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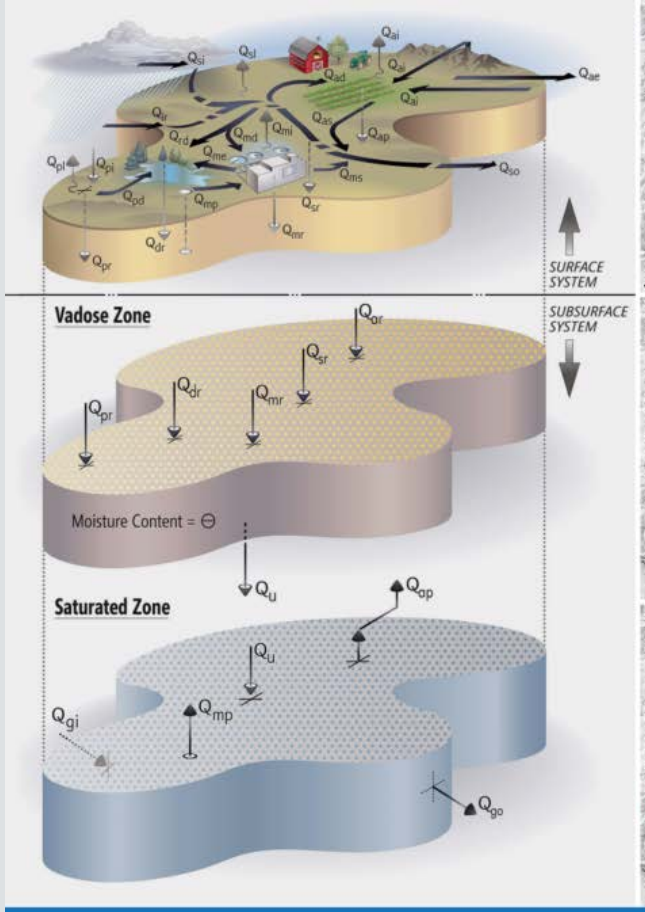
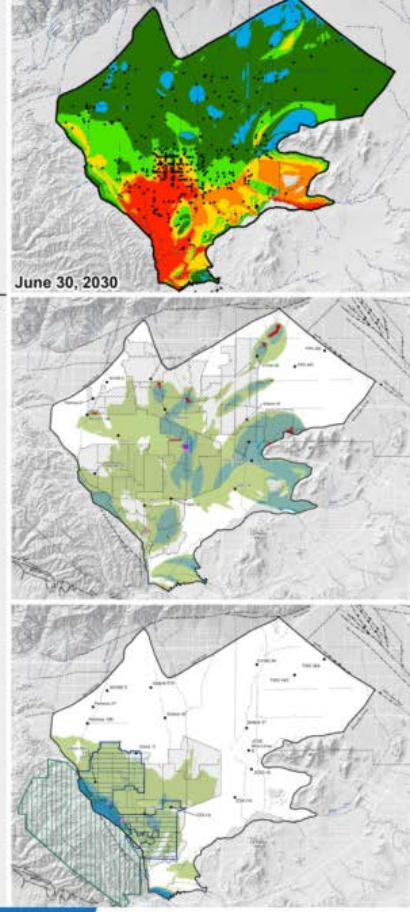
Chino Basin Maximum Benefit SNMP Update – Technical and Regulatory Overview

October 27, 2022

Overview

- Maximum Benefit SNMP and the Chino Basin Recycled Water Program
- Regulatory Problem Statement
- Investigation Questions
- Investigation Approach
- Results
- Regulatory Proposal





CHINO BASIN WATERMASTER
INLAND EMPIRE UTILITIES AGENCY

Total Dissolved Solids and Nitrate Concentration Projections for the Chino Basin

Prepared in Support of the Chino Basin Maximum Benefit Salt and Nutrient Management Plan

DRAFT REPORT – DECEMBER 2021

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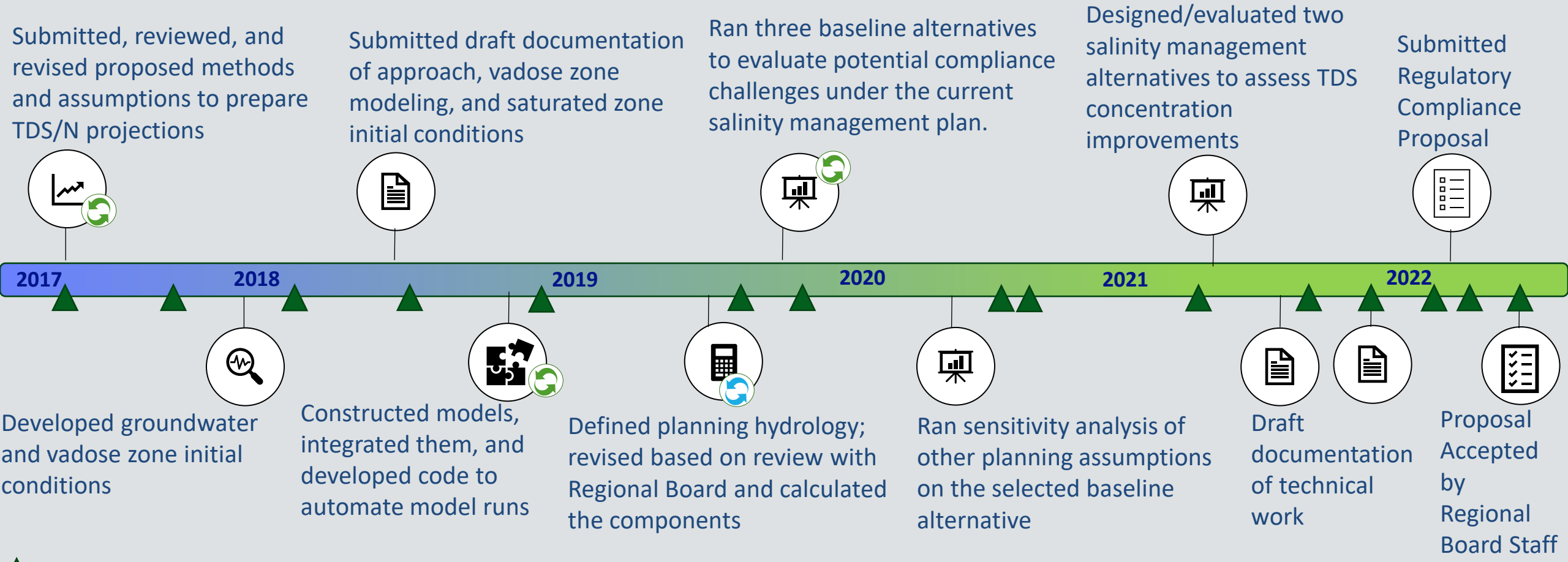
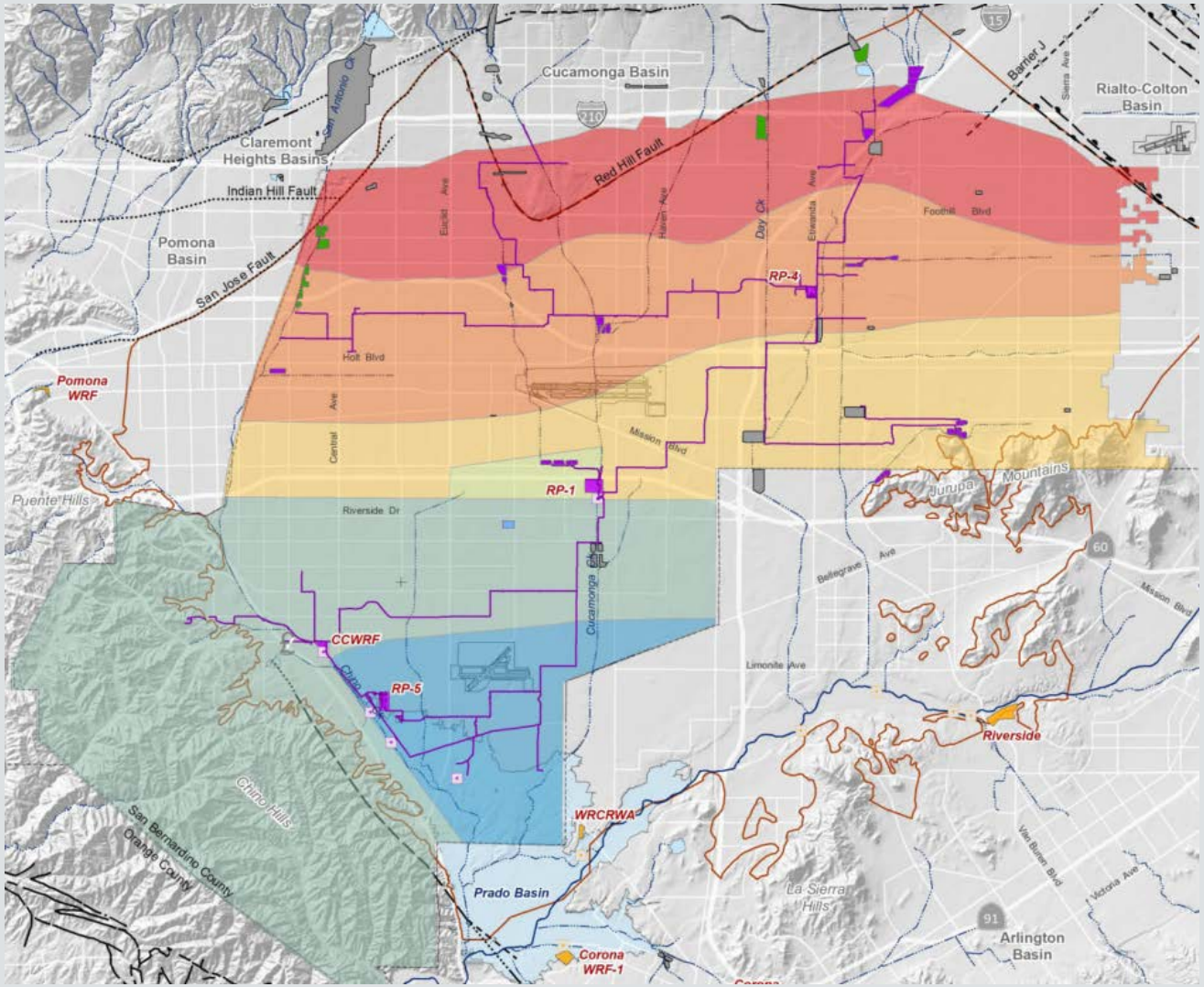
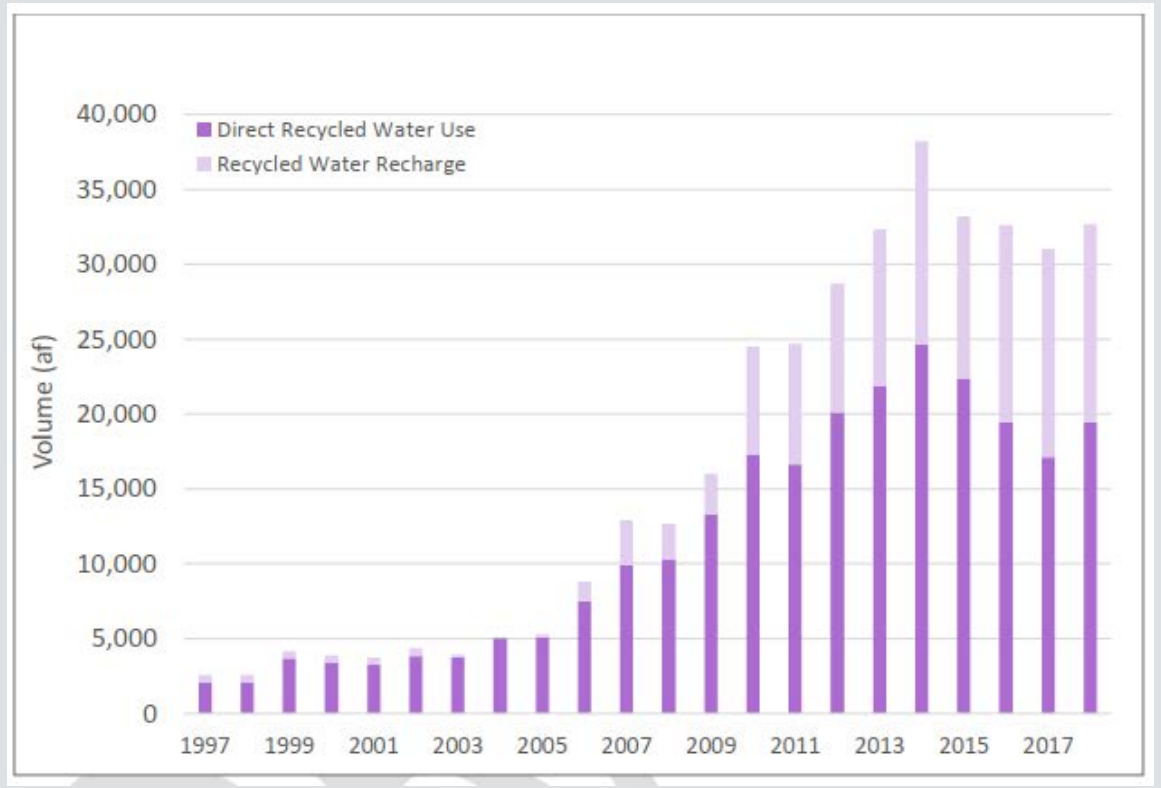
Work Completed 2017-2022



Chino Basin Recycled Water Program



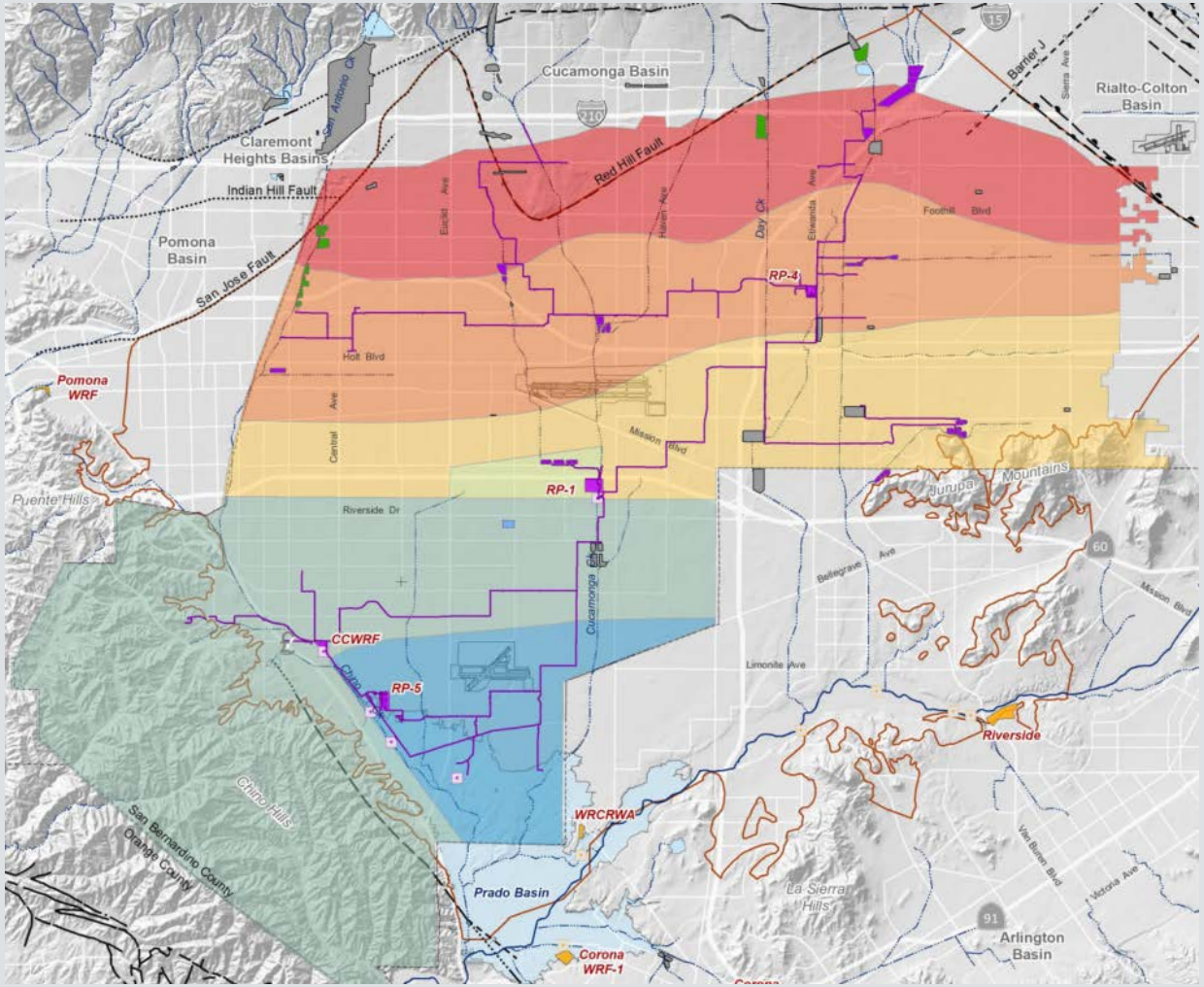


Maximum Benefit Commitments to Enable Recycled Water Use

Commitments 1 & 2	Surface water and groundwater monitoring
Commitments 3 & 4	Expand and operate the Desalters at an ultimate capacity of at least 40,000 afy
Commitment 5	Construct and operate recharge facilities
Commitment 6	Ensure that the IEUA recycled water TDS concentration does not exceed the permit limit of 550 mgl ***as measured on a 12-month flow weighted average***
Commitment 7	Ensure that the TDS/N concentration of artificial recharge < or = to objective for Chino-North as measured on a five-year, volume-weighted basis (420 and 5 mgl)
Commitment 8	Maintain hydraulic control of outflows from Chino-North to de minimis levels
Commitment 9	Recompute ambient water quality (TDS/nitrate) every three years

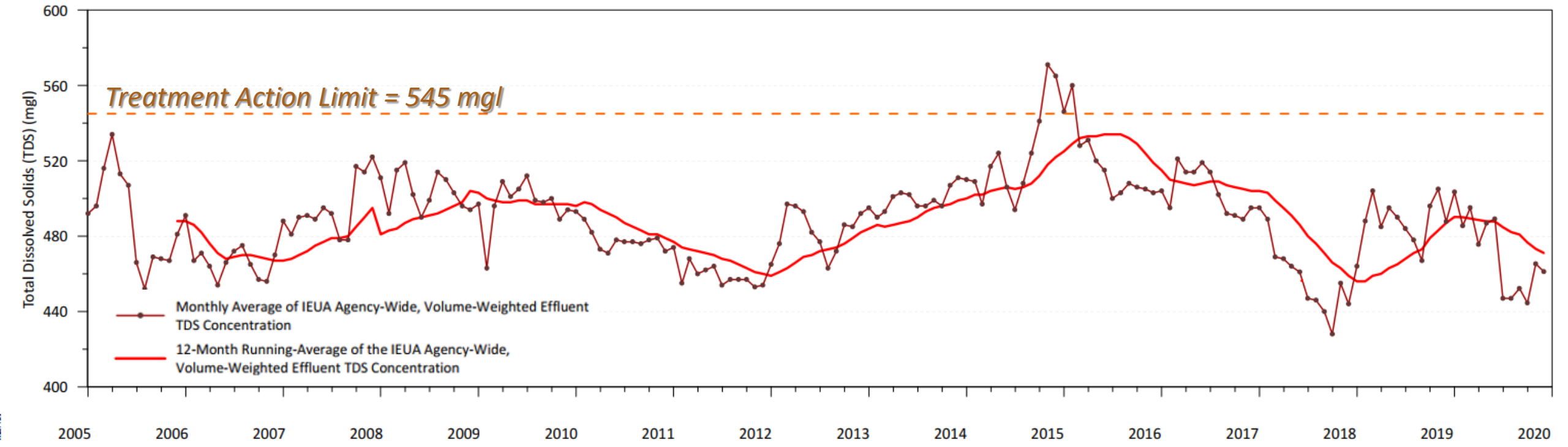
Regulatory Problem Statement

- Permit sets effluent compliance limit for collective IEUA facilities
- TDS limitation = 550 mgl
- Nitrate limitation = 8 mgl
- **Effluent compliance metric**: computed as the 12-month, flow-weighted average TDS and nitrate concentration of all four IEUA plants



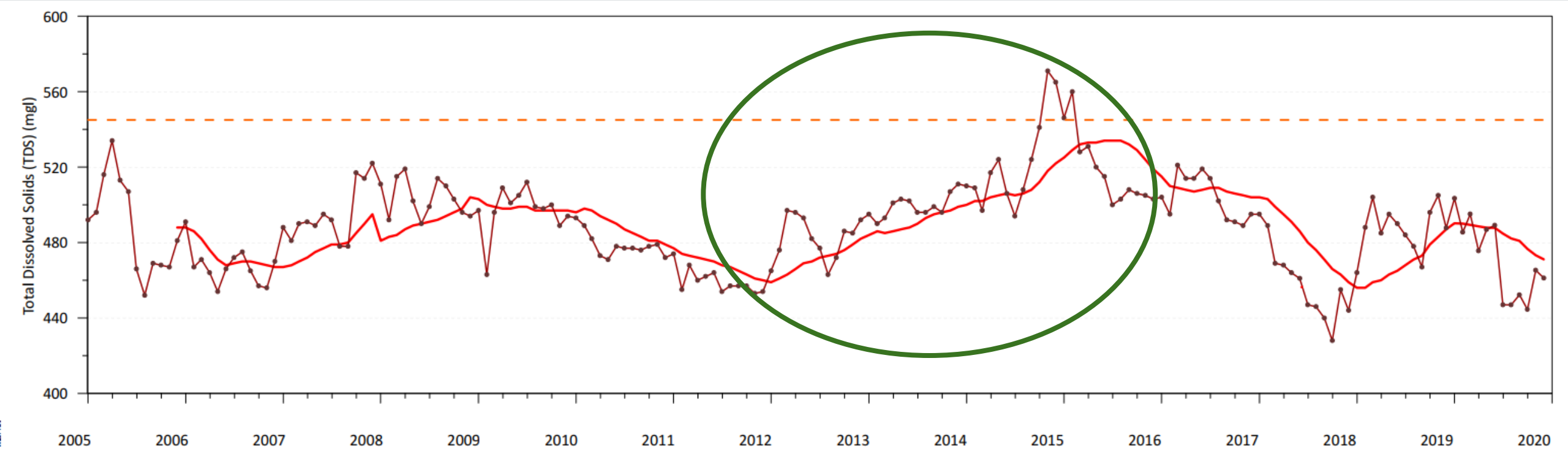
Regulatory Problem Statement

- Maximum Benefit SNMP requires action to implement treatment or mitigation program when recycled water TDS concentration equals 545 mgl for 3 consecutive months



Regulatory Problem Statement

- Recycled Water TDS varies seasonally and with hydrologic conditions, and increases during drought
- During 2012 to 2016 dry period, nearly triggered treatment/mitigation requirement



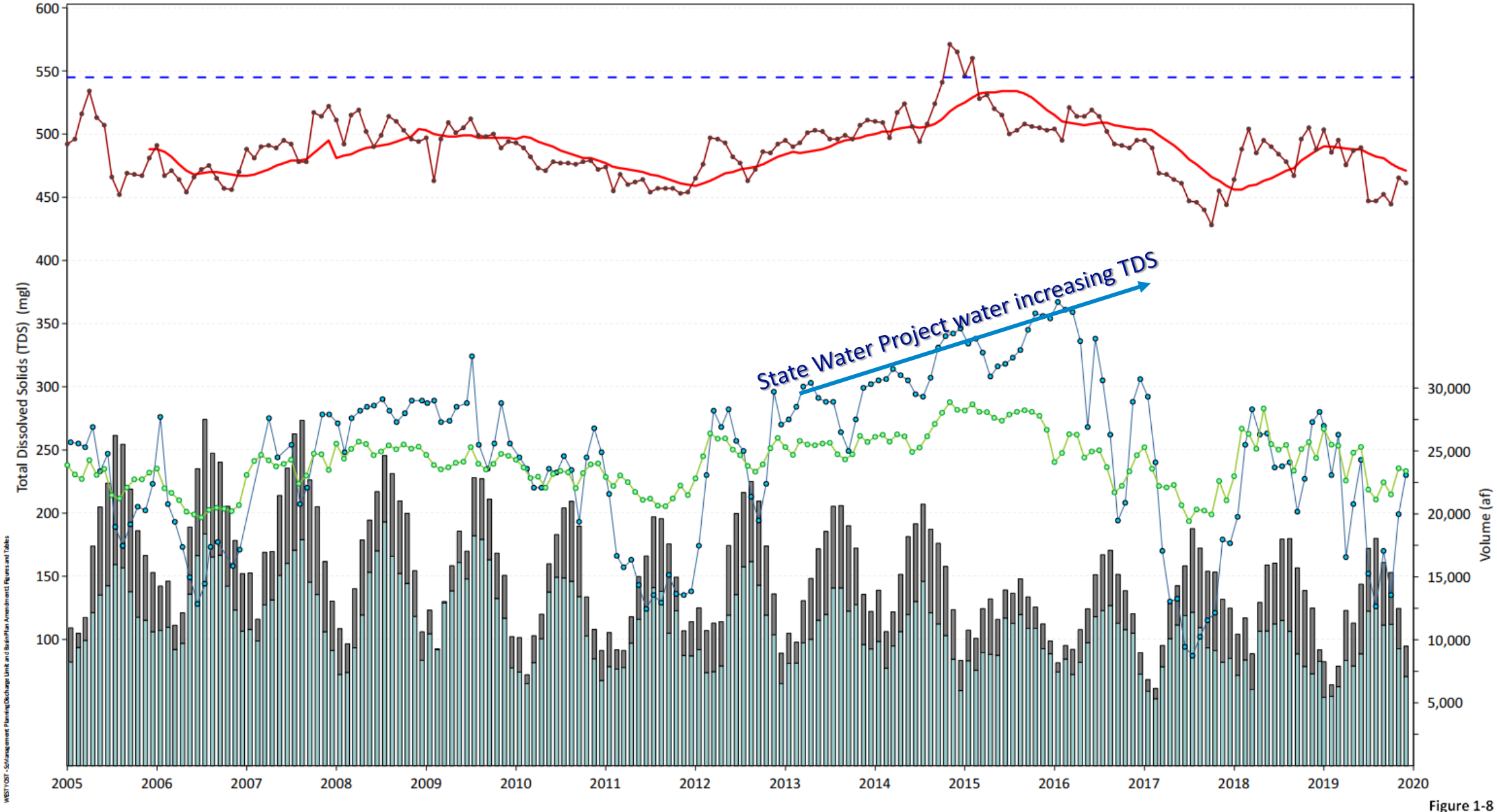


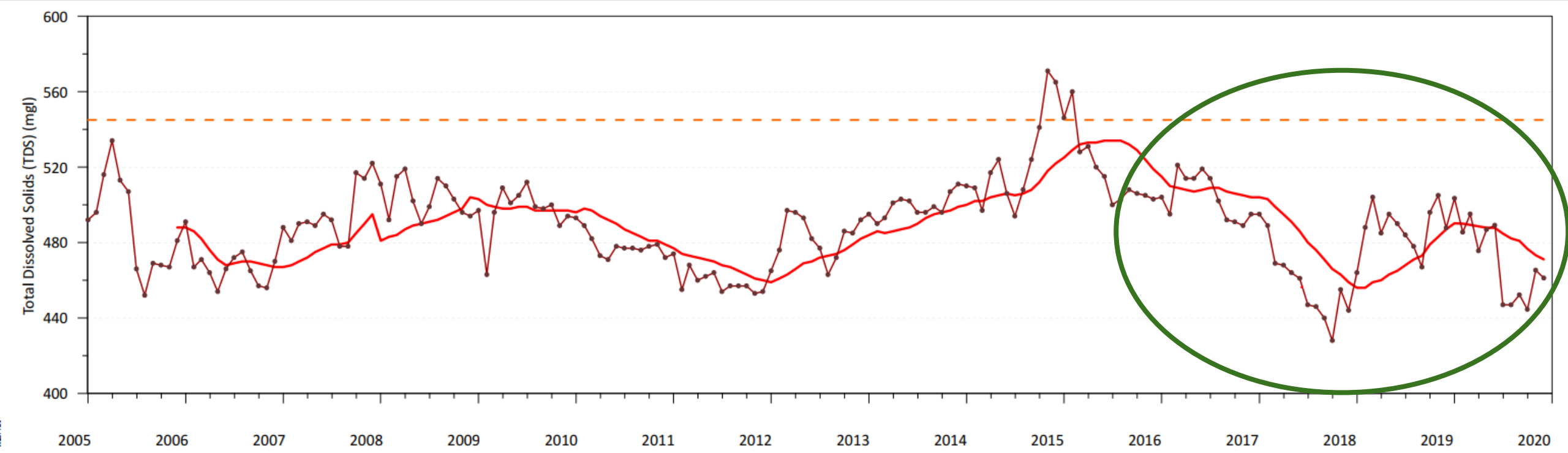
Figure 1-8

TDS Concentrations of
IEUA Agency-Wide Effluent and Water Supply, and SWP Water,
and Volume of IEUA Water Supply - 2005 to 2019

- Monthly Volume-Weighted TDS Concentration of the Water Supply in the IEUA Service Area
- Monthly TDS Concentration of SWP Water at Silverwood Lake
- Monthly Average of IEUA Agency-Wide, Volume-Weighted Effluent TDS Concentration
- 12-Month Running-Average of the IEUA Agency-Wide, Volume-Weighted Effluent TDS Concentration
- Monthly Volume of the Water Supply in the IEUA Service Area that is Local Sources
- Monthly Volume of the Water Supply in the IEUA Service Area that is SWP Water
- TDS Action Limit (545 mgl)

Regulatory Problem Statement

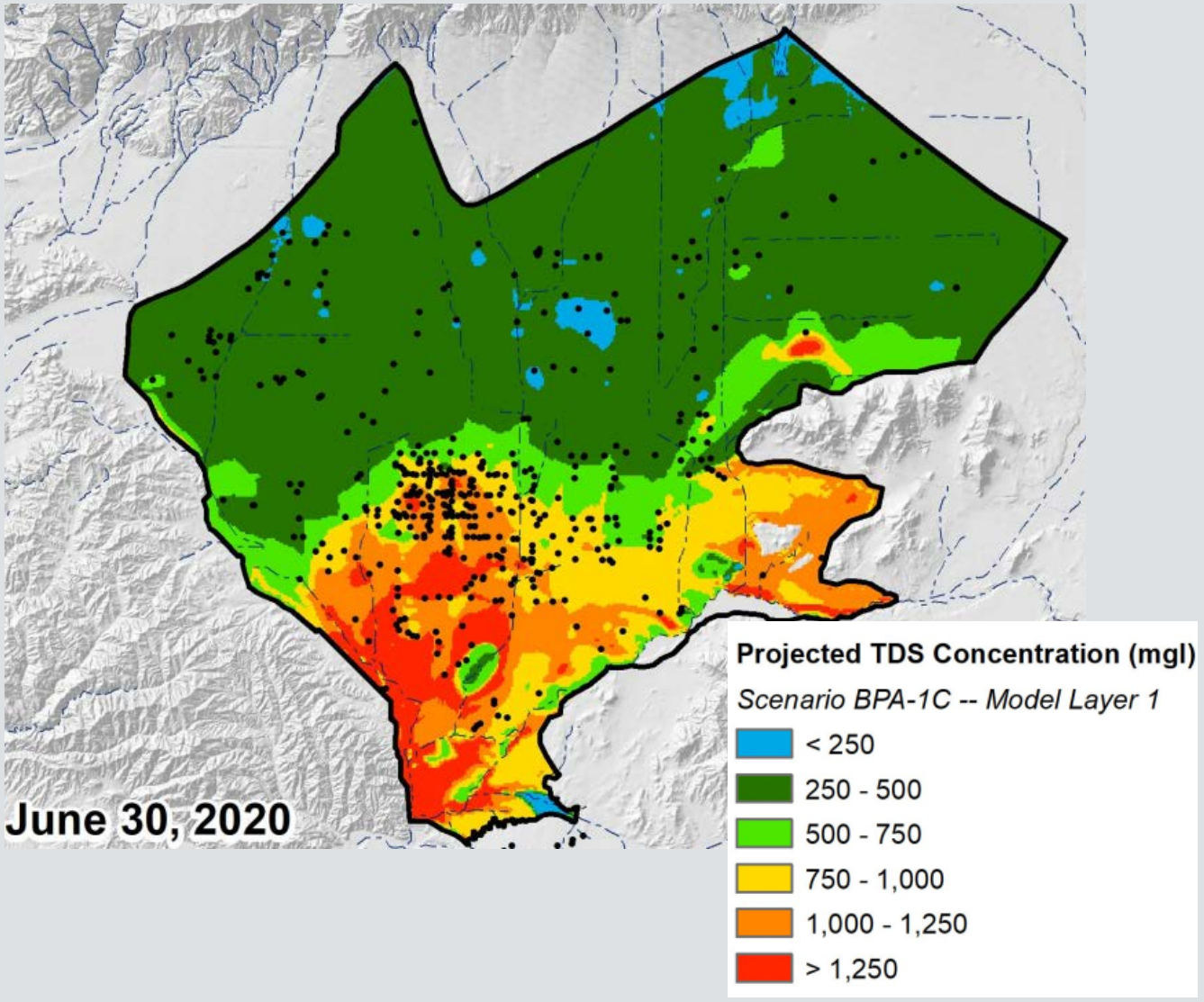
- Following 2012-2016 dry period, TDS of recycled water decreased
- Could TDS compliance metric be revised to a longer-term averaging period to avoid short-term condition of “non-compliance” during dry periods?



Investigation Questions

1. What is the impact to TDS and nitrate concentrations in the Chino Basin from allowing a longer-term flow-weighted averaging period?

2. What is the potential water quality benefit (improvement) when treatment or mitigation applied to comply with the current 12-month averaging metric?



Investigation Questions

1. What is the impact to TDS and nitrate concentrations in the Chino Basin from allowing a longer-term flow-weighted averaging period?

- Baseline scenario: How will TDS and nitrate concentrations change in the Chino Basin over time *absent implementation of salinity management actions* triggered by groundwater or effluent water quality conditions?
- This is necessary to understand:
  - relationship of exceedances of the compliance metrics to the hydrologic conditions
  - When and how often the compliance metrics would be exceeded under the ***specific sequence of hydrologic conditions simulated***

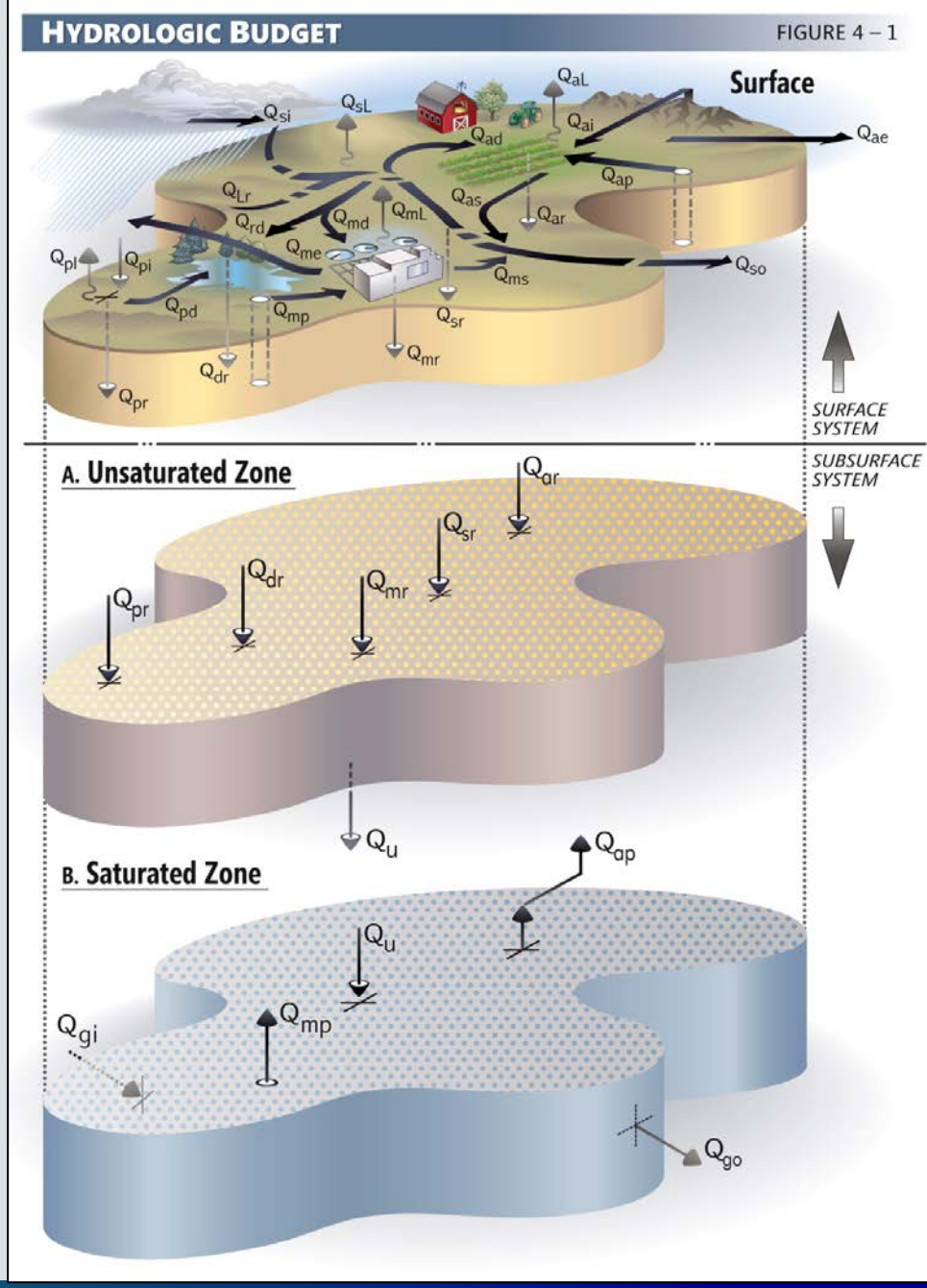
Investigation Questions

2. What is the potential water quality benefit (improvement) when treatment or mitigation applied to comply with the current 12-month averaging metric?

- What are the ***conceptual*** management alternatives to avoid periods of non-compliance in the baseline scenario?

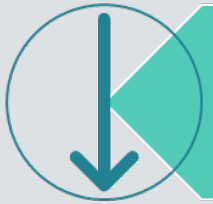
Technical Approach

- Define the TDS loading and export process in the Chino Basin
- Establish initial conditions in the saturated system and vadose zone
- Define 95-year baseline planning conditions and hydrology
  - assumes back-to-back occurrences of the driest 5-year period on record for the first 10 years of the simulation and at subsequent points in the planning period hydrology
- Estimate the future TDS concentrations in groundwater and recycled water for a baseline scenario and each compliance alternative



Project Innovations

Use Numerical fate and transport model to simulate basin-wide TDS concentrations



Incorporation of vadose zone processes:

- Solute lag time – created 35-year time history to load the Vadose Zone
- Geochemical transformations (precipitation of TDS)

Incorporation of feedback loops into the projections

(groundwater → water supply → recycled water → groundwater)

Project probability of non-compliance with recycled water TDS permit limitations under variable hydrologic conditions

Modeling Tools

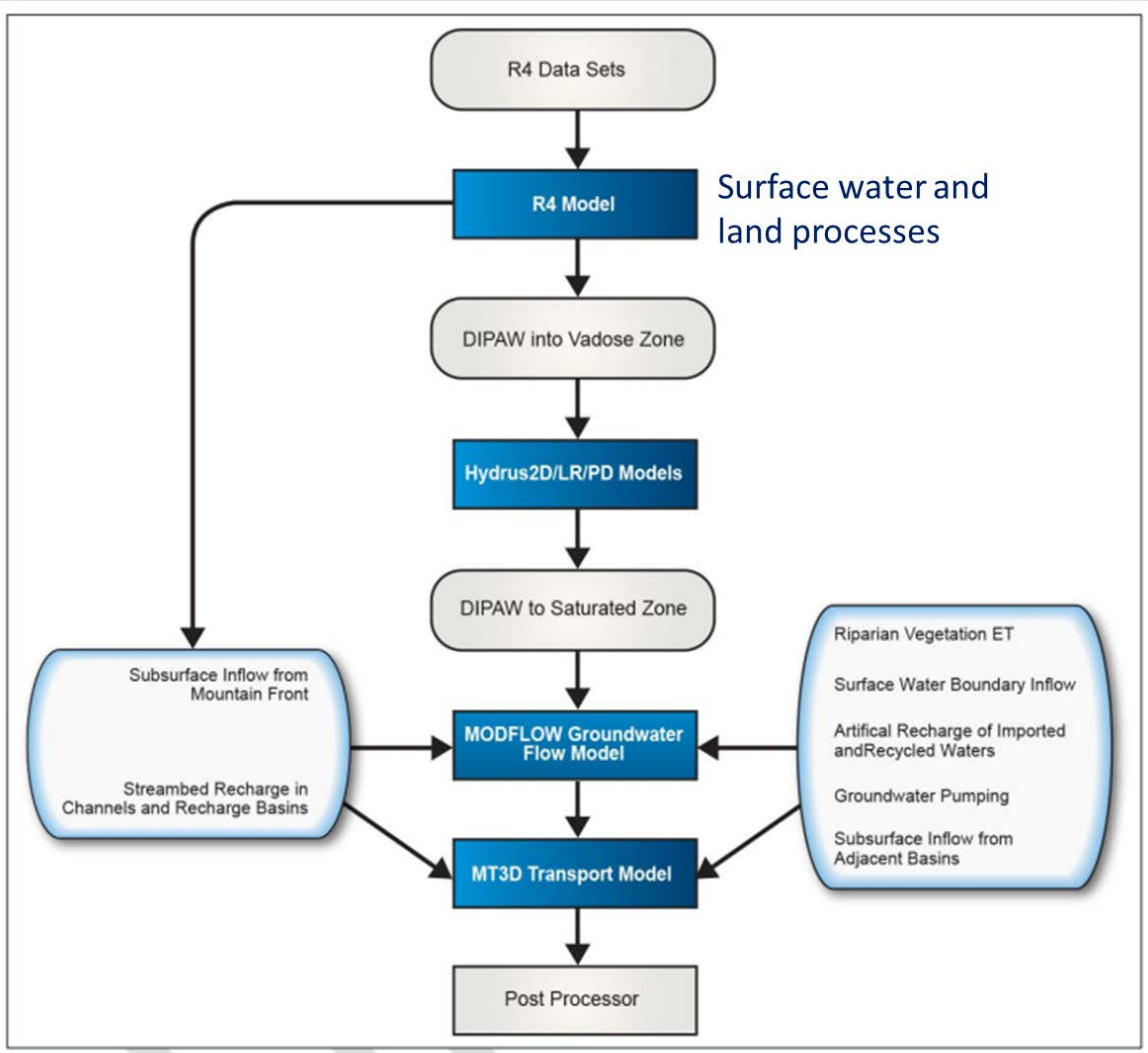
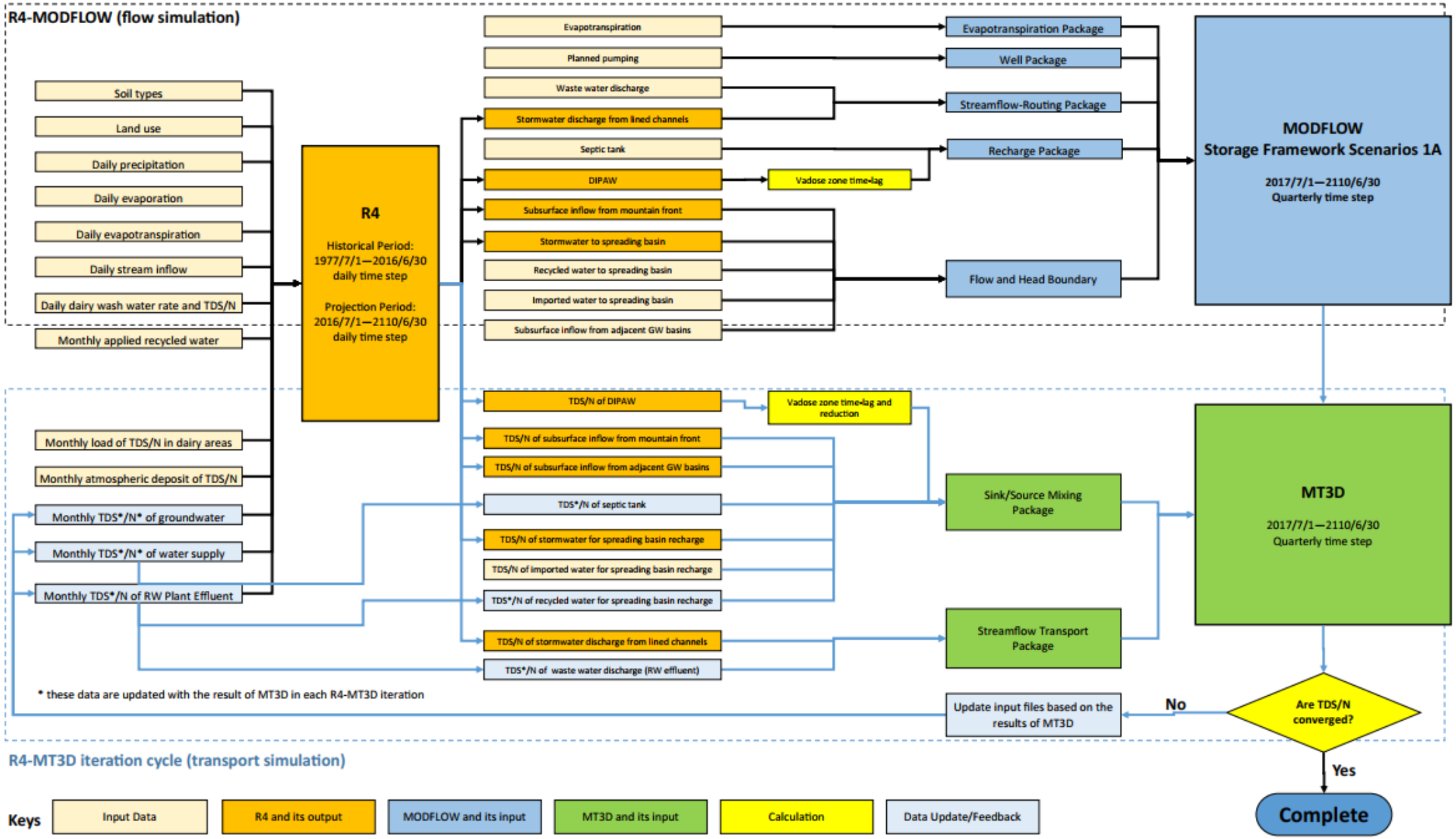


Figure 2-2. Numerical Tools Used to Project Future TDS and Nitrate Concentrations in the Chino Basin

- Surface Water Model (R4):
  - Surface water interaction with land surface
  - Route rainfall, runoff, rootzone, recharge
- Vadose Zone (Hydrus 2D, analytical tools)
  - Simulate fate and transport of deep infiltration of applied water
  - Lag time and geochemical transformation
- Groundwater Flow (MODFLOW)
- Groundwater and Surface Water Quality (MT3D)
- Post processor with automation to account for feed back loops

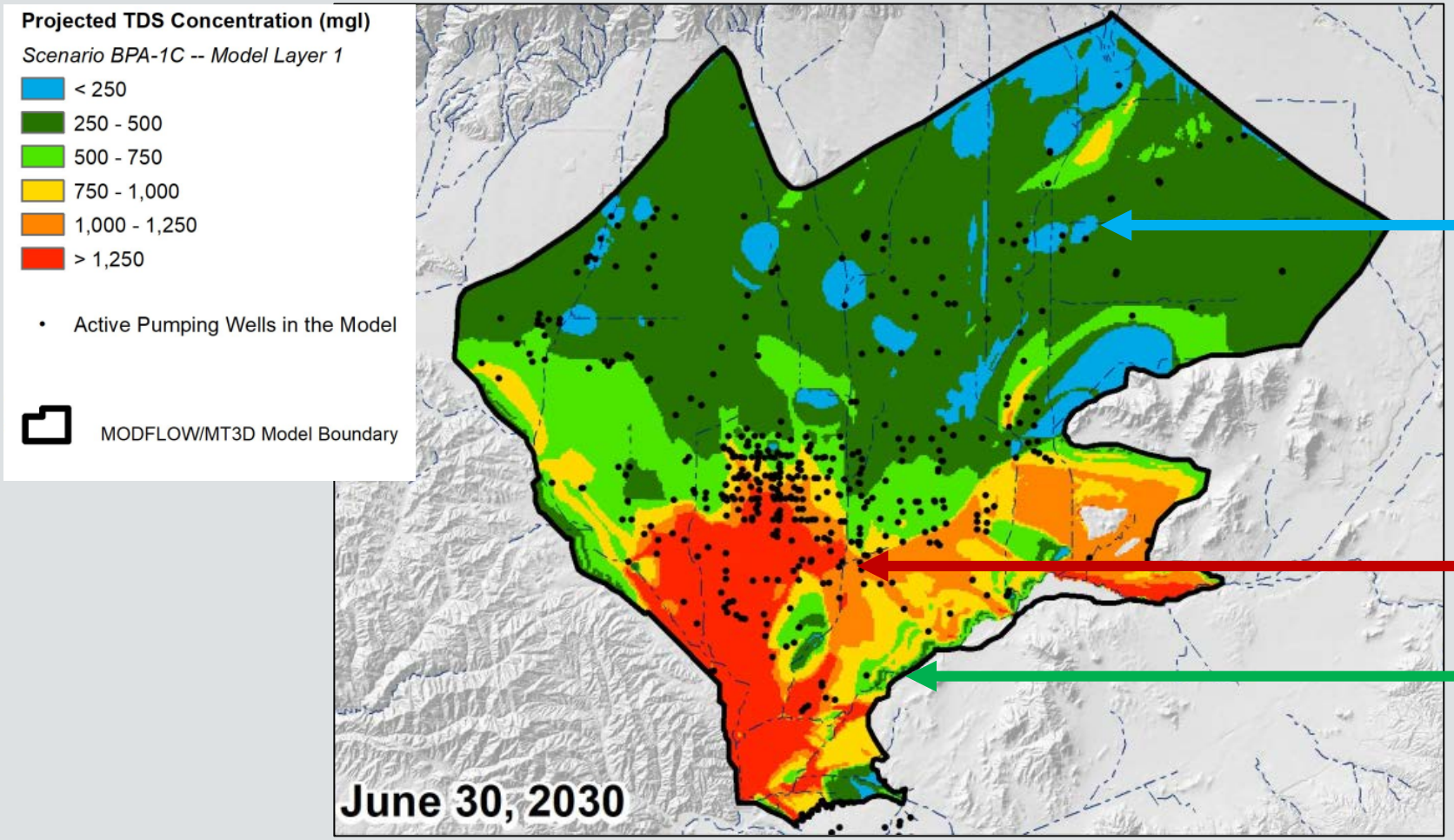
Figure 6-1. Data Flow and Coupling of the R4, MODFLOW, and MT3D Models



Model Demonstrations

- Spatial, depth distribution of TDS concentrations in Chino Basin
- TDS concentrations at wells
- Volume-weighted groundwater TDS in each management area, by aquifer layer
- Volume-weighted TDS concentration of agency water supplies
- TDS of recycled water at each IEUA treatment plant and in aggregate for compliance
- Volume-weighted TDS concentration of MAR sources (recycled, storm, and imported)
- TDS concentration of the Santa Ana River at Prado Dam

Spatial, depth distribution of TDS concentrations in Chino Basin

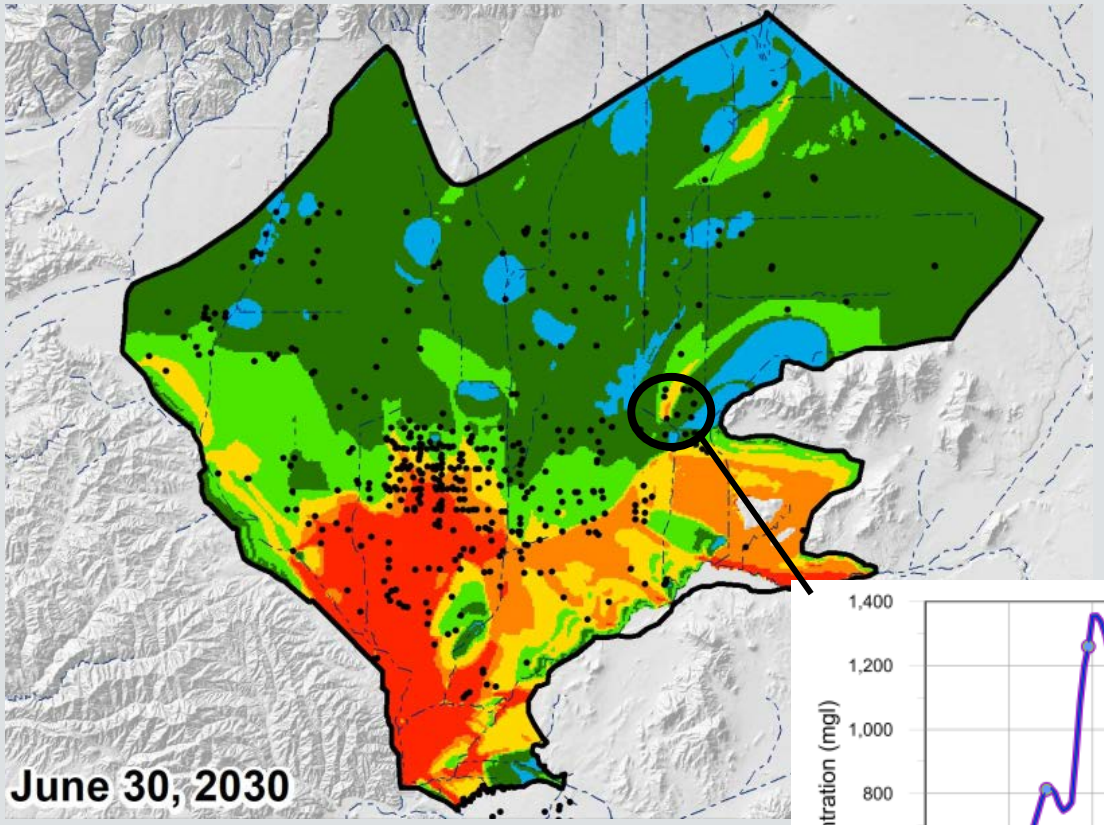


Recharge basins

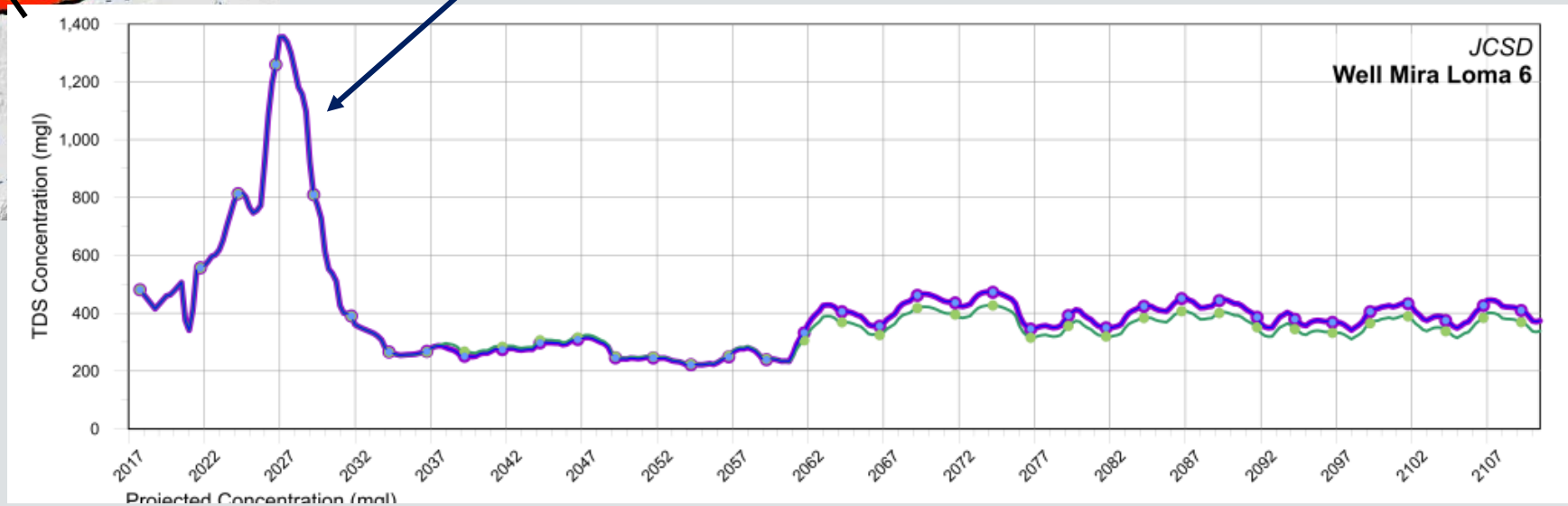
Agriculture and Dairies

Santa Ana River

TDS concentrations at wells



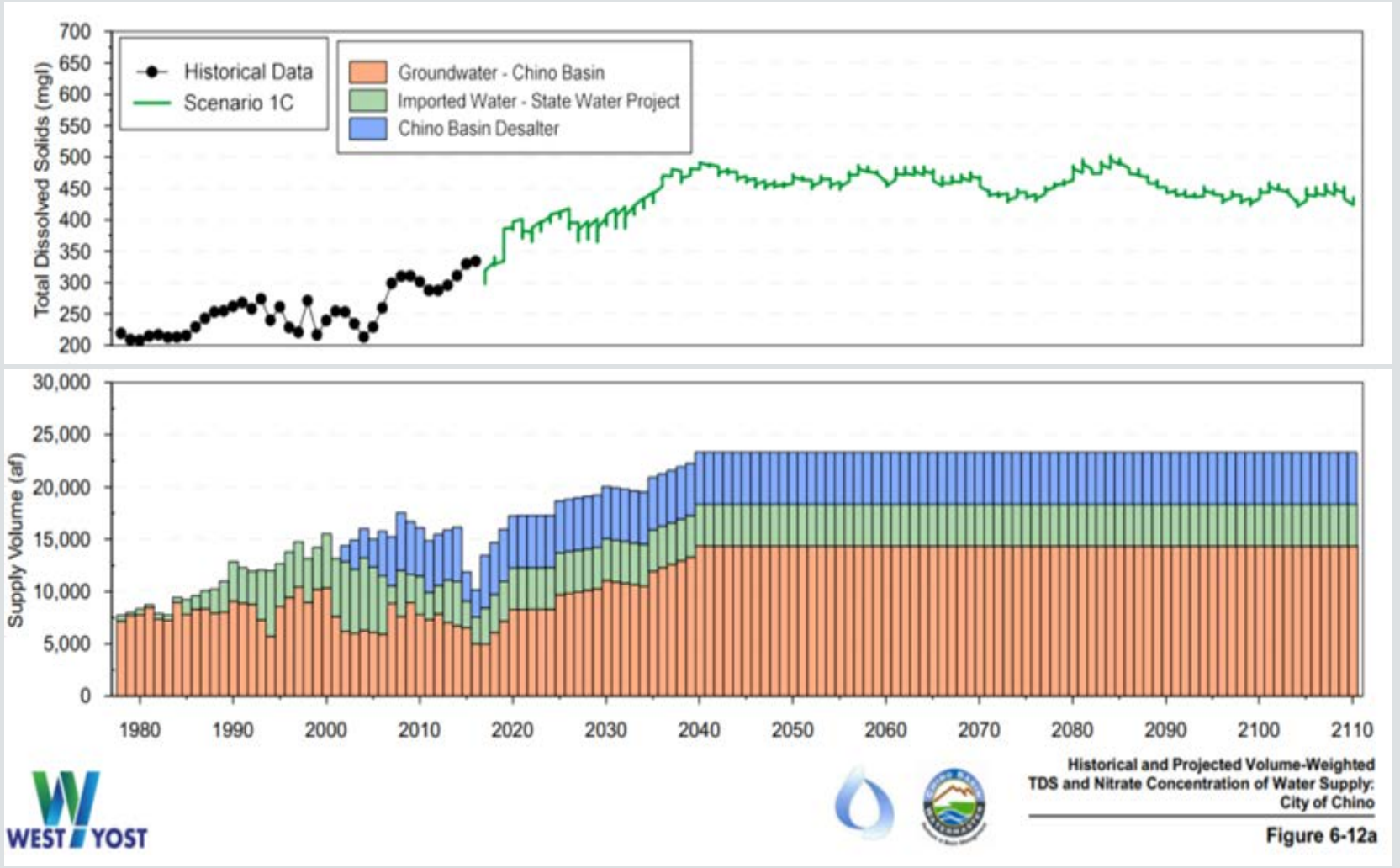
TDS Plume from Kaiser Steel Plant migrating past well



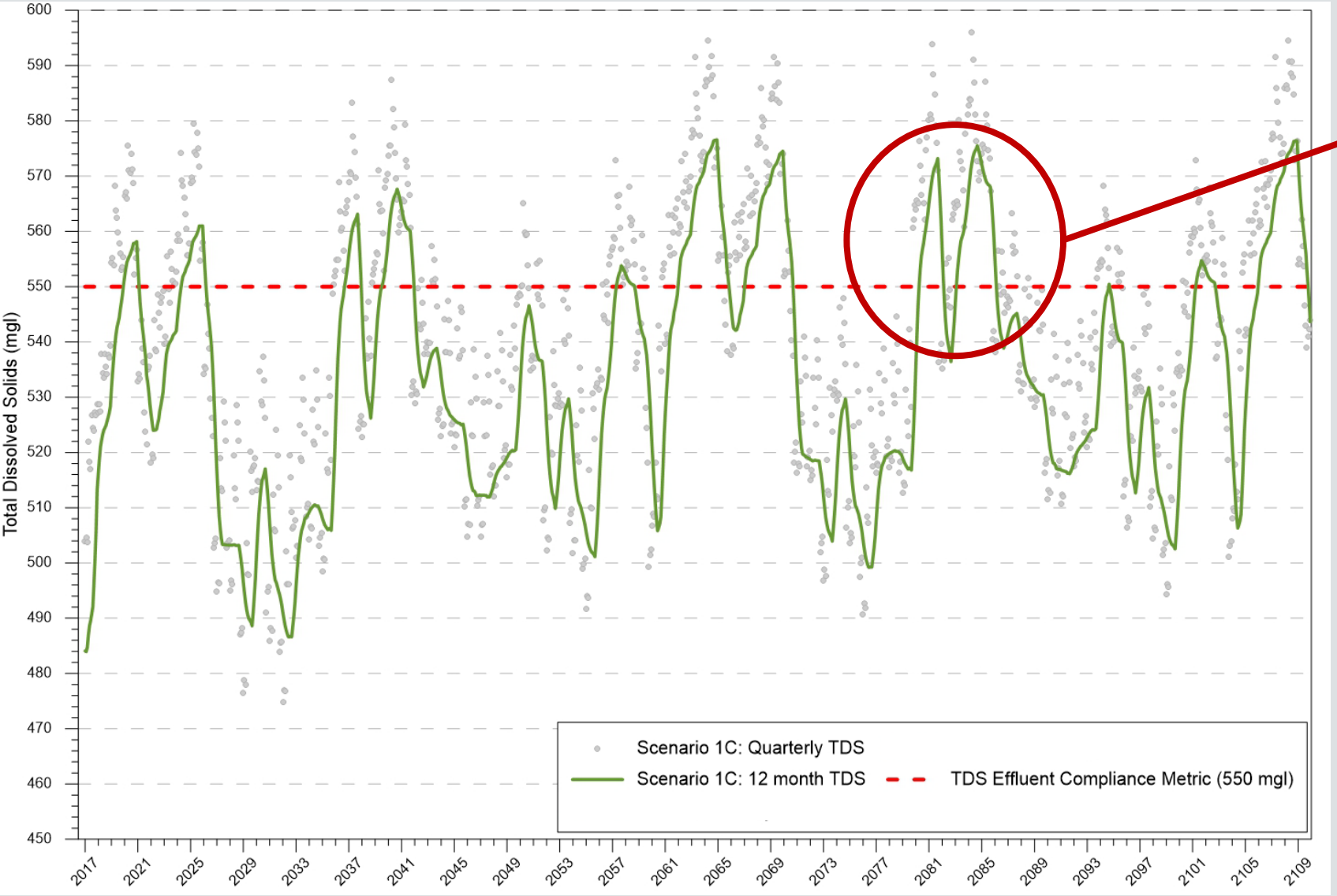
Volume-weighted TDS concentration of agency water supplies

Detailed Water Supply Plans

- Defined supply volumes, by source
- Projected TDS concentration of GW with models
- Developed assumptions for other water supplies
- Varied TDS of State Water Project Water with hydrologic conditions, consistent with historic observations



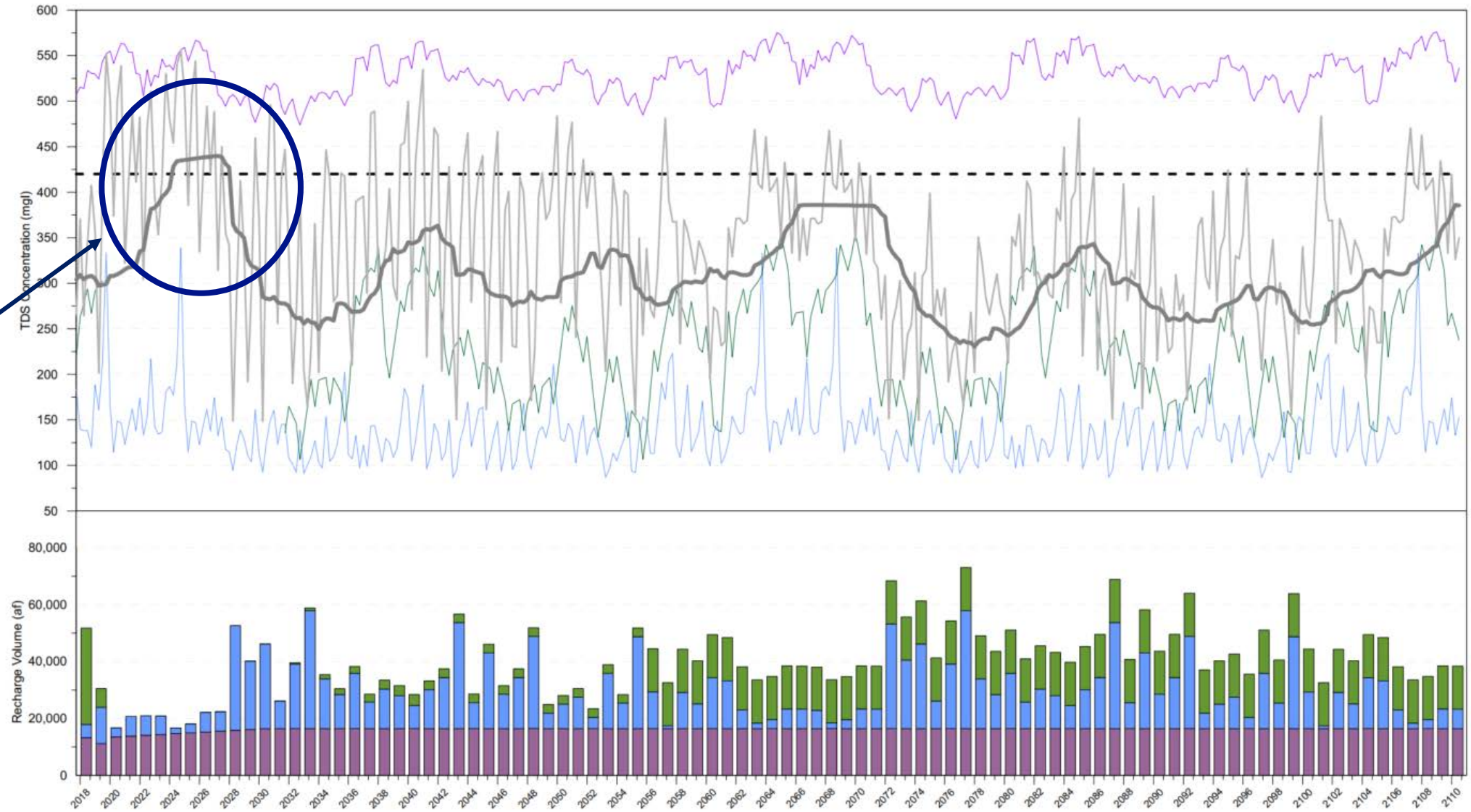
TDS of recycled water at each IEUA treatment plant and in aggregate for compliance



Periods of non-compliance when compliance metric (12-month average) TDS concentration exceeds 550 mgl (dashed red line)

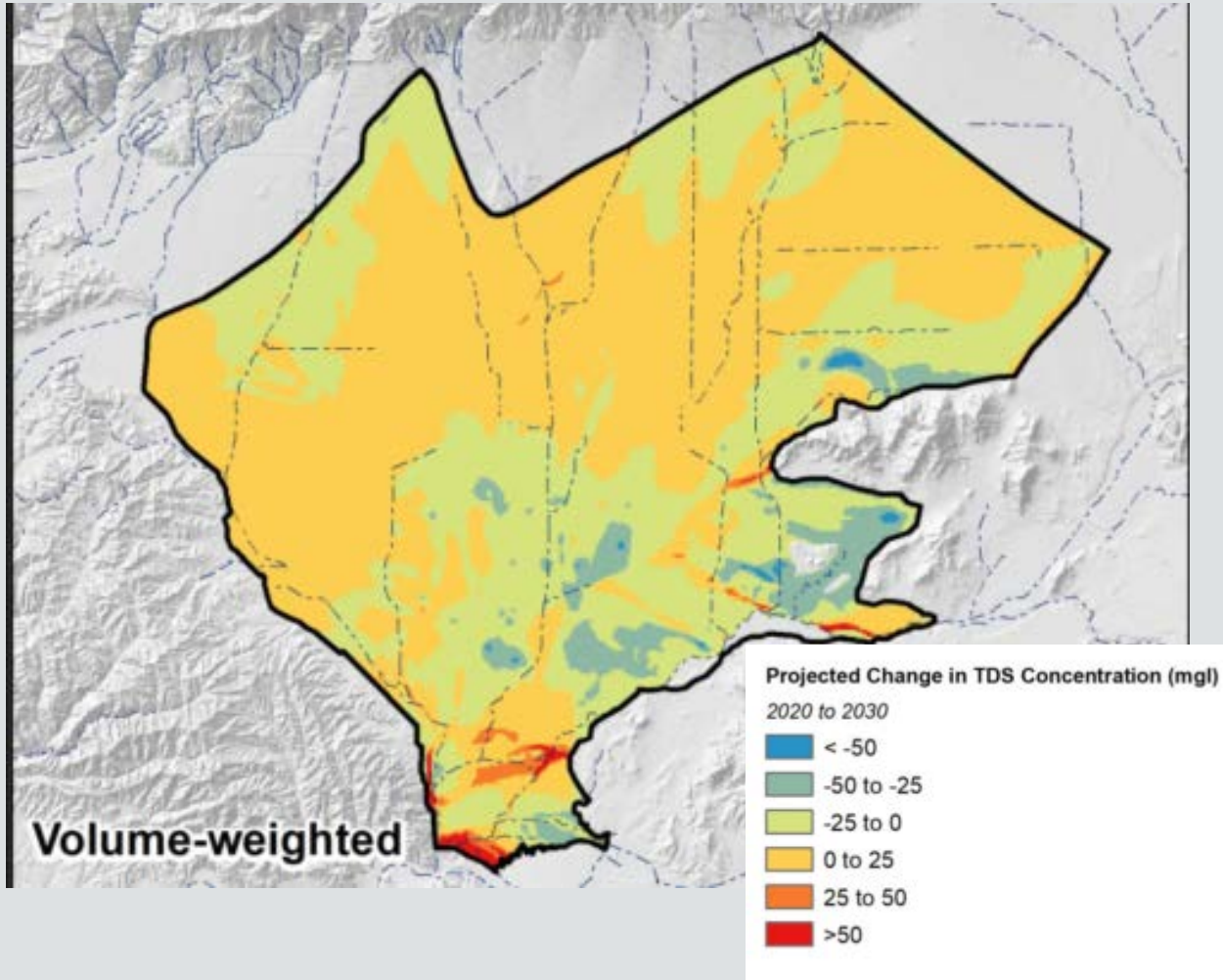
Volume-weighted TDS concentration of MAR sources (recycled, storm, and imported)

MAR Compliance Limit exceeded when no SWP water recharge



Key Observations from Baseline

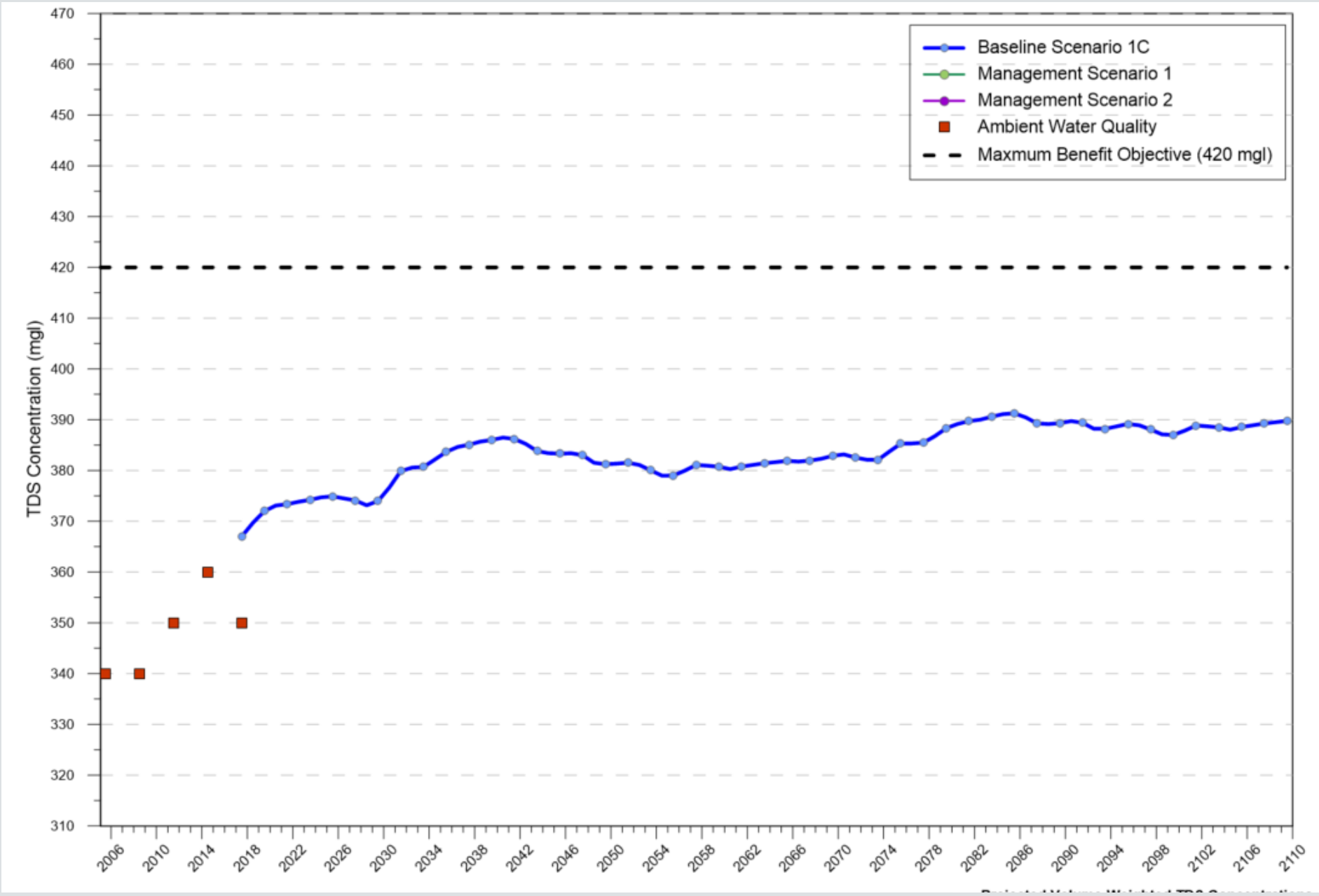
- By 2110, TDS concentrations are projected to
  - *increase by up to 25 mgl* in the northern portion of the basin and
  - *decrease by up to 50 mgl* in the southern area of the basin.
  - The area of greatest degradation, where TDS is projected to increase by more than 50 mgl are limited to within the Prado Basin MZ.



Volume-Weighted TDS in the Chino-North GMZ:

The volume-weighted TDS concentration of the Chino North GMZ is not projected to exceed the maximum benefit objective.

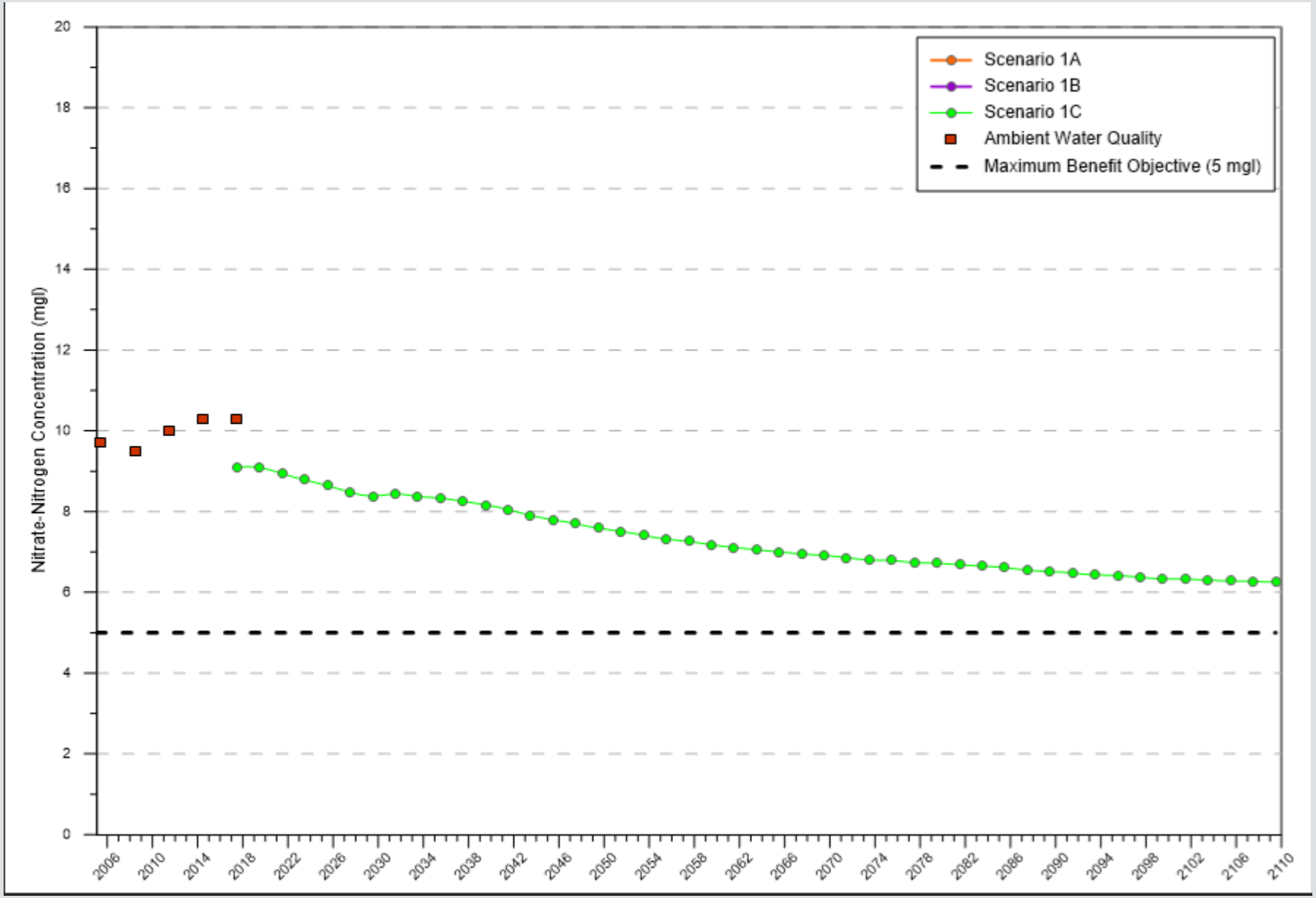
Over the 93-year planning period, the volume-weighted TDS increases from 367 to 390 mgl.



Volume-Weighted TDS in the Chino-North GMZ:

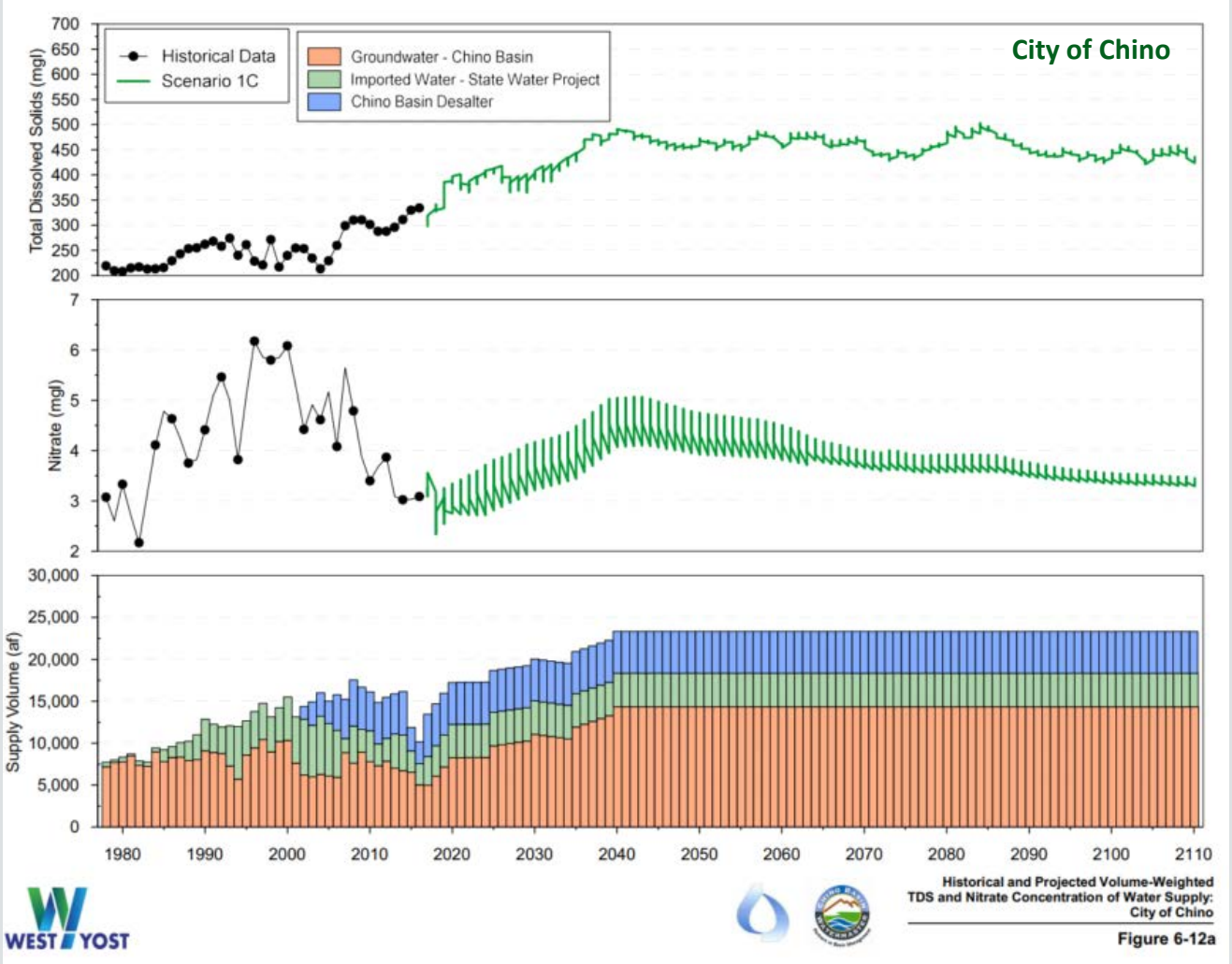
The volume-weighted N concentration of the Chino North GMZ is projected to decrease.

Over the 93-year planning period, the volume-weighted TDS decreases from 9.1 to about 6 mgl

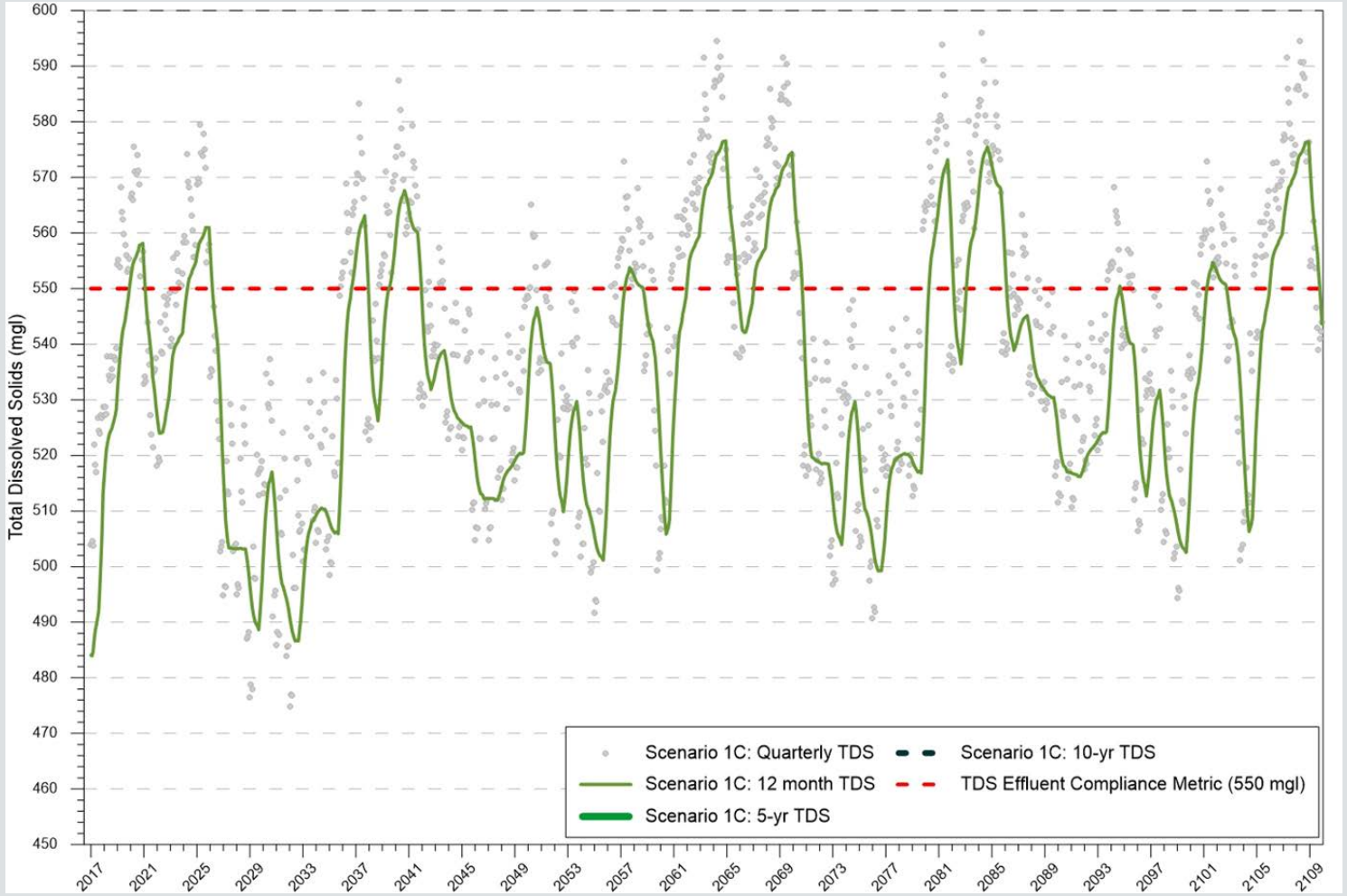


Key Observations from Baseline

- The model-projected composite water supply TDS concentrations are projected to generally be below the 500 mgl Secondary MCL for all suppliers through 2110.



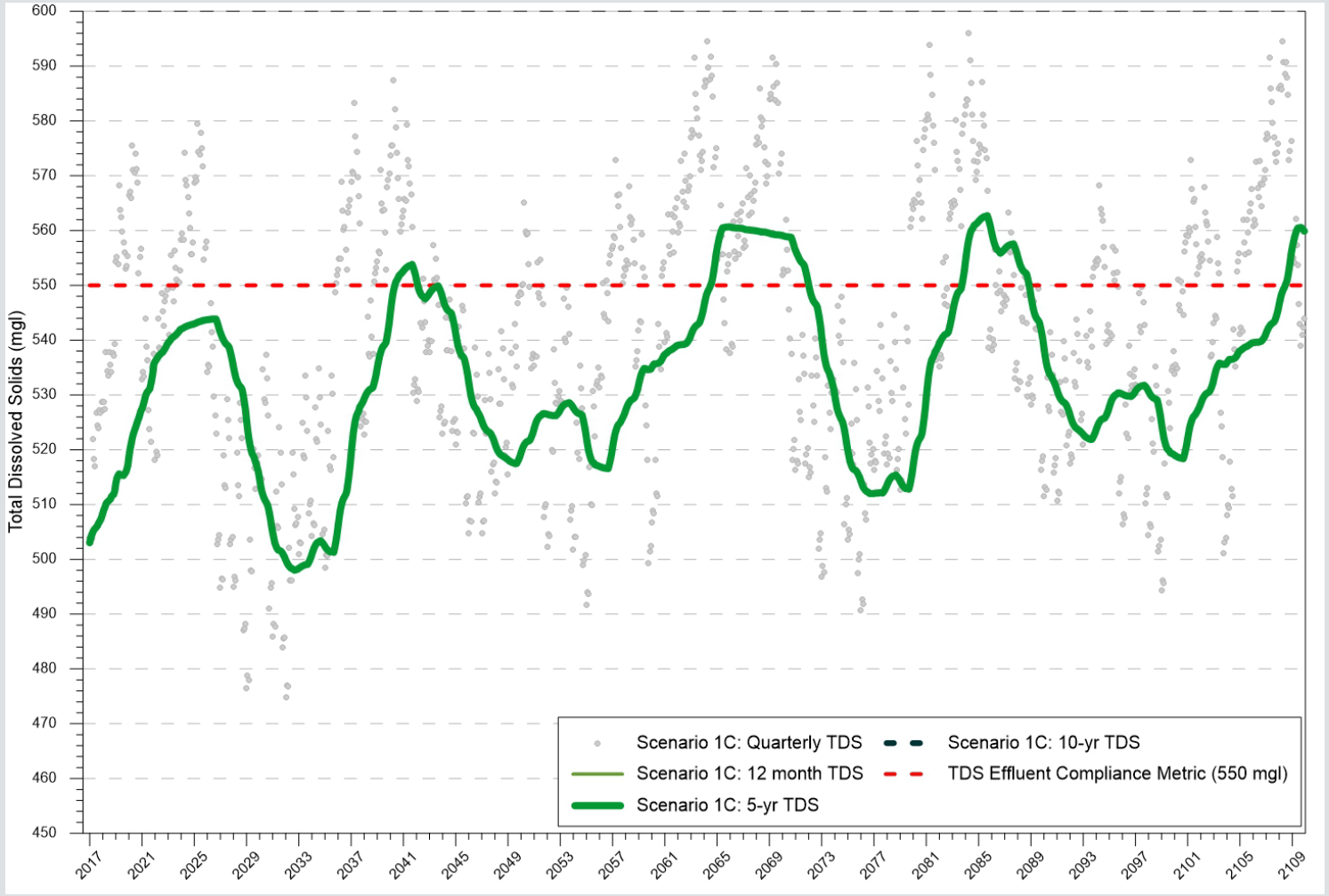
Key Observations from Baseline



- The probability of exceedance of IEUA's 550 mgl permit limit for a 12-month, five-year, and ten-year compliance metric were:
  - 12-month: exceeded about 27% of the time
  - Exceeds by as much as 27 mgl

**** Results are a function of the assumed hydrologic sequence. A different hydrology could yield a different timing and magnitude of exceedances***

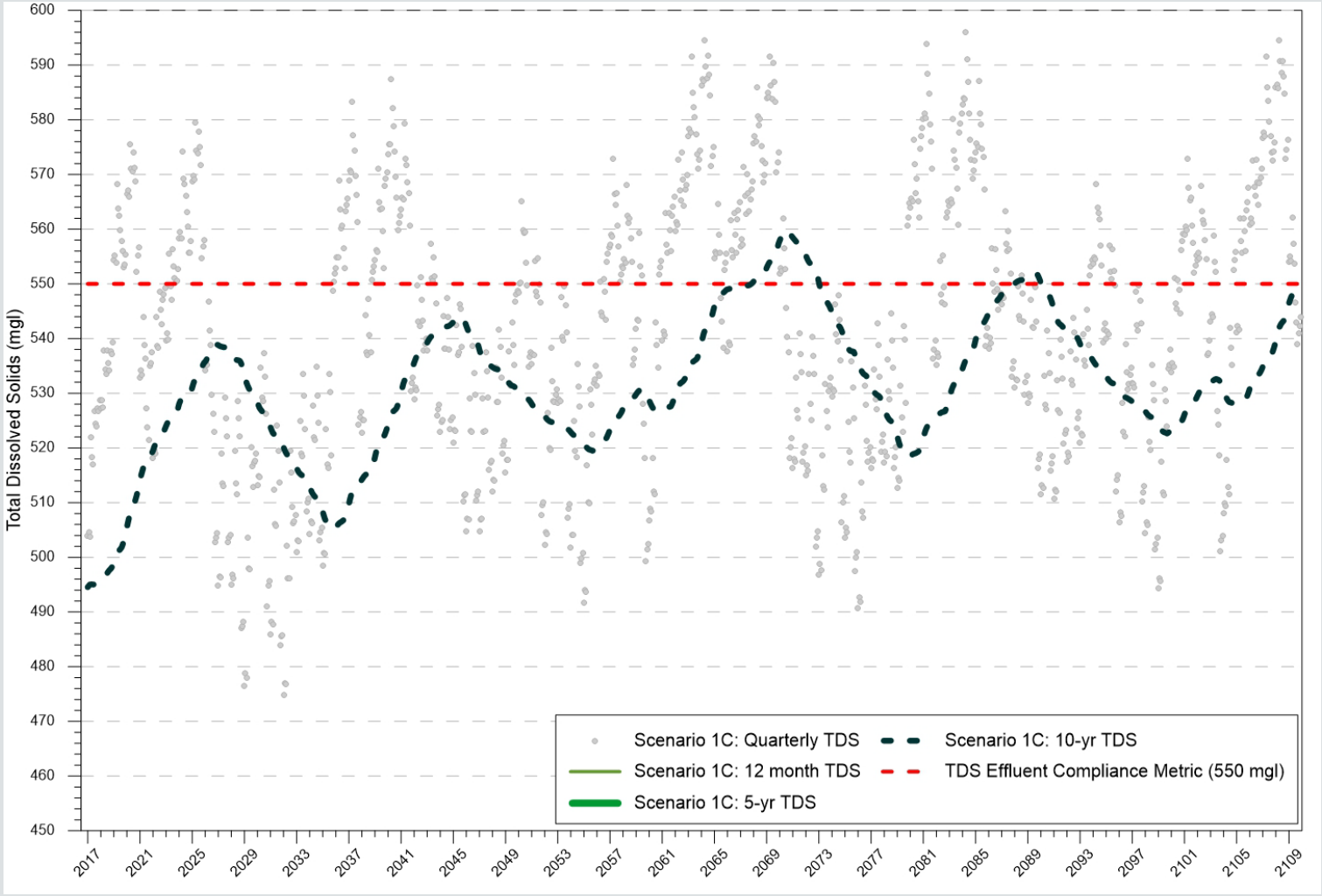
Key Observations from Baseline



- The probability of exceedance of IEUA's 550 mgl permit limit for a 12-month, five-year, and ten-year compliance metric were:
  - 5-year: exceeded about 17% of the time
  - Exceeds by as much as 12 mgl

**** Results are a function of the assumed hydrologic sequence. A different hydrology could yield a different timing and magnitude of exceedances***

Key Observations from Baseline

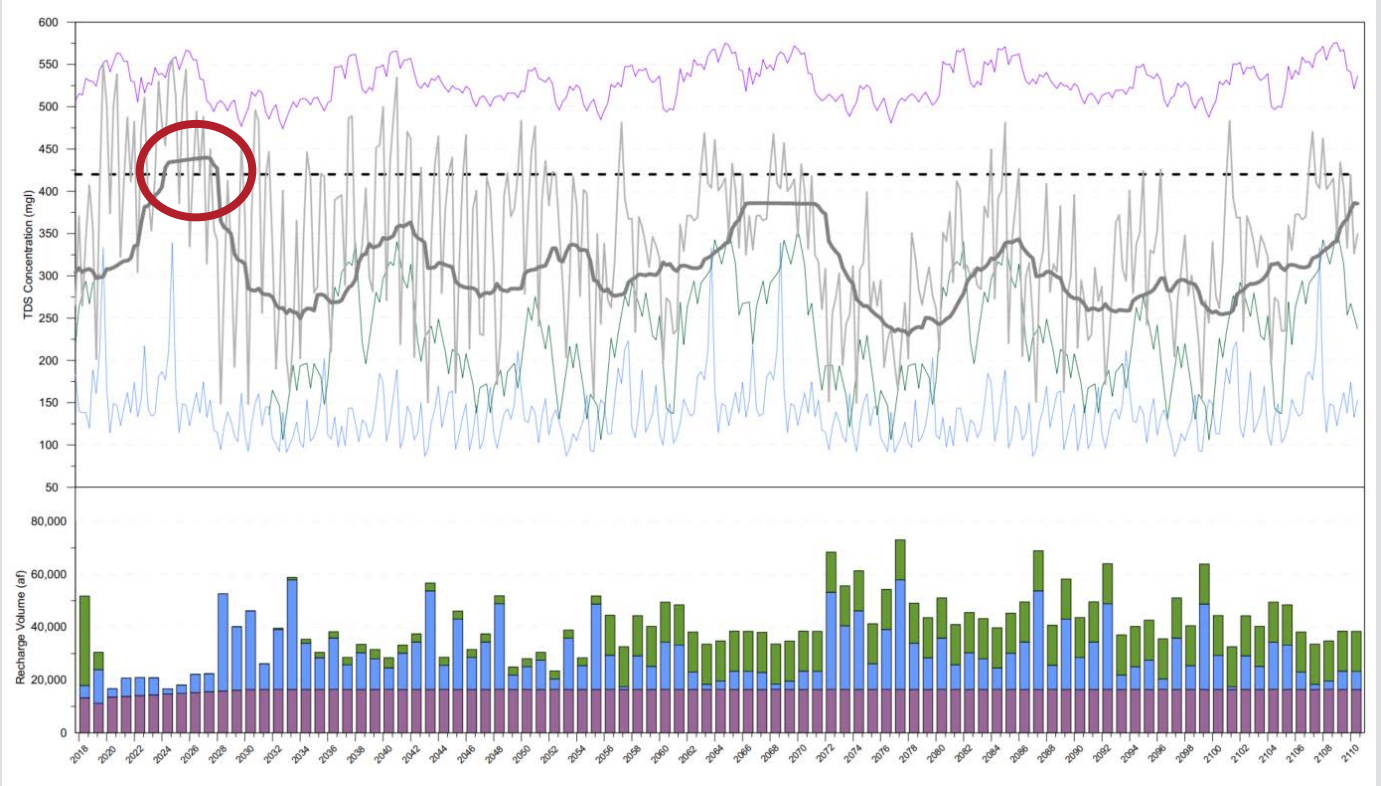


- The probability of exceedance of IEUA's 550 mgl permit limit for a 12-month, five-year, and ten-year compliance metric were:
  - 10-year: exceeded about 7% of the time
  - Exceeded by as much as 10 mgl

**** Results are a function of the assumed hydrologic sequence. A different hydrology could yield a different timing and magnitude of exceedances***

Key Observations from Baseline

- The five-year volume-weighted TDS concentrations in MAR only exceeds the maximum-benefit limit of 420 mgl early in the planning period in this assumed hydrology (2024 through 2028). This is because:
  - It is a period when SWP water recharge is not projected to occur in the Basin.
  - There is limited stormwater recharge due to a 10-year dry hydrologic conditions

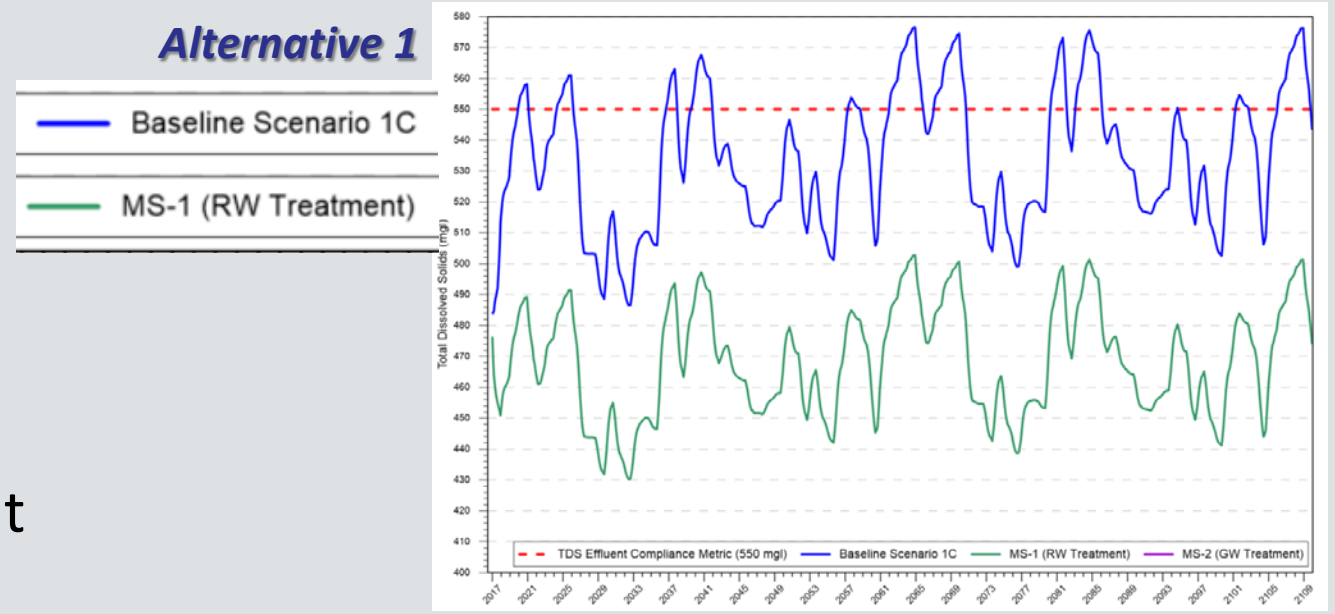


**** Results are a function of the assumed hydrologic sequence. A different hydrology could yield a different timing and magnitude of exceedances***

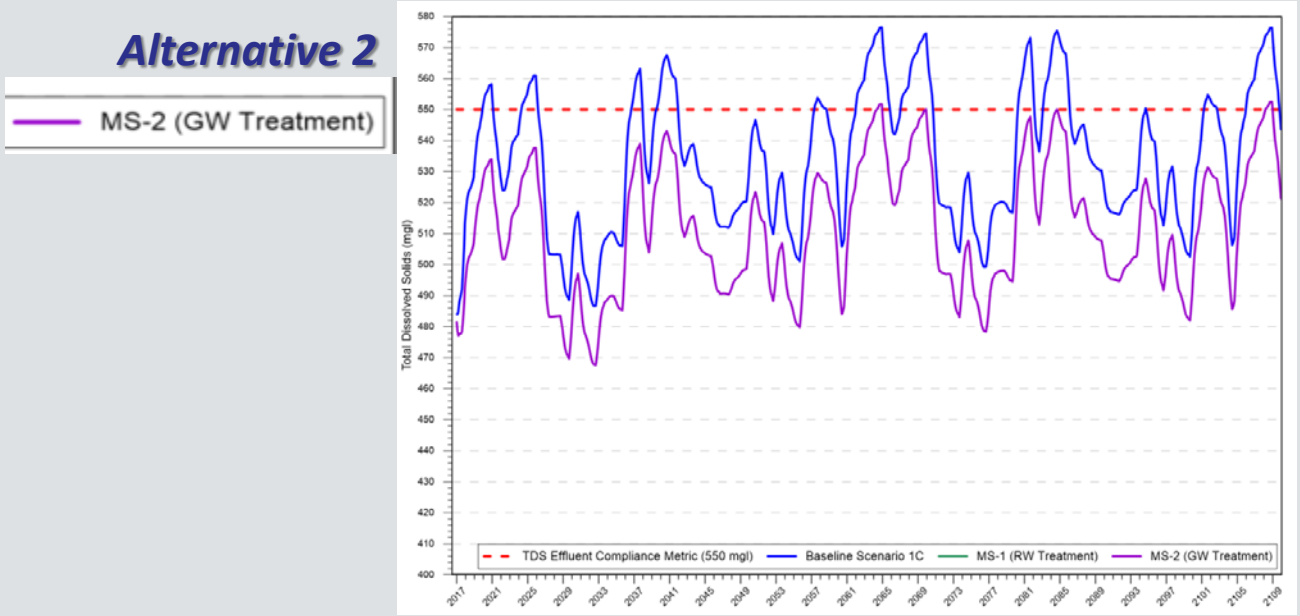
TDS Management Alternatives

- ***Conceptual*** Management Alternatives to Address Non-Compliance with IEUA permit limit based on 12-month average:
- Alternatives (2):
  1. RO recycled water to directly reduce TDS concentration(RP-1)
  2. RO highest TDS groundwater supplies from Chino Basin to indirectly reduce recycled water TDS concentration

Alternative 1

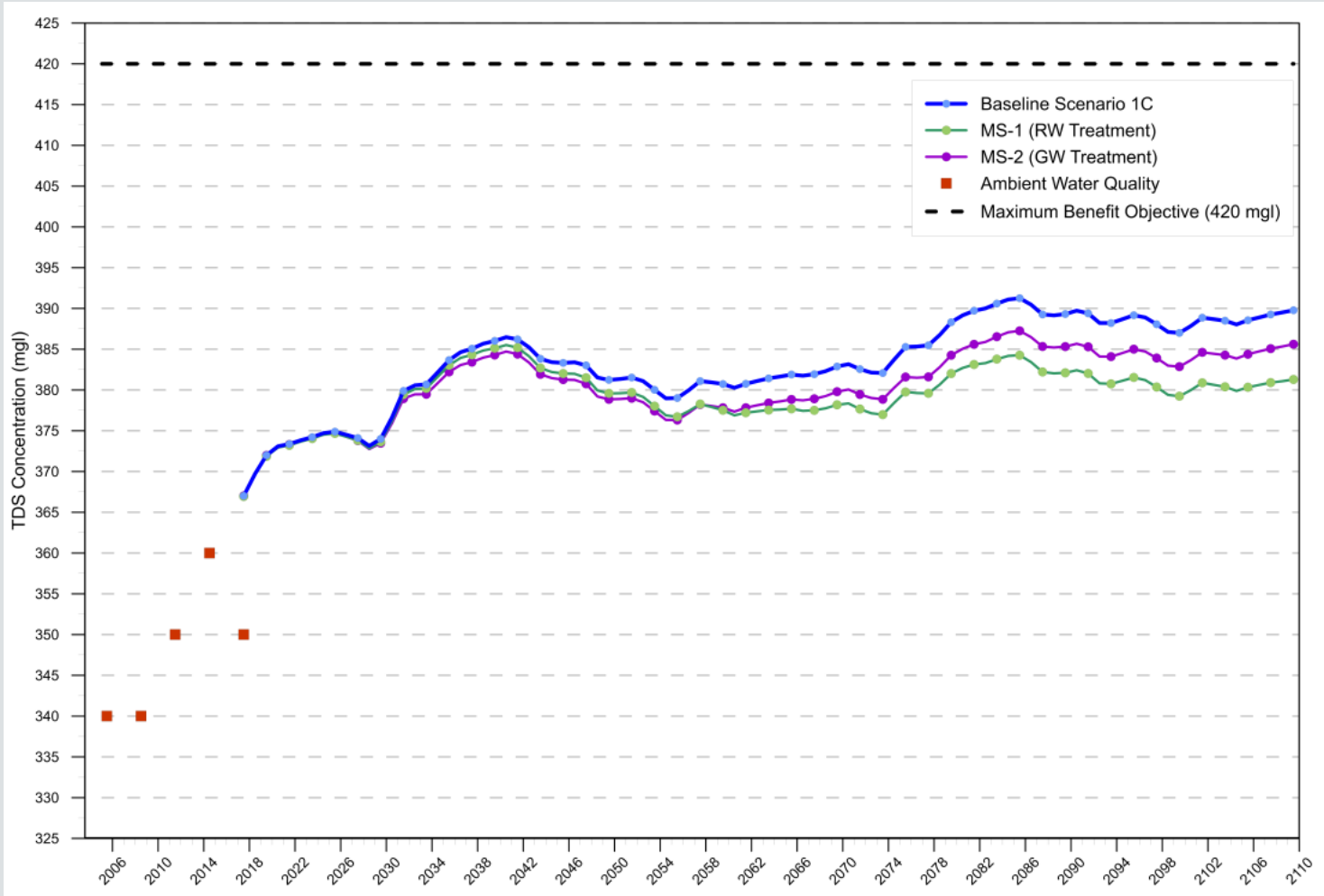


Alternative 2



TDS Management Alternative Results

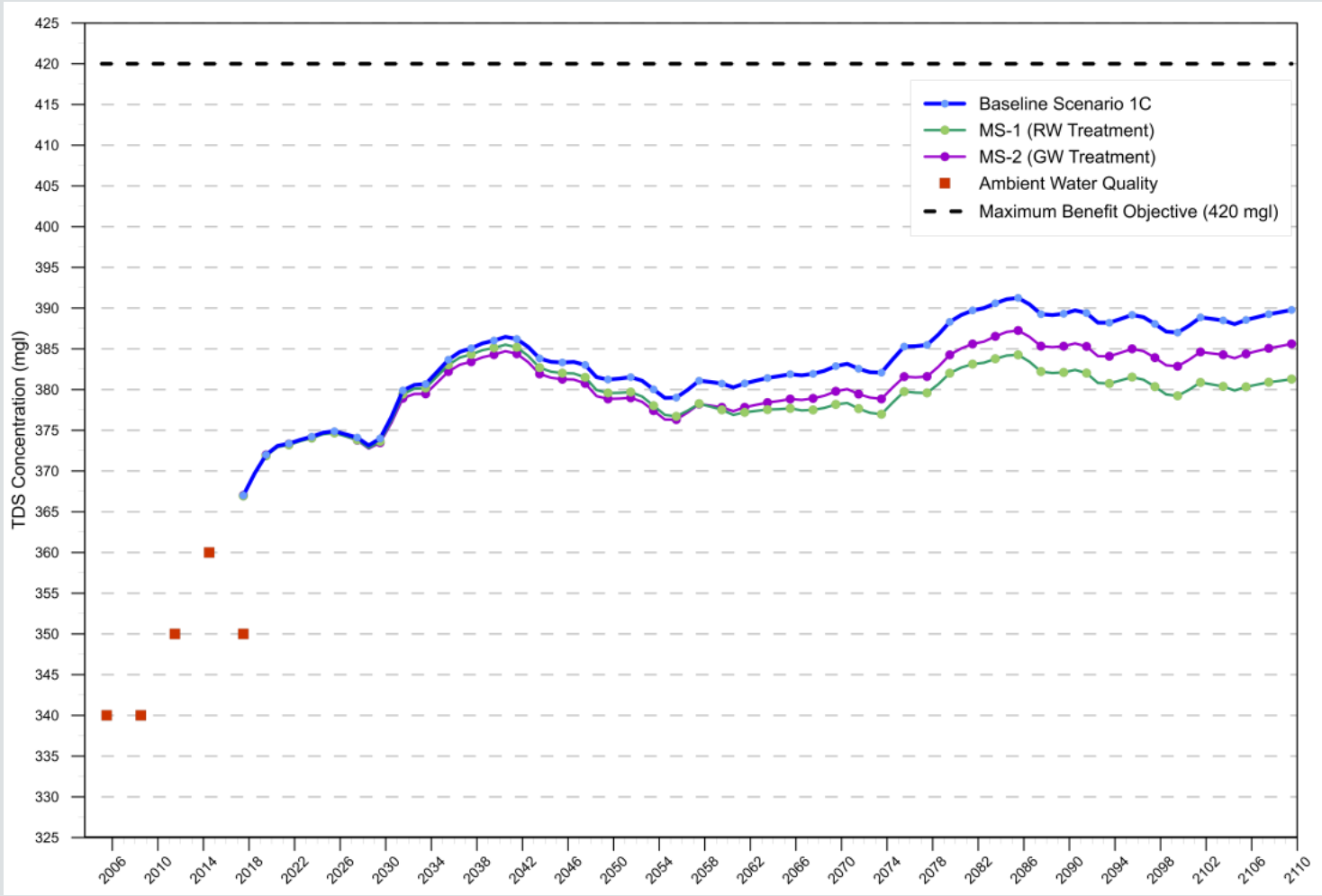
- Long-term, there is little improvement in the groundwater basin on a volume-weighted basis by implementing projects to comply with the 12-month metric
- Volume-weighted TDS improves by less than 10 mgl over the 93-year simulation period
  - 9 mgl improvement with recycled water RO
  - 4 mgl improvement with groundwater RO



Volume-weighted TDS concentration of Chino North Management Zone

TDS Management Alternative Results

- It takes about 12-20 years for management actions to begin to decrease the TDS concentration in the groundwater basin
- Even then the decreases in TDS concentration are only on the order of 1 to 2 mgl in that time period.

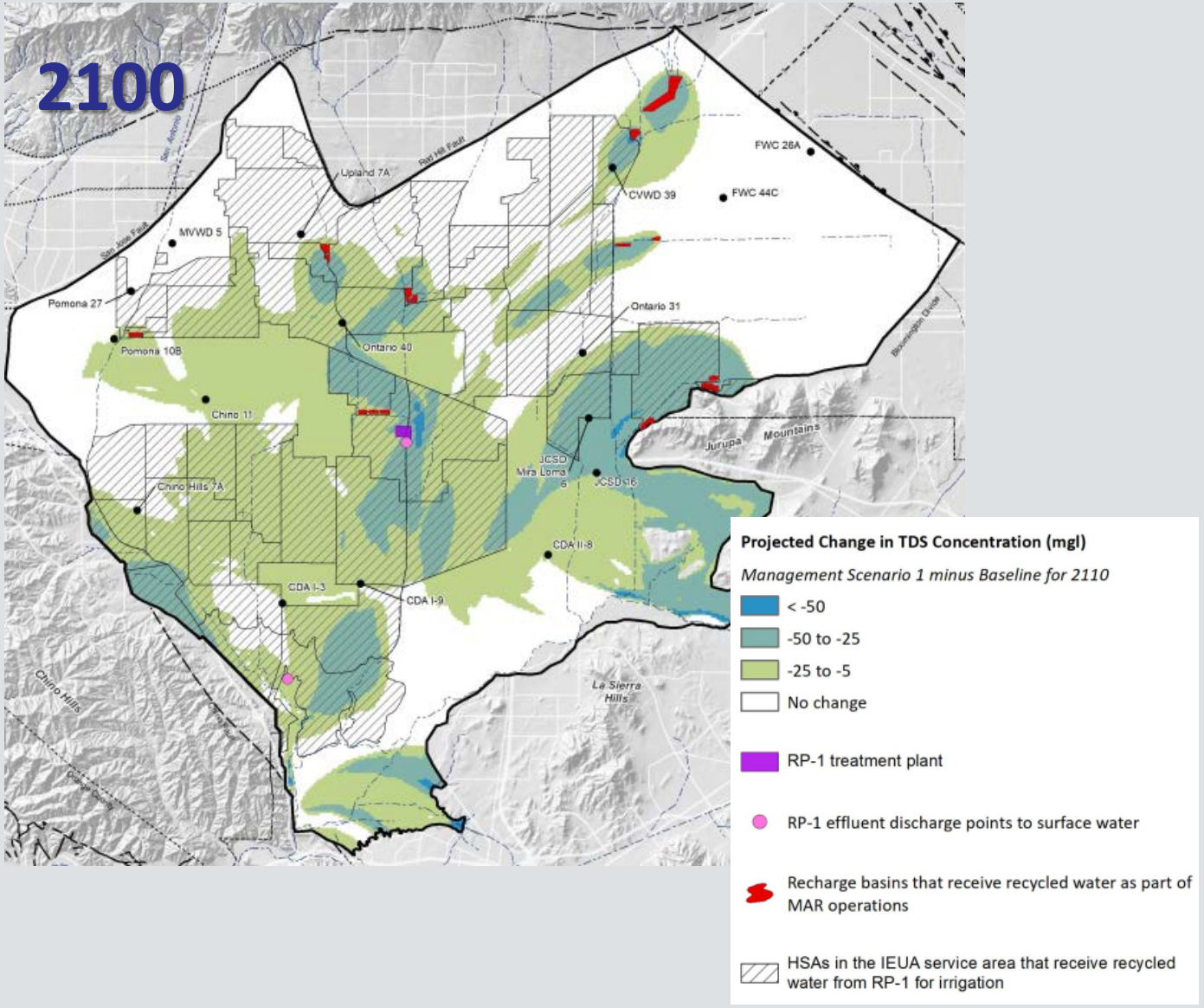


Volume-weighted TDS concentration of Chino North Management Zone

TDS Management Alternatives

- Alternatives do provide water quality benefits to the Basin
- The benefits are localized improvements based on design of each scenario
- Results illustrate it matters how the management actions are designed to maximize benefits of projects beyond “compliance”

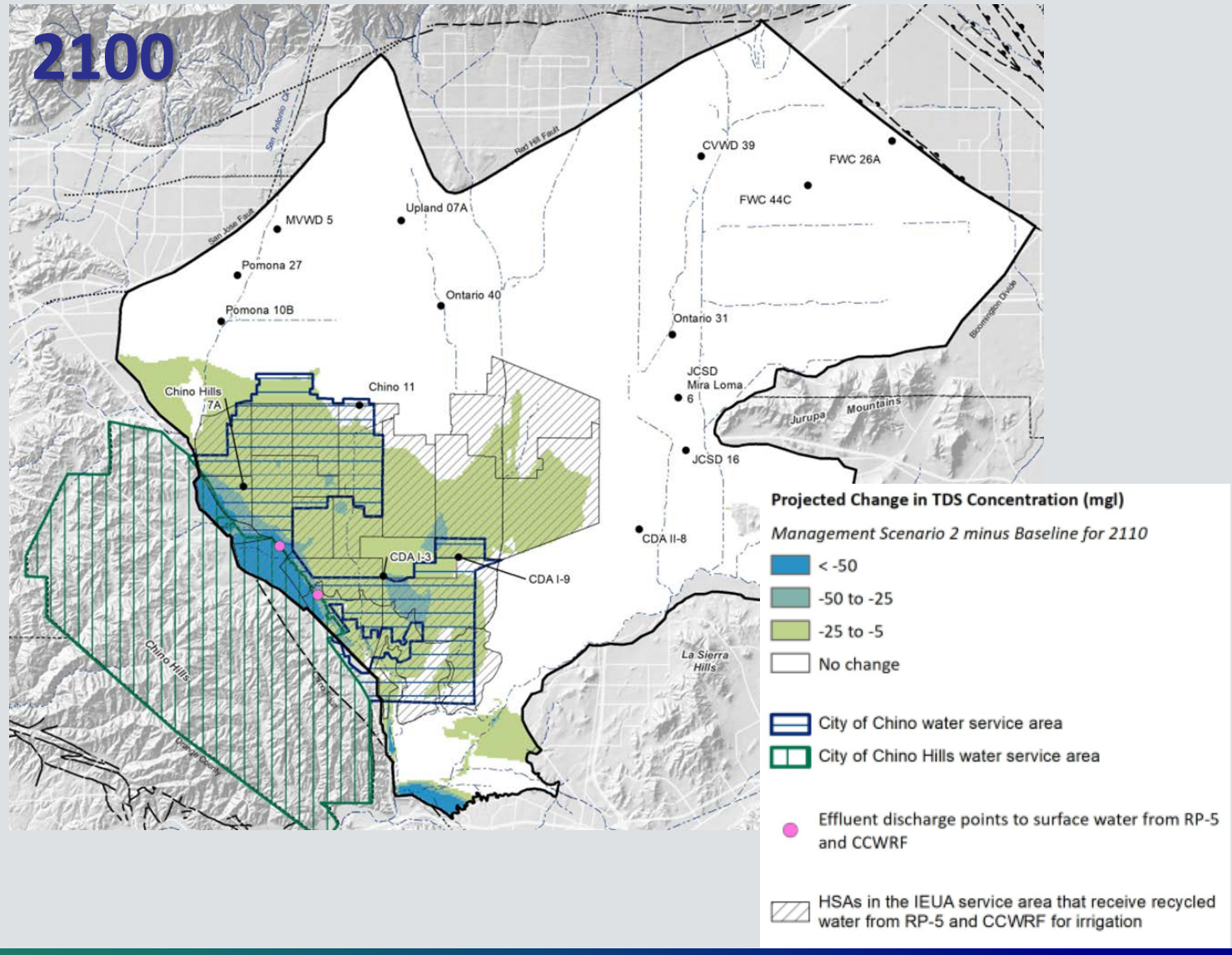
Alternative 1



TDS Management Alternatives

- Alternatives do provide water quality benefits to the Basin
- The benefits are localized improvements based on design of each scenario
- Results illustrate it matters how the management actions are designed to maximize benefits of projects beyond “compliance”

Alternative 2



Investigation Conclusions

What is the impact to TDS concentrations in the Chino Basin if the Regional Board allowed a longer-term flow-weighted average?

- The impact to the Chino Basin is minimal
- Even in the absence of mitigation actions, groundwater TDS and nitrate concentrations are changing slowly when evaluated on a volume-weighted basis for comparison to Basin Plan objectives
- The TDS concentrations remain below the Basin Plan objective through 2100
- Nitrate concentrations, which have always exceeded the Basin Plan objectives, are decreasing
- When evaluated spatially, the TDS and nitrate concentrations in the southern Chino Basin are decreasing due to the implementation of the maximum benefit commitments

Investigation Conclusions

What is the impact to TDS concentrations in the Chino Basin if the Regional Board allowed a longer-term flow-weighted average?

- Even with a longer-term, 10-year compliance metric, the effluent compliance limit is projected to be exceeded in the future. Exceedances would be less frequent and of lower magnitude under the longer averaging periods
- Allowing a 10-year TDS effluent compliance metric will not eliminate the need for mitigation actions in the future
- Hydrologic conditions as driver – we can't predict when the exceedances will occur without more detailed and multiple scenario analysis

Investigation Conclusions

What is the potential water quality benefit of alternative salinity management plans to comply with the 12-month in TDS compliance metric?

- There are multiple management approaches that can ensure IEUA will comply with the TDS effluent compliance limit under the current or a longer-term averaging period.
- Both recycled water and groundwater treatment programs can reduce recycled water TDS concentrations to achieve compliance and provide other localized water quality benefits.
- The benefits to the groundwater basin of reducing recycled water TDS concentrations are relatively minimal and are slow to be realized.
- The benefits to water supply and Santa Ana River TDS concentrations are also minimal.

Investigation Conclusions

What is the potential water quality benefit of alternative salinity management plans to comply with the 12-month in TDS compliance metric?

- Water quality improvements are localized, and it matters how the management actions are designed and implemented if the goal is to achieve specific water quality benefits beyond ensuring compliance with effluent compliance limits
- Management actions will likely result in mitigation in excess of what is required to merely achieve compliance with the permit limits.

Regulatory Findings

- Allowing a longer-term averaging period will not result in significant water quality impacts in Chino Basin, and will not impair beneficial uses
- The longer-term averaging period will afford IEUA and Watermaster time to develop optimum solutions for long-term compliance with discharge limits that can provide multiple and maximum benefits to the Chino Basin – This is consistent with the Chino Basin OBMP and the Maximum Benefit SNMP
- Maximum Benefit Commitments need to be updated and the Basin Plan amended
- Plan accepted by Regional Board staff and recommended for Basin Plan amendment!

Changes to the Maximum Benefit SNMP and Commitments

Amend Effluent Compliance Metric and Trigger for Action

Amend managed recharge compliance metric

Update monitoring program workplan (last update was 2012)

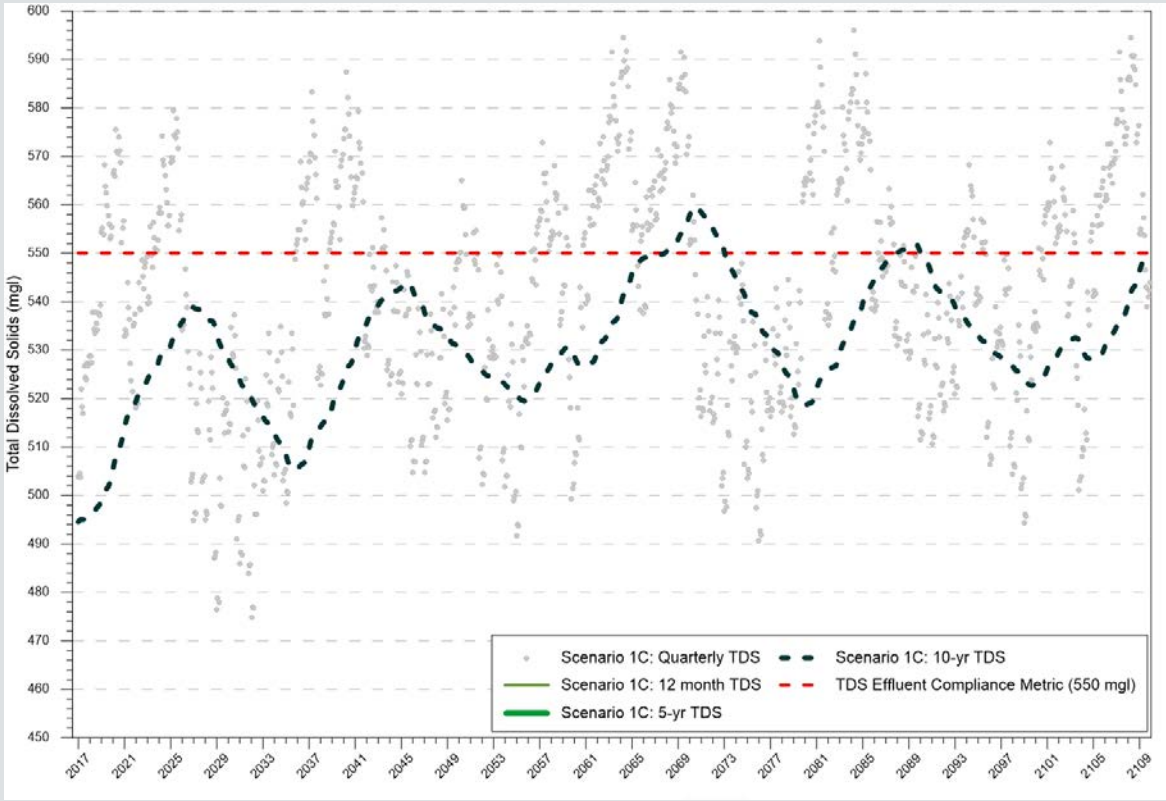
5-year update of the water quality model and projections – timed with groundwater model updates

Submit a research plan to address the limitations in the water quality modeling tools

Amend Effluent Compliance Metric and Trigger for Action

Regulatory TDS Compliance Metrics for IEUA Effluent		
Regulatory Metric Description	**Current Metric**	**Metric Accepted by Regional Board Staff**
Effluent TDS Compliance Limit	550 mgl	550 mgl
Effluent TDS Compliance Metric	12-month average of the agency-wide effluent concentration	10-year average (120-month) average of the agency-wide effluent concentration
TDS Action Limit for Planning Water Quality Improvements	When the effluent compliance metric based on a 12-month averaging period exceeds 545 mgl for three consecutive months	When the effluent compliance metric based on a 10-year averaging period exceeds 545 mgl for three consecutive months

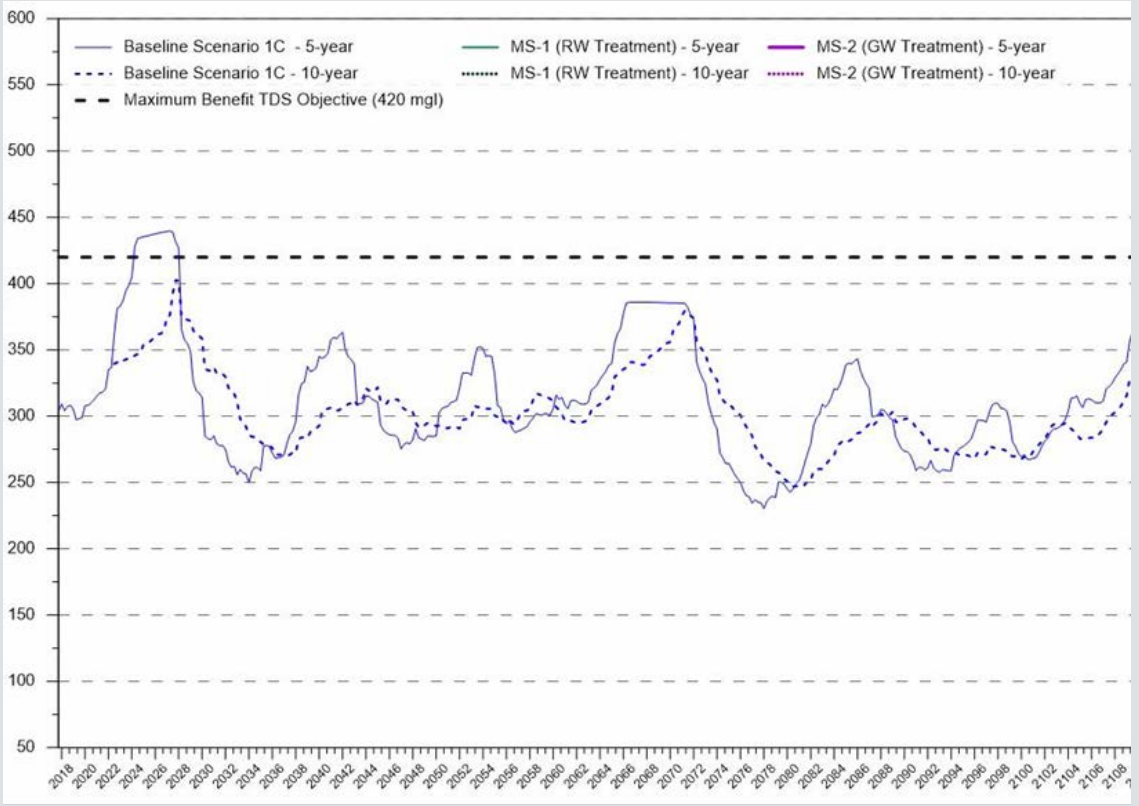
Baseline Scenario



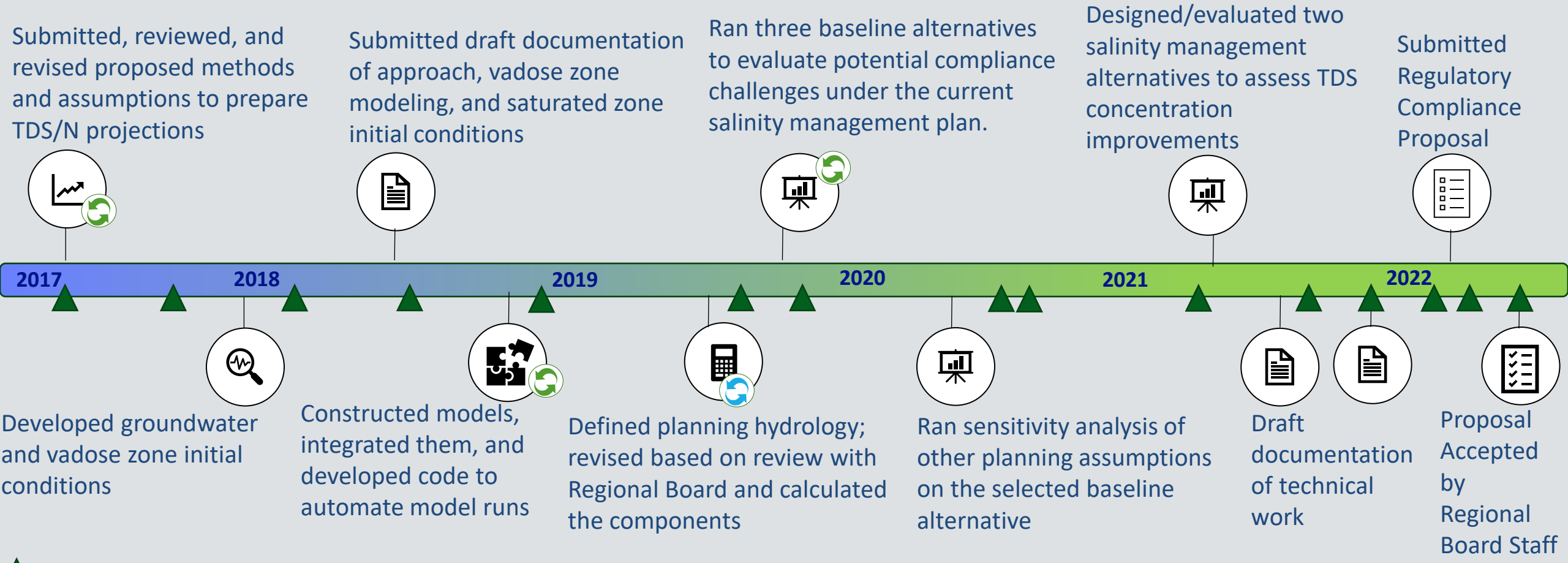
Amend managed recharge compliance metric

Regulatory TDS Compliance Metrics for Recharge		
Regulatory Metric Description	**Current Metric**	**Metric Accepted by Regional Board Staff**
Recharge TDS Compliance Limit	420 mgl	420 mgl
Managed Artificial Recharge Compliance Metric (maximum benefit commitment 7)	Recycled water recharge is limited to the amount that can be blended on a volume-weighted basis with other sources to comply with the TDS limit based on a ***5-year running-average***	Recycled water recharge is limited to the amount that can be blended on a volume-weighted basis with other sources to comply with the TDS limit based on a ***10-year running-average***

Baseline Scenario



Work Completed 2017-2022



THANK YOU
Questions/Comments?

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