



# Recomputation of Ambient Water Quality in the Santa Ana River Watershed for the Period 1999 to 2018

SAWPA Commission Meeting – July 21, 2020

Item No. 6.C.

# Definition of Terms

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## Groundwater Quality Objectives

- The Porter-Cologne Act defines water quality objectives as “...the limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area.”

## Ambient Water Quality

- Ambient is defined as the “surrounding environment.” In the context of this study, ambient nitrate and TDS refers to concentrations that are representative of a given volume of groundwater (water in storage in an MZ) for a given period (20-year period evaluated triennially).

# Background

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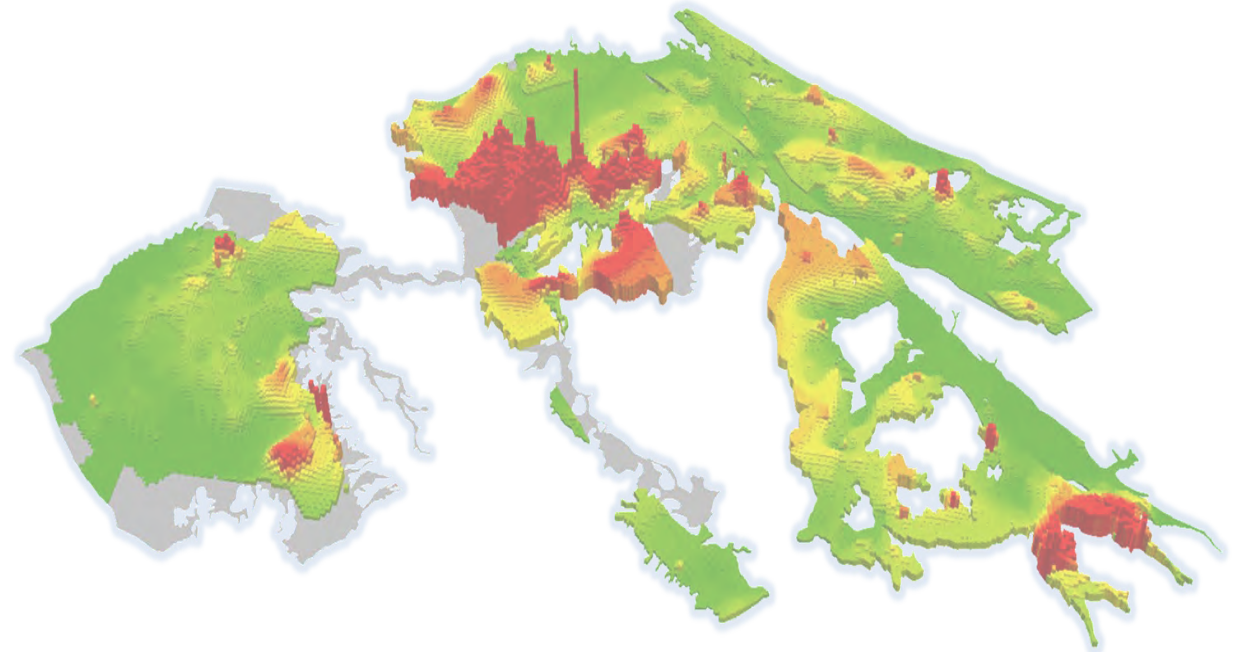
In 1995, a Task Force was formed to study the impacts that salt and nitrate have on the long-term sustainability of groundwater supply. The Task Force administered by SAWPA included the Regional Board:

- revised groundwater basin boundaries
- set new water quality objectives based on a better data set
- developed a rigorous scientific method for computing the volume-weighted ambient water quality

# 2004 Basin Plan Amendment (Resolution R8-2004-001)

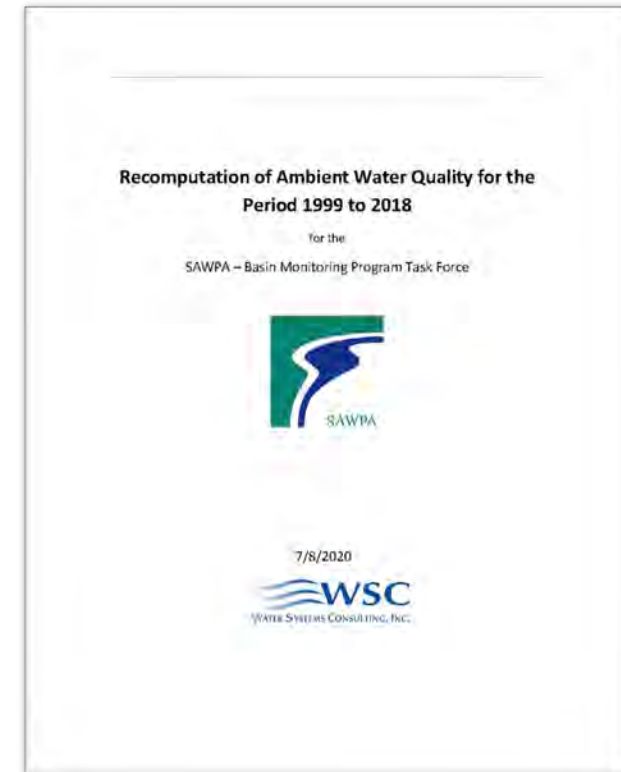
Requires the implementation of a watershed-wide monitoring program to:

- determine ambient water quality in groundwater
- assess compliance with groundwater quality objectives, and
- determine if assimilative capacity exists in groundwater management zones.



# Basin Monitoring Program Task Force

- Completed the ambient water quality computation six times:
  - 1984 to 2003
  - 1987 to 2006
  - 1990 to 2009
  - 1993 to 2012
  - 1996 to 2015, and
  - 1999 to 2018








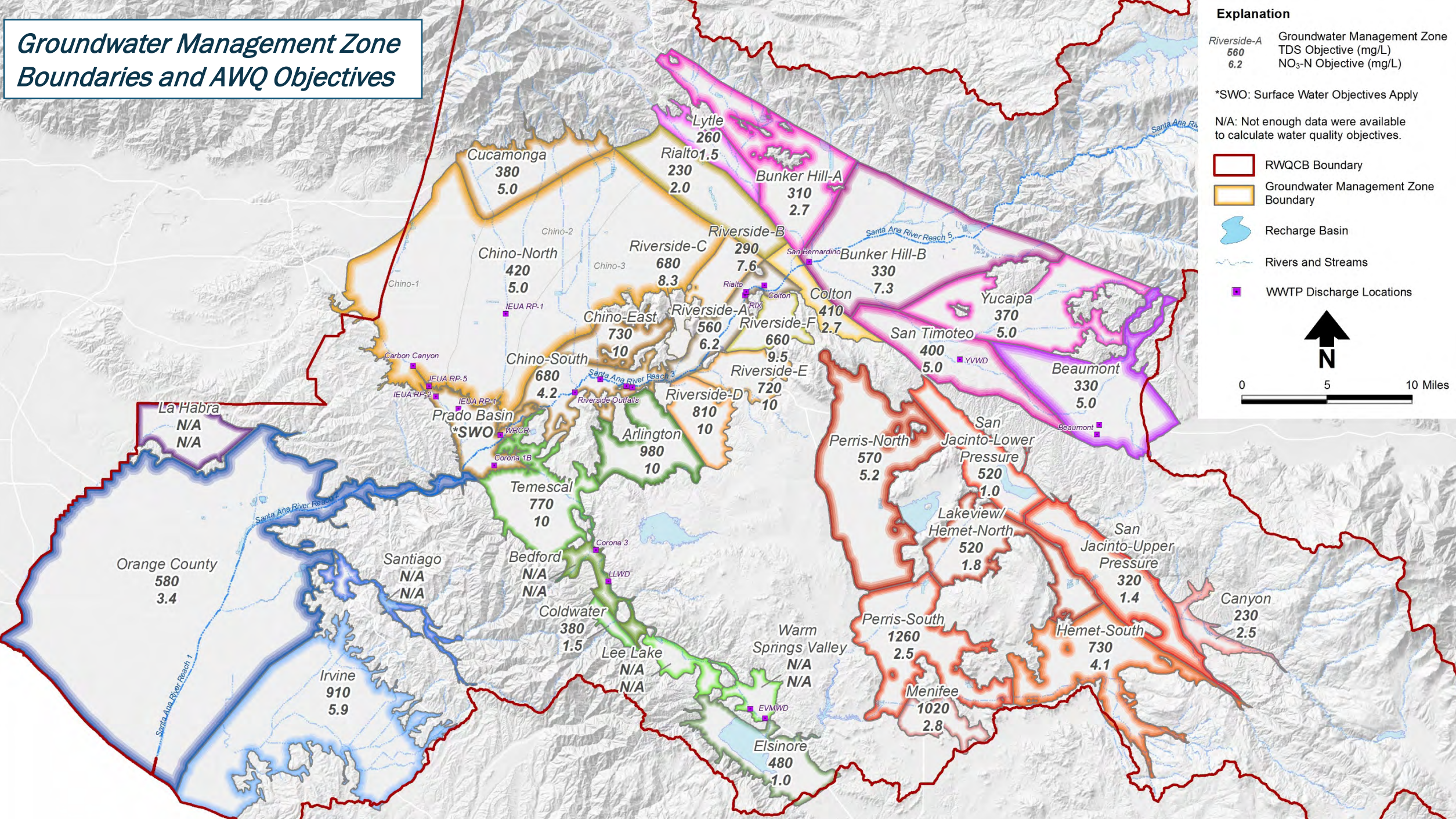
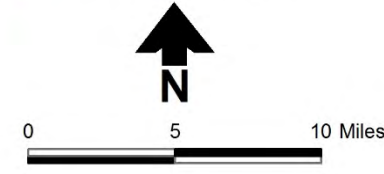
# Groundwater Management Zone Boundaries and AWQ Objectives

**Explanation**

|             |                                     |
|-------------|-------------------------------------|
| Riverside-A | Groundwater Management Zone         |
| 560         | TDS Objective (mg/L)                |
| 6.2         | NO <sub>3</sub> -N Objective (mg/L) |

\*SWO: Surface Water Objectives Apply  
 N/A: Not enough data were available to calculate water quality objectives.

-  RWQCB Boundary
-  Groundwater Management Zone Boundary
-  Recharge Basin
-  Rivers and Streams
-  WWTP Discharge Locations



# Triennial AWQ Recomputation Phases

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## 1: Data Gathering

- ✓ Data Compilation
- ✓ QA/QC, Process, and Upload recent data

## 2: Point Statistics

- ✓ Calculate Water Quality Point Statistics
- ✓ Shapiro-Wilk Test for Normality

## 3: Computations

- ✓ Groundwater Elevation Contours
- ✓ Nitrate, TDS Concentrations
- ✓ Compute ambient water quality for GMZ's

## 4: Interpretive Tools

- ✓ Innovative Interpretive Tool

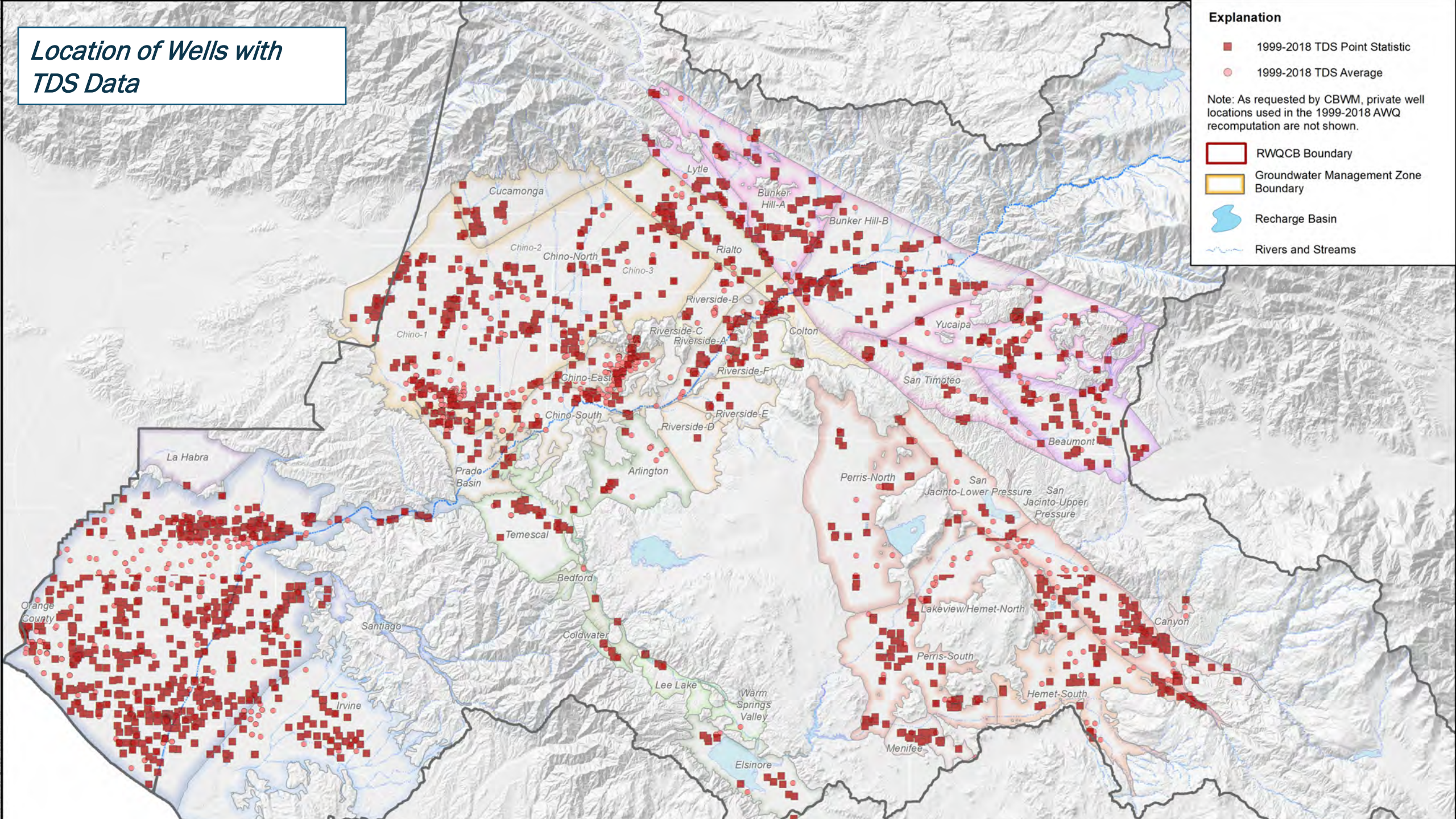
*Location of Wells with TDS Data*

**Explanation**

- 1999-2018 TDS Point Statistic
- 1999-2018 TDS Average

Note: As requested by CBWM, private well locations used in the 1999-2018 AWQ recomputation are not shown.

- ▭ RWQCB Boundary
- ▭ Groundwater Management Zone Boundary
- ☾ Recharge Basin
- ~ Rivers and Streams



Orange County

La Habra

Santiago

Irvine

Temescal

Coldwater

Lee Lake

Warm Springs Valley

Elsinore

Cucamonga

Lytle

Bunker Hill-A

Bunker Hill-B

Chino-2

Chino-North

Chino-3

Rialto

Riverside-B

Riverside-C

Riverside-A

Colton

Riverside-F

Riverside-E

Riverside-D

Yucaipa

San Timoteo

Beaumont

Perris-North

San Jacinto-Lower Pressure

San Jacinto-Upper Pressure

Lakeview/Hemet-North

Perris-South

Hemet-South

Menifee

Canyon



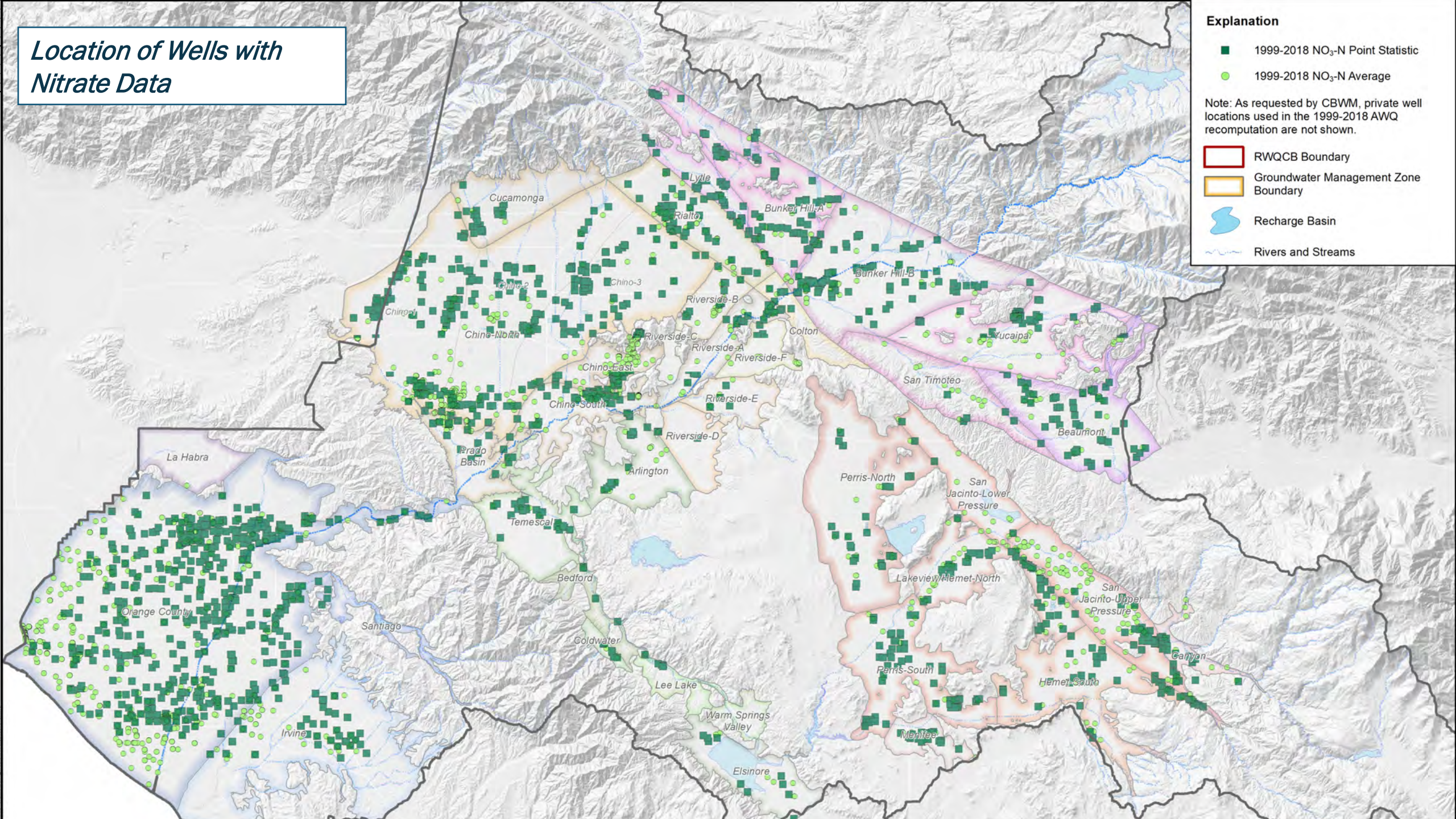
# Location of Wells with Nitrate Data

**Explanation**

- 1999-2018 NO<sub>3</sub>-N Point Statistic
- 1999-2018 NO<sub>3</sub>-N Average

Note: As requested by CBWM, private well locations used in the 1999-2018 AWQ recomputation are not shown.

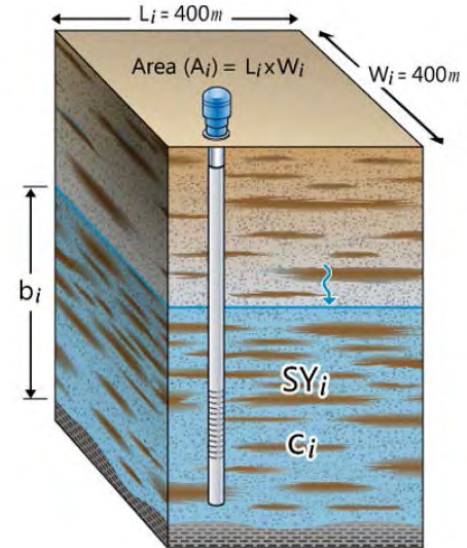
- RWQCB Boundary
- Groundwater Management Zone Boundary
- 🌊 Recharge Basin
- ~ Rivers and Streams



# Volume of Groundwater

$$V = \sum_{i=1}^n A_i \cdot (GWE_i - BOA_i) \cdot SY_i$$

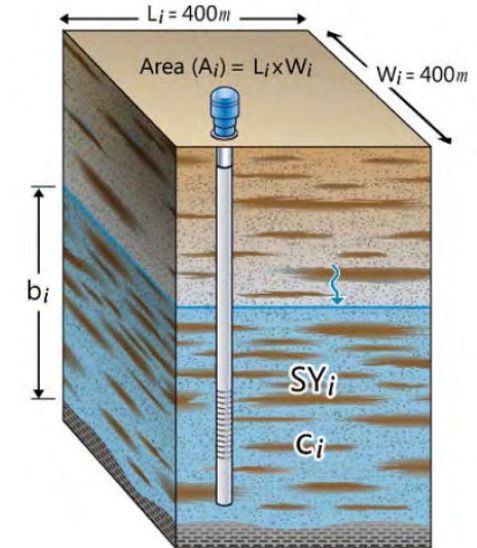
- where
- $V$  = volume of groundwater in the GMZ
  - $A_i$  = area of the  $i$ th grid cell
  - $GWE_i$  = groundwater elevation (feet msl)
  - $BOA_i$  = bottom of the aquifer of the  $i$ th grid cell (feet msl)
  - $SY$  = specific yield of the  $i$ th grid cell
  - $n$  = number of grid cells



Source: WEI, 2014

# Volume Weighted Estimate of AWQ

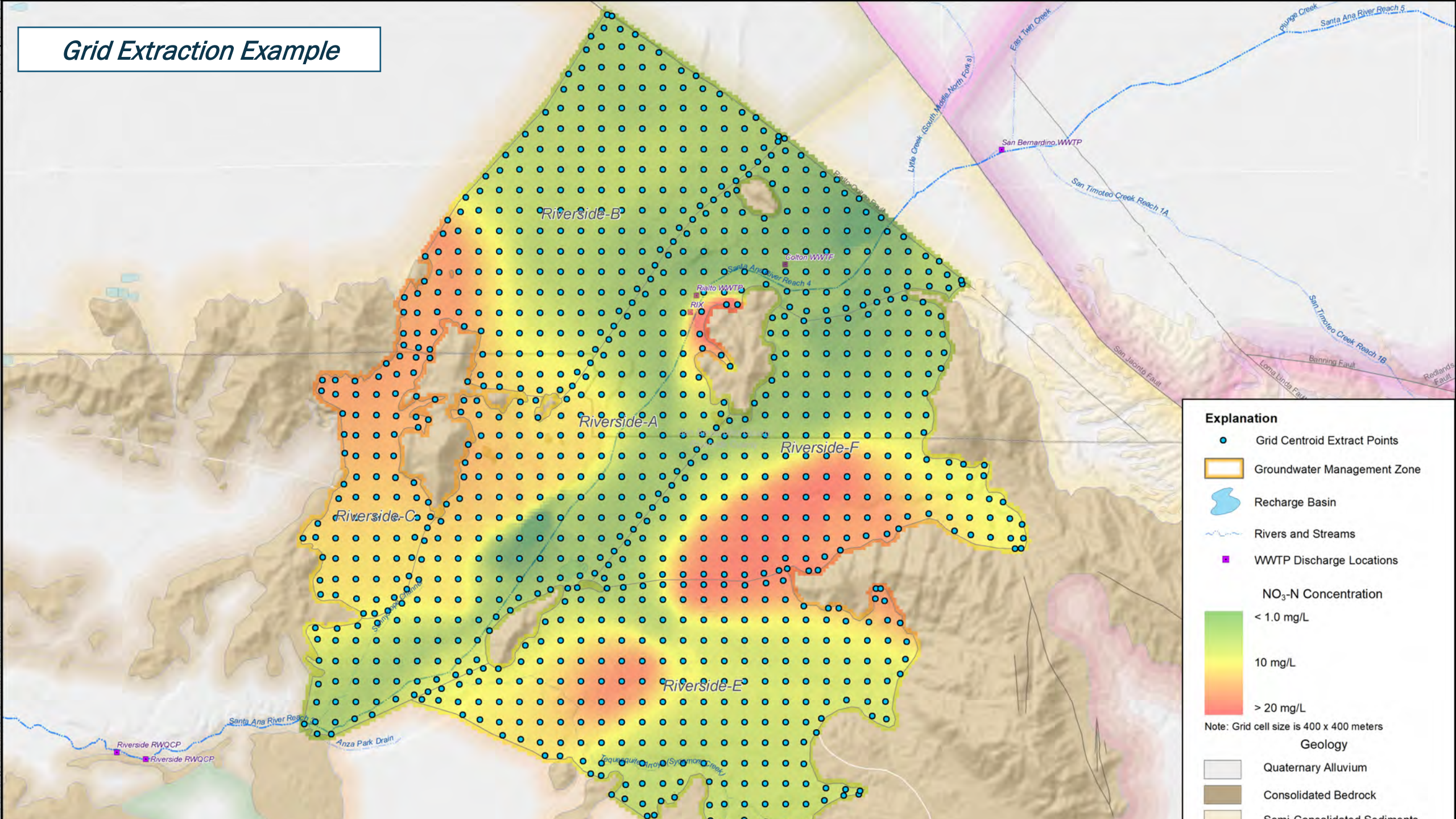
$$C_{avg} = \frac{\sum_{i=1}^n C_i \cdot V_i}{\sum_{i=1}^n V_i}$$



Source: WEI, 2014

- where  $C_{avg}$  = the volume-weighted current ambient concentration in a GMZ  
 $C_i$  = the current ambient concentration of groundwater in the  $i$ th grid cell  
 $V_i$  = the volume of groundwater in the  $i$ th grid cell  
 $n$  = number of grid cells

# Grid Extraction Example



**Explanation**

- Grid Centroid Extract Points
- Groundwater Management Zone
- Recharge Basin
- Rivers and Streams
- WWTP Discharge Locations

**$\text{NO}_3\text{-N}$  Concentration**

- < 1.0 mg/L
- 10 mg/L
- > 20 mg/L

Note: Grid cell size is 400 x 400 meters

**Geology**

- Quaternary Alluvium
- Consolidated Bedrock
- Semi-Consolidated Sediments

# 2018 Ambient Water Quality TDS

## Explanation

**440** Groundwater Management Zone  
1999-2018 TDS AWQ (mg/L)

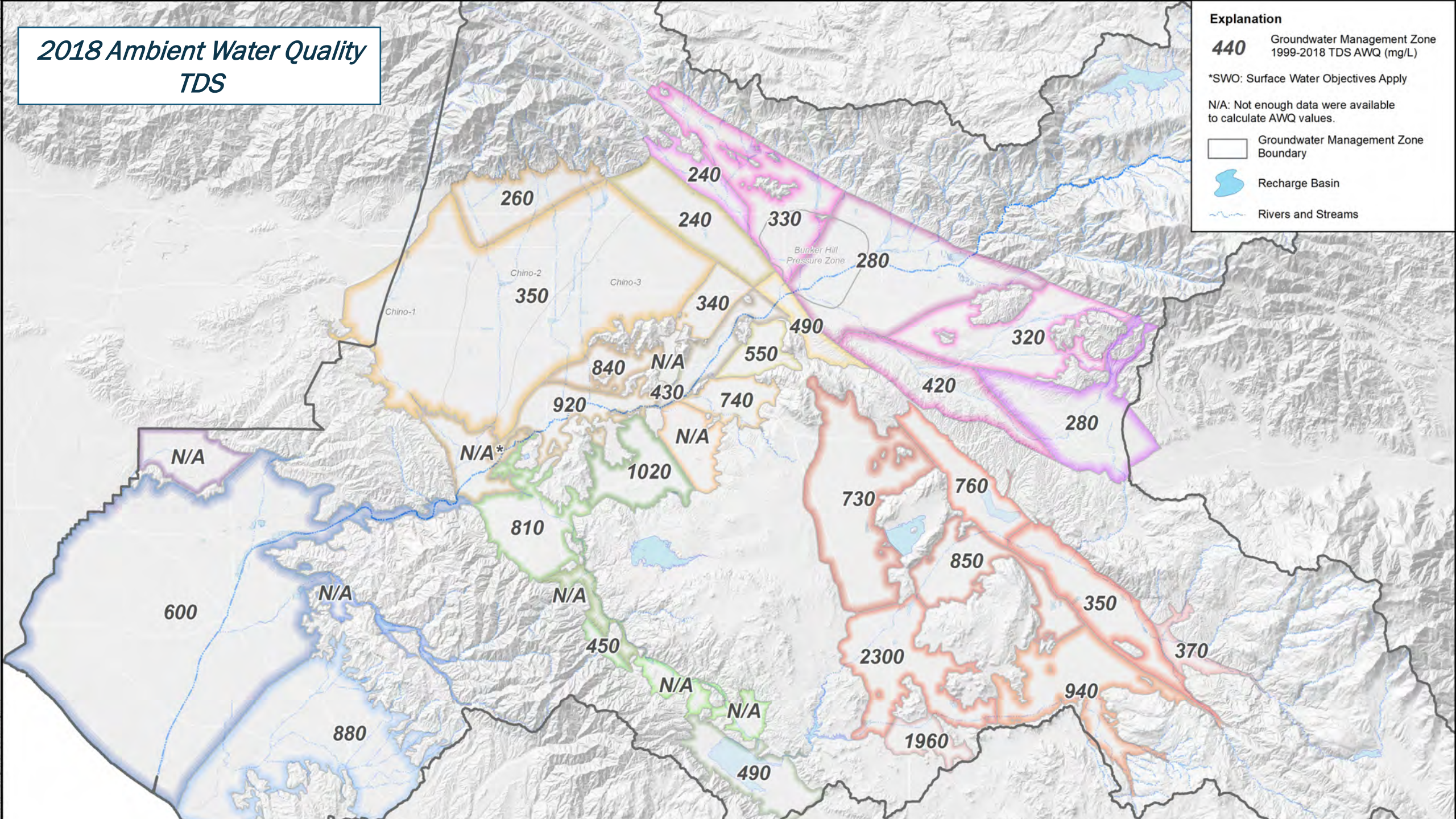
\*SWO: Surface Water Objectives Apply

N/A: Not enough data were available  
to calculate AWQ values.

Groundwater Management Zone  
Boundary

Recharge Basin

Rivers and Streams




# 2018 Ambient Water Quality TDS


**Explanation**


Riverside-A 430 Groundwater Management Zone 1996-2015 TDS AWQ (mg/L)


\*SWO: Surface Water Objectives Apply

N/A: Not enough data were available to calculate AWQ values.


 RWQCB Boundary


 Groundwater Management Zone Boundary


 Recharge Basin


 Rivers and Streams

**TDS Concentration**

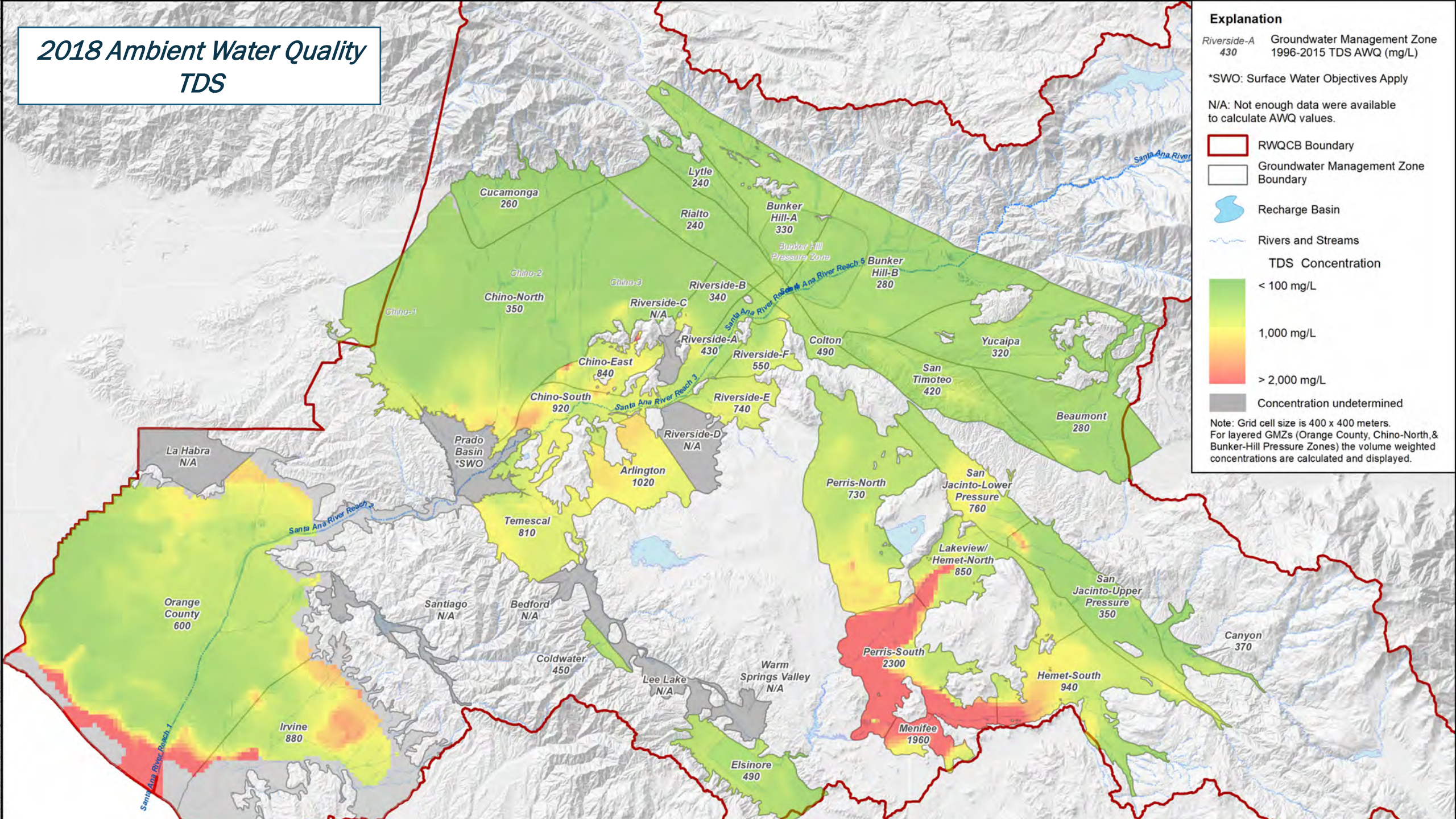
 < 100 mg/L

 1,000 mg/L

 > 2,000 mg/L

 Concentration undetermined

Note: Grid cell size is 400 x 400 meters. For layered GMZs (Orange County, Chino-North, & Bunker-Hill Pressure Zones) the volume weighted concentrations are calculated and displayed.






# 2018 Ambient Water Quality Nitrate as N

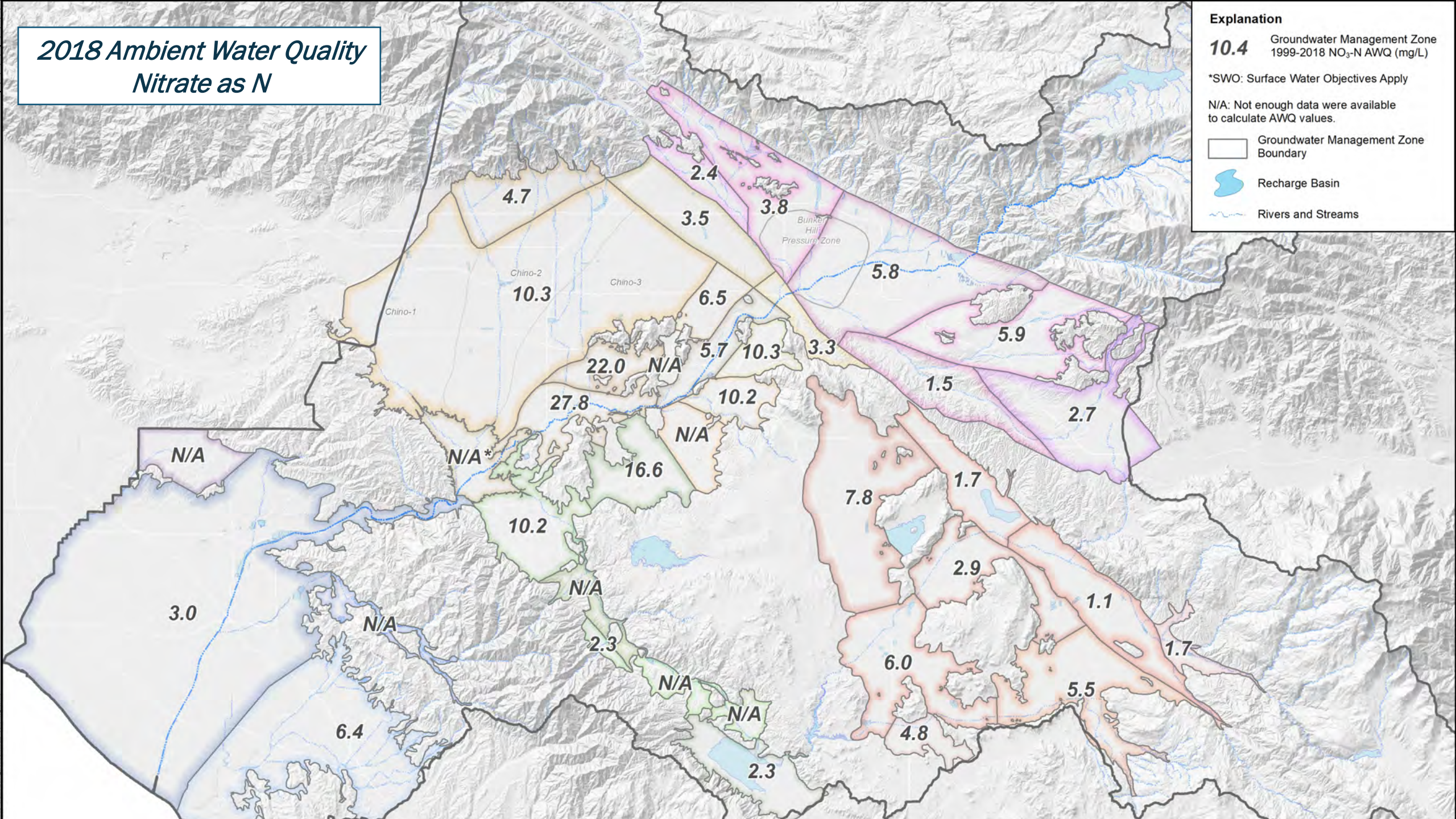
**Explanation**

**10.4** Groundwater Management Zone  
1999-2018 NO<sub>3</sub>-N AWQ (mg/L)

\*SWO: Surface Water Objectives Apply

N/A: Not enough data were available  
to calculate AWQ values.

-  Groundwater Management Zone  
Boundary
-  Recharge Basin
-  Rivers and Streams







# 2018 Ambient Water Quality Nitrate as N

**Explanation**





|                    |  |
|--------------------|--|
| Riverside-A<br>5.7 | Groundwater Management Zone<br>1996-2015 NO <sub>3</sub> -N AWQ (mg/L) |
|--------------------|--|

\*SWO: Surface Water Objectives Apply

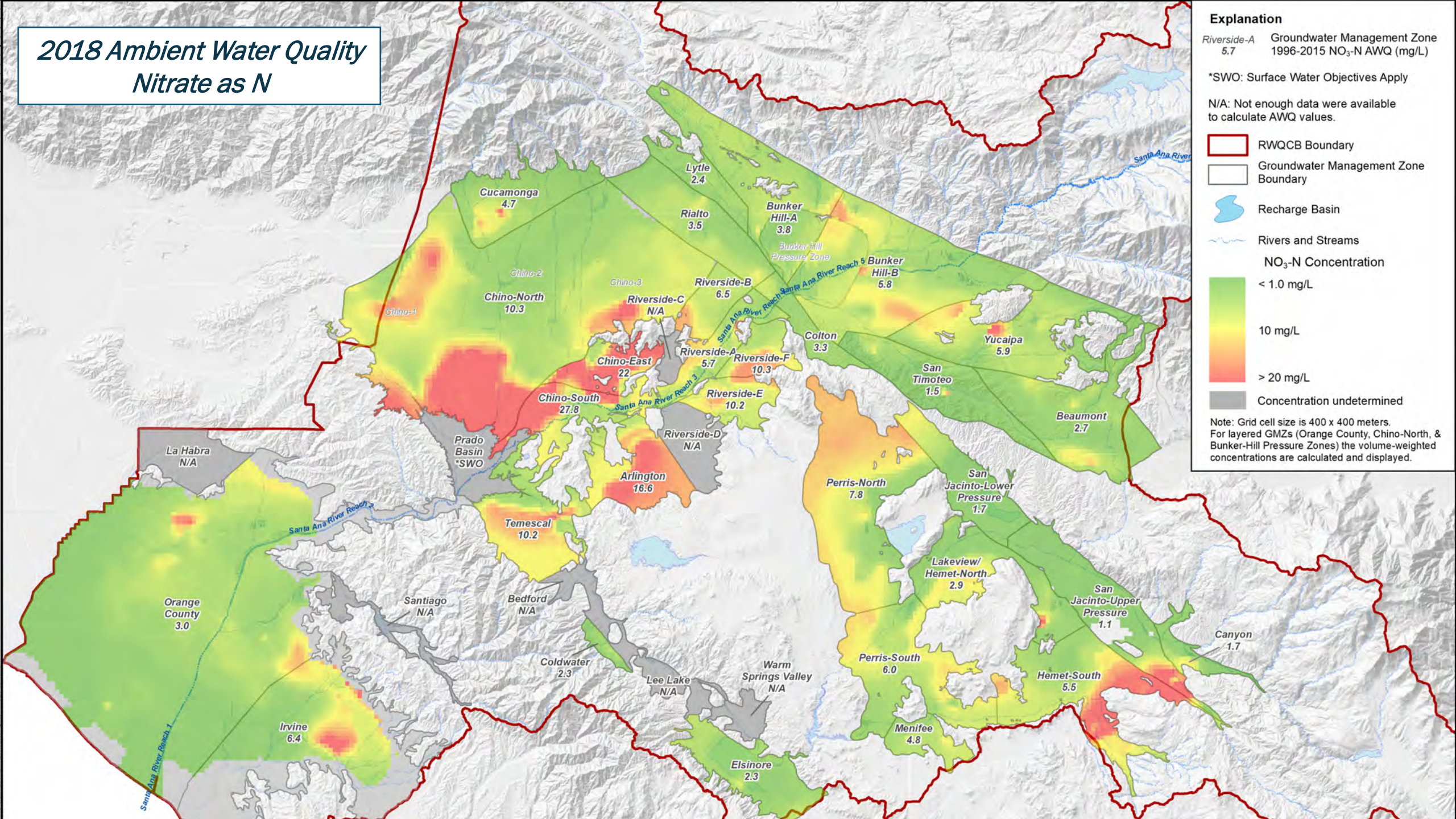
N/A: Not enough data were available to calculate AWQ values.

-  RWQCB Boundary
-  Groundwater Management Zone Boundary
-  Recharge Basin
-  Rivers and Streams

**NO<sub>3</sub>-N Concentration**

-  < 1.0 mg/L
-  10 mg/L
-  > 20 mg/L
-  Concentration undetermined

Note: Grid cell size is 400 x 400 meters. For layered GMZs (Orange County, Chino-North, & Bunker-Hill Pressure Zones) the volume-weighted concentrations are calculated and displayed.





# Interpretive Tools for each Groundwater Management Zone

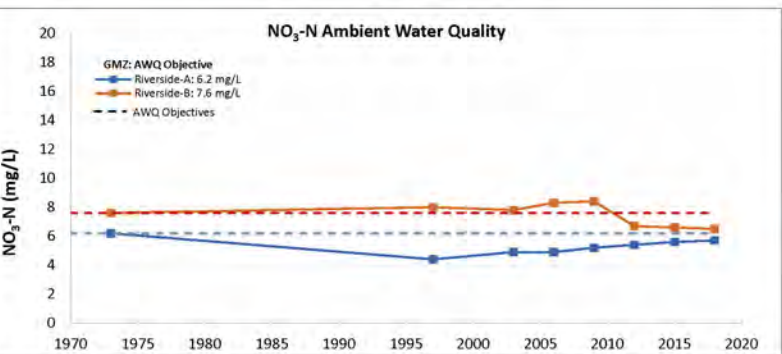
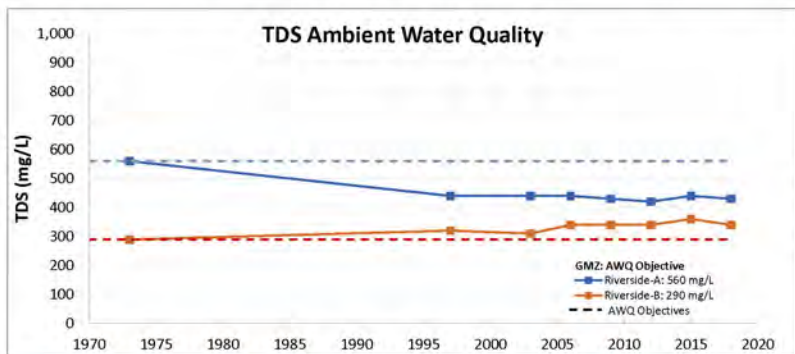
- Atlas Style Maps
- Nitrate Map
- Nitrate Change Map from 2015 version
- TDS Map
- TDS Change Map from 2015 version

**Attachment Contents:**  
 B13-1 Groundwater Storage and Elevation Contours Fall 2018  
 B13-2 NO<sub>3</sub>-N Concentration and Contour Map  
 B13-3 TDS Concentration and Contour Map  
 B13-4 NO<sub>3</sub>-N Concentration Change (1996-2015 to 1999-2018)  
 B13-5 TDS Concentration Change (1996-2015 to 1999-2018)



TDS and Nitrate Water Quality Objectives, Ambient Water Quality, and Assimilative Capacity

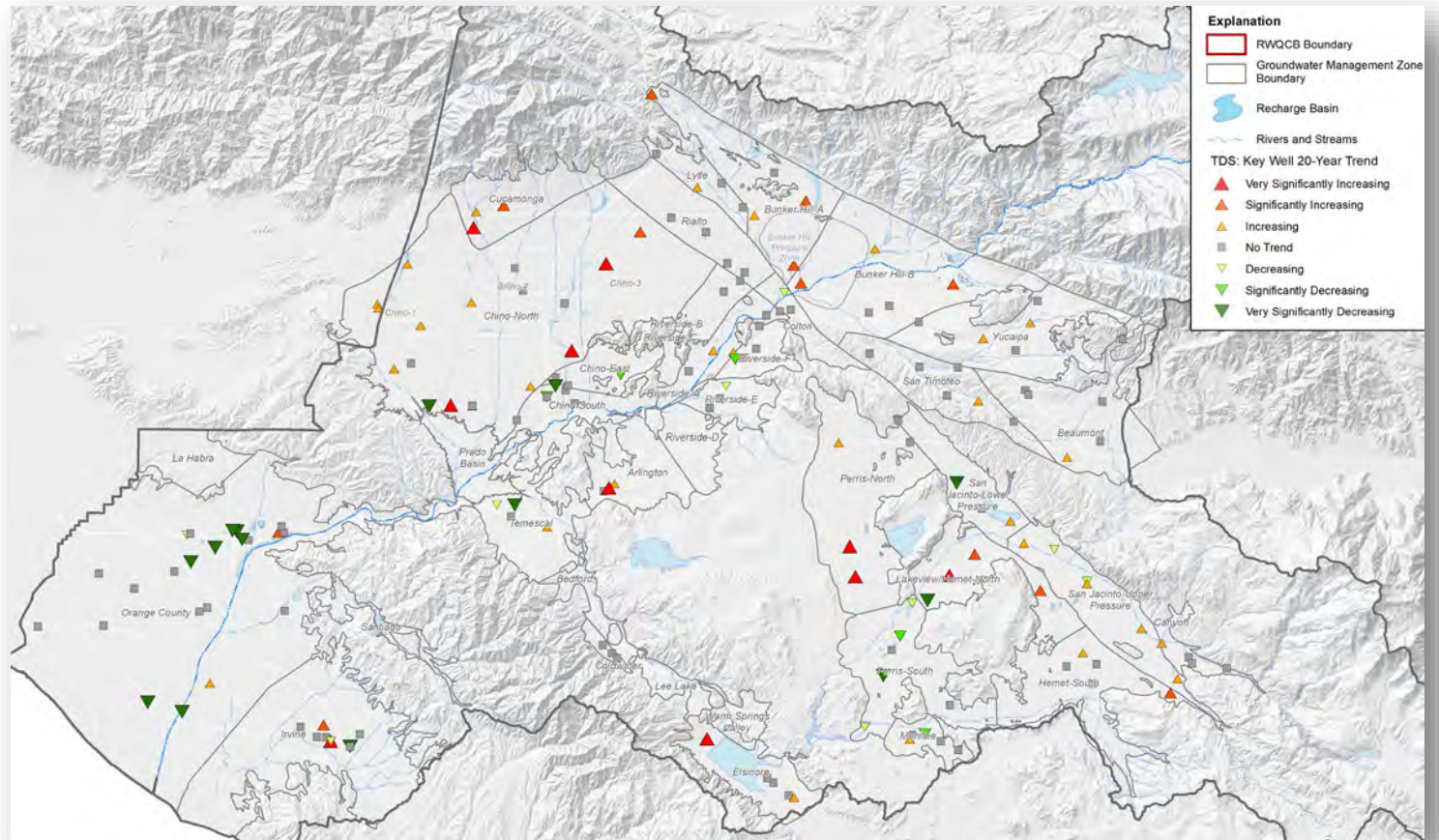
| Management Zone                      | Water Quality Objective | Historical Ambient (1954-1973) <sup>1</sup> | 1997 Ambient (1978-1997) | 2003 Ambient (1984-2003) | 2006 Ambient (1987-2006) | 2009 Ambient (1990-2009) | 2012 Ambient (1993-2012) | 2015 Ambient (1996-2015) | 2018 Ambient (1999-2018) | Difference from 2015 to 2018 | Assimilative Capacity |
|--------------------------------------|-------------------------|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|------------------------------|-----------------------|
| <b>Total Dissolved Solids (mg/L)</b> |                         |   |                          |                          |                          |                          |                          |                          |                          |                              |                       |
| Riverside-A                          | 560                     | 560   | 440                      | 440                      | 440                      | 430                      | 420                      | 440                      | 430                      | -10                          | 130                   |
| Riverside-B                          | 290                     | 289   | 320                      | 310                      | 340                      | 340                      | 340                      | 360                      | 340                      | -20                          | None (-50)            |
| <b>Nitrate as Nitrogen (mg/L)</b>    |                         |   |                          |                          |                          |                          |                          |                          |                          |                              |                       |
| Riverside-A                          | 6.2                     | 6.2   | 4.4                      | 4.9                      | 4.9                      | 5.2                      | 5.4                      | 5.6                      | 5.7                      | 0.1                          | 0.5                   |
| Riverside-B                          | 7.6                     | 7.6   | 8.0                      | 7.8                      | 8.3                      | 8.4                      | 6.7                      | 6.6                      | 6.5                      | -0.1                         | 1.1                   |



# Interactive Interpretive Tools

Accessible to the Task Force Members for further Analysis

- [Trend Maps](#)
- [Well Attrition Analysis](#)



# Summary of Ambient Water Quality

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The ambient water quality recomputation is a powerful tool to assist the stakeholders in managing the water resources in the Santa Ana Watershed:

- aids the Regional Board in identifying TDS and nitrate trends
- the assessment of assimilative capacity is critical in permitting projects, such as groundwater replenishment reuse projects
- assists the stakeholders in identifying areas of potential concern
- supports Santa Ana River wasteload allocation and discharge permits
- collaboration of stakeholders and Regional Board
- Scoping Committee being formed in BMPTF to evaluate AWQ to comply with the updated Recycled Water Policy



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QUESTIONS?