agency
2021 Maximum Benefit
Annual Report

Monthly and 12-Month Running Average of the IEUA Agency-Wide Effluent
TDS and TIN Concentrations - 2005 to 2021

Figure 2-8

During 2015, the TDS effluent compliance metric reached a historical-high value of 534 mgl for three consecutive months in June, July, and August. This was only 11 mgl below the action limit defined in Commitment number 6.

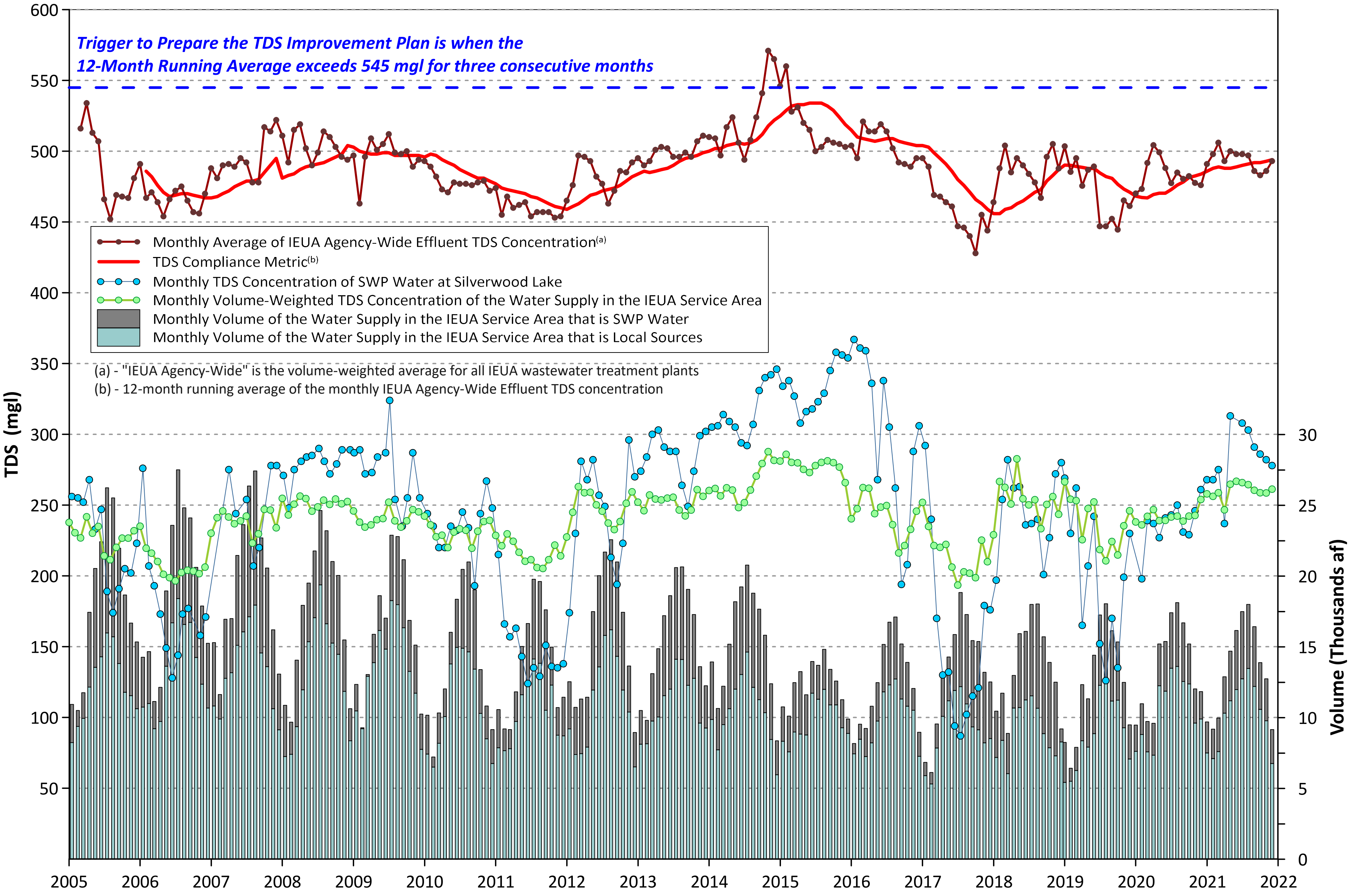
The TDS concentration of the effluent is influenced by the volume and TDS concentration of the water supplies served in the service areas tributary to the IEUA's treatment plants. Figure 2-9 includes the: 1) monthly, volume-weighted IEUA agency-wide effluent TDS concentration and effluent compliance metric; 2) monthly TDS concentrations of SWP water from Silverwood Lake;[19] 3) monthly, volume-weighted TDS concentrations of the combined water supplies served in the area tributary to the IEUA's treatment plants (e.g. total water supply, including SWP water); 4) volume of water supply served in the area tributary to the IEUA's treatment plants that is SWP water; and 5) the volume of water supply served in the area tributary to the IEUA's treatment plants that is from local sources (groundwater and surface water). A review of Figure 2-9 demonstrates the following water supply influence on the effluent compliance metric:

- From 2012 through early 2016, the SWP water seasonal-high TDS concentrations increased due to the statewide drought conditions that began in 2012. This increase correlates to the increase of the monthly total water supply TDS concentration, the monthly volume-weighted TDS, and the effluent compliance metric.
- The increase in the TDS concentration of the total water supply is less than the increase in TDS concentrations of the SWP supply because it includes local water supplies with lower-TDS concentrations.
- In 2015, the proportion of the total water supply that is SWP water decreased, reducing the effect of the increasing TDS concentration of SWP water on the volume-weighted TDS concentration of the total water supply.
- In 2016 and 2017, the TDS concentration of SWP water decreased due to wet-winter conditions in northern California. This also increased the availability of the SWP water supply, which resulted in a decreasing trend of the effluent compliance metric through mid-2017.
- In 2019, the wet-winter condition in California decreased both the TDS concentrations of SWP water and the total water supply, which resulted in a decreasing trend of the effluent compliance metric through 2019.
- In 2020 and 2021, the TDS concentration of SWP water increased due to dry-winter conditions in California, which caused the effluent compliance metric to slightly increase through 2021.

The relationships of the TDS concentrations plotted in Figure 2-9 indicate that the increase in the TDS concentration of SWP water during drought conditions contributed, in part, to the increase in the TDS concentration of the IEUA's effluent. Another likely cause of the increase in the effluent TDS concentration is the incorporation of the water conservation practices required by the State of California during drought conditions. Water conservation practices are evident in the decreased volume of total water supply plotted in Figure 2-9 since 2015, with 2015 having the lowest volume due to the state drought conservation mandates implemented at that time.

---

[19] Source of imported SWP water to the IEUA agencies.



K:Chino Basin Watermaster\PE7\GRAPHER\GR\MaxBen\AnnualR\Figure2-9 SO 3/30/2022

Prepared by:

WEST YOST
Water. Engineered

Prepared for:

Chino Basin Watermaster and
The Inland Empire Utilities Agency
2021 Maximum Benefit
Annual Report

The IEUA TDS Compliance Metric Compared to Monthly SWP TDS Concentration

2005 to 2021

Figure 2-9

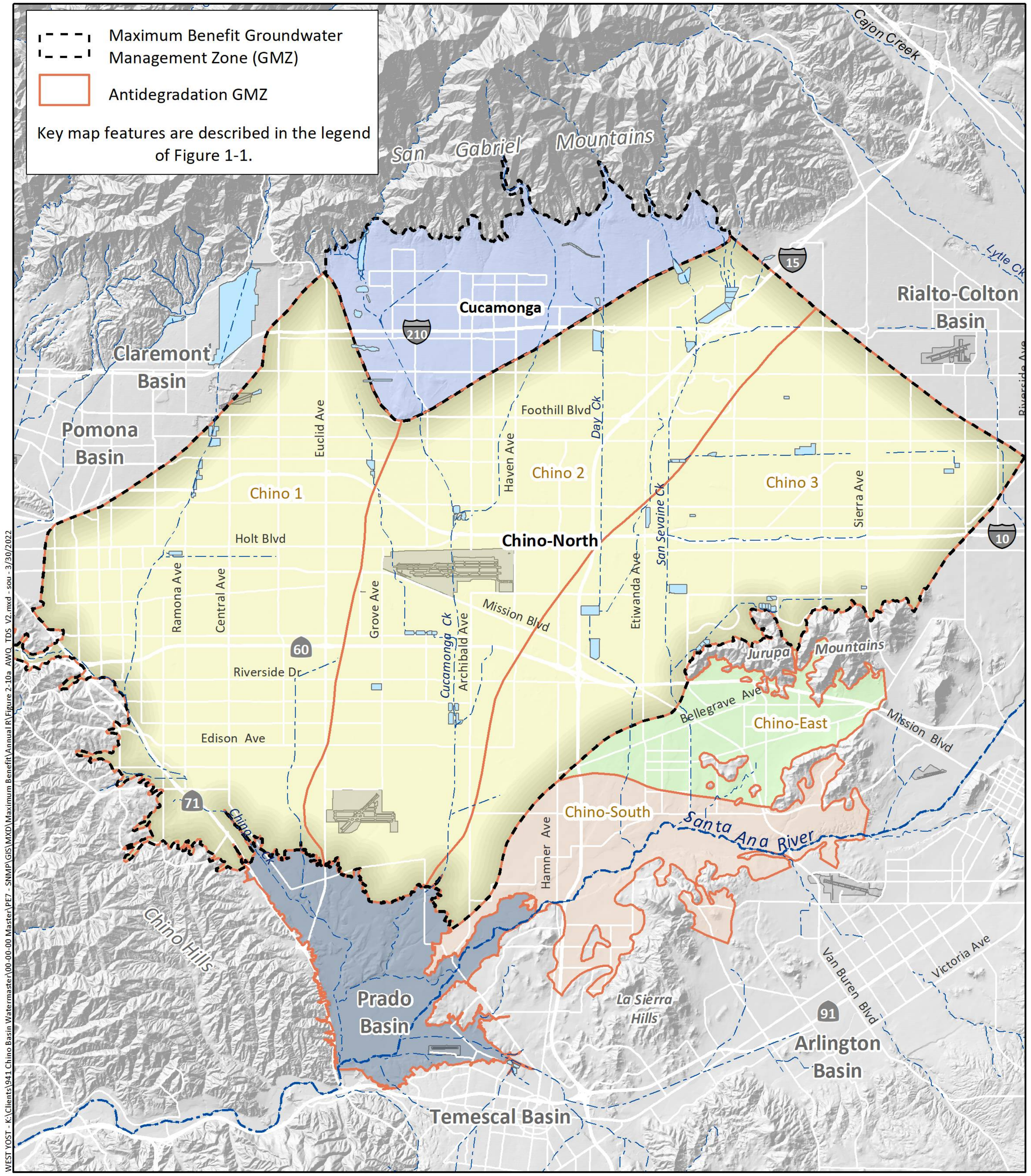
These observed water quality and water use trends suggest that drought conditions have a meaningful impact on the TDS concentrations of the water supply and recycled water and that future droughts similar to the 2012 to 2016 period could lead to short-term exceedances of the effluent compliance metric that is based on a short-term averaging period of 12-months. For this reason, Watermaster and the IEUA petitioned the Regional Board to modify the TDS compliance metric for recycled water to a longer-term averaging period. The Regional Board agreed that an evaluation of the compliance metric is warranted and directed Watermaster and the IEUA to develop a technical scope of work to analyze the impacts of the proposed change. The scope of work was submitted to the Regional Board in 2017 and includes the following tasks:

- Develop numerical modeling tools (R4, Hydrus 2D, MODFLOW, MT3D) to evaluate the projected TDS and nitrate concentrations of the Chino Basin.
- Define a baseline (status-quo) scenario and evaluate it with the new modeling tools.
- Define salinity management planning scenarios and evaluate them with the new modeling tools to compare the projected TDS and nitrate concentrations against the baseline scenario.
- Use the results to develop a draft regulatory compliance strategy that includes a longer-term average period for recycled water TDS concentrations.
- Collaborate with the Regional Board to review and finalize the regulatory strategy.
- Support the Regional Board in the preparation of a Basin Plan amendment upon approval of the regulatory strategy.

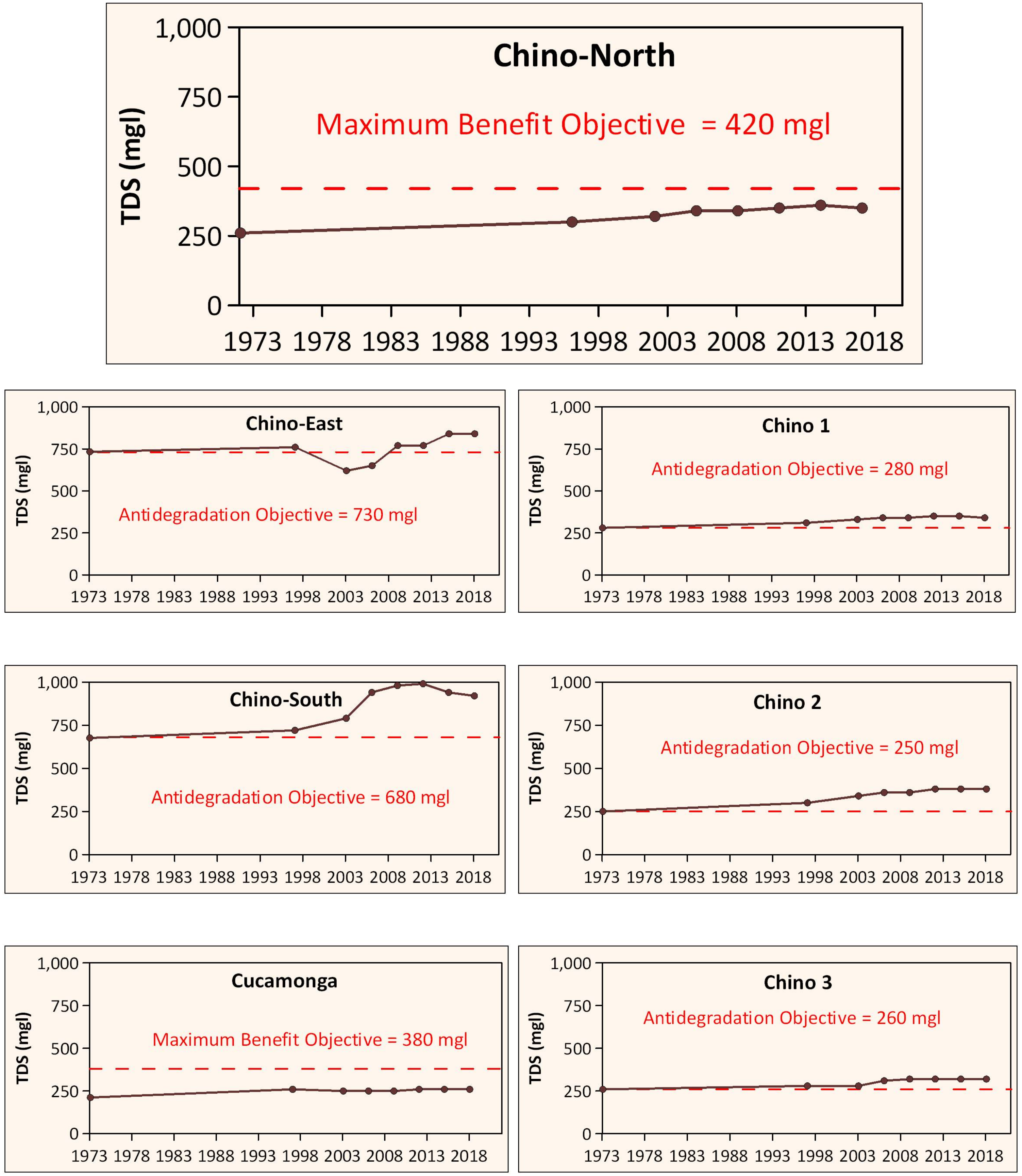
Watermaster and the IEUA began implementing the scope of work in July 2017 and have been working collaboratively with Regional Board staff to review interim work products and address new technical questions that have arisen. In 2021, Watermaster and the IEUA completed and submitted the documentation of the technical work, which includes the technical approach and methods; characterization of the processes that contribute to the loading and unloading of TDS and nitrate to the Chino Basin; and projections of the TDS concentration of Chino Basin groundwater, water supply, IEUA effluent, managed artificial recharge, and Santa Ana River under a baseline planning scenario and two alternative planning scenarios. Watermaster and the IEUA are currently working with the Regional Board to finalize a regulatory compliance strategy based on the projection results. Once approved, the Basin Plan will be amended to incorporate updates to the maximum benefit SNMP.

2.4 Ambient Groundwater Quality

Commitment number 9 requires that Watermaster and the IEUA recompute the ambient TDS and nitrate concentrations for the Chino Basin and Cucamonga GMZs every three years, beginning in July 2005. The method used to compute ambient TDS and nitrate concentrations was consistent with the method used by the TIN/TDS Task Force to determine the antidegradation objectives for the GMZs of the Santa Ana River Watershed. The most recent recomputation, covering the 20-year period from 1999 to 2018 was completed in July 2020 (WSC, 2020). Figures 2-10a and Figure 2-10b show trends of the current and all historical ambient TDS and nitrate concentration determinations. As of 2018, the ambient TDS concentration of Chino-North is 350 mgl, which is 10 mgl less than the 2015 ambient TDS concentration. There remains 70 mgl of assimilative capacity. The current ambient nitrate concentration of Chino-North is 10.3 mgl and there is no assimilative capacity, which has been the case since the adoption of the maximum benefit objectives in 2004.



WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PE7 - SNMP\GIS\MXD\Maximum Benefit\Annual R\Figure 2-10a_AWQ_TDS_V2.mxd - sou - 3/30/2022



Prepared by:

WEST YOST
Water. Engineered.

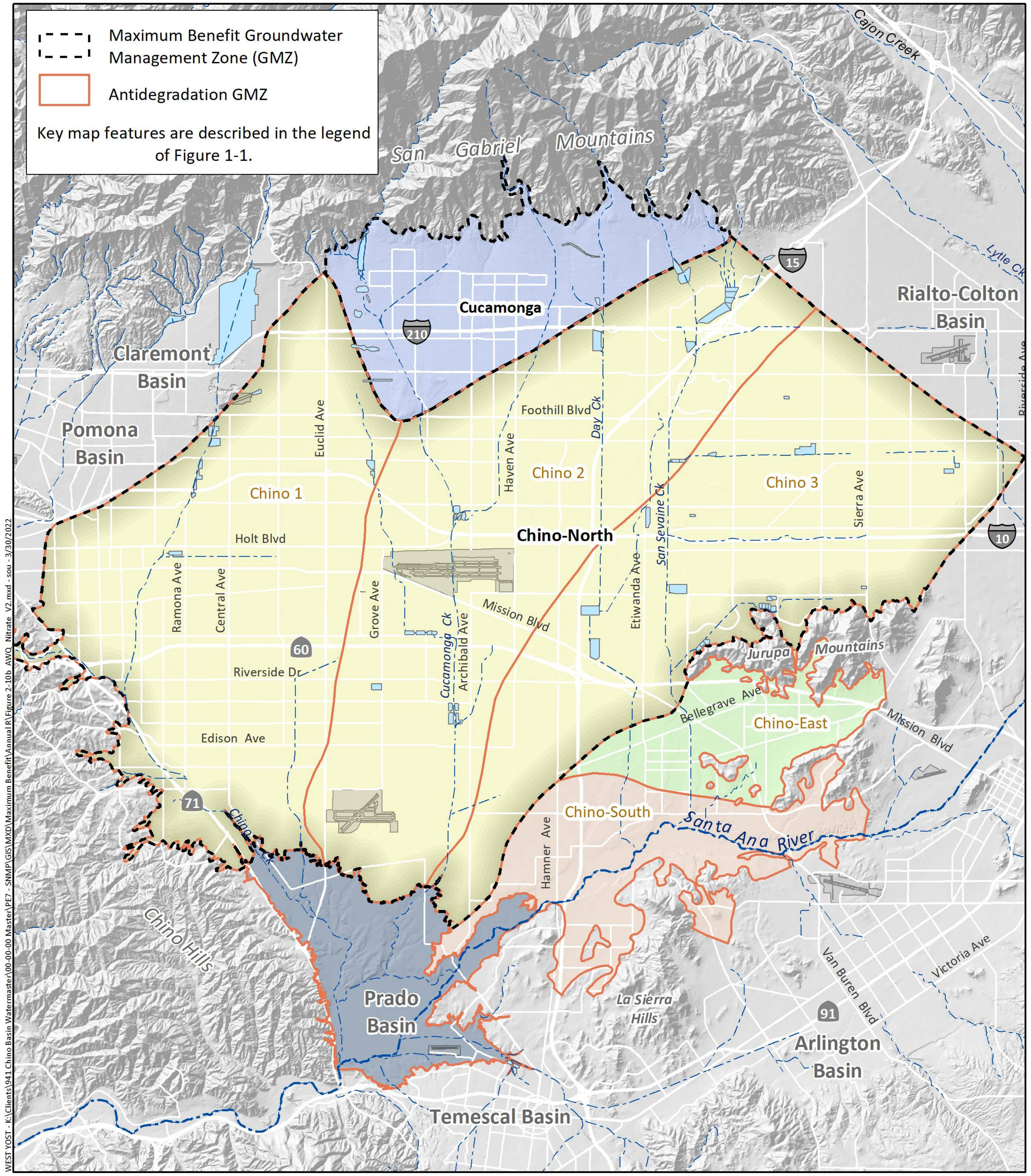
0 2 4 Miles
0 4 8 Km

Prepared for:

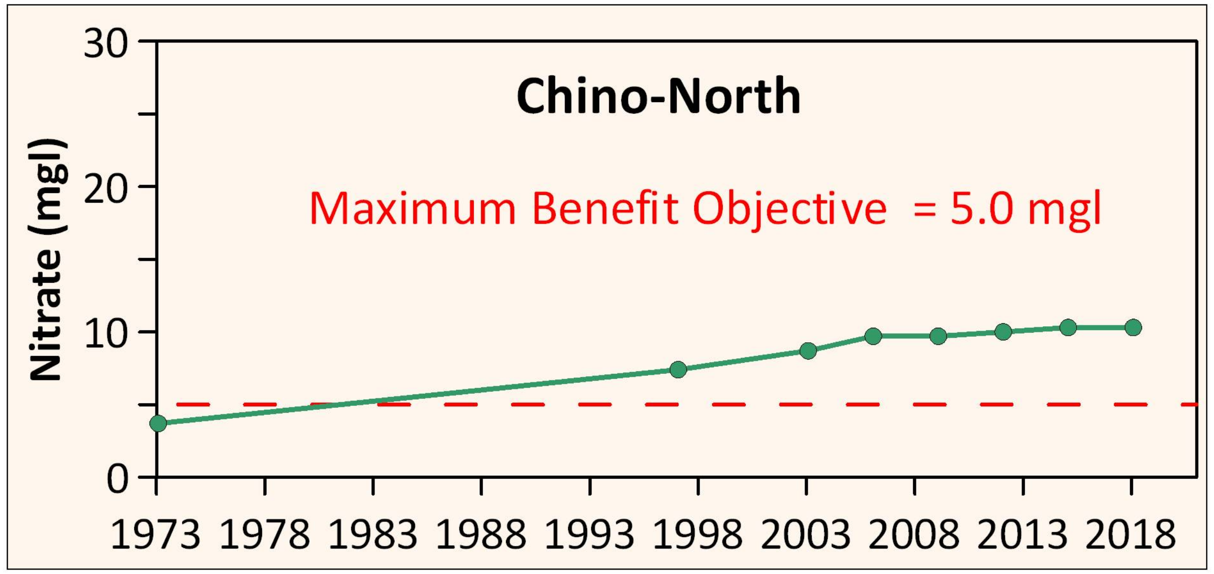
Chino Basin Watermaster and
the Inland Empire Utilities Agency
2021 Maximum Benefit
Annual Report

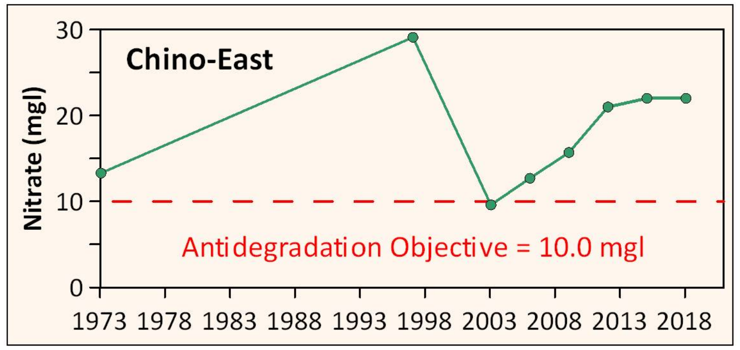
Trends in Ambient Water Quality
Determinations for Total Dissolved Solids
By Groundwater Management Zone

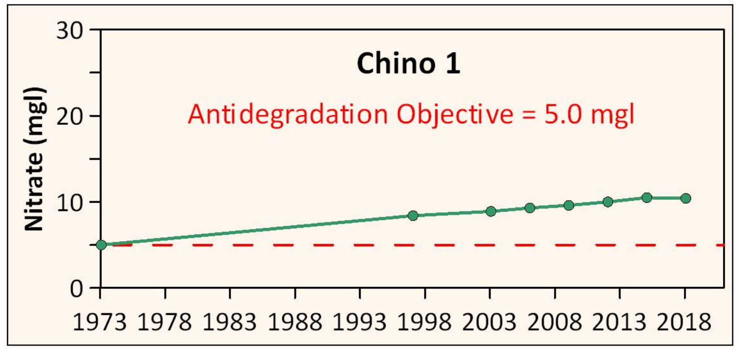
Figure 2-10a

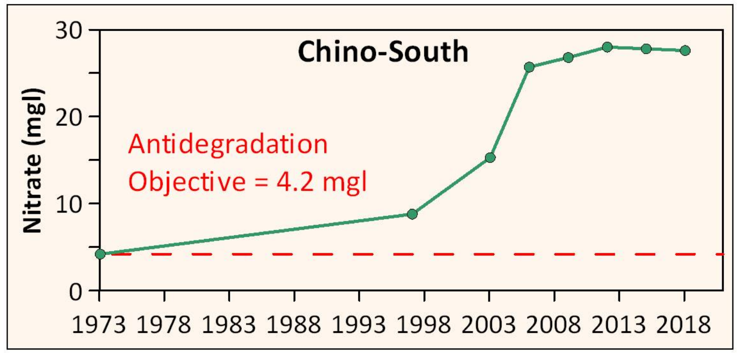


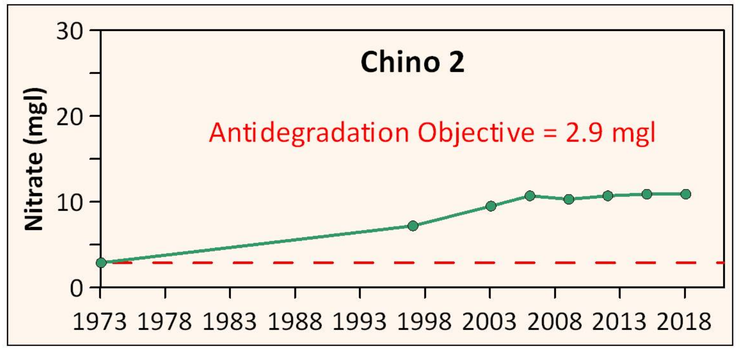
WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PE7 - SNMP\GIS\MXD\Maximum Benefit\Annual R\Figure 2-10b_AWQ_Nitrate_V2.mxd - sou - 3/30/2022

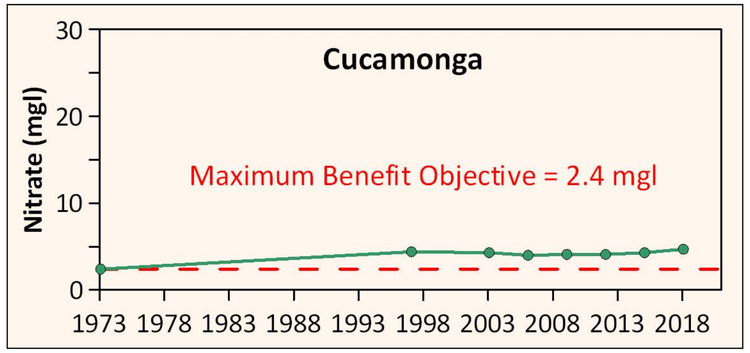


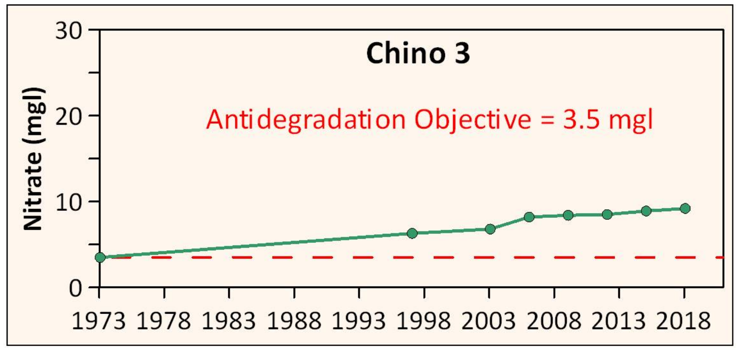












Prepared by:

WEST YOST
Water. Engineered.

0 2 4 Miles
0 4 8 Km

Prepared for:

Chino Basin Watermaster and
the Inland Empire Utilities Agency
2021 Maximum Benefit
Annual Report

Trends in Ambient Water Quality
Determinations for Nitrate
By Groundwater Management Zone

Figure 2-10b

3.0 DATA COLLECTED IN 2021

Groundwater and surface-water data collected for the Maximum-Benefit Monitoring Program pursuant to the 2014 Work Plan are used for both the maximum benefit monitoring directives of demonstrating hydraulic control and computing ambient water quality every three years. The data collected in 2021 for the Maximum-Benefit Monitoring Program include groundwater elevation, groundwater quality, and surface-water quality. The 2021 data collection efforts are described below.

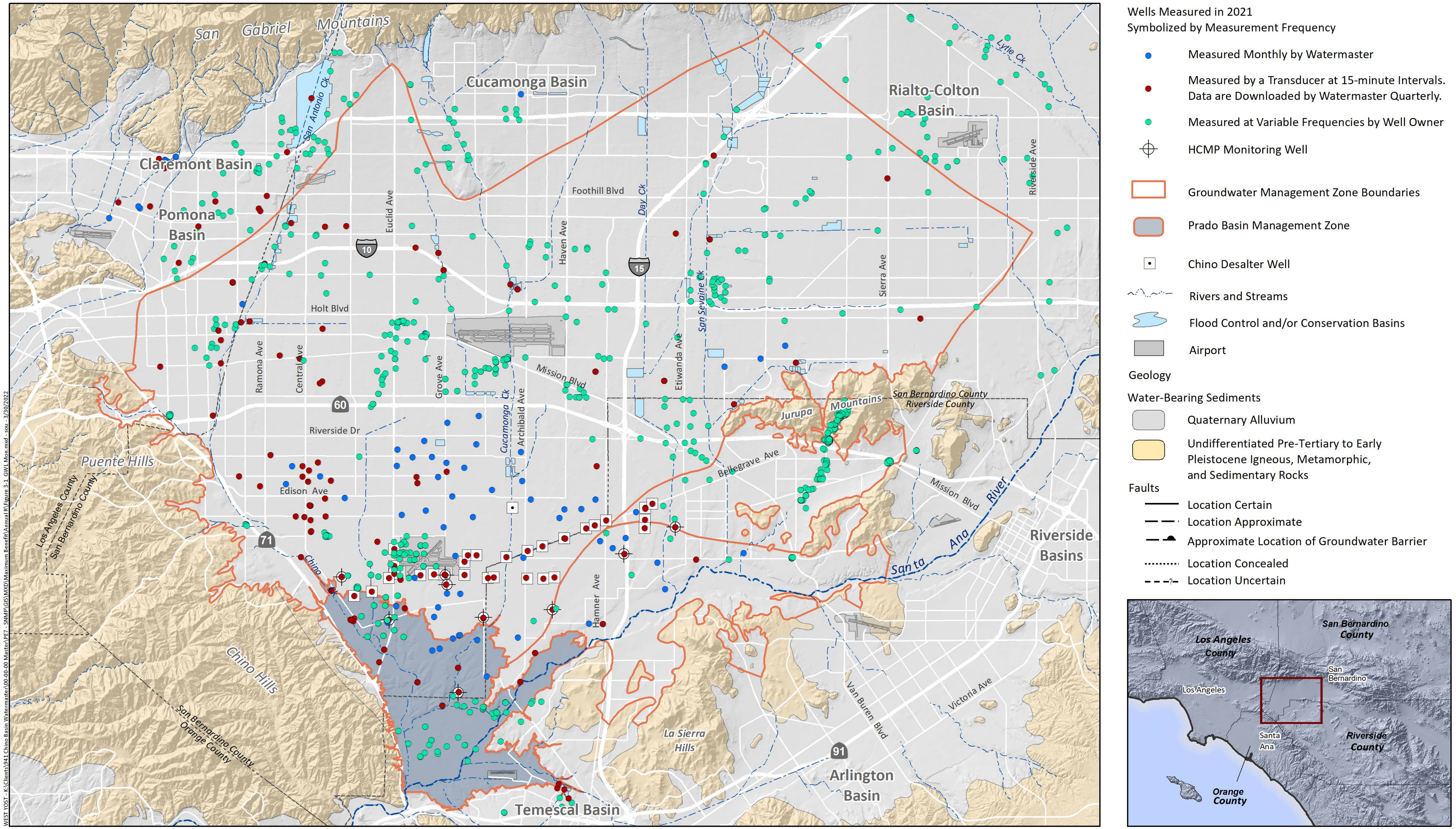
3.1 Groundwater Monitoring Program

Watermaster's Groundwater Monitoring Program consists of two main components: a groundwater-level monitoring program and a groundwater-quality monitoring program. These monitoring programs were designed and implemented to support the OBMP Implementation Plan and the other regulatory requirements of Watermaster and the IEUA. Watermaster's Groundwater Monitoring Program is summarized below with specific reference to the monitoring requirements of the maximum-benefit commitments.

3.1.1 Groundwater-Level Monitoring Program

Figure 3-1 shows the locations of the 1,140 wells that are included in Watermaster's groundwater-level monitoring program. The groundwater-level monitoring program supports many Watermaster management functions including the: periodic assessment of Safe Yield, groundwater model development and recalibration, cumulative impacts of transfers, balance of recharge and discharge, subsidence management, material physical injury assessments, estimation of storage change, other scientific demonstrations required for groundwater management, and many regulatory requirements such as the demonstration of hydraulic control and the triennial ambient water quality recomputation. The wells within the southern portion of the Basin were selected for inclusion in the monitoring program to assist in Watermaster's analyses of hydraulic control, land subsidence, and impacts of desalter pumping to private well owners and riparian vegetation in the PBMZ. The density of groundwater-level monitoring well network near the desalter well fields is greater than in outlying areas because hydraulic gradients are expected to be steeper near the desalter well fields, and these data are needed to assess the state of hydraulic control.

Figure 3-1 shows the wells where groundwater-level data were collected in 2021, symbolized by measurement frequency. At about 900 of these wells, water levels are measured by well owners, including municipal water agencies, the California Department of Toxic Substance Control (DTSC), the County of San Bernardino, and various consulting firms on behalf of their clients. The measurement frequency by municipal water agencies is typically about once per month, and Watermaster collects and compiles the data quarterly. The measurement frequency by other well owners varies, and Watermaster collects and compiles these data twice per year. The remaining 240 wells shown in Figure 3-1 are privately-owned wells or dedicated monitoring wells and majority of these wells are located in the southern portion of the Chino Basin. Watermaster staff measures water levels at these wells using manual methods once per month or with pressure transducers with data loggers that record water levels once every 15 minutes. Watermaster staff download the data loggers at wells with transducers installed on a quarterly basis. All water-level data are reviewed by Watermaster staff and uploaded to a centralized database management system that can be accessed online through HydroDaVE^{SM}. All groundwater-level data collected in 2021 are contained in the Microsoft (MS) Access database that has been included with this report as Appendix C. The well location information for private wells with groundwater-level data is excluded from the database in this report for confidentiality reasons.



WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PE7 - SNMP\GIS\MXD\Maximum Benefit\Annual R\Figure 3-1 GWL Mon.mxd - sou - 3/30/2022

Prepared by:

WEST YOST
Water. Engineered.

Prepared for:

Chino Basin Watermaster and
the Inland Empire Utilities Agency
2021 Maximum Benefit
Annual Report

Groundwater-Level Monitoring Program
Wells Monitored in 2021

Figure 3-1

3.1.2 Groundwater-Quality Monitoring Program

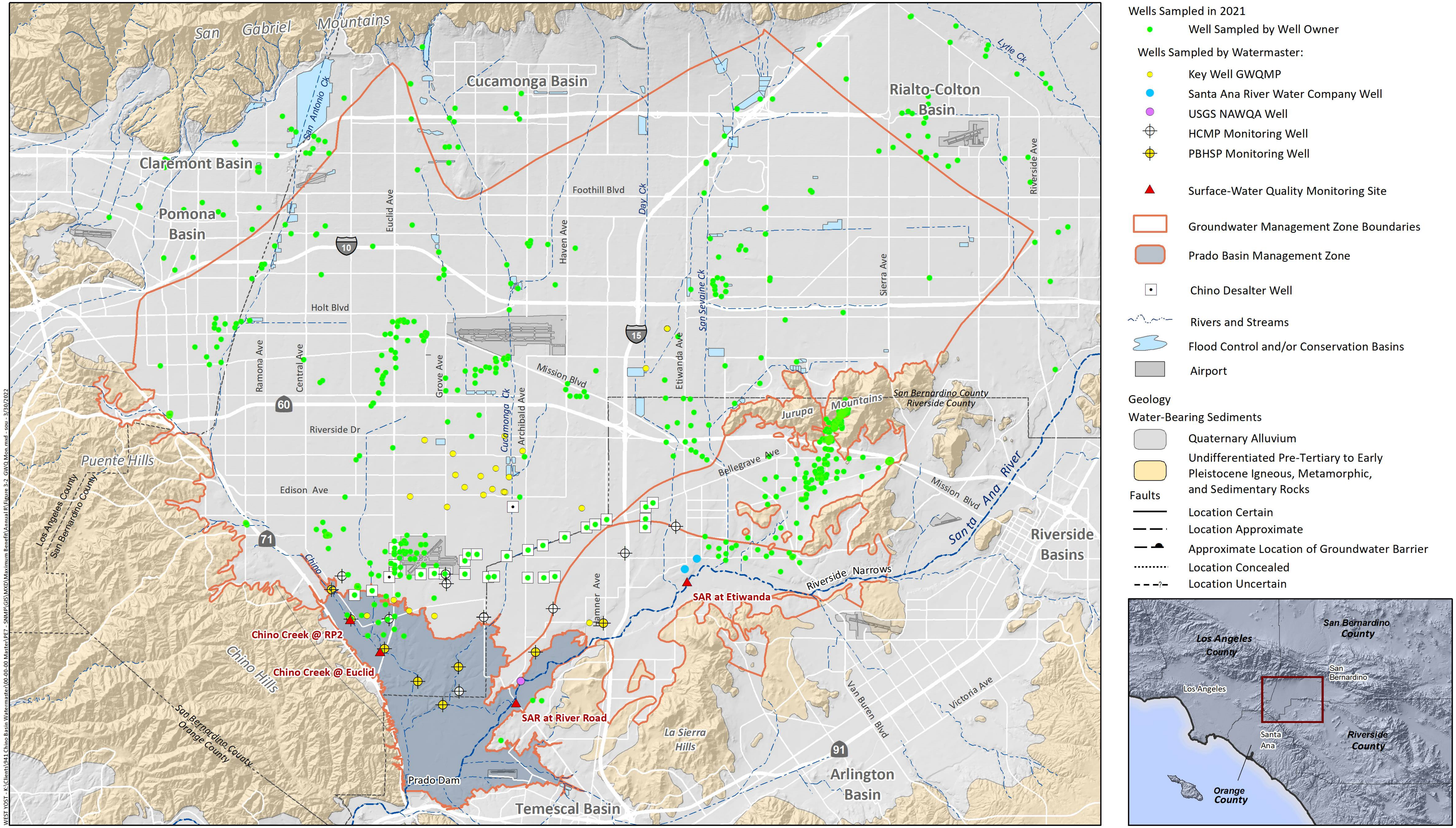
Figure 3-2 shows the locations of the 930 wells that are included in Watermaster's groundwater-quality monitoring program. Watermaster obtains groundwater-quality data, in part, to comply with two maximum-benefit commitments: the triennial ambient water quality recomputation and the analysis of hydraulic control. These data are also used to: prepare Watermaster's biennial SOB report, support groundwater modeling, characterize non-point source contamination and plumes associated with point-source discharges, and characterize present trends in groundwater-quality.

Figure 3-2 shows the wells with groundwater-quality data sampled by Watermaster or well owners in 2021. At 860 of these wells, groundwater-quality were sampled by well owners, including municipal water agencies, the DTSC, the County of San Bernardino, and various private companies and consulting firms. The sampling frequency and constituents tested vary by well and owner. These groundwater-quality data are collected and compiled by Watermaster twice per year. The remaining 70 wells shown in Figure 3-2 are privately-owned wells or dedicated monitoring wells that were sampled by Watermaster for various purposes. All groundwater samples collected by Watermaster are tested for the analytes listed in Table 3-1. Note that VOCs are sampled only at wells within or adjacent to known contamination plumes.

Table 3-1. Analyte List for the Groundwater-Quality Monitoring Program

Analyte	Laboratory Analysis Method
Major cations: Ca, Mg, K, Si, Na	EPA 200.7
Major anions: Cl, SO_4, NO_2, NO_3	EPA 300.0
Major Trace Elements Al, As, Ba, Cr, Mn	EPA 200.8
Total Hardness	SM 2340B
Total Alkalinity (incl. Carbonate, Bicarbonate, Hydroxide)	SM 2320B
Ammonia Nitrogen	EPA 350.1
Arsenic	EPA 200.8
Boron	EPA 200.7
Chromium, Total	EPA 200.8
Hexavalent Chromium	EPA 218.6
Fluoride	SM 4500F-C
Gross Alpha/Beta	EPA 900.0
Perchlorate	EPA 314.0
pH	SM2330B/SM 4500-HB
Specific Conductance	SM 2510B
Total Dissolved Solids	EPA 160.1/SM 2540C
Total Kjeldahl Nitrogen (TKN)	EPA 351.2
Organic Nitrogen	EPA 351.2
Total Organic Carbon	SM5310C/E415.3
Total Phosphorus	SM4500-PE/EPA 365.1
Turbidity	EPA 180.1
VOCs[a]	EPA 524.2
1,2,3 -Trichloropropane (Low Detection)	CASRL 524M-TCP

(a) Only at wells within or near known VOC plumes (Chino Airport, South Archibald, Pomona, GE Flatiron, GE Test cell, Former Crown Coach Facility, Alger Manufacturing Inc., Chino Institution for Men, Milliken Landfill, String Fellow)



WEST YOST - K:\Clients\941 Chino Basin Watermaster\00-00-00 Master\PE7 - SNMP\GIS\MXD\Maximum Benefit\Annual R\Figure 3-2_GWQ Mon.mxd - sou - 3/30/2022

Prepared by:

WEST YOST
Water. Engineered.

Prepared for:

Chino Basin Watermaster and the Inland Empire Utilities Agency
2021 Maximum Benefit
Annual Report

Groundwater and Surface-Water Quality Monitoring Program
Sites Monitored in 2021

Figure 3-2

In 2021, Watermaster performed the following groundwater-quality sampling:

- Annual and triennial samples were collected for the Key Well Groundwater Quality Monitoring Program (GWQMP). The Key Well GWQMP consists of a network of about 85 private wells predominantly in the southern portion of the Chino Basin and 11 monitoring wells, which include two multi-nested MZ-3 monitoring wells (six well casings), and two multi-nested former Kaiser Steel monitoring wells (five well casings). About eight of the private wells in proximity to contaminant plumes are sampled every year; the remaining private wells are sampled every three years. All of the monitoring wells are sampled every year. Watermaster is constantly evaluating and revising the private wells in the Key Well GWQMP as wells are abandoned or destroyed due to urban development. 21 private wells and 10 monitoring wells were sampled from August through November 2021.
- Annual samples were collected from nine multi-nested HCMP monitoring wells (21 well casings) in the southern portion of Chino Basin in August, September, and November 2021.
- Quarterly samples were collected at four shallow monitoring wells along the Santa Ana River, which consist of two former United States Geological Survey (USGS) National Water Quality Assessment (NAWQA) Program wells (Archibald 1 and Archibald 2) and two Santa Ana River Water Company (SARWC) wells (Wells 9 and 11). Samples were collected in January, April, July, and October 2021. Well SARWC 11 was destroyed in late 2021 and a groundwater sample was not collected at this well in October 2021. Watermaster is working with the SAWRC to replace SARWC 11 with a nearby well SARWC 10 for this monitoring program.
- Semi-annual samples were collected at four Prado Basin Habitat Sustainability Program (PBHSP) monitoring wells in two locations along Chino Creek in March 2021. And, annual samples were collected at all 18 PBHSP monitoring wells in nine locations along the fringes of the riparian habitat in September and November 2021.

All groundwater-quality data are reviewed by Watermaster staff and uploaded to a centralized database management system that can be accessed online through HydroDaVE^{SM}. All publicly available groundwater-quality data collected in 2021 are contained in the MS Access database included with this report as Appendix C. Groundwater-quality data collected at private wells in the Chino Basin are excluded from the database in this report for confidentiality reasons.

3.2 Surface-Water Quality Monitoring Program

Watermaster collects quarterly surface-water quality samples from two sites along the Santa Ana River, *SAR at Etiwanda* and *SAR at River Road*, and semi-annual[20] samples at two sites along Chino Creek, *CK at RP2* and *CK at Euclid,* for the PBHSP. Figure 3-2 shows the locations of these sites.

For surface water sites along the Santa Ana River, samples are collected on the same day as the quarterly groundwater-quality samples at the near-river NAWQA and SARWC wells. Samples were collected in January, April, July, and October 2021. Surface-water quality samples are tested for the analytes listed in Table 3-2. For the surface water sites along Chino Creek, the samples are collected on the same day as the semi-annual groundwater-quality samples at the nearby PBHSP monitoring wells. Samples were collected

---

[20] Only one semi-annual sample was collected at the two sites along Chino Creek in 2021 because the sample frequency was changed from semi-annual to no sampling in FY 2022.

in March 2021. All surface-water quality data are reviewed by Watermaster and uploaded to a centralized database management system that can be accessed online through HydroDaVE^{SM}. All surface-water quality data collected in 2021 are contained in the MS Access database included with this report as Appendix C.

Table 3-2. Analyte List for the Surface-Water Quality Monitoring Program

Analytes	Laboratory Analysis Method
Major cations: K, Na, Ca, Mg	EPA 200.7
Major anions: Cl, SO_4, NO_2, NO_3	EPA 300.0
Total Hardness	SM 2340B
Total Alkalinity (incl. Carbonate, Bicarbonate, Hydroxide)	SM 2320B
Boron	EPA 200.7
Ammonia-Nitrogen	EPA 350.1
pH	SM 4500-HB
Specific Conductance	SM 2510B
Total Dissolved Solids	E160.1/SM2540C
Total Kjeldahl Nitrogen (TKN)	EPA 351.2
Organic Nitrogen	EPA 351.2
Turbidity	EPA 180.1
Total Organic Carbon	SM5310C/E415.3

4.0 INFLUENCE OF RISING GROUNDWATER ON THE SANTA ANA RIVER

This section characterizes the influence of rising groundwater on the flow and quality of the Santa Ana River between the Riverside Narrows and Prado Dam (see locations in Figure 3-2). Rising groundwater from the Chino Basin to the Santa Ana River consists of groundwater from Chino-North that flows past the CCWF and unpumped groundwater south of and outside the influence of the Chino Basin Desalter well fields.[21]

4.1 Surface-Water Discharge Accounting

Annual estimates of the Chino Basin recharge and discharges (computational results from Watermaster's Chino Basin groundwater model) are used to evaluate the annual net contribution of rising groundwater to the Santa Ana River between the Riverside Narrows and Prado Dam. The purpose of this analysis is to estimate the magnitude of net rising groundwater in the Santa Ana River between Riverside Narrows and Prado Dam, which is the extent of the Santa Ana River flowing through Chino Basin (see Figure 1-1). Net rising groundwater is the combined losses and gains in Santa Ana River flow due to rising groundwater, streambed infiltration, and evapotranspiration (ET). Achieving hydraulic control should decrease net rising groundwater.

Table 4-1 is a water budget table from Watermaster's groundwater model that was updated and recalibrated to recalculate the safe yield in 2020 (WEI, 2020). The water budget table lists the annual recharge and discharge components for the Chino Basin as an input to, or computed by, the model for the calibration period of fiscal year 1978 to 2018, plus fiscal year 2019, 2020 and 2021 from the planning period for scenario *2020 SYR1*. Column 9, *Streambed Infiltration from the Santa Ana River*, is the annual estimate of streambed infiltration to the Chino Basin in the Santa Ana River downstream of the Riverside Narrows and the lower reaches of Chino Creek and Mill Creek. Column 19, *Rising Groundwater*, is the annual estimate of the combined groundwater discharge from Chino Basin to the Santa Ana River, Chino Creek, and Mill Creek. The net rising groundwater from Chino Basin to the Santa Ana River between Riverside Narrows and Prado Dam is calculated in Column 23 as the difference between groundwater discharge and streambed infiltration (Column 19 minus Column 9). Figure 4-1 shows the time history of this net rising groundwater calculation. With three exceptions, in 2001, 2003, and 2004, the net rising groundwater estimate is negative over the 44-year period. Negative values for net rising groundwater indicate that the volume of rising groundwater in this reach of the Santa Ana River is less than the combined volume of losses from the river due to streambed infiltration. Net rising groundwater decreased (larger negative values) as the Chino-I and Chino-II Desalters increased production in the southern Chino Basin starting in fiscal year 2005. These observations are consistent with conclusions from the monitoring data and demonstrate that hydraulic control is being achieved.

---

[21] See groundwater flow vectors in Figure 2-2.

Table 4-1. Water Budget for the Chino Basin for the Calibration and Planning Periods and Estimated Net Rising Groundwater

Fiscal Year	Recharge													Discharge						Change in Storage		Net Rising Groundwater Contribution to Surface Discharge
	Subsurface Inflow							Deep Infiltration of Precipitation and Applied Water	Santa Ana River Streambed Infiltration[a]	Infiltration from the Santa Ana River Tributaries	Managed Aquifer Recharge			Total Recharge	Groundwater Pumping			Riparian Veg ET	Rising Groundwater[d]	Total Discharge	Annual	Cumulative	
	Bloomington Divide	Chino/Puente Hills, Jurupa Hills, and Rialto Basin	Net Temescal Basin	Pomona Basin	Claremont Basin	Cucamonga Basin	Spadra Basin				Storm Water	Recycled Water	Imported Water		CDA Pumping	Overlying Non Ag and Appropriative Pools[b,c]	Overlying Agricultural Pool						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23) = (19) - (9)
1978	11,404	8,811	2,502	2,278	2,277	12,032	961	117,423	37,046	24,456	5,183	3,175	6,952	234,499	0	64,771	120,072	16,951	14,495	216,289	18,210	18,210	(22,552)
1979	11,002	9,659	3,101	2,867	2,574	11,628	576	122,211	33,871	15,620	2,951	3,049	28,347	247,456	0	65,008	118,922	17,257	12,619	213,805	33,651	51,861	(21,253)
1980	12,497	10,790	3,420	2,922	2,578	11,567	498	126,236	38,002	20,253	4,662	3,232	16,537	253,195	0	69,503	110,885	16,404	14,897	211,689	41,505	93,366	(23,105)
1981	13,071	10,955	4,216	3,024	2,585	11,537	476	126,479	30,545	7,647	1,219	3,451	20,850	236,055	0	72,927	116,470	17,194	13,035	219,626	16,429	109,795	(17,510)
1982	13,337	11,289	4,987	2,892	2,470	11,401	480	126,714	33,792	11,112	3,096	3,726	21,641	246,937	0	68,404	101,624	16,868	13,389	200,284	46,652	156,447	(20,403)
1983	13,316	10,685	5,161	3,008	2,597	11,552	496	132,273	35,436	18,011	6,703	3,873	27,590	270,704	0	67,259	94,508	16,139	17,899	195,805	74,898	231,346	(17,537)
1984	14,378	9,829	6,112	3,222	2,752	11,871	511	133,497	29,048	8,724	2,472	982	22,400	245,799	0	74,726	107,238	16,642	17,412	216,018	29,782	261,127	(11,636)
1985	13,577	8,729	6,343	3,085	2,561	11,887	526	128,408	30,446	6,257	2,032	0	20,782	234,631	0	79,626	105,444	16,810	14,364	216,243	18,388	279,515	(16,082)
1986	12,428	9,439	6,192	3,007	2,456	11,668	549	127,728	33,461	6,062	2,903	0	18,327	234,221	0	83,822	105,254	16,877	15,805	221,757	12,463	291,979	(17,656)
1987	11,951	8,844	6,493	2,944	2,379	11,309	553	121,909	32,772	2,874	1,789	0	19,938	223,754	0	88,675	104,829	17,090	14,383	224,976	(1,222)	290,756	(18,389)
1988	11,385	7,674	5,839	2,790	2,274	10,771	538	122,069	34,246	2,925	2,641	0	2,485	205,637	0	94,222	95,264	17,187	15,603	222,276	(16,640)	274,117	(18,643)
1989	11,408	7,528	5,339	2,681	2,214	10,364	529	120,836	31,310	1,422	2,393	0	7,332	203,357	0	97,218	89,511	17,407	14,798	218,935	(15,578)	258,539	(16,513)
1990	11,788	7,121	4,579	2,536	2,124	10,448	509	115,495	31,487	433	1,430	0	0	187,950	0	98,914	83,775	17,482	13,942	214,113	(26,163)	232,376	(17,545)
1991	12,630	6,656	4,009	2,421	2,092	10,335	474	113,633	33,477	712	2,198	0	3,634	192,271	0	88,986	83,073	17,525	14,171	203,756	(11,484)	220,891	(19,306)
1992	13,286	7,250	3,737	2,438	2,136	10,393	442	112,979	34,141	1,028	3,598	0	5,568	196,997	0	102,664	77,336	17,736	14,905	212,640	(15,643)	205,248	(19,237)
1993	13,611	8,300	2,863	2,725	2,434	10,588	423	116,794	37,980	2,239	6,619	0	14,224	218,800	0	88,040	83,284	17,404	17,162	205,889	12,910	218,159	(20,817)
1994	13,637	8,223	3,621	2,994	2,560	10,871	425	117,935	30,748	650	1,486	0	16,448	209,597	0	93,564	72,115	18,155	15,589	199,423	10,174	228,333	(15,159)
1995	13,478	9,217	2,488	2,899	2,507	10,967	428	119,075	35,361	1,538	4,662	0	10,375	212,995	0	98,173	62,171	17,711	19,136	197,191	15,803	244,136	(16,225)
1996	13,289	9,146	3,546	3,017	2,560	11,015	455	117,398	29,441	709	2,425	0	82	193,085	0	109,609	71,220	18,429	18,553	217,811	(24,726)	219,410	(10,888)
1997	13,292	9,072	3,290	2,829	2,430	10,883	481	116,836	30,483	1,007	3,305	0	16	193,925	0	112,998	68,968	18,564	18,917	219,448	(25,523)	193,887	(11,565)
1998	13,650	8,754	2,402	2,803	2,417	10,727	503	117,046	33,821	1,637	5,780	0	8,352	207,895	0	104,141	45,302	18,238	22,456	190,138	17,757	211,644	(11,365)
1999	13,956	8,514	3,516	2,936	2,489	10,756	494	115,042	26,381	519	1,007	0	5,839	191,449	0	118,738	46,730	19,035	22,794	207,298	(15,849)	195,795	(3,587)
2000	14,451	7,890	2,858	2,707	2,341	10,563	508	109,843	27,081	499	1,985	507	997	182,232	523	133,086	46,538	18,938	23,315	222,400	(40,168)	155,628	(3,767)
2001	14,556	7,970	3,132	2,532	2,254	10,223	525	107,823	25,419	598	3,162	500	6,538	185,230	9,470	120,396	41,429	18,717	26,464	216,476	(31,245)	124,382	1,045
2002	15,177	7,242	3,565	2,467	2,206	10,028	517	102,792	25,922	230	1,148	505	6,493	178,292	10,173	129,760	38,650	18,472	26,544	223,599	(45,307)	79,075	621
2003	15,747	6,518	2,932	2,377	2,145	9,868	504	102,305	28,672	859	6,284	185	6,548	184,945	10,322	123,471	36,507	18,157	26,630	215,087	(30,142)	48,934	(2,042)
2004	16,088	6,780	1,994	2,407	2,123	9,860	492	99,010	27,465	536	3,357	49	7,607	177,768	10,480	128,548	36,809	18,069	27,669	221,574	(43,807)	5,127	204
2005	14,346	7,918	721	2,643	2,336	9,816	481	99,647	30,922	5,917	17,648	158	12,259	204,813	10,595	112,943	34,503	17,178	29,844	205,064	(251)	4,876	(1,078)
2006	14,568	7,648	1,891	3,152	2,571	9,897	467	99,823	30,439	1,806	12,940	1,303	34,567	221,073	19,819	113,553	30,812	17,561	24,576	206,321	14,752	19,627	(5,862)
2007	15,150	7,607	1,268	2,911	2,413	9,826	412	96,008	29,276	79	4,745	2,993	32,960	205,647	28,529	123,695	29,919	18,276	21,441	221,859	(16,212)	3,415	(7,835)
2008	15,044	7,346	1,173	2,627	2,240	9,842	384	93,275	31,703	1,530	10,205	2,340	0	177,709	30,116	127,696	26,280	18,358	20,003	222,453	(44,744)	-41,329	(11,700)
2009	15,271	7,363	696	2,509	2,178	9,950	414	91,489	33,318	839	7,512	2,684	0	174,220	28,456	137,345	23,386	18,561	18,475	226,223	(52,003)	-93,331	(14,843)
2010	15,584	6,402	562	2,448	2,167	9,809	441	88,512	35,285	1,939	14,273	7,210	5,000	189,632	28,964	108,983	22,038	18,686	18,067	196,739	(7,107)	-100,438	(17,218)
2011	15,960	6,889	557	2,601	2,299	9,891	452	88,763	36,213	3,358	17,052	8,065	9,465	201,564	28,941	94,413	18,042	18,739	18,765	178,901	22,663	-77,775	(17,447)
2012	15,577	6,971	1,397	2,713	2,317	9,820	441	84,009	34,463	463	9,271	8,634	22,560	198,637	28,230	108,501	22,412	19,282	15,649	194,074	4,563	-73,212	(18,814)
2013	15,144	6,651	1,516	2,676	2,203	9,748	426	80,130	33,536	243	5,271	10,479	0	168,023	27,380	111,748	24,074	17,348	13,871	194,421	(26,398)	-99,610	(19,665)
2014	15,067	6,355	1,371	2,645	2,144	9,548	440	78,395	34,301	241	4,299	13,593	795	169,195	29,626	118,849	22,131	17,426	13,348	201,380	(32,185)	-131,795	(20,953)
2015	15,230	5,760	1,217	2,547	2,096	8,721	458	75,817	34,907	421	8,001	10,840	0	166,014	30,022	104,317	17,552	17,580	13,585	183,056	(17,042)	-148,837	(21,322)
2016	15,716	5,015	1,057	2,498	2,062	7,809	449	73,547	36,134	476	9,236	13,222	0	167,221	28,191	101,301	16,908	17,824	14,147	178,371	(11,150)	-159,988	(21,987)
2017	15,967	5,587	1,529	2,462	2,056	8,311	423	72,874	35,805	1,920	11,575	13,934	13,150	185,593	28,284	98,960	16,191	17,869	15,261	176,565	9,028	-150,960	(20,544)
2018	15,711	5,385	2,306	2,510	2,072	8,041	388	69,532	32,664	2,165	4,494	13,212	35,621	194,101	30,088	93,904	16,776	18,147	13,914	172,828	21,272	-129,687	(18,750)
2019	15,538	7,694	365	2,664	2,060	6,914	343	68,414	36,230	550	12,861	11,145	7,401	164,728	31,233	86,564	15,478	18,066	14,113	166,819	(2,092)	-131,779	(22,117)
2020	15,538	7,697	760	2,721	2,140	6,888	368	70,654	36,020	550	9,967	12,953	20,154	186,410	35,630	97,840	15,722	18,212	14,438	181,843	4,567	-127,212	(21,582)
2021	15,538	7,699	1,035	2,863	2,211	6,842	384	71,823	36,565	550	5,065	15,728	2,228	168,532	40,156	107,912	14,945	18,292	14,392	195,697	(27,165)	-154,377	(22,174)
Statistics for the Calibration Period 1978 through 2018																							
Total	572,725	325,781	125,499	111,751	95,688	426,142	19,947	4,381,613	1,326,822	159,955	223,013	131,900	472,281	8,373,116	418,208	4,133,457	2,484,952	728,293	737,893	8,502,803	-129,687		-588,929
Percent	6.8%	3.9%	1.5%	1.3%	1.1%	5.1%	0.2%	52.3%	15.8%	1.9%	2.7%	1.6%	5.6%	100.0%	4.9%	48.6%	29.2%	8.6%	8.7%	100.0%			
Average	13,969	7,946	3,061	2,726	2,334	10,394	487	106,869	32,362	3,901	5,439	3,217	11,519	204,222	10,200	100,816	60,609	17,763	17,997	207,385	-3,163		-14,364
Median	13,956	7,674	2,932	2,707	2,317	10,393	480	113,633	33,318	1,530	4,299	507	7,607	198,637	0	101,301	46,730	17,711	15,805	212,640	-7,107		-17,447
Maximum	16,088	11,289	6,493	3,222	2,752	12,032	961	133,497	38,002	24,456	17,648	13,934	35,621	270,704	30,116	137,345	120,072	19,282	29,844	226,223	74,898	291,979	1,045

Table 4-1. Water Budget for the Chino Basin for the Calibration and Planning Periods and Estimated Net Rising Groundwater

	Recharge														Discharge						Change in Storage		Net Rising Groundwater Contribution to Surface Discharge
	Subsurface Inflow							Deep Infiltration of Precipitation and Applied Water	Santa Ana River Streambed Infiltration[a]	Infiltration from the Santa Ana River Tributaries	Managed Aquifer Recharge			Total Recharge	Groundwater Pumping			Riparian Veg ET	Rising Groundwater[d]	Total Discharge	Annual	Cumulative	
Fiscal Year	Bloomington Divide	Chino/Puente Hills, Jurupa Hills, and Rialto Basin	Net Temescal Basin	Pomona Basin	Claremont Basin	Cucamonga Basin	Spadra Basin				Storm Water	Recycled Water	Imported Water		CDA Pumping	Overlying Non Ag and Appropriative Pools[b,c]	Overlying Agricultural Pool						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23) = (19) - (9)

Source: Water Budget from the Chino Basin groundwater model that was updated and recalibrated to calculate Safe Yield in 2020. The period includes the calibration period of fiscal year 1978 to 2018 and fiscal year 2019 to 2021 of the planning simulation period for Scenario 2020 SYR1 with updated historical managed aquifer recharge and pumping.

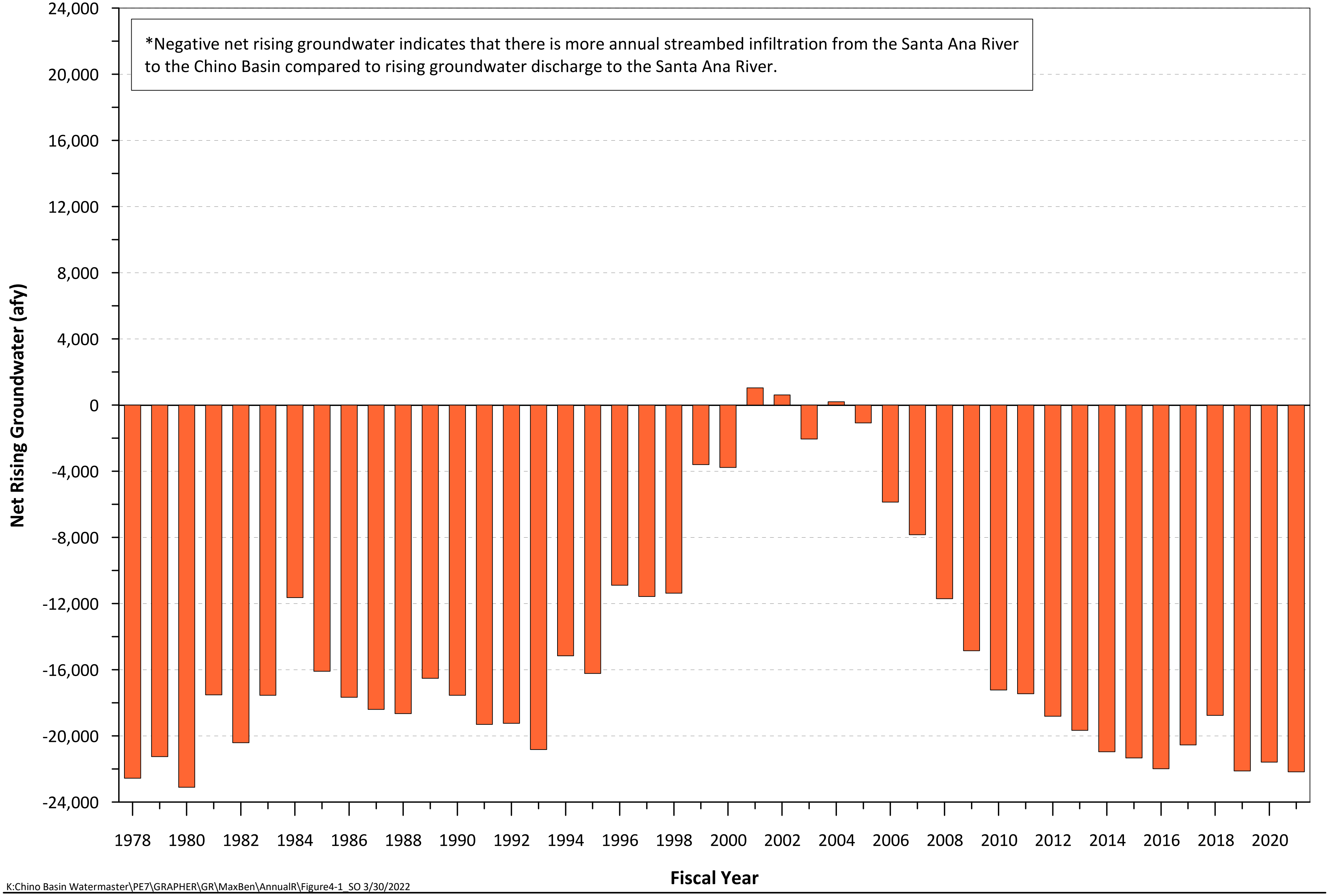
(a) Streambed infiltration from Santa Ana River includes infiltration at Santa Ana River below Riverside Narrows and at lower reaches of Chino and Mill Creeks

(b) Does not include San Antonio Water Company Wells 15 and 16, and Santa Ana River Water Company Well 9.

(c) Less injection in wells by General Electric.

(d) Rising groundwater discharge to Santa Ana River and Chino and Mill Creeks.

(Red Text) Indicates negative values.



K:Chino Basin Watermaster\PE7\GRAPHER\GR\MaxBen\AnnualR\Figure4-1_SO 3/30/2022

Prepared by:

WEST YOST
Water. Engineered

Prepared for:

Chino Basin Watermaster and
The Inland Empire Utilities Agency
2021 Maximum Benefit
Annual Report

Net Annual Rising Groundwater Contribution to Surface Discharge in Sana Ana River between Riverside Narrows and Prado Dam - 1978 to 2021

Figure 4-1

4.2 Analysis of Surface and Groundwater Interactions from Monitoring Data

Surface water and groundwater quality data collected for the Maximum Benefit Monitoring Program along the Santa Ana River in the Chino Basin can be used to characterize the groundwater and surface water interactions at these locations, and if it is an area of surface water recharge to Chino Basin (losing reach or river) or an area of rising groundwater discharge from Chino Basin (gaining reach of river). As described in Section 3.2, Watermaster collects quarterly surface-water quality samples from two sites along the Santa Ana River in Chino Basin, *SAR at Etiwanda* and *SAR at River Road*, and four nearby wells (SARWC 9 and 11 near *SAR at Etiwanda;* and Archibald 1 and 2 near *SAR at River Road)*. Figures 4-2a and 4-2b are exhibits that show the analysis of the groundwater and surface water interaction at these two sites along the Santa Ana River. The surface and groundwater quality data are used along with surface water discharge data, groundwater elevation measurements, model-simulated groundwater-flow directions, and groundwater quality at other wells, to analyze the groundwater and surface water interactions at these locations. Each figure includes the following data graphics:

- *A Piper diagram of general-mineral chemistry for groundwater and surface water*. Groundwater in the Chino Basin typically has a different general mineral chemistry than that of discharge in the Santa Ana River which is predominantly tertiary-treated discharge from POTWs and storm water discharge. Piper diagrams compare groundwater and surface-water via a graphical display of the ratio of the major cations and anions. Each Piper diagram shows the chemistry for the surface water station and the near-river wells, along with well/s further away from the river for comparison to typical Chino Basin groundwater. Water from similar or related sources will generally plot in similar locations on a piper diagram. The Piper diagram indicates where typical groundwater and surface water chemistry plot in the diagram for the region of interest based on available data.
- *A map of model-simulated groundwater-flow directions for 2021*. The simulated groundwater-flow directions are output information from the Chino Basin groundwater-flow model for Layer 1 for September 30, 2021 and are shown with arrow symbols. Model-simulated groundwater-flow directions can corroborate an understanding of the groundwater/surface-water interactions derived from the measured data. Groundwater-flow directions (arrows) that converge on a stream segment indicate a gaining reach (i.e., groundwater discharge to surface water). Groundwater-flow directions that diverge from a stream segment indicate a losing reach (i.e., streambed recharge to the basin).
- *A time-series chart of the surface-water discharge in Santa Ana River, groundwater elevation at the near-river monitoring wells, and the thalweg elevation in the adjacent river*. The groundwater elevation time-series are charted with the thalweg elevation of the adjacent river to determine the potential for groundwater discharge or streambed recharge. The thalweg elevation was determined from a 1-meter horizontal resolution digital elevation model of the ground surface (Associated Engineers, 2007).[22] And, daily discharge data at the USGS gage station at the Riverside Narrows (*SAR at MWD Xing*) are charted and compared with groundwater elevations at the near-river wells to characterize the relationship between discharge in the Santa Ana River and groundwater levels.

---

[22] The 1-meter resolution digital elevation model of the ground surface uses the Ayala Park datum, which is the same datum that was used to establish the reference-point elevations at the near-river monitoring wells. This allows for an accurate comparison between the thalweg elevation and the measured groundwater elevations.

- *A time-series chart of TDS concentrations in groundwater and surface water.* On these charts, TDS concentrations for groundwater and surface water are compared to help determine the source of groundwater at the near-river monitoring wells. The TDS concentrations of Santa Ana River discharge typically range from 500-700 mgl. In the southern portion of Chino Basin, shallow groundwater quality not impacted by the Santa Ana River can have TDS concentrations ranging from about 1,000 - 4,000 mgl.

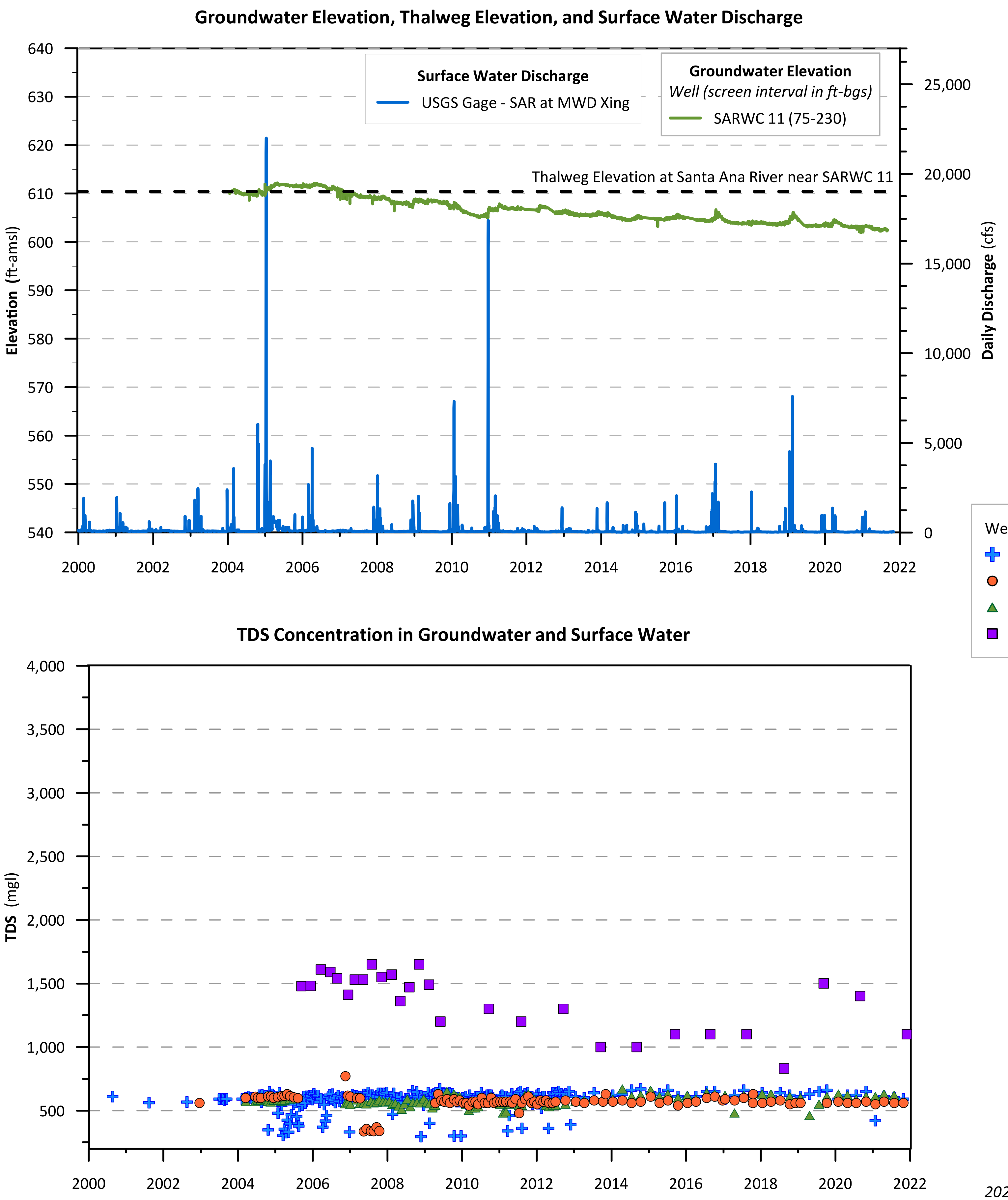
The analysis of the data in Figure 4-2a indicates that the *Santa Ana River at Etiwanda* area is an overall losing reach of the Santa Ana River in Chino Basin, characterized by streambed recharge, and demonstrating hydraulic control:

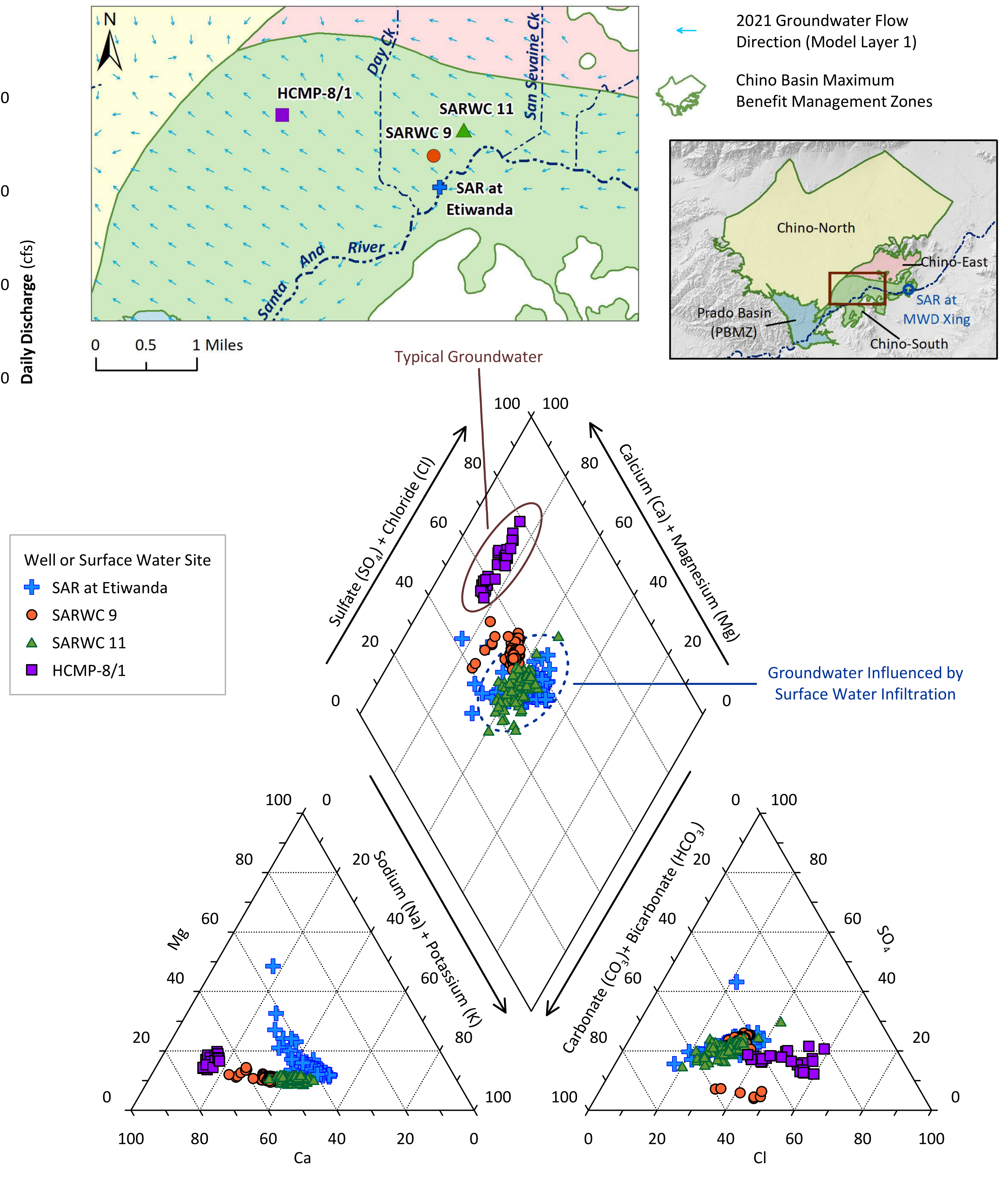
- The general-mineral chemistry for both near-river wells, SARWC 11 and SARWC 9, plots very close to the chemistry of surface water for SAR at Etiwanda on the Piper diagram, indicating that the source of the groundwater at these near-river wells is streambed recharge of the SAR. The general-mineral chemistry of the SARWC 11 and SARWC 9 does not plot near that of well HCMP-8/1 that is not near the river and representative of typical shallow groundwater in the southern Chino Basin, further demonstrating that the near-river wells are influenced by stream bed recharge of the Santa Ana River.
- The simulated groundwater-flow directions (arrow symbols on the map) diverge from the Santa Ana River, indicating that this is an area of streambed recharge.
- Starting in 2007, groundwater elevations at the SARWC 11 transition from just at the thalweg elevation of the adjacent Santa Ana River to below the thalweg, indicating that this is an area of streambed recharge from mid-2007. This transition aligns with the onset of the Chino-II Desalter pumping and the Peace Agreement.
- Groundwater elevations at SARWC 11 increase slightly during and immediately after periods of storm water discharge as measured by the USGS gage located upstream (SAR at MWD Xing), suggesting that storm water discharge is a source of recharge to the groundwater.
- The TDS concentrations at SARWC 11 and SARWC 9 typically fluctuate between 560-660 mgl, which are similar to the TDS concentrations in the Santa Ana River as sampled at SAR at Etiwanda, while the TDS concentrations of the further away well HCMP-8/1 are higher ranging from about 1,000 to 1,600 mgl. These observations further indicate that the source of groundwater at the SARWC wells is Santa Ana River recharge.

The analysis of the data in Figure 4-2b indicates that the *SAR at River Road* area is an overall gaining reach of the river, characterized by groundwater discharge to the river from the southern Chino Basin south of the desalters in Chino-South and PBMZ, however the primary source of the groundwater in this area is mix of surface water recharge and groundwater discharge. The approximate area near the Archibald 1 and 2 wells is where the Santa Ana River changes from an overall area of streambed recharge (losing reach) to an area of rising groundwater discharge (gaining reach) in the PBMZ:

- In the Piper diagram, the general-mineral chemistry for both near-river wells, Archibald 1 and Archibald 2, plots between the chemistry of surface water for SAR at River Road and well HCMP-6/1 that is not near the river, indicating that the source of groundwater at these near-river wells is a combination of streambed recharge and groundwater. Also shown on this Piper diagram are the near-river wells PB-3/1 and PB-3/2 just slightly upstream from the Archibald wells. The general-mineral chemistry for both PB-3/1 and PB-3/2 plots with the chemistry of surface water for SAR at Etiwanda, indicating that the source of the groundwater at these near-river wells just upstream of the Archibald wells is streambed recharge of the Santa Ana River. This further demonstrates that the Archibald wells are an area characterized by Chino Basin discharge to the river and there is a transition in the surface water and groundwater interaction between the PB-3 and Archibald wells.

- The simulated groundwater-flow directions (arrow symbols on the map) converge at the Santa Ana River at the Archibald 1 and 2 wells location, indicating that this is an area of rising groundwater discharge. However, the simulated flow directions show this is a transitional area where the groundwater-flow directions change from diverging along the river indicating streambed recharge, to converging indicating an area of rising groundwater discharge. The groundwater-flow directions are diverging along from SAR at River Road to the SAR at Etiwanda, indicating a long stretch of streambed recharge, and demonstrating hydraulic control up stream of the SAR at River Road in Chino Basin.
- Groundwater elevations at Archibald 1 and 2 are above the thalweg elevation of the Santa Ana River near the Archibald wells, indicating that this is an area of groundwater discharge. The groundwater elevation at the upstream PB-3/1 and PB-3/2 wells are below the thalweg elevation, indicating that this is an area of streambed recharge.
- Groundwater elevations at the Archibald 1 and 2 increase slightly during and immediately after periods of storm water discharge as measured by the USGS gage located upstream (SAR at MWD Xing), suggesting that storm water discharge is a source of recharge to the groundwater.
- The TDS concentrations at Archibald 1 and 2 near-river wells have progressively declined over the period of record, ranging between 700-1,500 mgl from 2004 to 2013, and since 2013 have ranged between 500-600 mgl which are similar to the concentrations in the Santa
- Ana River. This trend suggests that over time, the groundwater in the area of the Archibald wells became more influenced by groundwater that is recharged by the Santa Ana River upstream (such as the PB-3 area). The TDS concentrations of the PB-3 wells upstream range from 500-700 mgl which are similar to the TDS concentrations in the Santa Ana River. In contrast, the TDS concentrations of the further away HCMP-6/1 well are higher, ranging from about 1,500 to 3,800 mgl. These observations further indicate that the source of groundwater at the Archibald wells is groundwater discharge that has been influenced by groundwater receiving recharge of the Santa Ana River upgradient (northeast) of the Archibald wells.





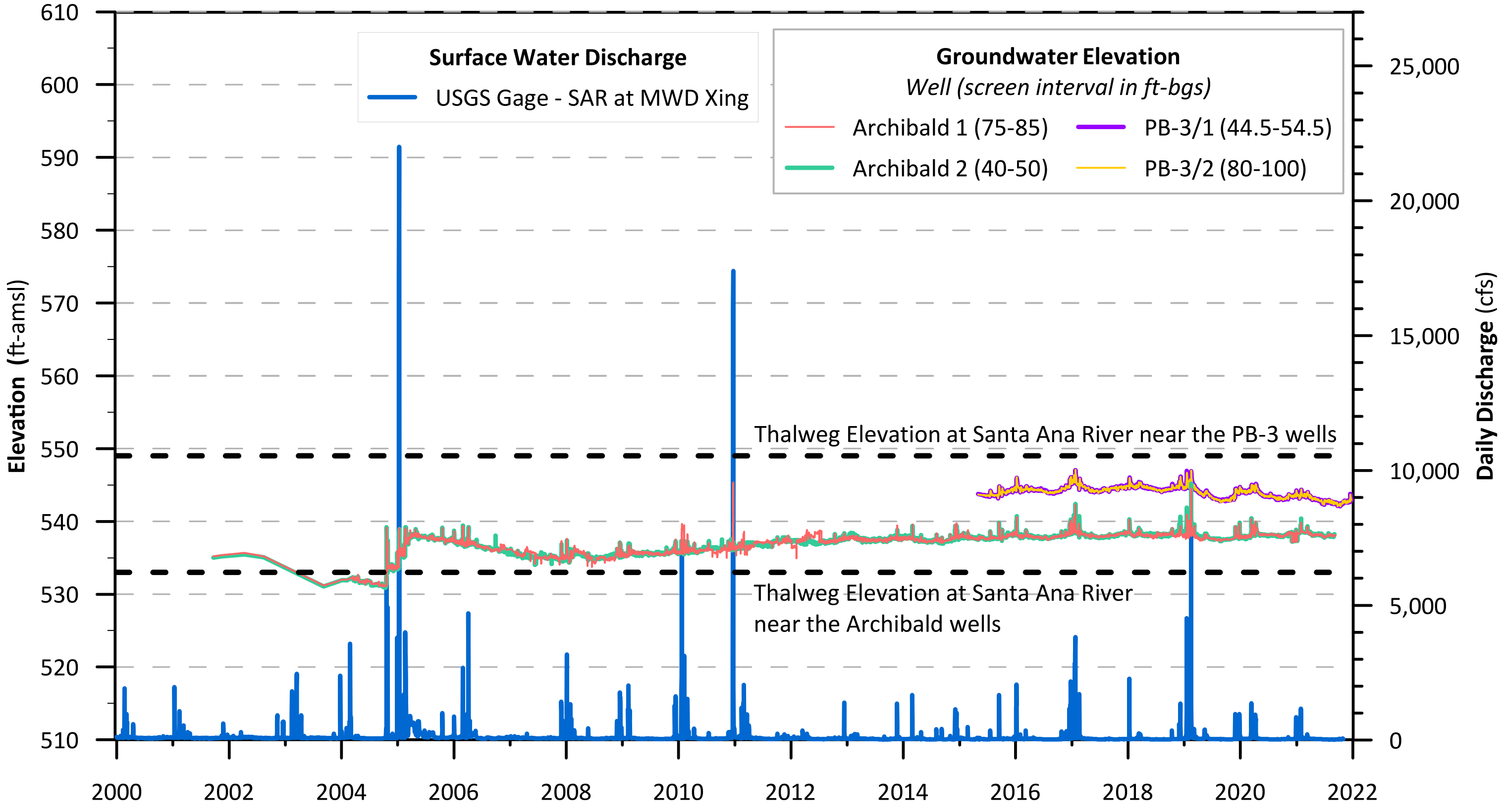
Chino Basin
2021 Maximum Benefit
Annual Report

Prepared for:

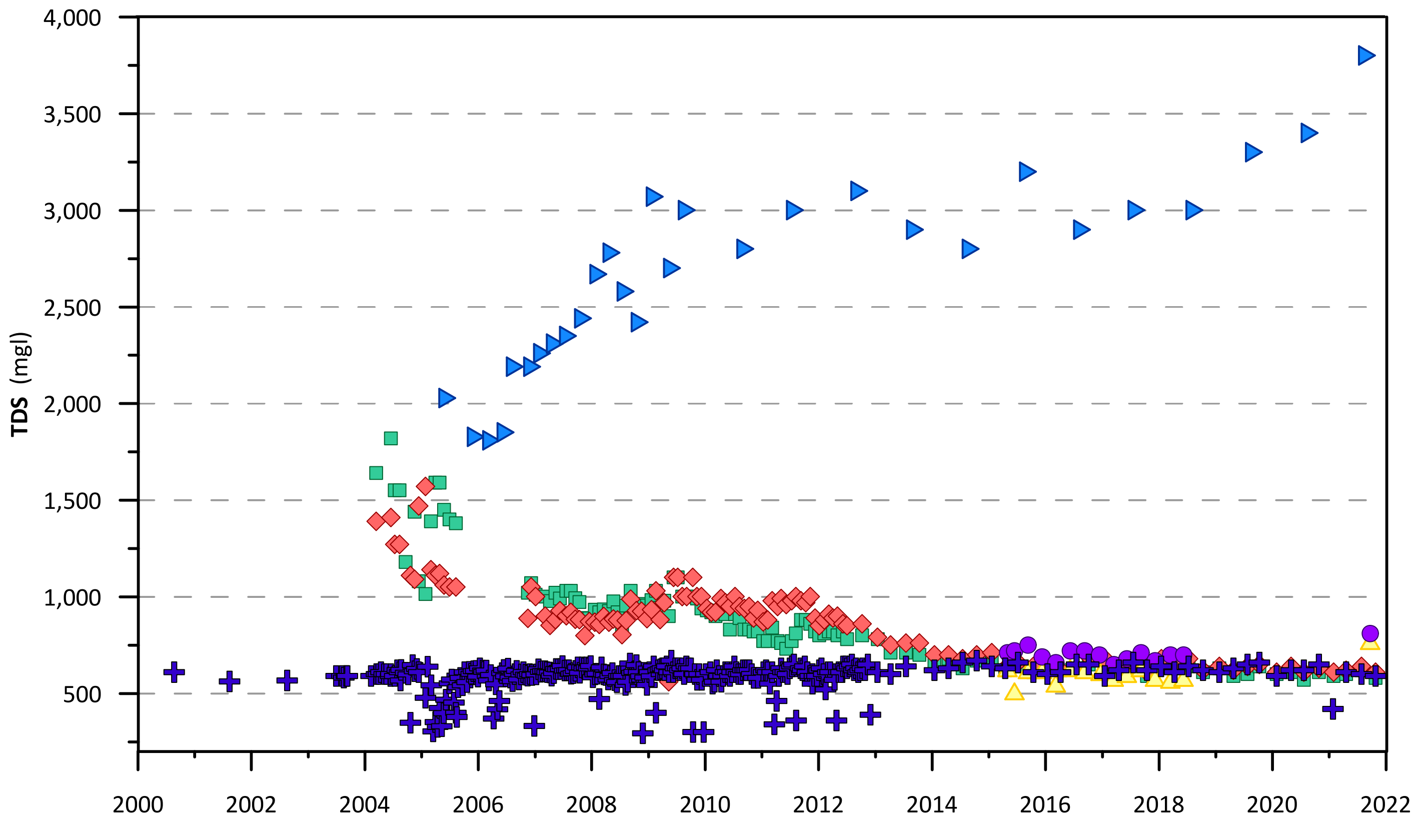
Groundwater and Surface Water Interactions
Santa Ana River Near Etiwanda

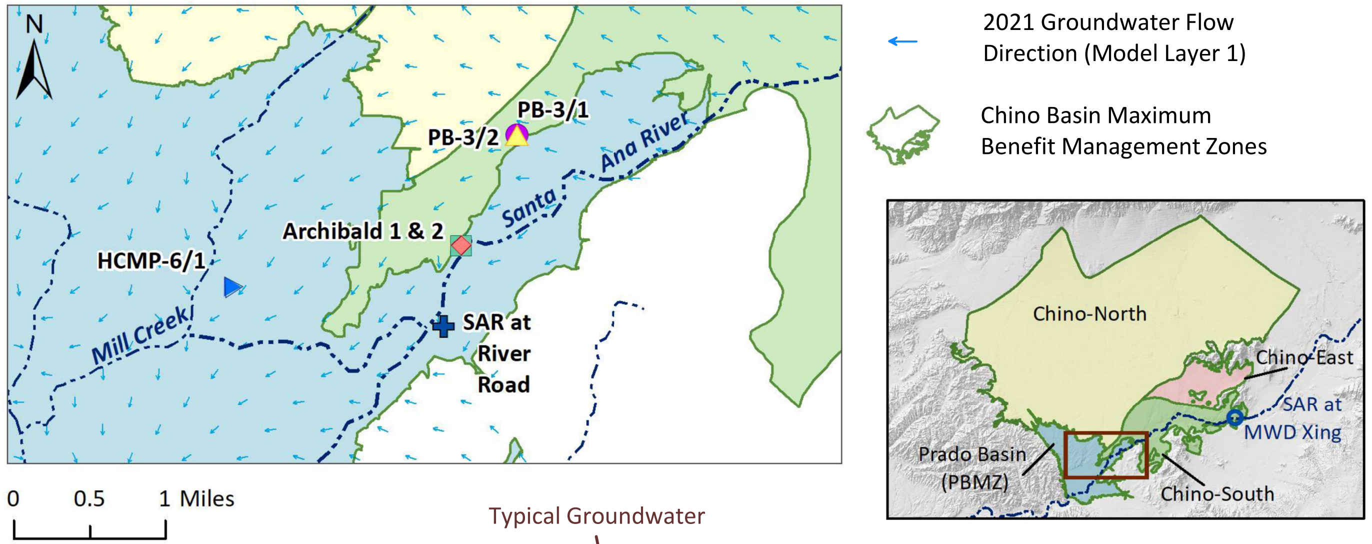
Figure 4-2a

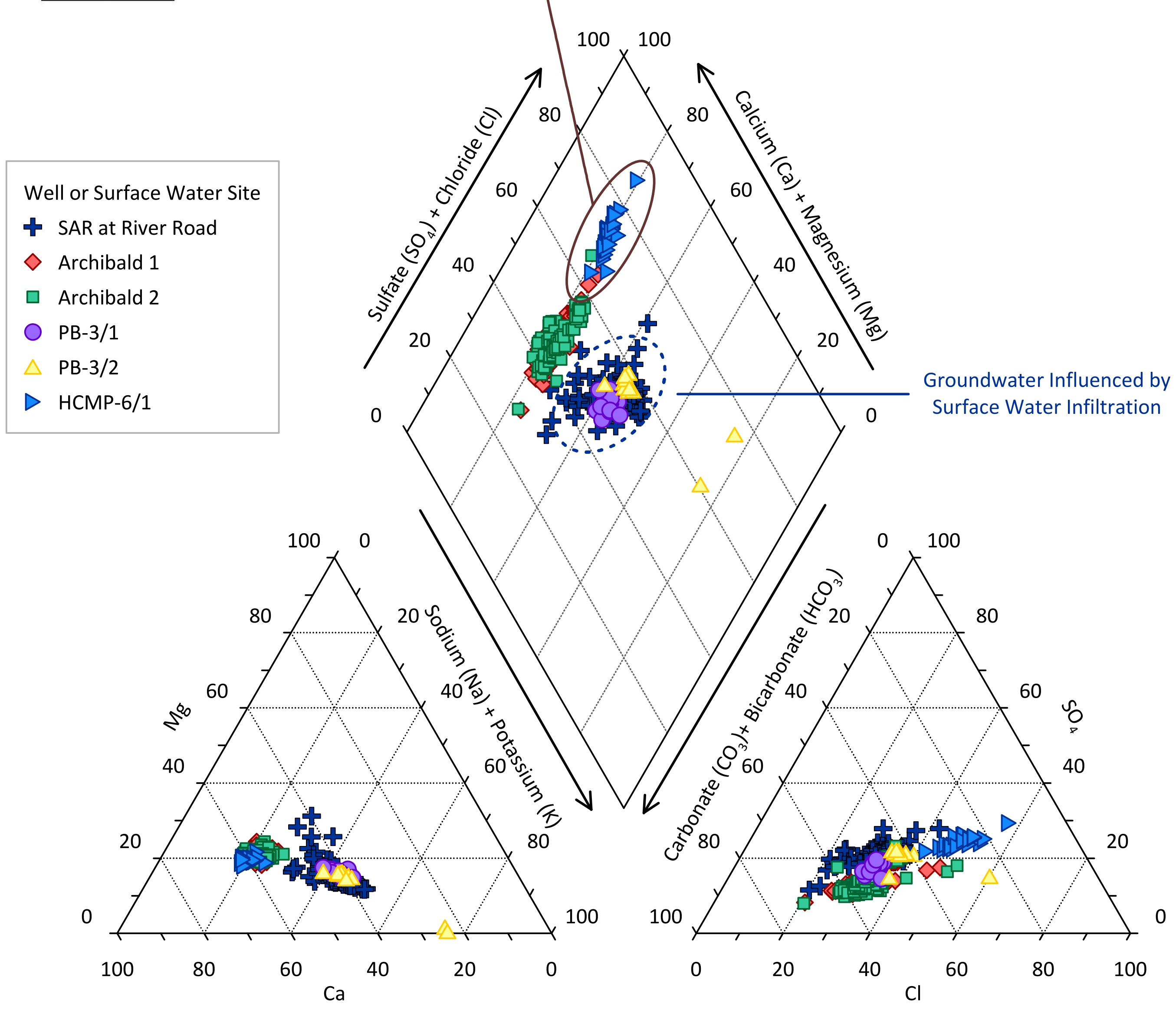
Groundwater Elevation, Thalweg Elevation, and Surface Water Discharge



TDS Concentration in Groundwater and Surface Water







Chino Basin
2021 Maximum Benefit
Annual Report

Prepared for:

Groundwater and Surface Water Interactions
Santa Ana River Near River Road

Figure 4-2b

4.3 Surface-Water Quality at Prado Dam

Rising groundwater from the Chino Basin to the Santa Ana River consists of groundwater from Chino--North that flows past the CCWF and unpumped groundwater outside of the area of influence of the Chino Basin Desalter well fields. Groundwater discharge from Chino-North to the PBMZ is either pumped by wells, consumed by riparian vegetation in the PBMZ, or becomes rising groundwater and contributes to Santa Ana River discharge at Prado Dam. Calibration of the 2008 Wasteload Allocation Model (1994-2006) estimated that rising groundwater in the PBMZ had an average TDS concentration of about 850 mgl (WEI, 2009b). This estimate is consistent with a 2015 TDS mass-balance characterization of the Santa Ana River (WEI, 2015d) and recent sampling at PBMZ monitoring wells (WEI, 2019b).

The Santa Ana River Watermaster (SARWM) has compiled annual reports pursuant to the 1969 stipulated judgment[23] that contain annual estimates of: significant discharges to the Santa Ana River, estimates of the storm flow and base flow discharge, and the volume-weighted TDS concentration of discharge at the Riverside Narrows and at Prado Dam (SARWM, 2020). These estimates are used herein to demonstrate the impact of rising groundwater outflow on the TDS concentration of the Santa Ana River at Prado Dam. Figure 4--3 is a time-history chart of the annual discharge components in the Santa Ana River at Prado Dam and the associated annual volume-weighted TDS concentrations as reported by the SARWM. The base flow discharge is represented by two bars: 1) the SARWM estimate of base flow discharge at Prado Dam minus the rising groundwater from the Chino Basin component and 2) the total rising groundwater discharge from the Chino Basin to the Santa Ana River estimated with the Watermaster's 2020 groundwater model update as shown in column 19 of Table 4-1. The sum of these two terms equal the SARWM estimate of base flow discharge at Prado Dam. Figure 4- also shows the five-year moving average of the SARWM's estimate of the annual flow-weighted TDS concentration of the Santa Ana River at Prado Dam. This five-year moving average is the metric the Regional Board uses to determine compliance with the Basin Plan TDS concentration objective of 650 mgl for Reach 2 of the Santa Ana River (Reach 2 TDS metric) (Regional Board, 2016). Note that:

- Since about 1980, annual estimates of rising groundwater discharge from the Chino Basin to the Santa Ana River, which ranged from about 13,000 to 30,000 afy, have been a small percentage of total annual flow at Prado Dam, ranging from about three percent during wet years to about 17 percent during dry years.
- From 2005 to 2015, the model-estimated groundwater discharge from Chino-North to the PBMZ ranged from 550 afy to 740 afy without the operation of the CCWF24, which represents a small fraction of the total rising groundwater from the Chino Basin to the Santa Ana River. It represents, on average, about four percent of rising groundwater discharge from the Chino Basin to the Santa Ana River, and about less than one percent of the total flow in the Santa Ana River at Prado Dam.
- In 2016, the CCWF commenced operation, further reducing the groundwater discharge from the Chino-North to the PBMZ to the de minimis threshold levels (less than 1,000 afy). The model-projected groundwater discharge past the CCWF ranges from about 400 to 630 afy in

---

[23] The Santa Ana River was adjudicated in the 1960s, and a stipulated judgment was filed in 1969 (Orange County Water District v. City of Chino et al., Case No. 117628, County of Orange). Since the Judgment was filed, the SARWM has compiled annual reports

[24] See Figure 2-3 of this report for modeling projections of groundwater discharge from Chino-North to the PBMZ past the CCWF.

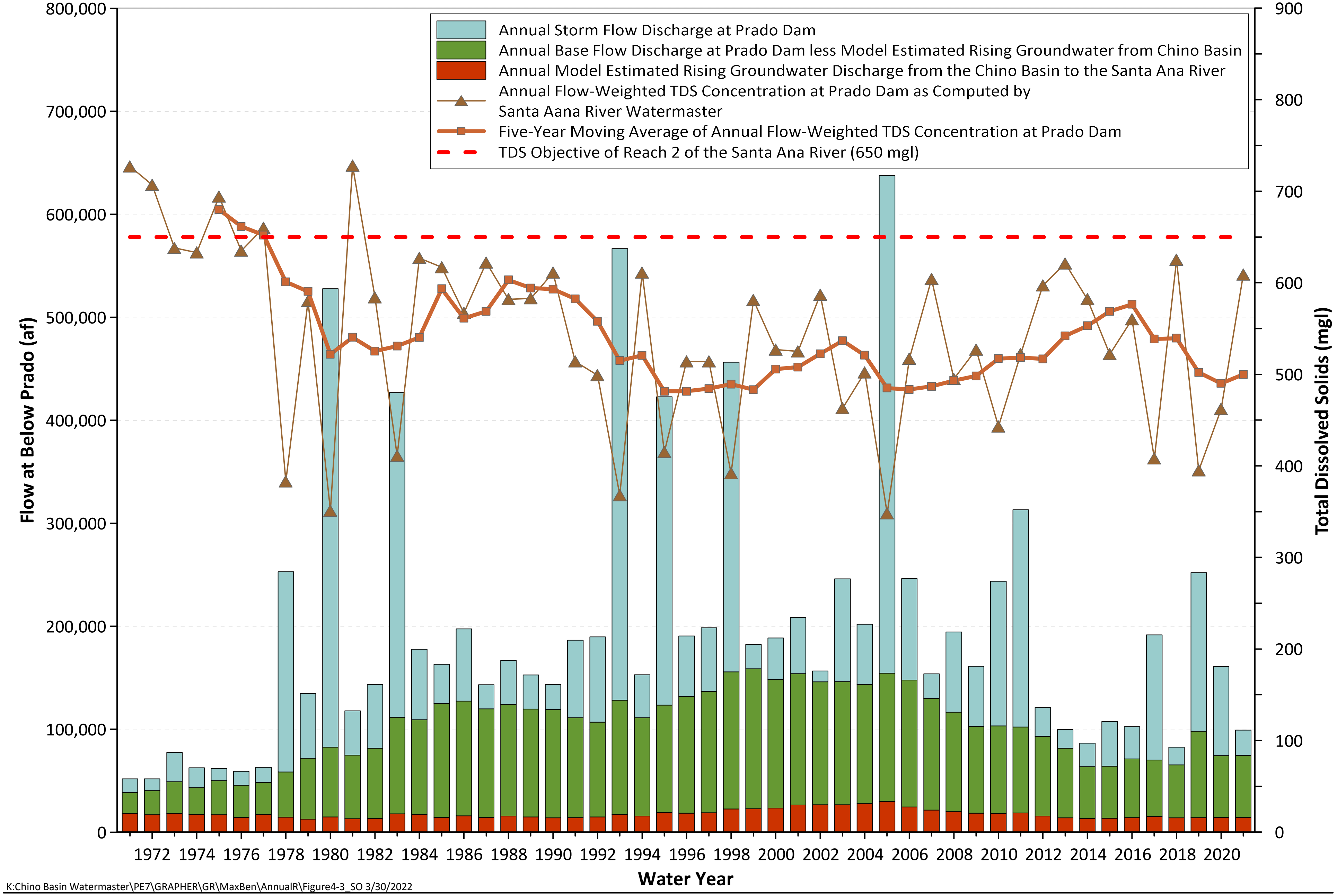
2016 through 2050.[25] This represents about three percent of the total rising groundwater discharge to the Santa Ana River from the Chino Basin, and less than one percent of the total flow in the Santa Ana River at Prado Dam.

- Since about 1980, the Reach 2 TDS metric has ranged between 481 and 603 mgl and has not exceeded the TDS objective of 650 mgl—even during extended dry periods when storm water dilution of the Santa Ana River is relatively little (e.g., water years 1984 through 1992, 1999 through 2004, and 2012 through 2016).
- The Reach 2 TDS metric increased continuously from water year 2006 to water year 2016, which coincides with a dry climatic period with a decrease in low-TDS storm water flow and a steady decrease in the volume of base flow discharge. The decrease in baseflow is mostly attributable to the decrease in wastewater discharges to the Santa Ana River.
- In water year 2021, the Reach 2 TDS metric was 500 mgl, an increase of 10 mgl from the previous year.

These observations suggest that the rising groundwater discharge from the Chino Basin to the Santa Ana River has had a *de minimis* impact on the flow and TDS concentration of the Santa Ana River since 1978 and has never contributed to an exceedance of the TDS objective for Reach 2. The groundwater discharge from the Chino-North to the PBMZ that becomes rising groundwater discharge in the Santa Ana River has historically been small compared to total discharge in the Santa Ana River and has further decreased with the operation of the CCWF. Based on the trends observed since 2005, the Reach 2 TDS metric will likely continue to increase as other conditions that affect the flow and quality of the Santa Ana River change over time, such as the continued reduction of wastewater effluent discharges to the River, and/or an increase in the duration and frequency of dry periods due to climate change. Given that wastewater effluent discharges are projected to further decline, the maintenance of hydraulic control of Chino-North will become increasingly important to protecting the water quality of the Santa Ana River at Prado Dam and downstream beneficial uses.

---

[25] See Figure 2-3 of this report for modeling projections of groundwater discharge from Chino-North to the PBMZ past the CCWF.



K:Chino Basin Watermaster\PE7\GRAPHER\GR\MaxBen\AnnualR\Figure4-3_SO 3/30/2022

Prepared by:

WEST YOST
Water. Engineered

Prepared for:

Chino Basin Watermaster and
The Inland Empire Utilities Agency
2021 Maximum Benefit
Annual Report

TDS and Components of Discharge of the
Santa Ana River at Prado Dam
Water Year 1971 to 2021

Figure 4-3

5.0 REFERENCES

Black and Veatch. (2008). *Optimum Basin Management Program, Chino Basin Dry-Year Yield Program Expansion – Project Development Report, Volumes I – IV.* December 2008.

California Regional Water Quality Control Board, Santa Ana Region. (2004). *Resolution No. R8-2004-0001 Resolution Amending the Water Quality Control Plan for the Santa Ana River Basin to Incorporate an Updated Total Dissolved Solids (TDS) and Nitrogen Management Plan for the Santa Ana Region*.

California Regional Water Quality Control Board, Santa Ana Region. (2011). *Demonstration and Monitoring of Hydraulic Control for the Chino Creek Well Field.* Letter to Chino Basin Watermaster and Inland Empire Utilities Agency dated October 12, 2011.

California Regional Water Quality Control Board, Santa Ana Region. (2012). *Resolution No. R8-2012-0026 Resolution Approving the Revised Chino Basin Maximum Benefit Surface Water and Groundwater Monitoring Program Proposals as Required in the Total Dissolved Solids and Nitrogen Management Plan Specified in the Water Quality Control Plan for the Santa Ana River Basin.*

California Regional Water Quality Control Board, Santa Ana Region. (2014a). *Chino Basin Hydraulic Control.* Letter to Chino Basin Watermaster and Inland Empire Utility Agency dated January 23, 2014.

California Regional Water Quality Control Board, Santa Ana Region. (2014b). *Consideration of Approval of a Revised Chino Basin Maximum Benefit Groundwater Monitoring Program Submitted in Compliance with the Total Dissolved Solids (TDS) and Nitrogen Management Plan Specified in the Water Quality Control Plan for the Santa Ana River Basin - Resolution No. R8-2014-0035*

California Regional Water Quality Control Board, Santa Ana Region. (2014c). *Chino Basin Hydraulic Control.* Letter to Chino Basin Watermaster and Inland Empire Utility Agency dated June 25, 2014.

California Regional Water Quality Control Board, Santa Ana Region. (2014d). *Maintenance of Hydraulic Control: Submittal of Well Operational Plan.* Letter to Chino Basin Watermaster and Inland Empire Utility Agency dated September 25, 2014.

California Regional Water Quality Control Board, Santa Ana Region. (2015). *Maintenance of Hydraulic Control: Submittal of Well Operational Plan.* Letter to Chino Basin Watermaster and Inland Empire Utility Agency dated January 6, 2015.

California Regional Water Quality Control Board, Santa Ana Region. (2016). *Water Quality Control Plan Santa Ana River Basin (Region 8) 1995*. Updated February 2016.

California Regional Water Quality Control Board, Santa Ana Region. (2021). *Request for Update of the Chino Basin Watermaster and Inland Empire Utilities Agency 2005 Proposal for Mitigation of Temporary Loss of Hydraulic Control of the Chino Basin*. Letter from the Regional Board. September 2021.

Chino Basin Municipal Water District v. City of Chino et al., San Bernardino Superior Court, No. 164327. (1978).

Chino Basin Watermaster and the Inland Empire Utility Agency (2014a) *RE: Chino Basin Desalter Authority Expansion Schedule.* Letter to the Regional Water Quality Control Board dated May 30, 2014.

Chino Basin Watermaster and the Inland Empire Utility Agency (2014b) *Maintenance of Hydraulic Control.* Letter to the Regional Water Quality Control Board dated September 23, 2014.

Chino Basin Watermaster and the Inland Empire Utility Agency (2014c) *Maintenance of Hydraulic Control.* Letter to the Regional Water Quality Control Board dated December 24, 2014.

Chino Basin Watermaster and the Inland Empire Utility Agency (2015) *Maintenance of Hydraulic Control: Submittal of Well Operational Plan.* Letter to the Regional Water Quality Control Board dated June 30, 2015.

Daniel B. Stephens & Associates, Inc. (2017). *Recomputation of Ambient Water Quality in the Santa Ana River Watershed for the Period 1996 to 2015*. Prepared for the Santa Ana Watershed Project Authority Basin Monitoring Program Task Force Under contract to CDM Smith, dated September 22, 2017.

James M. Montgomery, Consulting Engineers, Inc. (1991). *Nitrogen and TDS Studies, Santa Ana Watershed*.

Montgomery Watson. (1995). *Chino Basin Water Resources Management Study.*

Santa Ana River Watermaster. (2020). *Forty Seventh Annual Report of the Santa Ana River Watermaster for Water Year October 1, 2018 – September 30, 2019*. Prepared for Orange County Water District v. City of Chino, et al. Case No. 117628 – County of Orange.

US EPA. (1998). *EPA Guidance for Quality Assurance Project Plans*. EPA QA/G-5. Office of Research and Development. EPA/600/R-98/018.

WSC. (2020). Recomputation of Ambient Water Quality in the Santa Ana River Watershed for the Period 1999 to 2018. Prepared for Santa Ana Watershed Project Authority – Basin Monitoring Program Task Force. July 8, 2020.

Watson, I., & Burnett, A. (1995). H*ydrology: An Environmental Approach*. Boca Raton: CRC Press.

West Yost. (2021a). *Optimum Basin Management Program 2020 State of the Basin Report.* Prepared for the Chino Basin Watermaster. June 2021.

West Yost. (2021b). *Chino Basin Maximum Benefit Monitoring Program 2020 Annual Report. Prepared for the Chino Basin Watermaster and the Inland Empire Utilities Agency.* April 15, 2021.

Wildermuth, M.J. (1993). *Letter Report to Montgomery Watson regarding the Combined Well Field for the Chino Basin Desalter*. September 21, 1993.

Wildermuth Environmental, Inc. (1999). *Optimum Basin Management Program. Phase I Report*. Prepared for the Chino Basin Watermaster.

Wildermuth Environmental, Inc. (2000). *TIN/TDS Phase 2A: Tasks 1 through 5, TIN/TDS Study of the Santa Ana Watershed, Technical Memorandum*.

Wildermuth Environmental, Inc. (2002). *Optimum Basin Management Program, Draft Final Initial State of the Basin Report*. Prepared for the Chino Basin Watermaster.

Wildermuth Environmental, Inc. (2004a). *Draft Chino Basin Maximum Benefit Implementation Plan for Salt Management and Commitments from the Chino Basin Watermaster and Inland Empire Utilities Agency.* Letter to the Santa Ana Regional Water Quality Control Board dated February 20. 2004.

Wildermuth Environmental, Inc. (2004b). *Optimum Basin Management Program, Final Hydraulic Control Monitoring Program Work Plan.* Prepared for the Chino Basin Watermaster and the Inland Empire Utilities Agency. May 2004.

Wildermuth Environmental, Inc. (2005). *Optimum Basin Management Program, State of the Basin Report–2004.* Prepared for the Chino Basin Watermaster.

Wildermuth Environmental, Inc. (2006a). *Chino Basin Maximum Benefit Monitoring Program 2005 Annual Report*. Prepared for the Chino Basin Watermaster and the Inland Empire Utilities Agency. April 15, 2006.

Wildermuth Environmental, Inc. (2006b). *Draft Report, Analysis of Future Replenishment and Desalter Plans Pursuant to the Peace Agreement and Peace II Process*. Prepared for the Chino Basin Watermaster.

Wildermuth Environmental, Inc. (2006c). *Draft Report, Addendum to the Draft April 2006 Report, Analysis of Future Replenishment and Desalter Plans Pursuant to the Peace Agreement and Peace II Process.* Prepared for the Chino Basin Watermaster.

Wildermuth Environmental, Inc. (2007a). *Chino Basin Groundwater Model Documentation and Evaluation of the Peace II Project Description*.

Wildermuth Environmental, Inc. (2007b). *Chino Basin Maximum Benefit Monitoring Program 2006 Annual Report*. Prepared for the Chino Basin Watermaster and Inland Empire Utilities Agency. April 15, 2007.

Wildermuth Environmental, Inc. (2007c). *Optimum Basin Management Program, State of the Basin Report–2006*. Prepared for the Chino Basin Watermaster.

Wildermuth Environmental, Inc. (2007d). *Letter to Kenneth R. Manning - Evaluation of Alternative 1C and Declining Safe Yield*.

Wildermuth Environmental, Inc. (2008a*). Response to Condition Subsequent No. 3 from the Order Confirming Motion for Approval of the Peace II*. Prepared for the Chino Basin Watermaster.

Wildermuth Environmental, Inc. (2008b). Chino Basin Maximum Benefit Monitoring Program 2007 Annual Report. Prepared for the Chino Basin Watermaster and the Inland Empire Utilities Agency. April 15, 2008.

Wildermuth Environmental, Inc. (2009a). *Chino Basin Maximum Benefit Monitoring Program 2008 Annual Report*. Prepared for the Chino Basin Watermaster and the Inland Empire Utilities Agency. April 15, 2009.

Wildermuth Environmental, Inc. (2009b). *2004 Basin Plan Amendment Required Monitoring and Analyses, 2008 Santa Ana River Wasteload Allocation Model Report*. Prepared for Basin Monitoring Program Task Force.

Wildermuth Environmental, Inc. (2009c). *Chino Basin Optimum Basin Management Program, State of the Basin Report–2008*. Prepared for the Chino Basin Watermaster. November 2009.

Wildermuth Environmental, Inc. (2009d). *2009 Production Optimization and Evaluation of the Peace II Project Description*. Prepared for the Chino Basin Watermaster. November 25, 2009.

Wildermuth Environmental, Inc. (2010). *Chino Basin Maximum Benefit Monitoring Program 2009 Annual Report*. Prepared for the Chino Basin Watermaster and the Inland Empire Utilities Agency. April 15, 2010.

Wildermuth Environmental, Inc. (2011a). *Chino Basin Maximum Benefit Monitoring Program 2010 Annual Report*. Prepared for the Chino Basin Watermaster and the Inland Empire Utilities Agency. April 15, 2011.

Wildermuth Environmental, Inc. (2011b). *TIN/TDS*: Recomputation of Ambient Water Quality in the Santa Ana Watershed for the Period 1990 to 2009. Technical Memorandum. August 2011.

Wildermuth Environmental, Inc. (2011c). *Optimum Basin Management Program 2010 State of the Basin Atlas*. Prepared for the Chino Basin Watermaster. December 2011.

Wildermuth Environmental, Inc. (2012a). *Optimum Basin Management Program, Hydraulic Control Monitoring Program 2012 Work Plan.* February 2012.

Wildermuth Environmental, Inc. (2012b). *Optimum Basin Management Program Chino Basin Maximum Benefit Annual Report* 2011. Prepared for the Chino Basin Watermaster and the Inland Empire Utilities Agency. April 15, 2012.

Wildermuth Environmental, Inc. (2013a). *Chino Basin Maximum Benefit Monitoring Program 2012 Annual Report*. Prepared for the Chino Basin Watermaster and the Inland Empire Utilities Agency. April 15, 2013.

Wildermuth Environmental, Inc. (2013b). *Optimum Basin Management Program 2012 State of the Basin Atlas*. Prepared for the Chino Basin Watermaster. June 2013.

Wildermuth Environmental, Inc. (2013c). *Optimum Basin Management Program, Maximum Benefit Monitoring Program 2014 Work Plan.* December 23, 2013.

Wildermuth Environmental, Inc. (2014a). *2013 Chino Basin Groundwater Model Update and Recalculation of Safe Yield Pursuant to the Peace Agreement. Draft Report.* January 2014.

Wildermuth Environmental, Inc. (2014b). *Chino Basin Maximum Benefit Monitoring Program 2013 Annual Report*. Prepared for the Chino Basin Watermaster and the Inland Empire Utilities Agency. April 15, 2014.

Wildermuth Environmental, Inc. (2014c). *TIN/TDS*: Recomputation of Ambient Water Quality in the Santa Ana Watershed for the Period 1993 to 2012. Technical Memorandum. August 2014.

Wildermuth Environmental, Inc. (2015a). *Chino Basin Maximum Benefit Monitoring Program 2014 Annual Report*. Prepared for the Chino Basin Watermaster and the Inland Empire Utilities Agency. April 15, 2015.

Wildermuth Environmental, Inc. (2015b). *Optimum Basin Management Program 2014 State of the Basin Report*. Prepared for the Chino Basin Watermaster. June 2015.

Wildermuth Environmental, Inc. (2015c). *2013 Chino Basin Groundwater Model Update and Recalculation of Safe Yield Pursuant to the Peace Agreement - Final Report*. Prepared for the Chino Basin Watermaster. October 2015.

Wildermuth Environmental, Inc. (2015d). *Investigation and Characterization of the Cause(s) of Recent Exceedances of the TDS Concentration Objective for Reach 3 of the Santa Ana River.* Prepared for the Santa Ana Watershed Project Authority. February 2015.

Wildermuth Environmental, Inc. (2016). *Chino Basin Maximum Benefit Monitoring Program 2015 Annual Report*. Prepared for the Chino Basin Watermaster and the Inland Empire Utilities Agency. April 15, 2016.

Wildermuth Environmental, Inc. (2017). *Chino Basin Maximum Benefit Monitoring Program 2016 Annual Report*. Prepared for the Chino Basin Watermaster and the Inland Empire Utilities Agency. April 15, 2017.

Wildermuth Environmental, Inc. (2018). *Chino Basin Maximum Benefit Monitoring Program 2017 Annual Report*. Prepared for the Chino Basin Watermaster and the Inland Empire Utilities Agency. April 15, 2018.

Wildermuth Environmental, Inc. (2019a). *Storage Framework Investigation Final Report.* Prepared for the Chino Basin Watermaster. October 2018; amended January 2019.

Wildermuth Environmental, Inc. (2019b). *Annual Report of the Prado Basin Habitat Sustainability Committee – Water Year 2018.* June 5, 2019.

Wildermuth Environmental, Inc. (2020). *2020 Safe Yield Recalculation Report.* May 2020.

Appendix A

Quarterly Pumping and Export of TDS and Nitrate by the Chino Basin Desalters from 2004 to 2021 (Digital)

Appendix B

The IEUA Five-Year, Volume-Weighted TDS and TIN Computation for Managed Aquifer Recharge

Table No. 1: TDS and NO_3-N Data Table

	Volume (acre-feet)				TDS (mg/L)					NO_3-N (mg/L)				
Month	SW/LR	IW	RW	Total	SW/LR (Mean)	IW	RW	Σ (Vol x TDS)	5-yr Avg	SW/LR (Mean)	IW	RW*	Σ (Vol x TDS)	5-yr Avg
Jul-05	647	1,488	20	2,155	129	189	458	373809		2.9	0.6	2.3	2885	
Aug-05	137	1,545	254	1,936	129	174	447	399909		2.9	0.5	1.6	1564	
Sep-05	299	2,763	268	3,329	129	191	467	691278		2.9	0.4	2.1	2634	
Oct-05	876	2,313	150	3,340	129	205	459	656175		2.9	0.3	1.5	3529	
Nov-05	344	3,567	100	4,010	129	202	455	810393		2.9	0.5	1.8	2800	
Dec-05	669	3,617	77	4,362	129	223	475	929286		2.9	0.6	2.1	4408	
Jan-06	762	3,548	154	4,463	177	276	483	1188208		1.1	0.8	2.8	4015	
Feb-06	1,679	3,467	209	5,355	177	207	451	1109014		1.1	0.8	2.7	5287	
Mar-06	3,177	2,043	0	5,219	95	193	443	697408		0.5	0.8	2.9	3297	
Apr-06	3,337	2,568	0	5,905	115	173	437	827652		0.8	0.6	4.2	4182	
May-06	857	3,190	0	4,046	115	149	442	573690		0.8	0.4	5.4	2025	
Jun-06	216	3,597	73	3,886	115	128	488	520838		0.8	0.3	3.3	1460	
Jul-06	156	956	449	1,561	115	144	455	359551		0.8	0.3	2.3	1459	
Aug-06	182	4,467	619	5,269	115	173	454	1074838		0.8	0.3	2.1	2955	
Sep-06	273	6,749	616	7,638	115	177	427	1488730		0.8	0.4	2.5	4197	
Oct-06	300	6,150	224	6,675	115	170	435	1177526		0.8	0.3	3.6	2969	
Nov-06	296	5,257	93	5,646	115	158	436	905165		0.8	0.5	2.9	2989	
Dec-06	697	5,429	260	6,386	115	271	447	1667416		2.5	0.6	3.4	5918	
Jan-07	543	3,201	160	3,904	115	247	466	927308		2.5	0.8	3.3	4413	
Feb-07	1,140	706	130	1,976	115	301	464	403809		2.5	0.9	4.0	3989	
Mar-07	200	48	117	365	115	295	477	93031		2.5	1.0	3.0	895	
Apr-07	532	4	130	666	115	275	470	123292		2.5	1.0	2.8	1698	
May-07	245	0	182	427	115	244	481	115621		2.5	0.8	4.8	1487	
Jun-07	206	0	10	216	115	249	478	28445		2.5	0.5	3.0	543	
Jul-07	141	0	141	282	329	254	492	115864		0.9	0.5	3.9	683	
Aug-07	197	0	78	275	329	207	475	101948		0.9	0.5	3.3	444	
Sep-07	218	0	143	361	329	220	481	140613		0.9	0.3	3.4	690	
Oct-07	285	0	132	417	366	272	542	175777		0.7	0.4	4.9	865	
Nov-07	915	0	346	1,261	366	278	497	506679		0.7	0.6	3.1	1757	
Dec-07	1,481	0	53	1,534	130	278	506	219871		1.7	0.8	3.8	2667	
Jan-08	4,558	0	1	4,559	86	271	493	392987		0.7	0.9	4.6	3337	
Feb-08	1,427	0	196	1,623	101	248	450	232422		1.5	1.0	3.8	2878	
Mar-08	155	0	360	515	101	275	456	179969		1.5	1.1	3.0	1303	
Apr-08	150	0	260	410	101	281	483	140669		1.5	1.3	3.8	1208	
May-08	588	0	369	957	376	284	481	398503		0.7	0.9	4.8	2190	
Jun-08	128	0	261	389	376	285	490	175914		0.7	0.8	5.8	1612	
Jul-08	142	0	291	433	376	290	489	195594		0.7	0.7	6.0	1854	
Aug-08	111	0	245	356	382	281	465	156409		0.5	0.7	4.0	1027	
Sep-08	99	0	86	185	382	272	467	78001		0.5	0.4	4.6	442	
Oct-08	161	0	395	556	382	279	487	253867		0.5	0.5	6.5	2650	
Nov-08	677	0	229	906	432	289	461	398131		0.6	0.6	3.5	1198	
Dec-08	2,363	0	88	2,451	112	289	446	304660		1.1	0.7	4.2	3031	
Jan-09	224	0	356	580	112	287	464	190341		1.1	0.7	3.9	1625	
Feb-09	3,080	0	52	3,132	66	289	413	224746		0.5	0.8	3.3	1698	
Mar-09	299	0	182	481	66	272	434	98661		0.5	0.6	2.6	612	
Apr-09	106	0	311	417	66	273	463	151093		0.5	0.6	2.4	795	
May-09	79	0	156	235	379	284	468	102878		0.5	0.5	2.4	416	
Jun-09	153	0	293	446	379	287	479	198306		0.5	0.5	4.6	1411	
Jul-09	107	0	90	197	379	324	465	82368		0.5	0.6	3.2	344	
Aug-09	113	0	200	313	292	254	446	122229		0.2	0.4	2.9	594	
Sep-09	108	0	296	404	292	235	447	163848		0.2	0.1	2.8	841	
Oct-09	614	17	807	1,438	189	255	455	487420		1.4	0.2	2.9	3205	
Nov-09	489	3	1,210	1,702	189	287	444	629794		1.4	0.5	2.8	4026	
Dec-09	2,851	0	563	3,414	100	255	441	532946		1.0	0.7	2.5	4262	

Table No. 1: TDS and NO_3-N Data Table

	Volume (acre-feet)				TDS (mg/L)					NO_3-N (mg/L)				
Month	SW/LR	IW	RW	Total	SW/LR (Mean)	IW	RW	**Σ (Vol x TDS)**	5-yr Avg	SW/LR (Mean)	IW	RW*	**Σ (Vol x TDS)**	5-yr Avg
Jan-10	4,190	0	473	4,663	68	244	444	496489		0.6	0.7	2.4	3751	
Feb-10	3,715	6	167	3,888	94	235	418	420493		1.3	0.7	3.3	5281	
Mar-10	593	0	612	1,205	94	220	419	311908		1.3	0.8	3.1	2658	
Apr-10	1,156	365	617	2,138	94	220	417	446130		1.3	0.9	2.6	3421	
May-10	179	2,433	1,185	3,797	270	235	423	1121340		0.9	0.8	2.8	5436	
Jun-10	159	2,176	990	3,325	270	232	433	976102	203	0.9	0.6	3.0	4391	1.1
Jul-10	164	0	748	912	270	245	442	374597	205	0.9	0.6	3.2	2544	1.1
Aug-10	183	0	718	901	270	234	434	360817	207	0.9	0.5	3.7	2838	1.1
Sep-10	190	0	836	1,026	309	193	423	411920	208	0.4	0.2	3.6	3088	1.1
Oct-10	670	0	923	1,593	309	244	440	612919	210	0.4	0.1	3.9	3917	1.1
Nov-10	1,156	0	773	1,929	100	267	450	463450	211	1.0	0.4	4.1	4277	1.2
Dec-10	7,036	0	262	7,298	240	248	430	1797782	213	0.7	0.5	3.8	6238	1.1
Jan-11	1,695	0	478	2,173	240	215	430	611254	212	0.7	0.7	4.2	3273	1.2
Feb-11	2,395	0	407	2,802	240	166	422	745176	214	0.7	0.7	4.4	3579	1.2
Mar-11	2,673	0	188	2,861	150	157	413	478632	216	2.2	0.5	4.6	6738	1.2
Apr-11	399	0	751	1,150	150	163	411	368605	221	2.2	0.6	4.6	4313	1.3
May-11	323	3,729	997	5,049	150	143	422	1002210	222	2.2	0.3	3.3	5282	1.3
Jun-11	167	5,736	984	6,887	275	124	422	1172590	222	0.1	0.2	3.4	4521	1.3
Jul-11	244	7,810	706	8,760	275	135	412	1412035	218	0.1	0.5	3.1	5715	1.2
Aug-11	97	7,138	486	7,721	305	129	418	1153623	215	0.8	0.4	2.8	4185	1.2
Sep-11	163	7,529	639	8,331	305	151	413	1450791	213	0.8	0.3	3.8	4772	1.2
Oct-11	888	83	924	1,895	305	136	418	668564	217	0.8	0.2	4.1	4490	1.3
Nov-11	1,174	0	648	1,822	95	135	412	378506	220	1.1	0.3	3.9	3767	1.3
Dec-11	538	0	870	1,408	69	138	411	394455	218	1.1	0.4	4.8	4779	1.4
Jan-12	926	0	826	1,752	73	174	422	416352	218	0.7	0.5	4.8	4600	1.4
Feb-12	1,166	0	664	1,830	73	230	436	374306	218	0.7	0.5	4.3	3698	1.4
Mar-12	2,117	0	381	2,498	73	281	451	325796	216	0.7	0.5	3.4	2825	1.4
Apr-12	1,625	0	367	1,992	73	268	454	285010	215	0.7	0.5	3.9	2598	1.4
May-12	177	0	1,171	1,348	421	282	466	620049	217	1.6	0.7	3.8	4712	1.4
Jun-12	151	0	952	1,103	421	257	454	495353	220	1.6	0.5	3.3	3420	1.4
Jul-12	216	0	547	763	421	249	443	333110	221	1.6	0.5	3.2	2085	1.4
Aug-12	186	0	322	508	371	213	438	209899	221	0.7	0.3	3.3	1173	1.4
Sep-12	154	0	481	635	371	194	439	268173	222	0.7	0.2	3.7	1883	1.4
Oct-12	338	0	615	953	371	223	455	405346	222	0.7	0.1	3.6	2441	1.4
Nov-12	388	0	921	1,309	371	296	456	564333	223	0.7	0.2	4.3	4175	1.4
Dec-12	1928	0	576	2,504	176	270	461	604864	224	4.9	0.3	3.9	11654	1.5
Jan-13	713	0	1,284	1,997	66	274	466	645687	231	0.6	0.6	4.8	6556	1.6
Feb-13	579	0	1,107	1,686	96	284	454	558439	233	1.4	0.8	4.9	6185	1.6
Mar-13	449	0	1,387	1,836	54	300	472	678910	235	0.1	1.1	4.6	6370	1.6
Apr-13	75	0	1,113	1,188	54	303	471	527969	236	0.1	1.0	4.6	5117	1.6
May-13	204	0	1,052	1,256	394	291	471	575868	237	0.1	0.8	4.4	4652	1.6
Jun-13	68	0	1,074	1,142	394	288	486	548488	239	0.1	0.5	3.4	3698	1.7
Jul-13	108	0	876	984	394	288	469	453794	240	0.1	0.3	3.3	2914	1.7
Aug-13	98	0	930	1,028	394	264	466	471527	241	0.1	0.0	3.9	3669	1.7
Sep-13	112	0	1449	1,561	360	249	476	730624	243	1.7	0.1	4.3	6359	1.7
Oct-13	242	0	1441	1,683	360	274	469	762469	245	1.7	0.0	4.7	7255	1.7
Nov-13	394	0	1307	1,701	360	299	483	772794	247	1.7	0.1	4.5	6561	1.7
Dec-13	414	0	1374	1,788	140	302	495	738433	251	1.1	0.4	4.6	6798	1.8

Table No. 1: TDS and NO_3-N Data Table

	Volume (acre-feet)				TDS (mg/L)					NO_3-N (mg/L)				
Month	SW/LR	IW	RW	Total	SW/LR (Mean)	IW	RW	**Σ (Vol x TDS)**	5-yr Avg	SW/LR (Mean)	IW	RW*	**Σ (Vol x TDS)**	5-yr Avg
Jan-14	196	195	997	1,388	140	305	493	578128	253	1.1	0.5	4.5	4805	1.8
Feb-14	1,274	235	848	2,357	132	306	497	661107	257	1.5	0.6	4.5	5879	1.8
Mar-14	665	282	782	1,729	245	314	467	616698	259	0.6	0.9	4.6	4239	1.9
Apr-14	589	72	1,177	1,838	245	309	496	749989	261	0.6	0.8	4.2	5349	1.9
May-14	131	11	1,322	1,464	369	305	500	712383	263	1.1	0.8	3.8	5203	1.9
Jun-14	76	0	1,090	1,166	369	294	486	557325	264	1.1	0.6	3.3	3708	1.9
Jul-14	67	0	574	641	369	292	470	294238	265	1.1	0.6	2.8	1676	1.9
Aug-14	195	0	825	1,020	369	307	481	468433	266	1.1	0.4	3.2	2887	1.9
Sep-14	163	0	1145	1,308	339	331	514	643986	268	0.9	0.3	3.9	4641	1.9
Oct-14	87	0	1247	1,334	339	340	522	680739	269	0.9	0.4	3.1	3968	1.9
Nov-14	903	0	864	1,767	130	342	548	590670	269	0.2	0.4	4.1	3686	1.9
Dec-14	3820	0	126	3,946	73	346	544	345444	266	0.8	0.5	4.9	3488	1.9
Jan-15	676	0	623	1,299	246	334	513	485557	273	1.0	0.7	5.4	4011	2.0
Feb-15	729	0	954	1,683	102	338	527	576798	279	1.8	0.8	4.3	5375	2.0
Mar-15	339	0	1,123	1,462	102	327	506	602367	280	1.8	0.8	4.0	5067	2.0
Apr-15	327	0	994	1,321	102	308	507	537312	283	1.8	0.9	4.4	5008	2.0
May-15	660	0	1,069	1,729	102	316	506	608234	283	1.8	0.8	4.9	6383	2.1
Jun-15	30	0	1,296	1,326	327	318	495	651848	285	1.0	0.6	3.4	4494	2.1
Jul-15	702	0	750	1,452	327	323	482	590867	286	1.0	1.0	3.8	3514	2.1
Aug-15	79	0	705	784	327	329	475	360708	286	1.0	0.3	3.5	2565	2.1
Sep-15	1,078	0	1,125	2,203	280	345	480	841340	287	0.2	0.2	3.8	4498	2.1
Oct-15	732	0	1,278	2,010	280	358	474	810732	287	0.2	0.1	3.8	5009	2.1
Nov-15	300	0	806	1,106	280	356	476	467334	289	0.2	0.1	4.2	3422	2.1
Dec-15	1,112	0	1,333	2,445	65	354	470	698826	291	1.7	0.3	4.8	8283	2.2
Jan-16	2,398	0	1,042	3,440	46	367	465	595099	288	0.6	0.7	5.7	7209	2.2
Feb-16	478	0	1,352	1,830	46	361	472	660132	290	0.6	0.7	4.5	6337	2.2
Mar-16	1,519	0	858	2,377	99	359	504	582813	292	1.0	0.9	4.0	4977	2.2
Apr-16	317	0	1,162	1,479	291	336	492	664347	293	2.4	0.8	4.1	5529	2.2
May-16	468	0	1,525	1,993	291	268	488	880267	300	2.4	0.6	3.7	6789	2.3
Jun-16	45	0	1,286	1,331	291	338	486	637463	310	2.4	0.5	3.2	4269	2.4
Jul-16	43	0	944	987	291	305	479	464231	323	2.4	0.3	3.8	3711	2.6
Aug-16	64	0	1,057	1,121	291	262	480	526390	338	2.4	0.1	4.5	4961	2.8
Sep-16	87	0	1,447	1,534	303	194	466	699940	354	0.2	0.1	4.6	6602	3.0
Oct-16	405	4160	1,345	5,910	180	208	461	1558536	349	2.9	0.1	4.5	7761	2.9
Nov-16	591	40	1,432	2,063	163	288	454	758363	352	1.3	0.2	4.3	6861	2.9
Dec-16	3,389	60	860	4,309	92	306	479	741934	345	0.9	0.2	4.1	6591	2.8
Jan-17	4712	0	431	5,143	86	292	479	609244	336	0.5	0.3	4.5	4419	2.7
Feb-17	1846	0	542	2,388	86	240	454	403660	334	0.5	0.6	4.8	3571	2.7
Mar-17	136	0	1598	1,734	86	170	441	715947	340	0.5	0.8	3.7	6018	2.8
Apr-17	81	1551	1517	3,149	86	130	441	877108	342	0.5	0.5	3.4	5987	2.8
May-17	194	0	1620	1,814	324	132	437	770616	342	0.5	0.3	3.4	5554	2.8
Jun-17	26	6319	1141	7,486	324	94	435	1099173	328	0.5	0.2	3.2	4905	2.6
Jul-17	68	7346	952	8,366	324	87	417	1057919	314	0.5	0.2	4.1	5800	2.5
Aug-17	317	7068	932	8,317	324	102	423	1217994	302	0.5	0.2	4.9	6453	2.4
Sep-17	53	3794	1307	5,154	267	115	415	992861	298	0.7	0.2	5.0	7428	2.3
Oct-17	83	4477	1433	5,993	267	121	396	1131570	292	0.7	0.2	4.2	7231	2.3
Nov-17	32	2480	1413	3,926	267	179	430	1060282	290	0.7	0.4	4.5	7422	2.3
Dec-17	23	4768	1591	6,381	306	176	424	1521360	289	2.2	0.5	4.0	8937	2.2

Table No. 1: TDS and NO_3-N Data Table

	Volume (acre-feet)				TDS (mg/L)					NO_3-N (mg/L)				
Month	SW/LR	IW	RW	Total	SW/LR (Mean)	IW	RW	Σ (Vol x TDS)	5-yr Avg	SW/LR (Mean)	IW	RW*	Σ (Vol x TDS)	5-yr Avg
Jan-18	1514	4130	701	6,344	306	197	438	1583606	287	2.2	0.6	3.4	8126	2.1
Feb-18	428	0	998	1,426	148	254	461	523722	287	1.4	0.7	3.4	3960	2.1
Mar-18	1832	0	310	2,142	43	282	476	226292	283	1.3	0.7	3.4	3422	2.1
Apr-18	105	0	1105	1,210	43	262	456	508798	283	1.3	0.5	3.3	3799	2.1
May-18	122	0	1447	1,569	43	282	477	695296	283	1.3	0.5	3.1	4632	2.1
Jun-18	42	62	1321	1,425	419	236	470	653092	283	0.7	0.3	2.8	3739	2.1
Jul-18	82	60	1176	1,318	419	237	466	596863	284	0.7	0.1	3.0	3642	2.1
Aug-18	36	0	1397	1,432	382	240	457	652387	284	0.3	0.1	3.1	4293	2.1
Sep-18	43	0	1477	1,520	382	201	442	669458	284	0.3	0.1	3.3	4923	2.1
Oct-18	369	0	898	1,267	382	227	460	553690	283	0.3	0.1	3.1	2921	2.1
Nov-18	959	0	1168	2,128	205	272	480	757967	282	1.3	0.2	3.0	4761	2.0
Dec-18	1219	0	945	2,164	153	280	454	615408	281	0.2	0.3	3.2	3263	2.0
Jan-19	3079	19	657	3,754	153	269	472	785796	278	0.2	0.3	3.4	2862	2.0
Feb-19	3932	106	9	4,047	153	230	429	629649	275	0.2	0.5	3.2	867	1.9
Mar-19	2177	192	512	2,881	153	262	438	607781	273	0.2	0.4	3.3	2189	1.9
Apr-19	139	1068	1080	2,286	153	165	435	667610	271	0.2	0.5	2.9	3682	1.9
May-19	796	447	955	2,197	250	207	449	719663	270	0.5	0.2	2.9	3259	1.9
Jun-19	31	4896	1270	6,197	250	242	457	1772872	269	0.5	0.3	2.2	4128	1.8
Jul-19	31	4620	1123	5,774	384	152	416	1180771	266	0.4	0.3	2.7	4476	1.8
Aug-19	54	4841	995	5,890	384	126	420	1048907	262	3.9	0.2	2.6	3957	1.7
Sep-19	32	2165	1134	3,331	384	170	423	859840	260	3.9	0.1	2.9	3732	1.7
Oct-19	38	1813	1614	3,465	384	135	412	923797	258	3.9	0.2	2.8	5008	1.7
Nov-19	1616	1198	1290	4,104	384	199	434	1419377	260	3.9	0.1	3.4	10827	1.7
Dec-19	2557	2577	918	6,052	95	230	439	1239023	262	0.6	0.1	3.8	5211	1.7
Jan-20	174	492	748	1,414	95	230	436	455946	261	0.6	0.2	3.1	2518	1.7
Feb-20	316	0	1008	1,324	95	198	438	471329	261	0.6	0.7	3.0	3235	1.7
Mar-20	2543	0	1025	3,568	131	239	452	795874	259	0.9	0.5	3.5	5797	1.7
Apr-20	2490	155	820	3,464	131	237	458	737484	257	0.9	0.5	4.0	5571	1.6
May-20	121	473	1266	1,860	285	227	453	715037	258	0.7	0.5	3.5	4777	1.6
Jun-20	17	444	1440	1,901	285	241	457	769942	258	0.7	0.4	3.1	4648	1.6
Jul-20	11	110	1330	1,451	285	243	448	625797	258	0.7	0.2	3.0	3998	1.6
Aug-20	18	0	1442	1,460	359	250	454	661647	258	0.5	0.2	2.8	3999	1.6
Sep-20	18	0	1634	1,652	359	231	451	743306	259	0.5	0.2	2.9	4773	1.6
Oct-20	24	9	2030	2,063	359	229	447	917518	259	0.5	0.2	2.7	5532	1.6
Nov-20	290	1498	1749	3,536	359	246	443	1246288	260	0.5	0.2	2.7	5124	1.6
Dec-20	2490	545	1528	4,563	190	246	439	1277043	260	0.6	0.2	2.9	6083	1.6
Jan-21	1758	25	868	2,651	87	268	458	556531	261	0.7	0.2	2.9	3796	1.6
Feb-21	227	76	891	1,194	200	268	452	468802	261	0.1	0.2	2.6	2310	1.6
Mar-21	1063	0	849	1,912	200	275	472	613226	262	0.1	0.2	2.6	2293	1.6
Apr-21	93	0	1350	1,443	200	237	463	643756	262	0.1	0.5	2.6	3497	1.5
May-21	134	0	1274	1,409	275	313	472	637883	261	0.5	0.3	3.2	4082	1.5
Jun-21	185	2	1311	1,498	275	313	464	659573	261	0.5	0.3	2.7	3683	1.5
Jul-21	215	108	1209	1,532	275	308	470	660811	261	0.5	0.4	2.6	3322	1.5
Aug-21	58	69	1387	1,514	298	303	471	691175	262	3.4	0.4	2.9	4250	1.5
Sep-21	99	33	1791	1,923	298	291	457	857296	262	3.4	0.2	2.9	5467	1.5
Oct-21	157	27	1979	2,164	298	286	459	962997	264	3.4	0.3	2.9	6314	1.5
Nov-21	75	33	1673	1,781	298	282	455	793083	265	3.4	0.4	2.9	5139	1.5
Dec-21	5558	13	686	6,257	156	278	465	1186635	264	0.7	0.4	2.8	5965	1.5

SW/LR (Mean): Stormwater / Local Runoff (Mean) is a monthly average value of all SW/LR data collected during the month. For months without data available, previous month's data is carried down

SW/LR (Max): Stormwater / Local Runoff (Max) is a monthly maximum value of all SW/LR data collected during the month. For months without data available, previous month's data is carried down

IW: Imported Water based on monthly Table D data received from the Metropolitan Water District. For months without data available, previous month's data is carried down

RW: Recycled Water based on a monthly average of all available RP-1 & RP-4 effluent data and RP-1/RP-4 RW Blend at NRG Turnout data

* 25% nitrogen loss coefficient has been applied to calculate recycled water nitrate-nitrogen quality per Basin Plan Amendment

Maximum Benefit Water Quality Objectives in Chino North Management Zone for TDS is 420 mg/L and nitrate-nitrogen is 5 mg/L, based on a 5-year running average

Appendix C

2021 Maximum Benefit Digital Database