# Item 9
# Mojave Basin SNMP

Mike Plaziak, PG
Supervising Engineering Geologist
South Lahontan Basin Division
Lahontan Water Board

CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

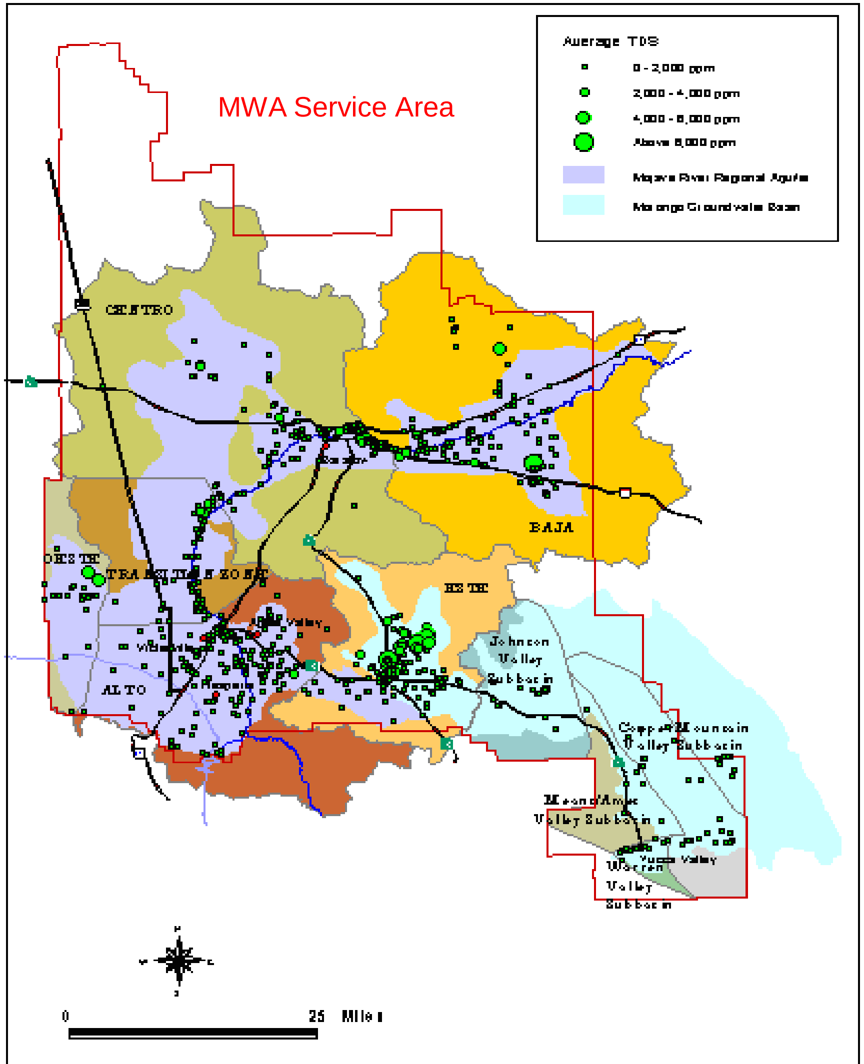
# Agenda

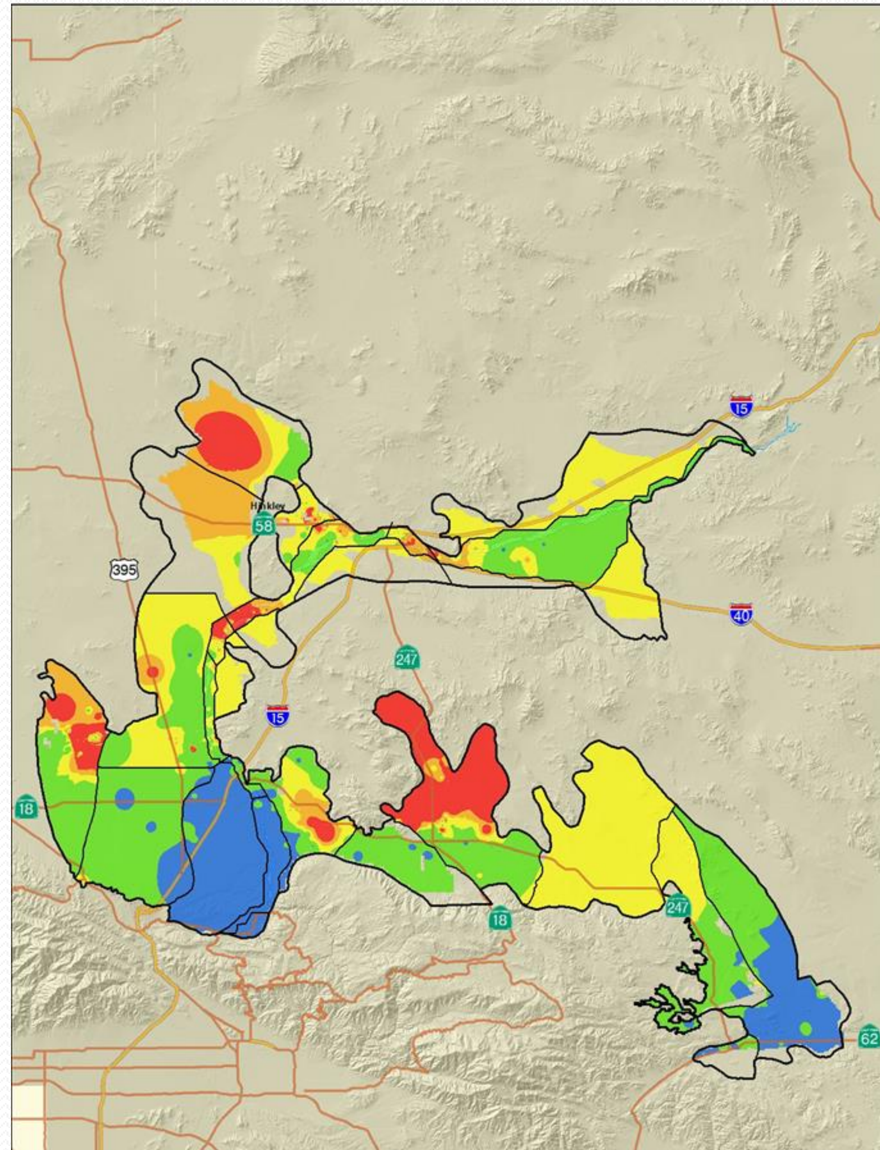
- Part I – Lance Eckhart – Mojave Water Agency
  - ✓ Mojave Basin Salt Nutrient Management
- Part II – Mike Plaziak – Lahontan Water Board
  - ✓ Compliance with SB Recycled Water Policy
  - ✓ Regulatory Application of the SNMP to the Mojave Basin
  - ✓ Water Quality Trading
  - ✓ Fellowship of the Mojave

# Compliance with SB Recycled Water Policy

- Basin-wide groundwater monitoring program
- Understanding of various sources of salts and nutrients into the sub-basins
- Assimilative capacity estimates
- Identification of sensitive sub-basins
- No proposed change to Water Quality Objectives

# Application of SNMP to the Mojave Basin



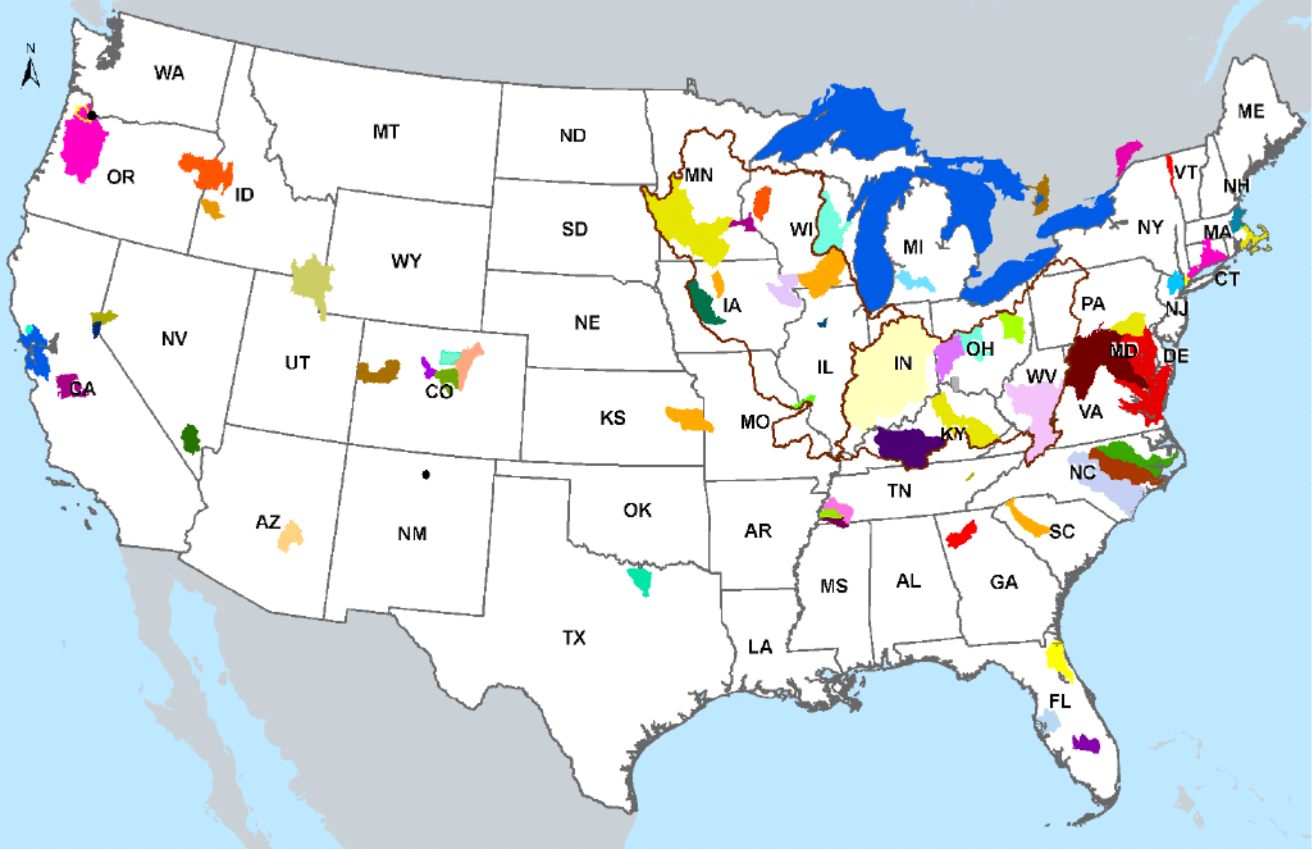




Source: Mojave Water Agency

# Water Quality Trading

- Where one party, facing relatively large pollutant reduction costs, compensates another party to achieve less costly pollutant reduction with the same or greater water quality benefit
- Federal Guidance: US EPA Water Quality Trading Policy – 2003
- Primarily salts and nutrients
- Surface water focus
- TMDLs as a guide

# Watershed Scale Water Quality Trading Programs




Source: Environmental Trading Network
**http://www.envtn.org/**

# Fellowship of the Mojave

- Stakeholders include MWA, VVWRA, Mojave RCD, PG&E and the Lahontan Water Board
- Consideration of WQT to address nutrient loading in the Upper Mojave Groundwater Basin
- Basin study funded in part by VVWRA and US Bureau of Reclamation
  1. Projections of water supply and demand including an assessment of risks related to climate changes
  2. Analysis of how existing water and power infrastructure and operations will perform given population increases, climate change and other impacts
  3. Development of adaptation and mitigation strategies to meet future water demands
  4. Analysis of alternatives with respect to cost, environmental impact, risk, stakeholder response and other attributes

# Questions?

# Mojave Salt and Nutrient Management Plan
# June 10, 2015 Lahontan RWQCB Meeting

**Lance Eckhart, PG, CHG**
**Director of Basin Management and Resource Planning**

# SNMP Goals and Objectives

- *Develop a collaborative program that captures the current body of knowledge*
- Manage S/N sources on a basin-subbasin scale to meet water quality objectives (WQOs) and protect beneficial uses
- Characterize existing and future basin-wide groundwater quality
- Estimate basin-wide assimilative capacity used by recycled water projects
- Leverage findings/tools to guide other S/N-related management and regulatory policies

# SNMP Goals and Objectives

- Questions addressed by SNMP:

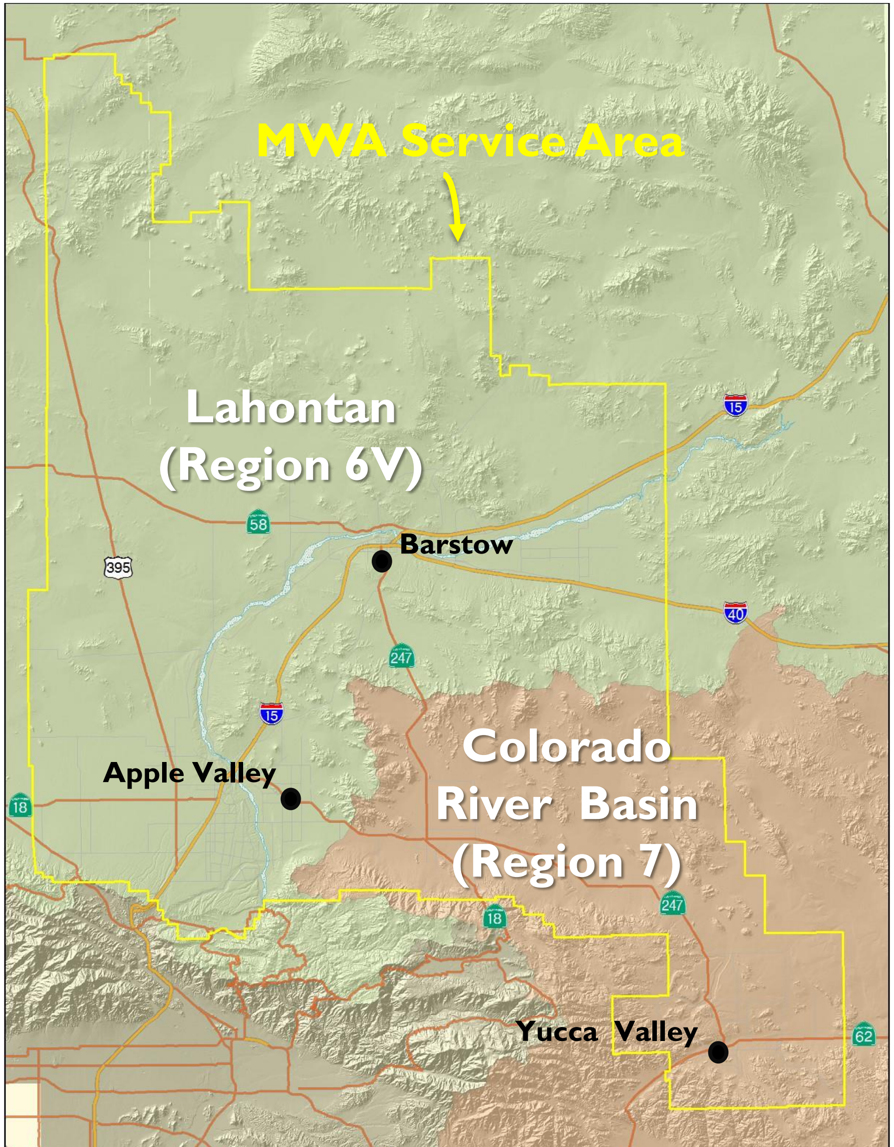
  Groundwater Quality

  - What is the existing groundwater quality relative to BPOs?
  - Are S/N groundwater concentrations increasing, decreasing, or flat?
  - Is the monitoring network adequate for comparing S/N concentrations against WQOs on a basin/subbasin-wide scale?

  S/N Loading and Impacts

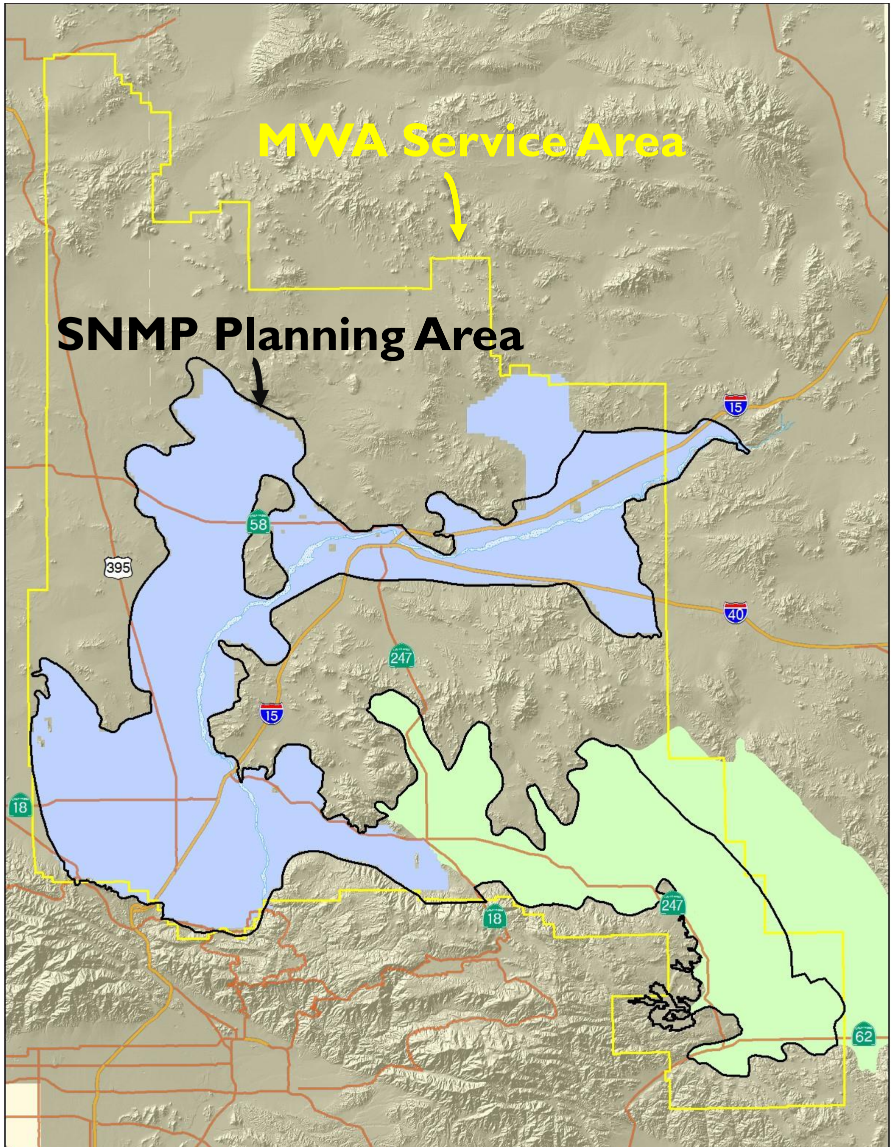
  - What are the major contributing S/N loading sources (sources, flows, concentrations)?
  - What is the effect of individual loading factors on groundwater quality? Water projects? Population growth? SWP water recharge? Septics?

# Mojave SNMP Planning Area



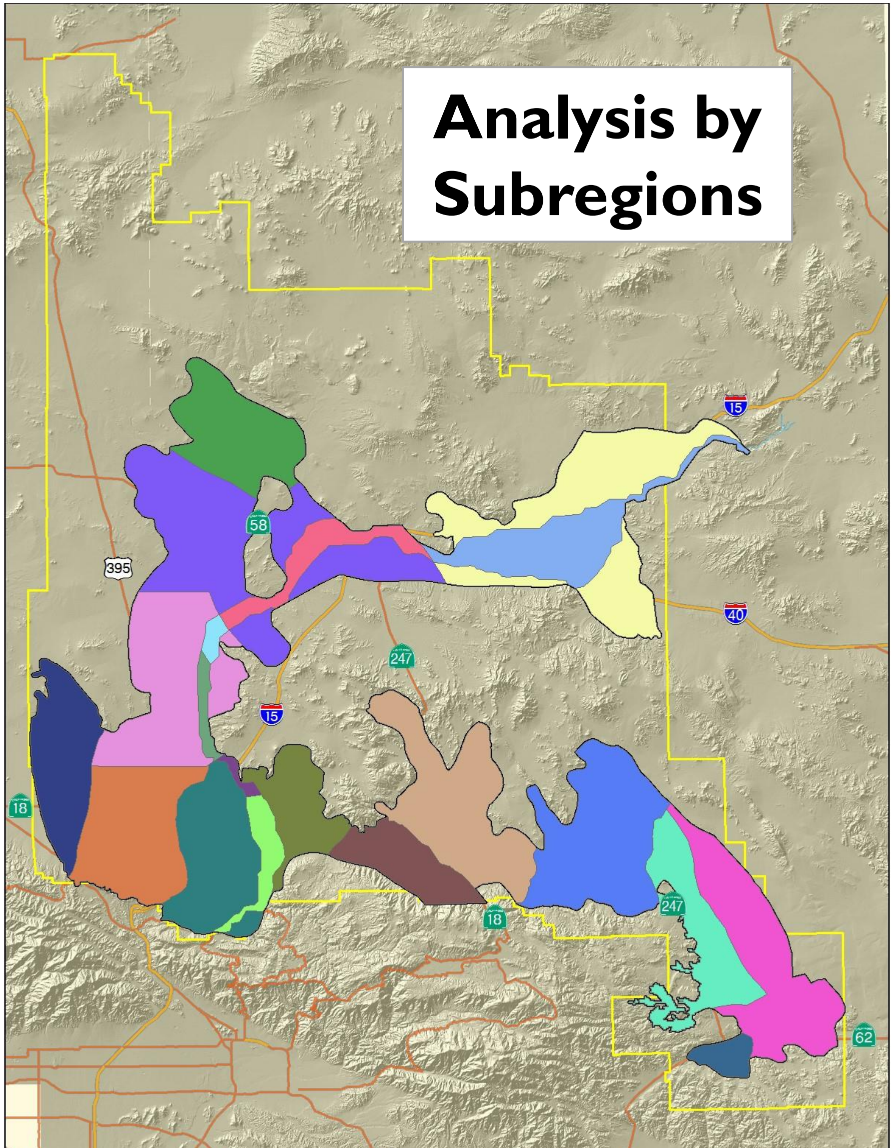

- MWA Service Area (5,000 mi$^2$)
- Overlaps two RWQCBs
  - Lahontan
  - Colorado River

# Mojave SNMP Planning Area




- Two major basins
  - Mojave River Basin
  - Morongo Basin
- SNMP Planning Area
  - Includes key basin areas within MWA service area
  - Based on scientifically-established basin boundaries
  - Contributing watershed areas are accounted for in estimates of recharge from storm runoff

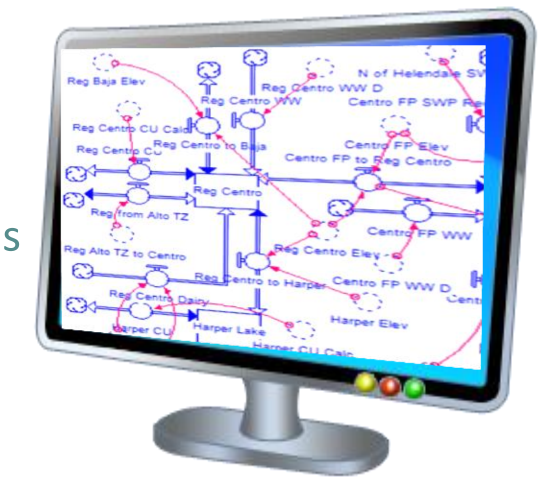
# Mojave SNMP Planning Area




- Planning Area divided into 20 subregions for analysis
- Boundaries based on
  - Hydrogeology
  - Groundwater Quality
- Mojave River Basin: Aligned with MBA Management Subareas - floodplain and regional aquifers
- Morongo Basin: Aligned with USGS subbasin boundaries (includes Pioneertown)

# Mojave SNMP Approach

## Leveraging Foundational Technical Work




2001 – USGS Mojave River Basin MODFLOW Model

2003 – Alto Transition Zone Basin Conceptual Model

2004 – MWA IRWMP - STELLA model (flows)

Warren, Copper Mountain-Joshua Tree MODFLOW Models

2005 – Este Subarea Hydrogeologic Report

2007 – STELLA model refinement (TDS transport module added)

Ames, Means, Johnson Valley Basin Conceptual Models

2008 – R-Cubed Project (Alto Subarea) Hydrogeologic Evaluation

2009 – Oeste Subarea Hydrogeologic Report

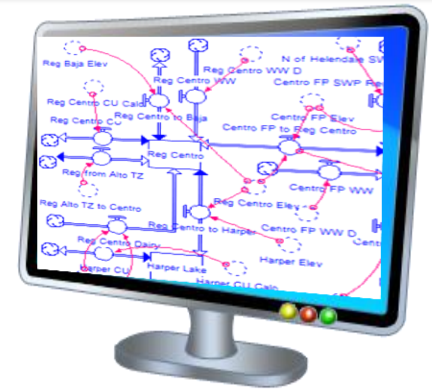
2010 – MWA UWMP update water demand forecast model (2010-2035)

2011 – Ames Valley MODFLOW Model

2014 – Baja and Centro Subareas Basin Conceptual Model

MBA Watermaster consumptive use/return flow estimate refinement (ongoing)

# SNMP S/N Mixing Model:

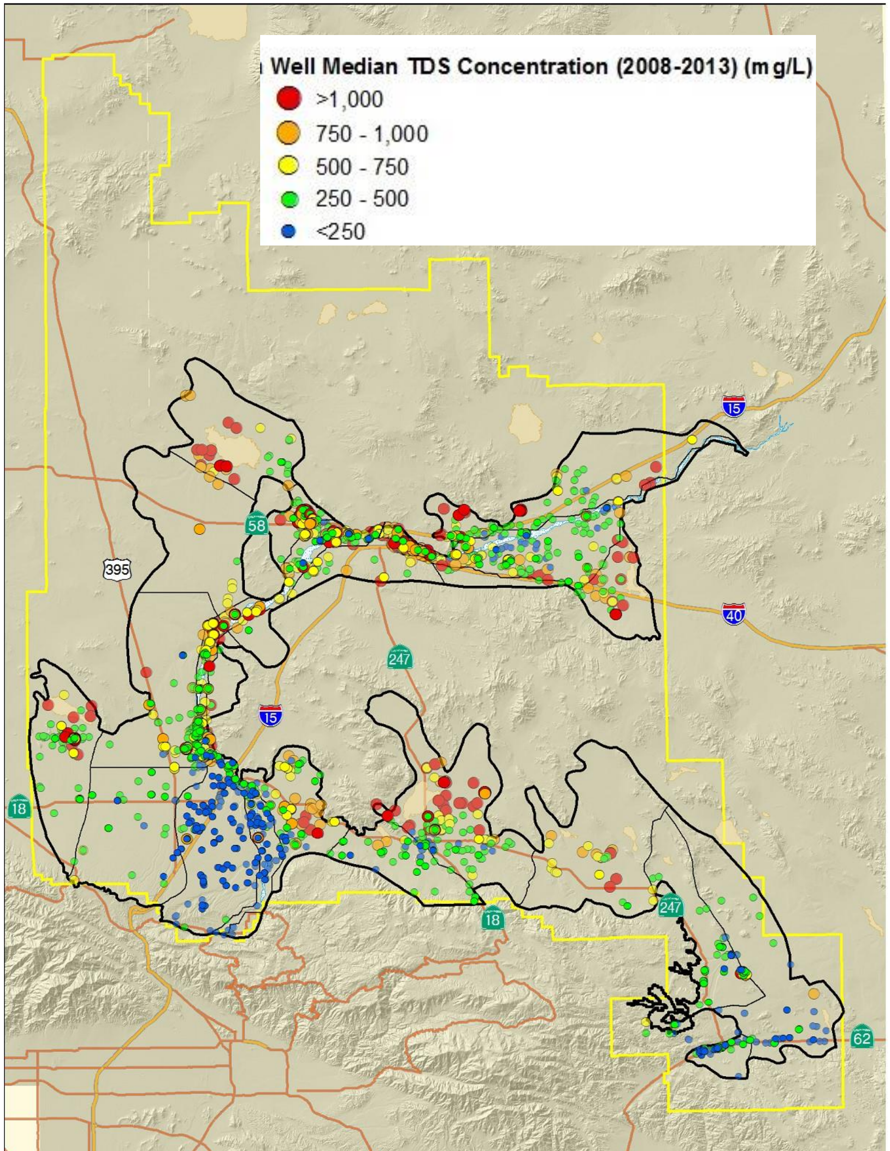


- Written in STELLA software package:

  *Structural Thinking Experimental Learning Laboratory with Animation*

- Used to track inflows and outflows of S/Ns for 20 subregions over a 70-year future predictive period
- Limitations: instantaneous mixing; average over large areas; no absolute concentrations computed at a given location (basin level analysis)
- Advantages: fast simulations over large areas, scalable, compatible with relative analysis at planning level; good screening tool for decision making

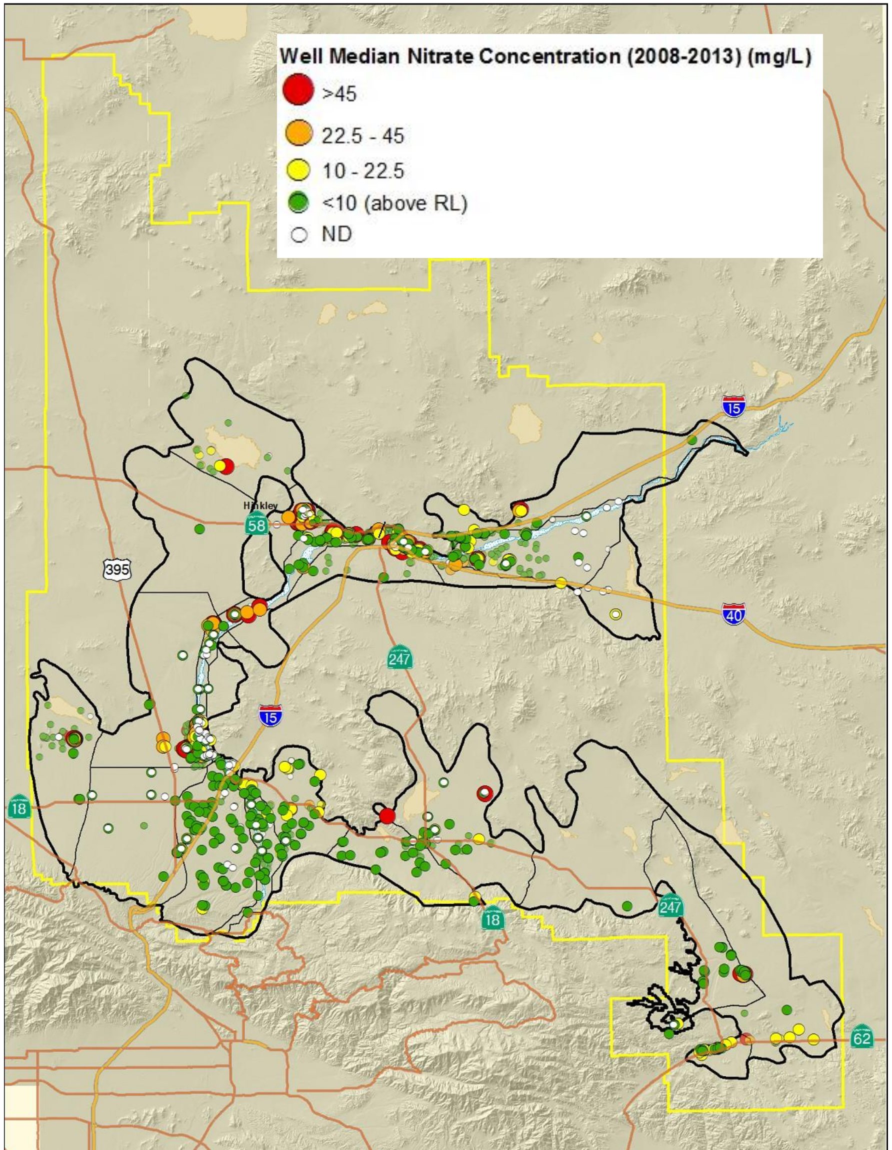
# Ambient Groundwater Quality Characterization/Mapping




- Use well medians based on last 5 years of data
- TDS

Note: pre-2008 data also shown on map

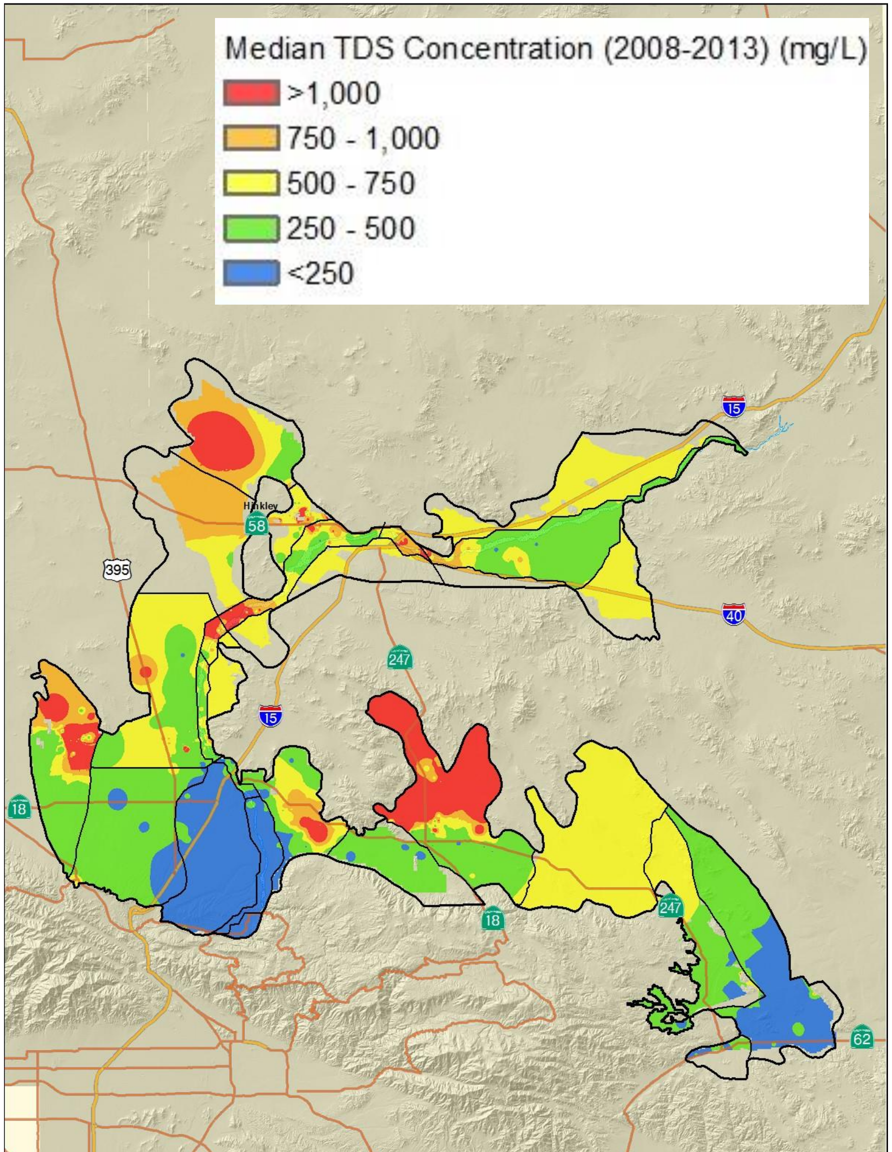
# Ambient Groundwater Quality Characterization/Mapping




- Use well medians based on last 5 years of data
- Nitrate-$NO_3$

Note: pre-2008 data also shown on map

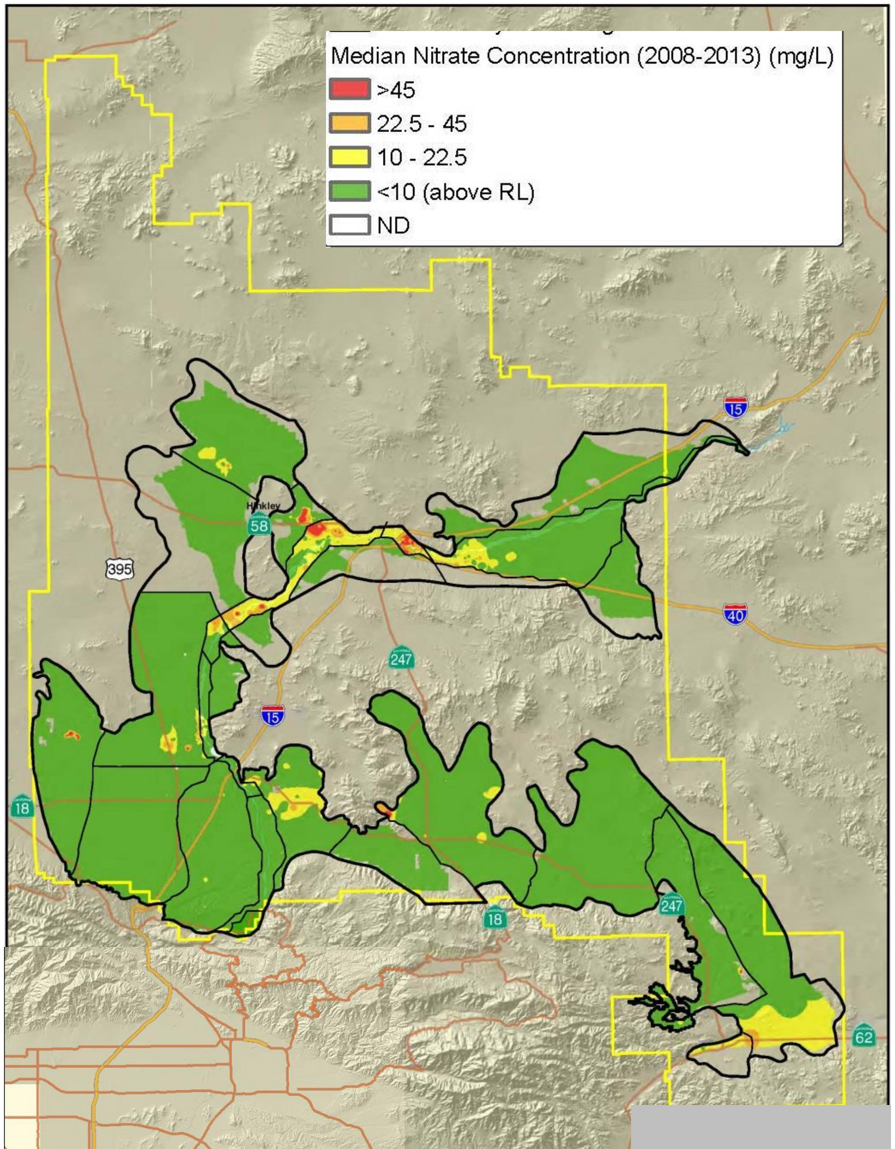
# Ambient Groundwater Quality Characterization/Mapping




- Use well medians based on last 5 years of data
  - *Used older vintage data as necessary*
- De-cluster the data
- Contour/interpolate data

TDS

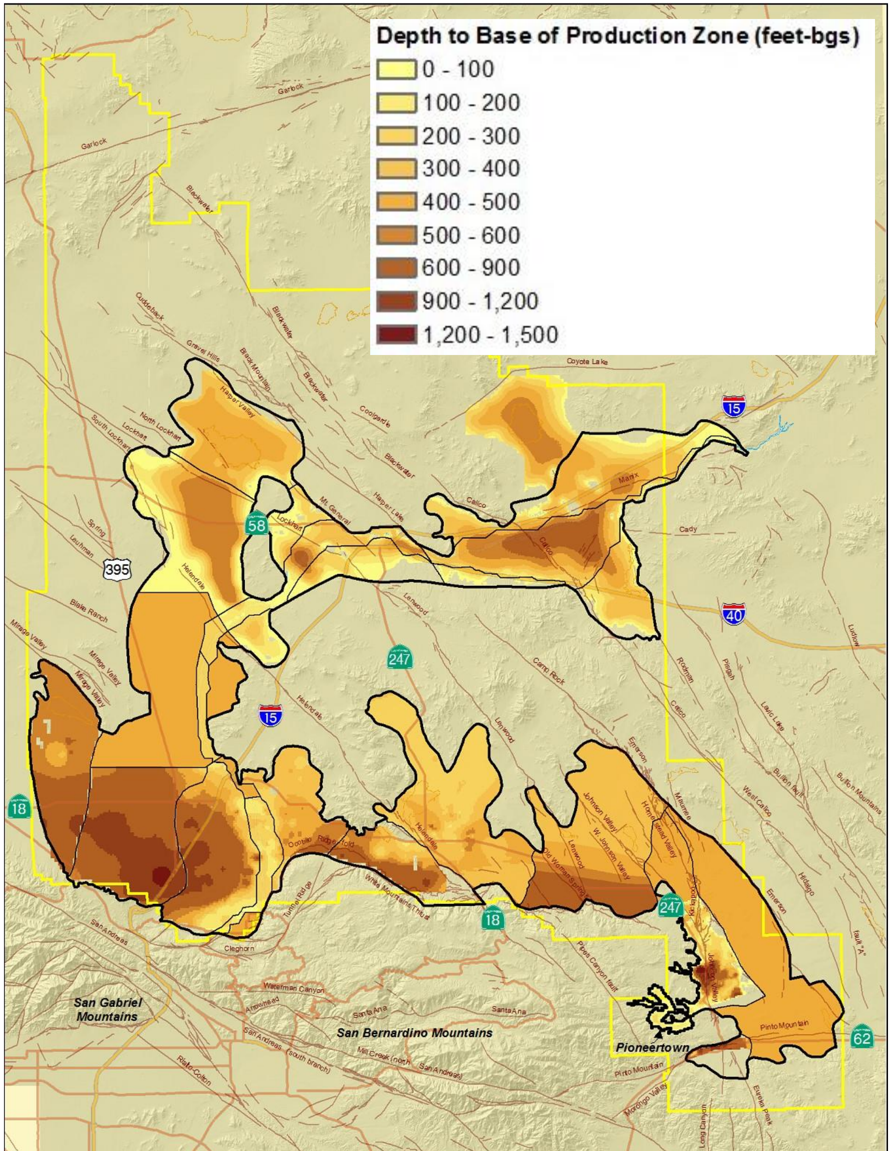
# Ambient Groundwater Quality Characterization/Mapping




- Use well medians based on last 5 years of data
  - *Used older vintage data as necessary*
- De-cluster the data
- Contour/interpolate data

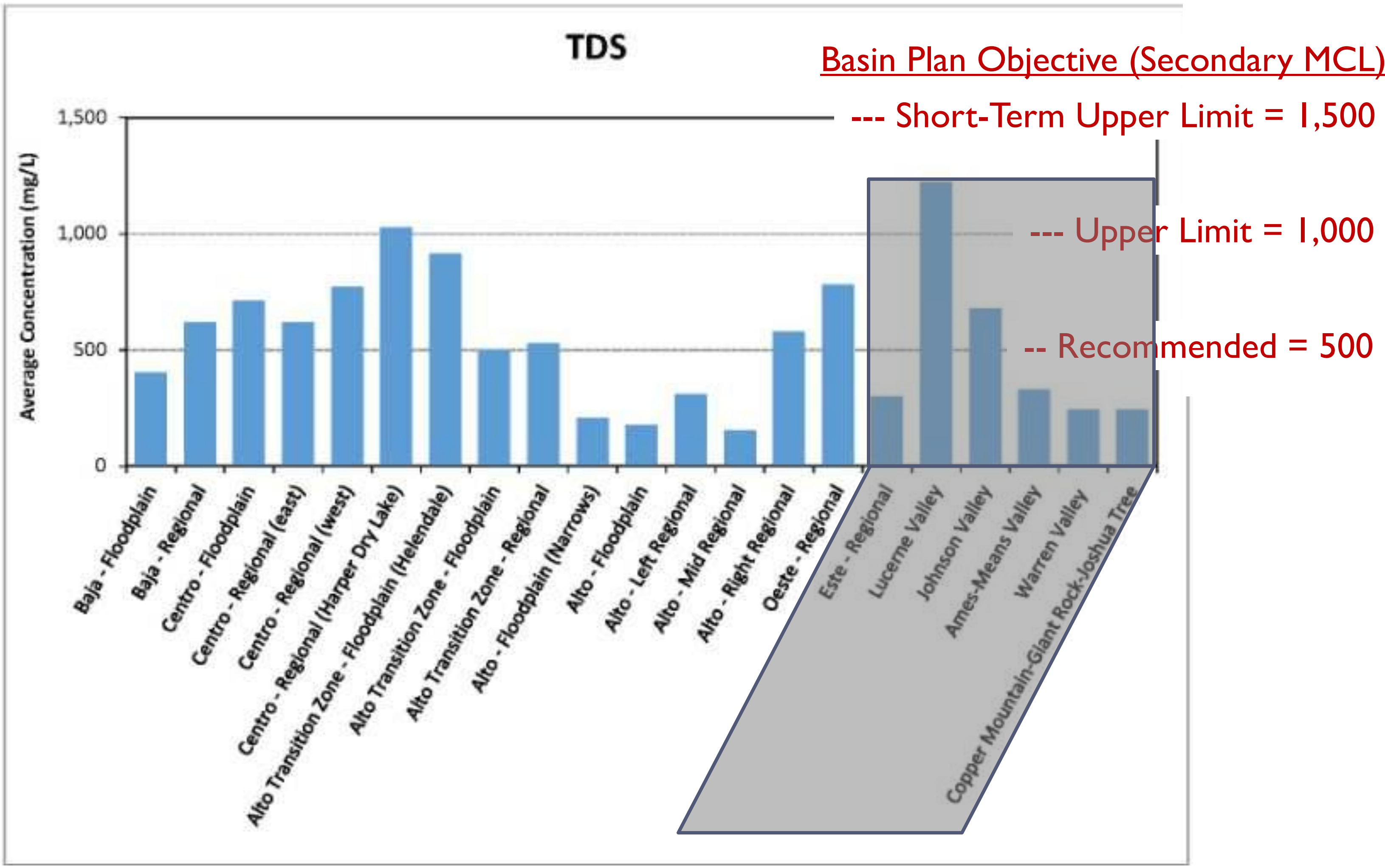
## Nitrate-$NO_3$

# Ambient Groundwater Quality Characterization/Mapping



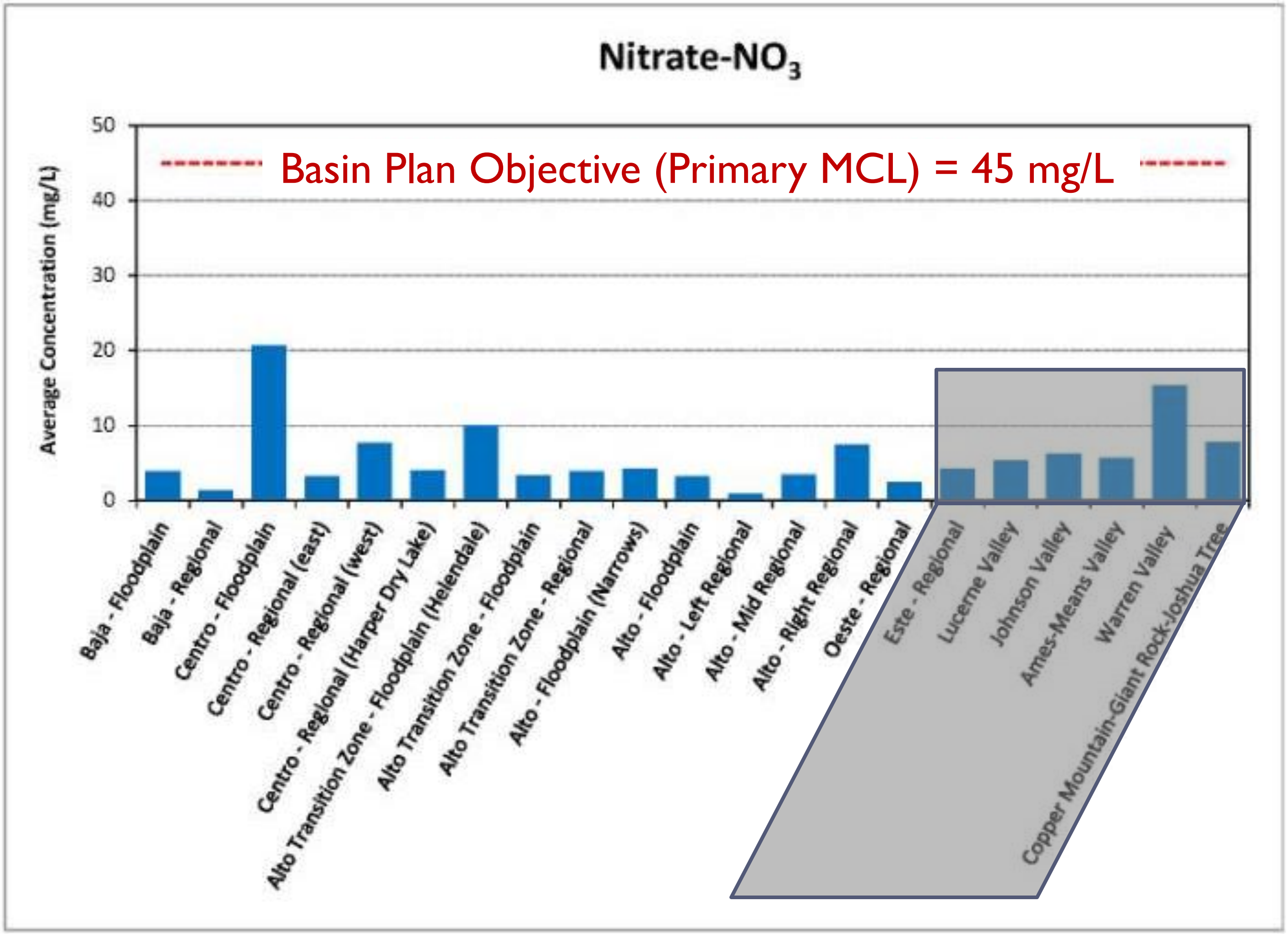

- Calculate average TDS/nitrate concentration by subregion
- Use groundwater volume in operational storage
  - Depth to base of production zone

# Ambient Groundwater Quality Characterization/Mapping




Average Existing (2008-2013) TDS Concentration

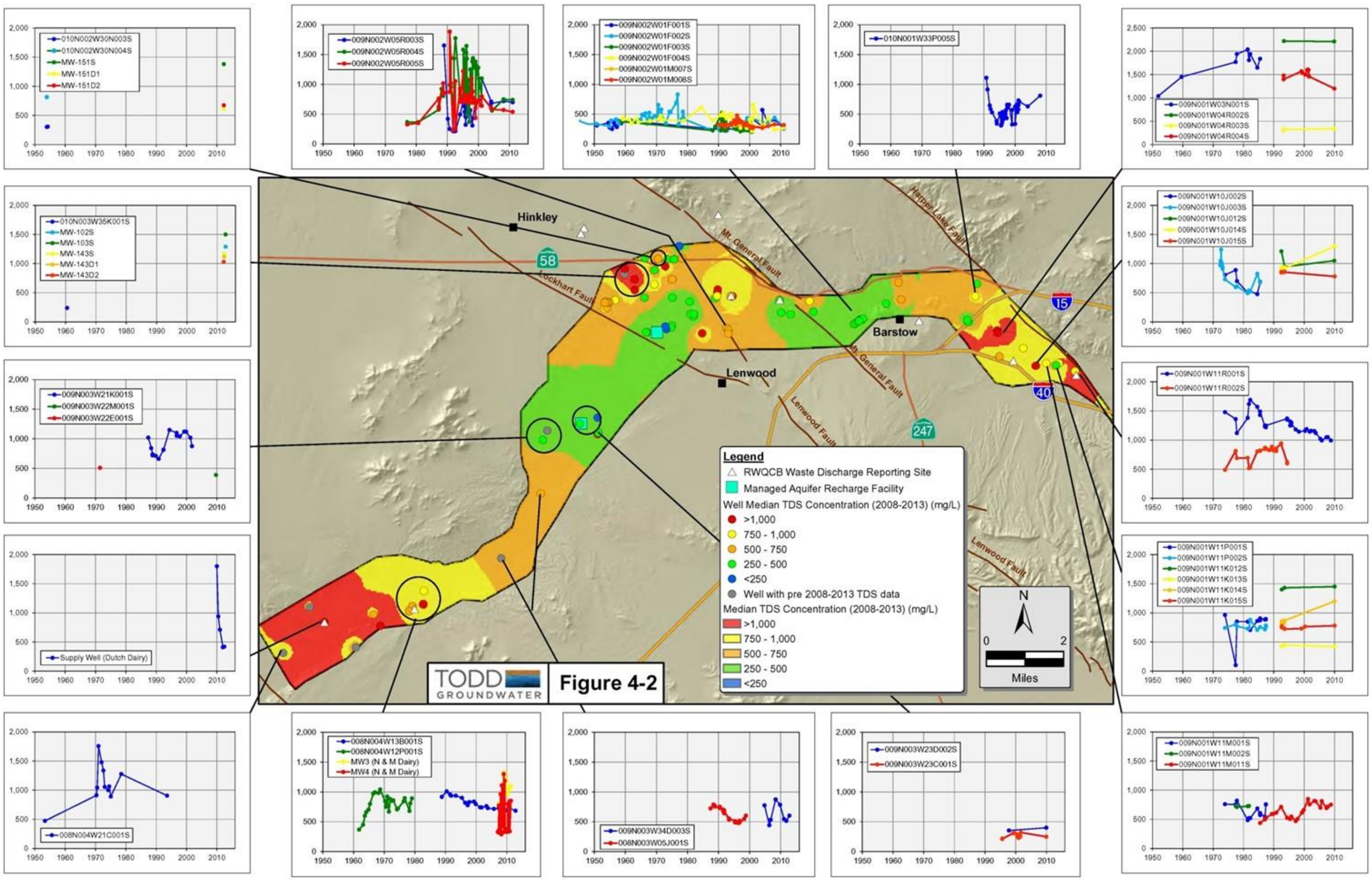
# Ambient Groundwater Quality Characterization/Mapping



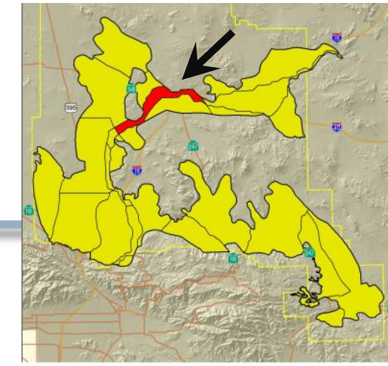

Average Existing (2008-2013) Nitrate-$NO_3$ Concentration

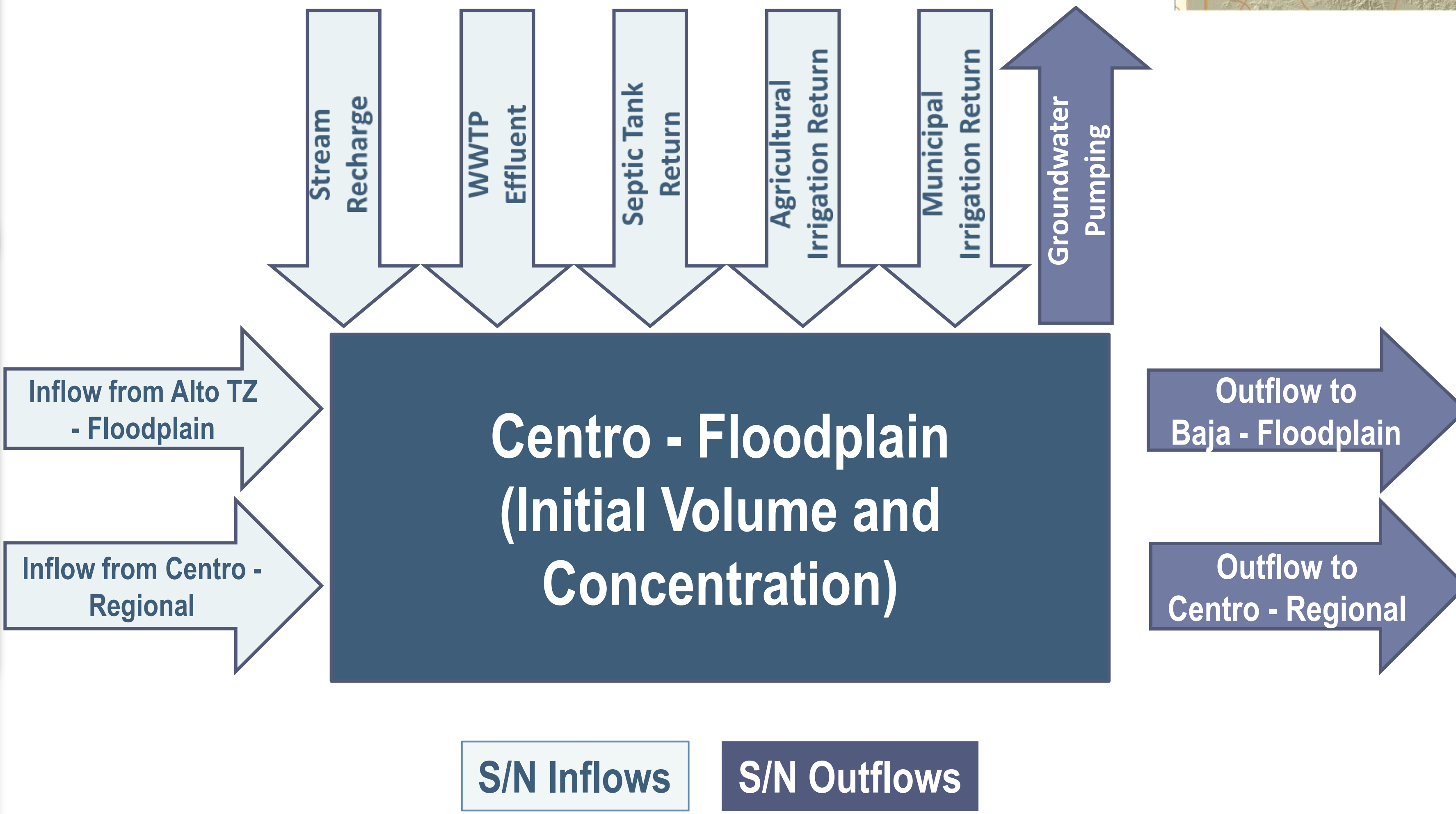
# Ambient Groundwater Quality Characterization/Trend Analysis

- Example: Centro - Floodplain Time-Concentration Plot Map (TDS)



# Summary TDS Mass Fluxes - Example: Centro - Floodplain





# Future Simulations

- 3 Future Scenarios:
  - Scenario 1 – 2012 Base Case
  - Scenario 2 – Growth with <u>no</u> recycled water projects
  - Scenario 3 – Growth with recycled water projects

<table>
<tr><th rowspan="2">Model Component</th><th colspan="3">Mojave River Basin</th><th colspan="3">Morongo Basin</th></tr>
<tr><th>Scenario 1 (Baseline)</th><th>Scenario 2 (Growth with No Recycled Water Projects)</th><th>Scenario 3 (Growth with Recycled Water Projects)</th><th>Scenario 1 (Baseline)</th><th>Scenario 2 (Growth with No Recycled Water Projects)</th><th>Scenario 3 (Growth with Recycled Water Projects)</th></tr>
<tr><td>Hydrologic Conditions</td><td colspan="3">Variable (1931 to 1999 repeated)[a]</td><td colspan="3">Fixed (Average)</td></tr>
<tr><td>Stream Recharge</td><td colspan="3" rowspan="2">Variable (calculated by SNMP mixing model)[b]</td><td colspan="3">Not applicable</td></tr>
<tr><td>Subsurface Flows</td><td colspan="3">Fixed (Average)</td></tr>
<tr><td>Groundwater Production</td><td rowspan="3">2012</td><td colspan="2" rowspan="3">Annual Projection[c]<br>(MWA demand model)</td><td rowspan="3">2012</td><td colspan="2" rowspan="3">Annual Projection[b]<br>(MWA demand model)</td></tr>
<tr><td>Return Flows</td></tr>
<tr><td>Imported SWP water</td></tr>
<tr><td>Wastewater Treatment</td><td colspan="2">Existing Facilities</td><td>Existing and Planned Facilities</td><td colspan="2">Existing Facilities</td><td>Existing and Planned Facilities</td></tr>
</table>

# Future Simulations

- 3 Future Scenarios:
  - Scenario 1 – 2012 Base Case
  - Scenario 2 – Growth with no recycled water projects
  - Scenario 3 – Growth with recycled water projects

## Recycled Water Projects Simulated in Scenario 3

| Agency | Simulated Planned Future Recycled Water Projects | Subregion(s) directly affected | Recycled Water Use |
|---|---|---|---|
| VVWRA | SWRP (Apple Valley) | Alto - Right Regional<br>Alto Transition Zone - Floodplain | Landscape Irrigation |
| | SWRP (Hesperia) | Alto - Mid Regional<br>Alto Transition Zone - Floodplain | Landscape Irrigation |
| City of Victorville | IWWTP - Excess Recycled Water Recharge at VVWRA Pond 14 | Alto Transition Zone - Floodplain | Excess Recycled Water Pond Discharge |
| Helendale CSD | Recycled Water Reclamation Plant | Alto Transition Zone - Floodplain (Helendale) | Landscape Irrigation |
| HDWD | Regional WWTP | Warren Valley | Pond Recharge |

Victor Valley Wastewater Reclamation Agency (VVWRA)
Helendale Community Services District (Helendale CSD)
Hi-Desert Water District (HDWD)

Subregional Water Reclamation Plant (SWRP)
Industrial Wastewater Treatment Plant (IWWTP)
Regional Wastewater Treatment Plant (Regional WWTP)

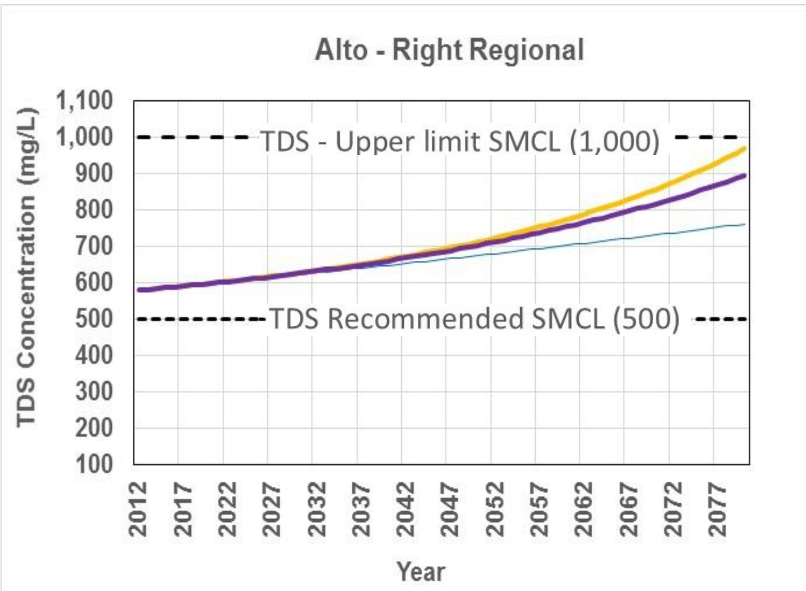
# Salt and Nutrient Transport Model: Key Findings

**Example – Recycled Water Project in a Septic Tank-Sensitive Area**

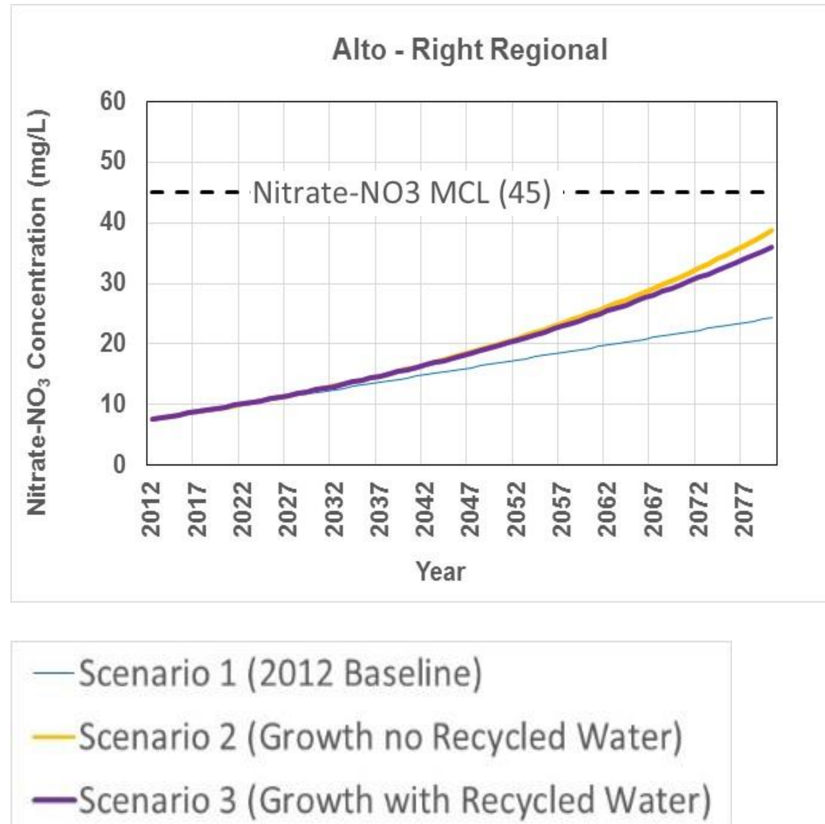
# Recycled Water Project Impact
## *in a SepticTank Sensitive Area*

- Alto – Right Regional (i.e. Apple Valley Regional Aquifer)

TDS




Nitrate



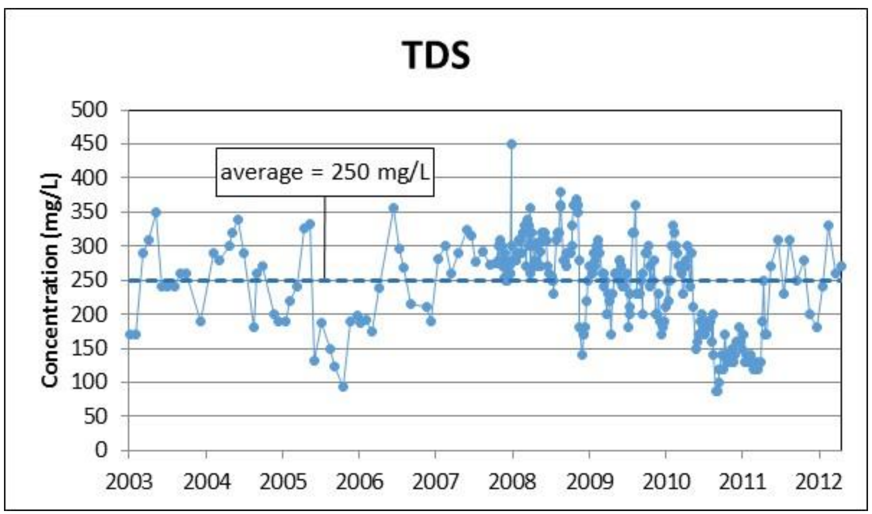

- -74 mg/L TDS
- -2.6 mg/L Nitrate-$NO_3$

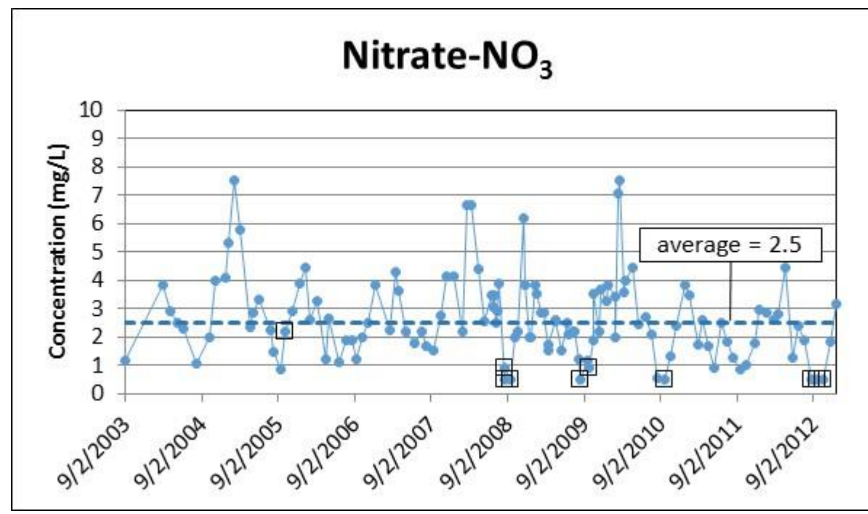
# Salt and Nutrient Transport Model: Key Findings

## Example – Benefit of SWP Water Recharge

# SWP Water Recharge

- SWP water quality (average 2003 to 2013)
  - 250 mg/L TDS
  - 2.5 mg/L Nitrate-$NO_3$
- Average concentration applied to future years



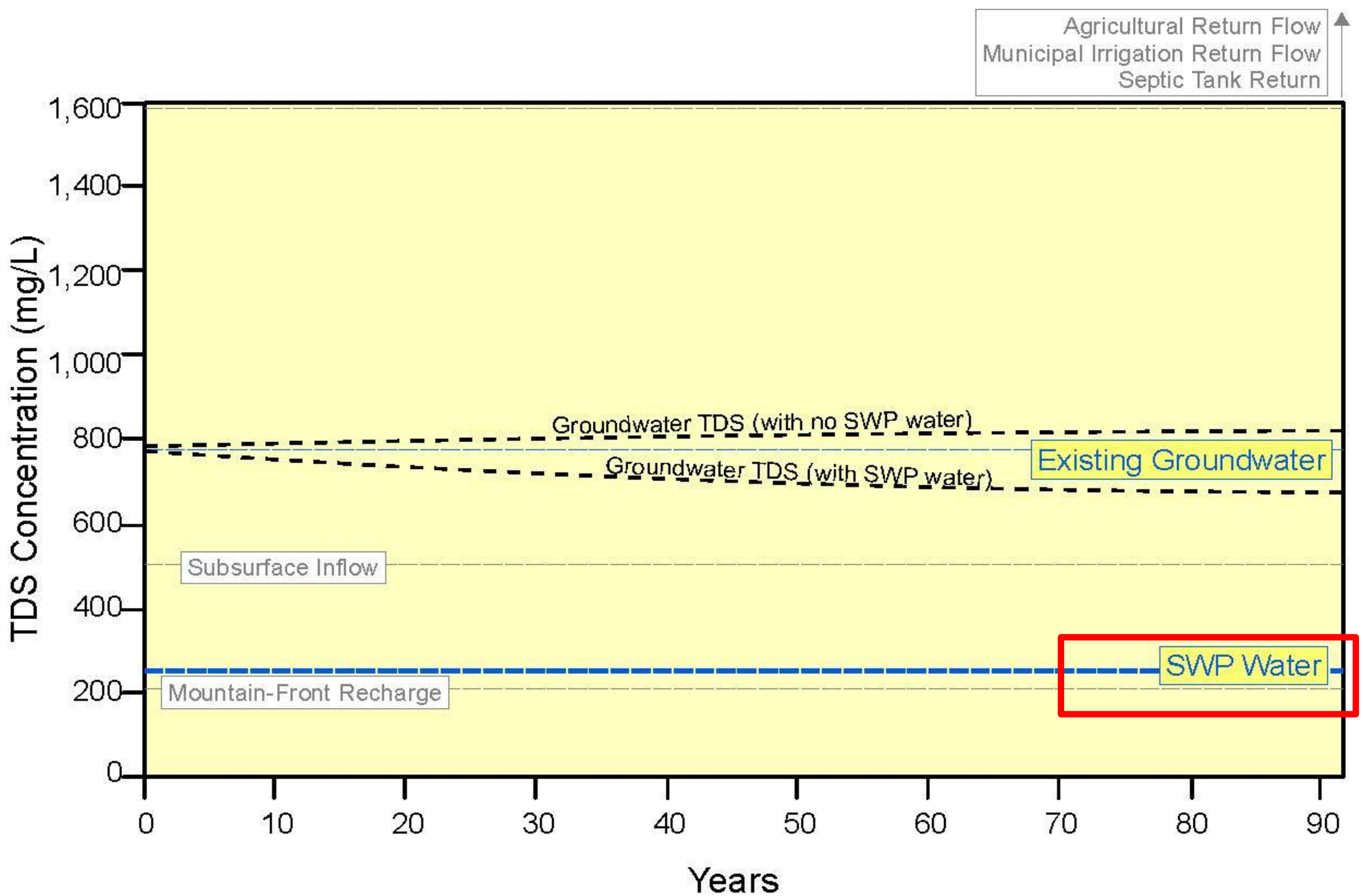

□ = non-detect

# SWP Water Recharge

- For TDS, SWP water is of higher quality than existing groundwater in 4 of 6 subregions receiving SWP water
- Benefit of SWP water recharge is evident but dependent on time

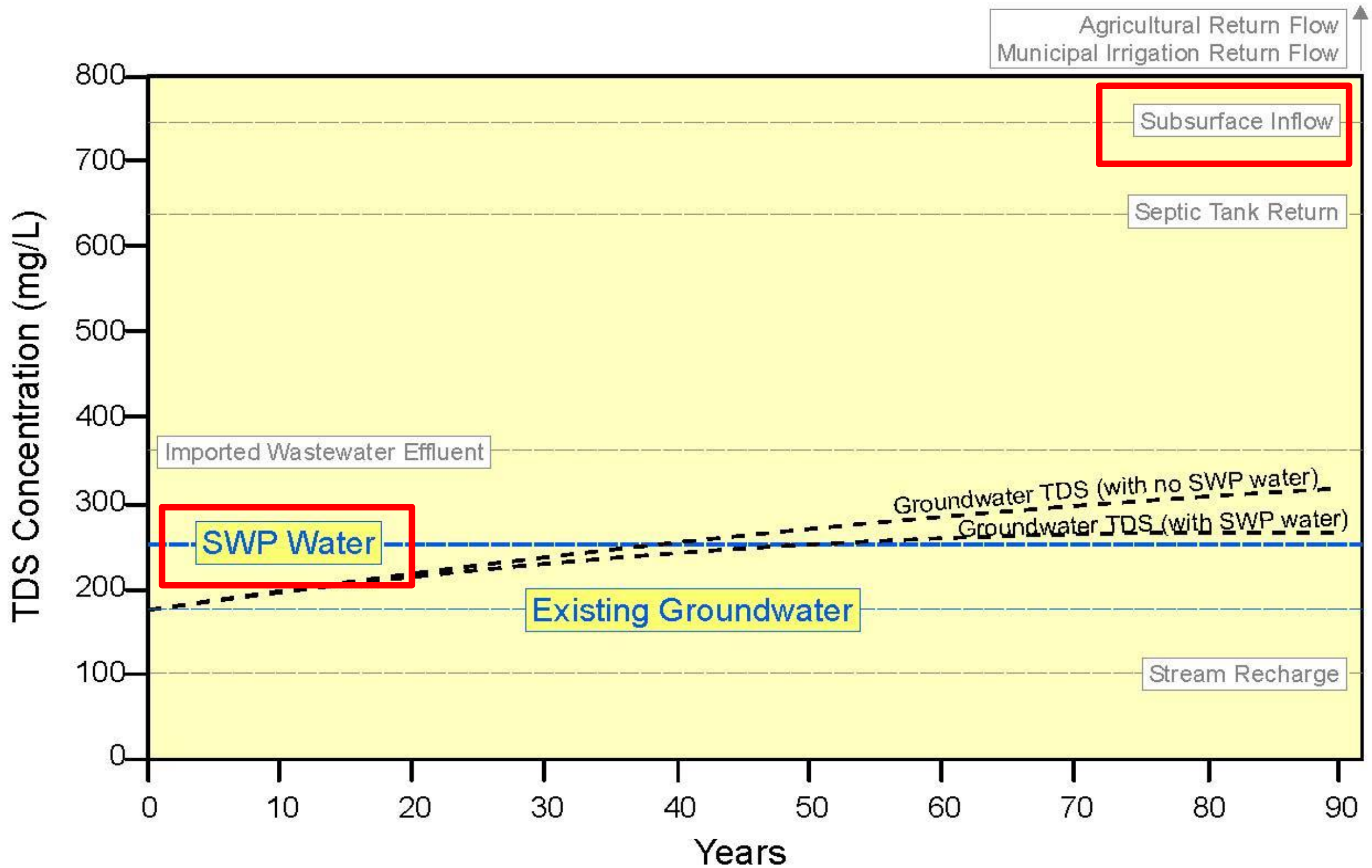
# SWP Water Recharge

- Oeste – Regional (i.e. Phelan and El Mirage)



# SWP Water Recharge

- Alto – Floodplain (i.e. Upper Mojave River)



# Salt and Nutrient Transport Model: Key Findings

- Existing Assimilative Capacity Calculation

| Subregion | TDS | | | | Nitrate-$NO_3$ | |
|---|---|---|---|---|---|---|
| | Average TDS Groundwater Concentration | Assimilative Capacity[a] | | | Average Nitrate-$NO_3$ Groundwater Concentration | Assimilative Capacity[a] |
| | | BPO = 500 mg/L | BPO = 1,000 mg/L | BPO = 1,500 mg/L | | BPO = 45 mg/L |
| **MOJAVE RIVER BASIN** | | | | | | |
| Baja - Floodplain | 401 | 99 | 599 | 1,099 | 3.9 | 41.1 |
| Baja - Regional | 617 | -117 | 383 | 883 | 1.4 | 43.6 |
| Centro - Floodplain | 711 | -211 | 289 | 789 | 20.7 | 24.3 |
| Centro - Regional (east) | 618 | -118 | 382 | 882 | 3.2 | 41.8 |
| Centro - Regional (west) | 771 | -271 | 229 | 729 | 7.7 | 37.3 |
| Centro - Regional (Harper Dry Lake) | 1,028 | -528 | -28 | 472 | 4.0 | 41.0 |
| Alto Transition Zone - Floodplain (Helendale) | 915 | -415 | 85 | 585 | 10.0 | 35.0 |
| Alto Transition Zone - Floodplain | 500 | 0 | 500 | 1,000 | 3.4 | 41.6 |
| Alto Transition Zone - Regional | 529 | -29 | 471 | 971 | 3.9 | 41.1 |
| Alto - Floodplain (Narrows) | 205 | 295 | 795 | 1,295 | 4.3 | 40.7 |
| Alto - Floodplain | 177 | 323 | 823 | 1,323 | 3.3 | 41.7 |
| Alto - Left Regional | 310 | 190 | 690 | 1,190 | 0.9 | 44.1 |
| Alto - Mid Regional | 153 | 347 | 847 | 1,347 | 3.5 | 41.5 |
| Alto - Right Regional | 579 | -79 | 421 | 921 | 7.5 | 37.5 |
| Oeste - Regional | 781 | -281 | 219 | 719 | 2.5 | 42.5 |
| Este - Regional | 299 | 201 | 701 | 1,201 | 4.3 | 40.7 |
| **MORONGO BASIN** | | | | | | |
| Lucerne Valley | 1,224 | -724 | -224 | 276 | 5.4 | 39.6 |
| Johnson Valley | 678 | -178 | 322 | 822 | 6.2 | 38.8 |
| Ames-Means Valley | 330 | 170 | 670 | 1,170 | 5.7 | 39.3 |
| Warren Valley | 243 | 257 | 757 | 1,257 | 15.4 | 29.6 |
| Copper Mountain-Giant Rock-Joshua Tree | 242 | 258 | 758 | 1,258 | 7.8 | 37.2 |

# Salt and Nutrient Transport Model: Key Findings

- Future Assimilative Capacity Calculation

| Subregion | TDS | | | | Nitrate-$NO_3$ | |
|---|---|---|---|---|---|---|
| | Simulated Future (2081) Groundwater TDS Concentration (mg/L) | Assimilative Capacity[a] | | | Simulated Future (2081) Groundwater Nitrate-$NO_3$ Concentration (mg/L) | Assimilative Capacity[a] |
| | | BPO = 500 mg/L | BPO = 1,000 mg/L | BPO = 1,500 mg/L | | BPO = 45 mg/L |
| **MOJAVE RIVER BASIN** | | | | | | |
| Baja - Floodplain | 429 | 71 | 571 | 1,071 | 7.9 | 37.1 |
| Baja - Regional | 664 | -164 | 336 | 836 | 5.2 | 39.8 |
| Centro - Floodplain | 598 | -98 | 402 | 902 | 35.5 | 9.5 |
| Centro - Regional | 786 | -286 | 214 | 714 | 11.8 | 33.2 |
| Centro - Regional (Harper Dry Lake) | 1,018 | -518 | -18 | 482 | 4.7 | 40.3 |
| Alto Transition Zone - Floodplain (Helendale) | 874 | -374 | 126 | 626 | 21.0 | 24.0 |
| Alto Transition Zone - Floodplain | 535 | -35 | 465 | 965 | 36.6 | 8.4 |
| Alto Transition Zone - Regional | 534 | -34 | 466 | 966 | 6.6 | 38.4 |
| Alto - Floodplain (Narrows) | 395 | 105 | 605 | 1,105 | 17.3 | 27.7 |
| Alto - Floodplain | 262 | 238 | 738 | 1,238 | 10.7 | 34.3 |
| Alto - Left Regional | 378 | 122 | 622 | 1,122 | 4.2 | 40.8 |
| Alto - Mid Regional | 362 | 138 | 638 | 1,138 | 13.4 | 31.6 |
| Alto - Right Regional | 896 | -396 | 104 | 604 | 36.0 | 9.0 |
| Oeste - Regional | 702 | -202 | 298 | 798 | 6.7 | 38.3 |
| Este - Regional | 318 | 182 | 682 | 1,182 | 11.1 | 33.9 |
| **MORONGO BASIN** | | | | | | |
| Lucerne Valley | 1,240 | -740 | -240 | 260 | 9.7 | 35.3 |
| Johnson Valley | 686 | -186 | 314 | 814 | 7.0 | 38.0 |
| Ames-Means Valley | 343 | 157 | 657 | 1,157 | 6.5 | 38.5 |
| Warren Valley | 359 | 141 | 641 | 1,141 | 22.5 | 22.5 |
| Copper Mountain-Giant Rock-Joshua Tree | 248 | 252 | 752 | 1,252 | 8.4 | 36.6 |

# Salt and Nutrient Transport Model: Key Findings

- Effect of recycled water projects do not result in significant assimilative capacity use in affected subregions
- The SNMP does not recommend any changes to BPOs
- Groundwater characterization and S/N modeling results provide the technical foundation to guide local planning and future Regional Board policy decisions

# Groundwater Monitoring Plan

- Collaborative, multi-agency effort
- Active monitoring network is basin-wide, yet focused where S/N loading, pumping, and groundwater management occur
- Existing monitoring programs adequate for comparing concentrations of S/N loading to WQOs on subregional-scale
- Data publicly accessible; no additional reporting proposed
- MWA is committed to supporting the Regional Boards in the protection of beneficial uses and providing data to guide future policy decisions and address local issues as they arise

# Questions/Discussion