



# TURLOCK SUBBASIN GSP ANNUAL REPORT WY 2022

JOINT MEETING – TURLOCK SUBBASIN TECHNICAL ADVISORY COMMITTEES

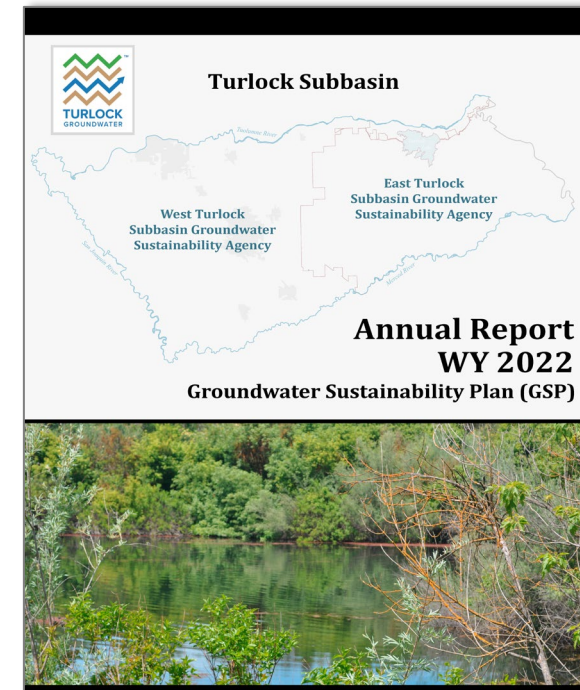
MARCH 21, 2023



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# AGENDA

- Reporting period and timing
- Model development and draft results (W&C)
- Additional draft results
  - Sustainable management criteria / hydrographs
  - Groundwater elevation contour maps
  - Water quality analysis
  - Subsidence
- Schedule



# REPORTING PERIOD AND TIMING

## 2<sup>ND</sup> ANNUAL REPORT

- Reporting period WY 2022 (October 2021 through September 2022)
- Includes first monitoring event (Spring 2022) since GSP adoption January 2022
- Annual Report includes:
  - Model update for WY 2022
  - Hydrographs for RMWs through Spring 2022 monitoring event
  - Groundwater elevation contour maps: Fall 2021 and Spring 2022
  - Model water budgets and change in groundwater in storage
  - Water use tables for WY 2022
  - Water quality analysis
  - Subsidence update

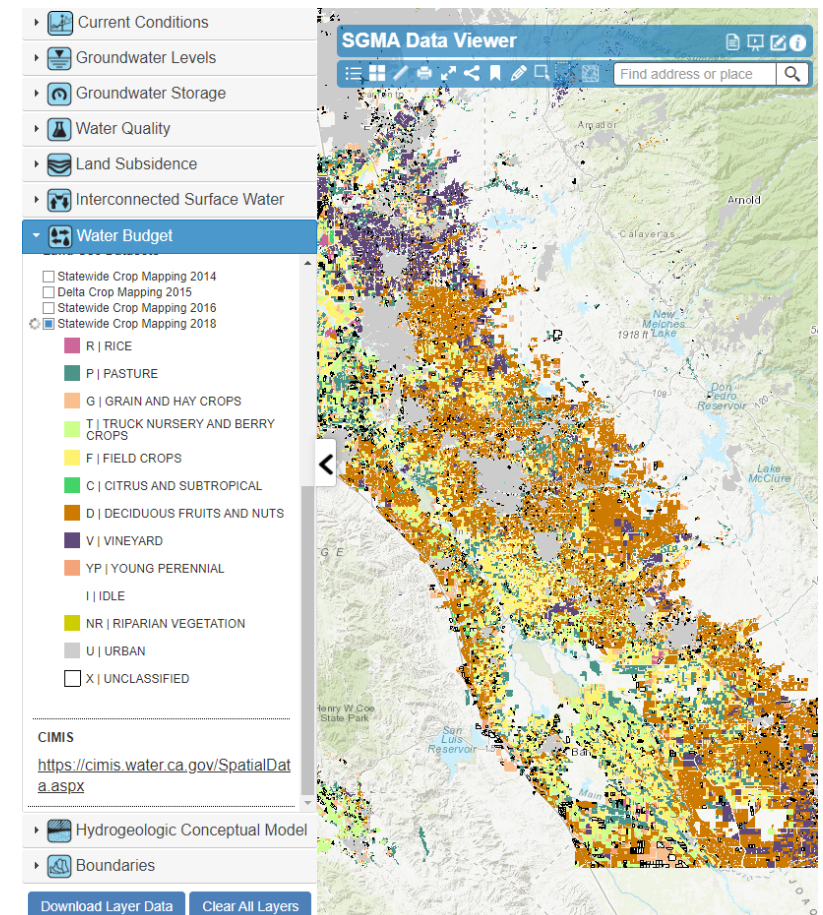
# MODEL UPDATE

- **Goals:** Support the Annual Report by developing:
  - Subbasin-wide water budgets
  - Temporal and spatial estimates of groundwater production
  - Temporal and spatial estimates of change in storage by aquifer
- **Model Use:** Update the Turlock Groundwater Model for WY 2022
  - Extend all time-series input files with the best available data.
  - A verification of the model performance will be performed.
  - No changes to the model parameters or structure will be made.

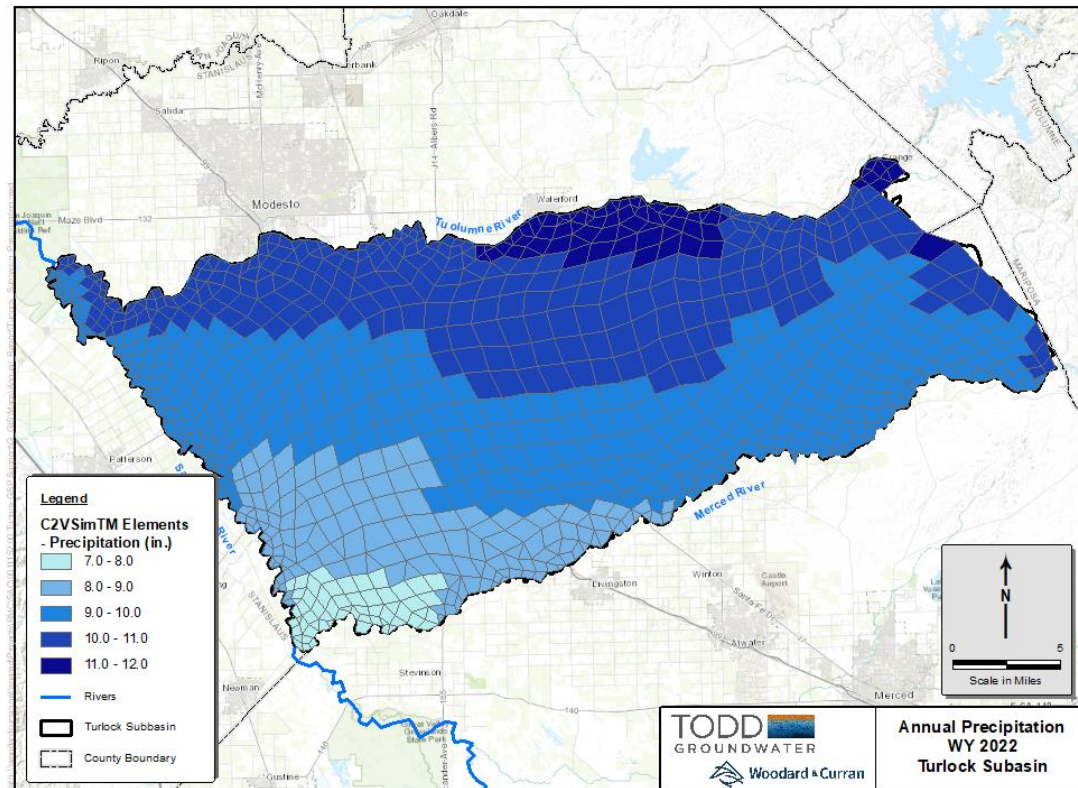
# PUBLICLY AVAILABLE DATA

## State, Federal, & Other Resources:

- Precipitation PRISM
  - Evapotranspiration CIMIS
  - Land Use Data DWR
  - Stream Flow Data CDEC & USGS
  - Groundwater Levels CASGEM & WDL
- DWR SGMA Data Viewer



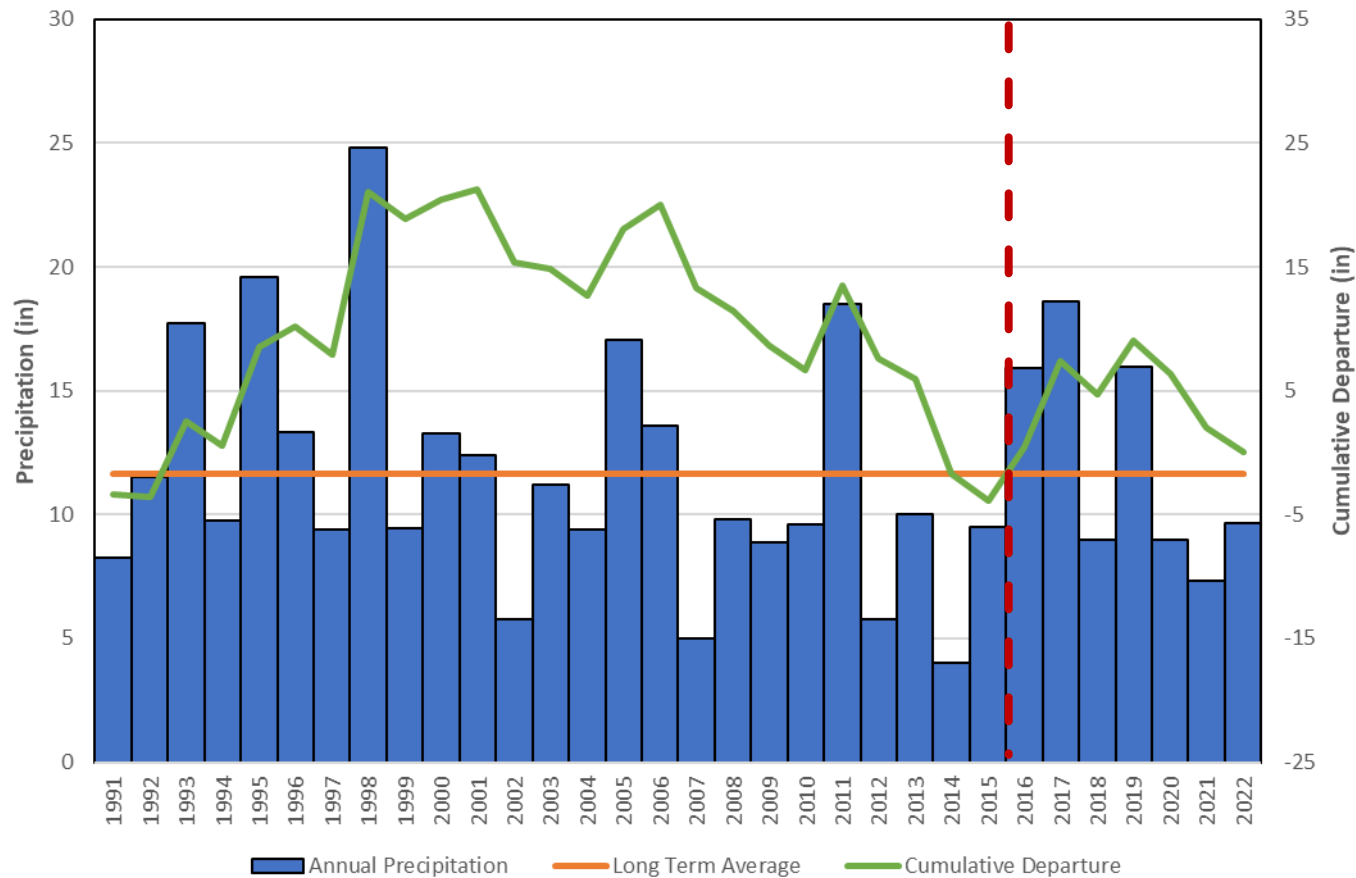
# PRECIPITATION



## Data Source:

- PRISM
  - 2016 15.94 in
  - 2017 18.62 in
  - 2018 8.97 in
  - 2019 15.98 in
  - 2020 8.98 in
  - 2021 7.31 in
  - 2022 9.65 in

# PRECIPITATION

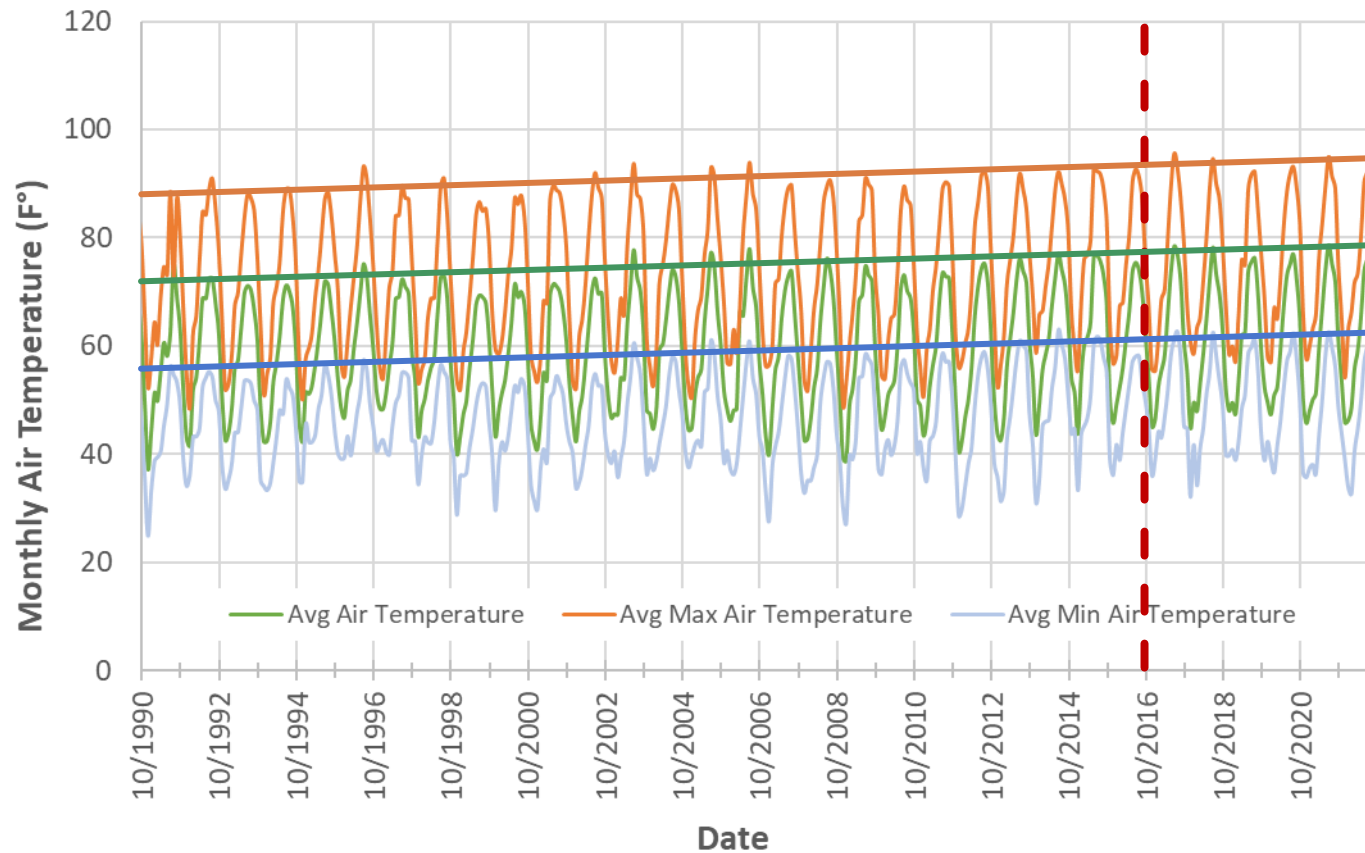


## Data Source:

### ■ PRISM

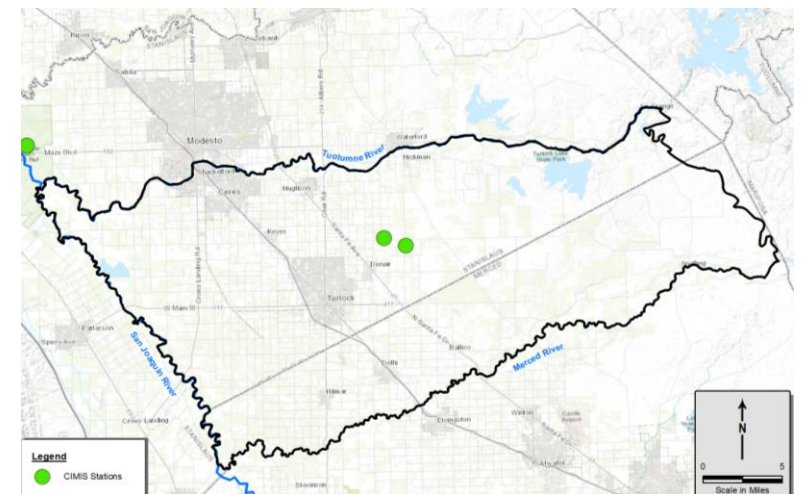
■ 2016	15.94 in
■ 2017	18.62 in
■ 2018	8.97 in
■ 2019	15.98 in
■ 2020	8.98 in
■ 2021	7.31 in
■ 2022	9.65 in

# TEMPERATURE



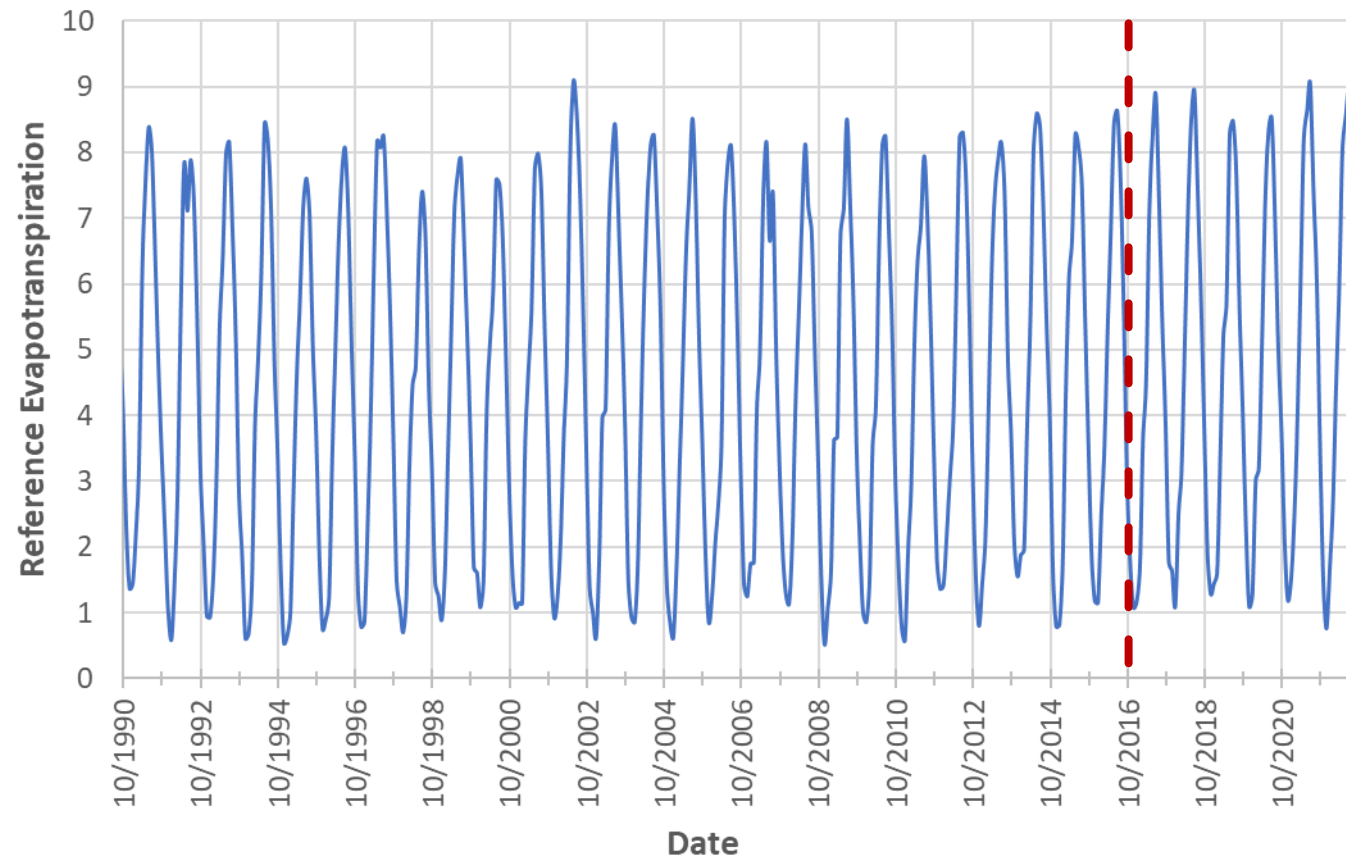
## Data Source:

- CIMIS Stations
  - #71 (Modesto)
  - #168 (Denair)
  - #206 (Denair II)



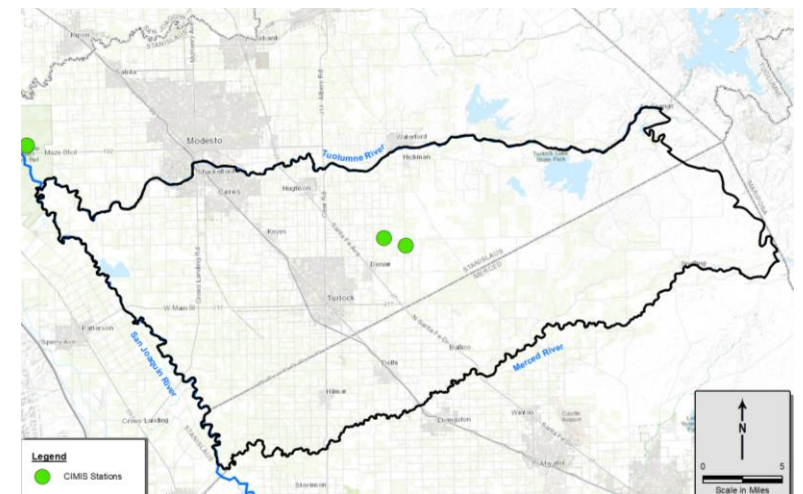


# EVAPOTRANSPIRATION

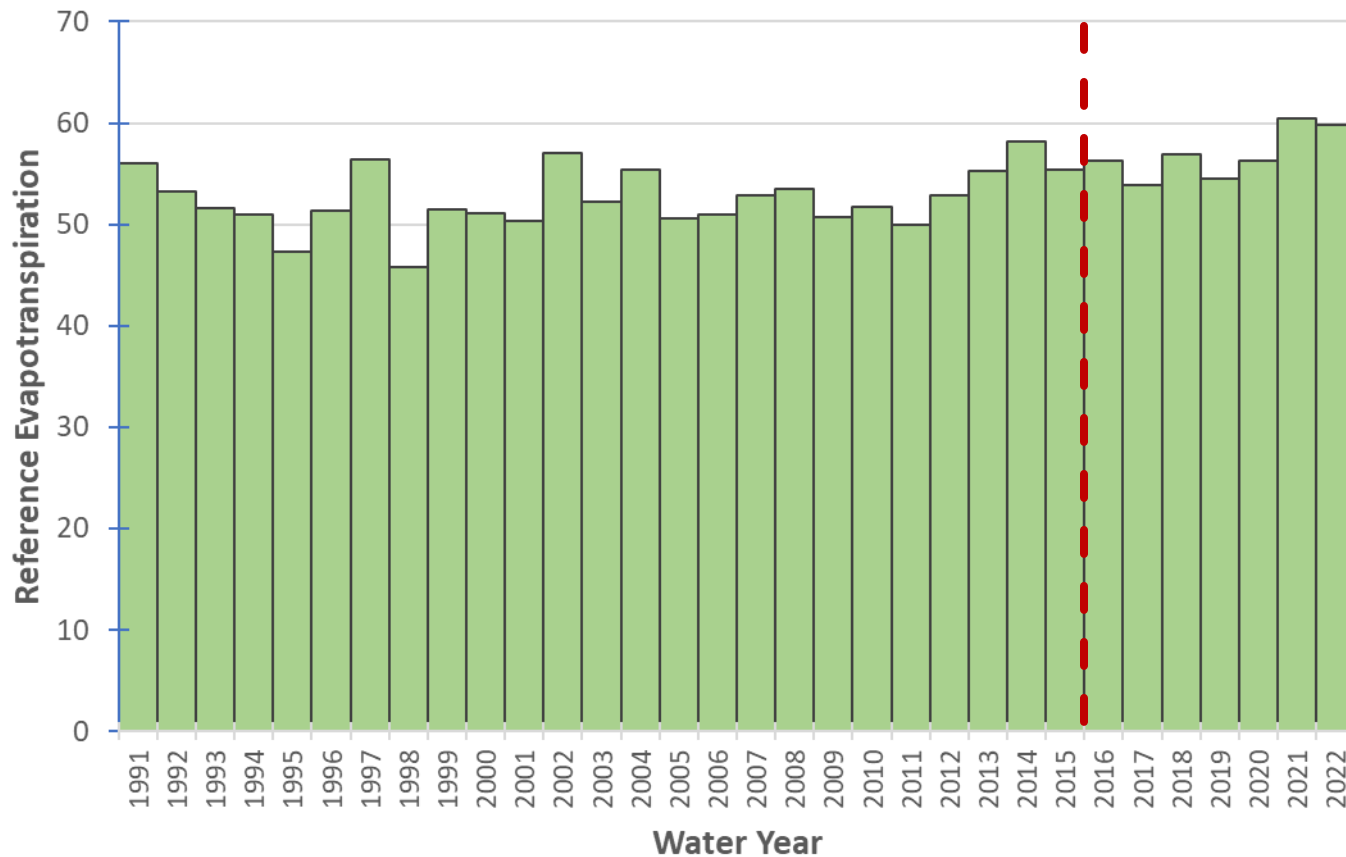


## Data Source:

- CIMIS Stations
  - #71 (Modesto)
  - #168 (Denair)
  - #206 (Denair II)

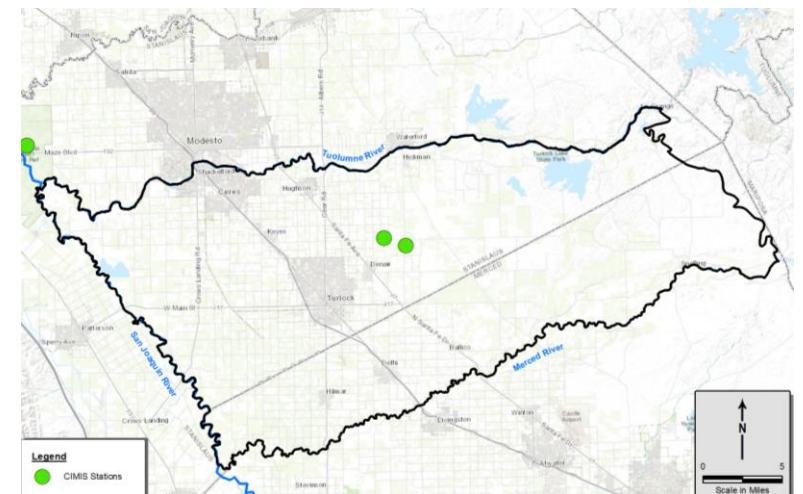


# EVAPOTRANSPIRATION

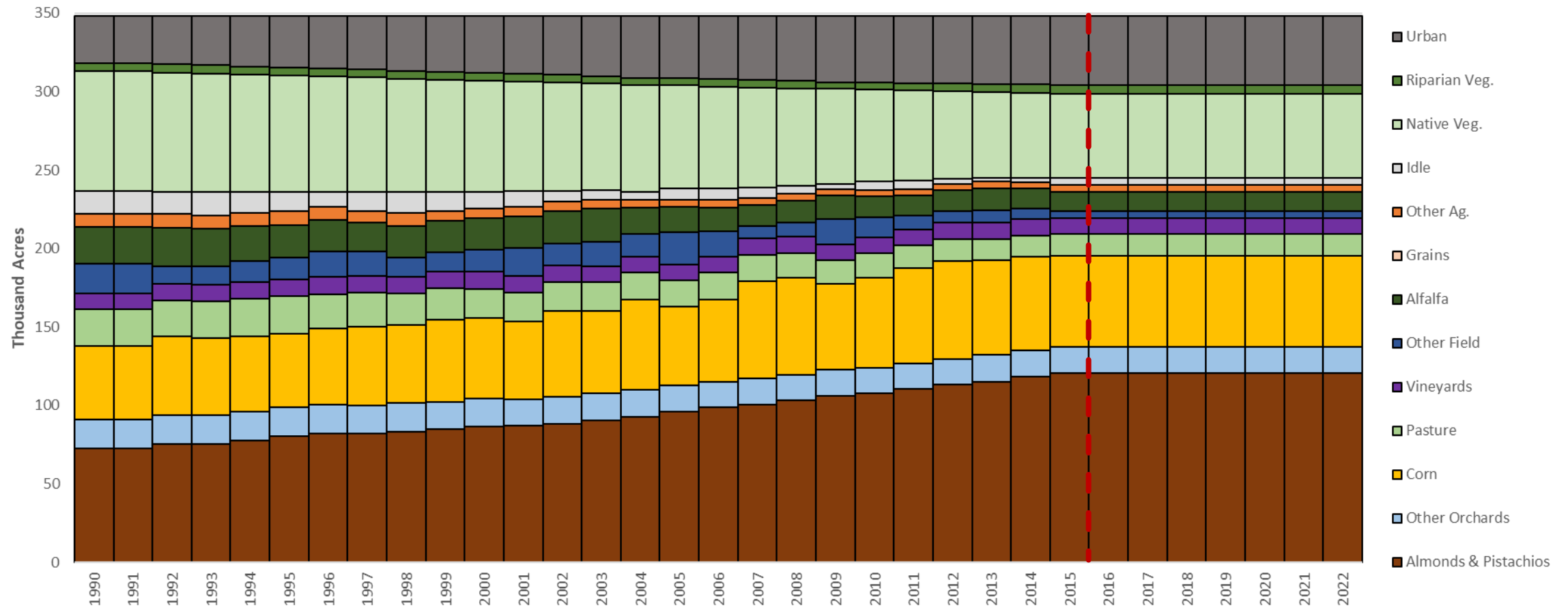


## Data Source:

- CIMIS Stations
  - #71 (Modesto)
  - #168 (Denair)
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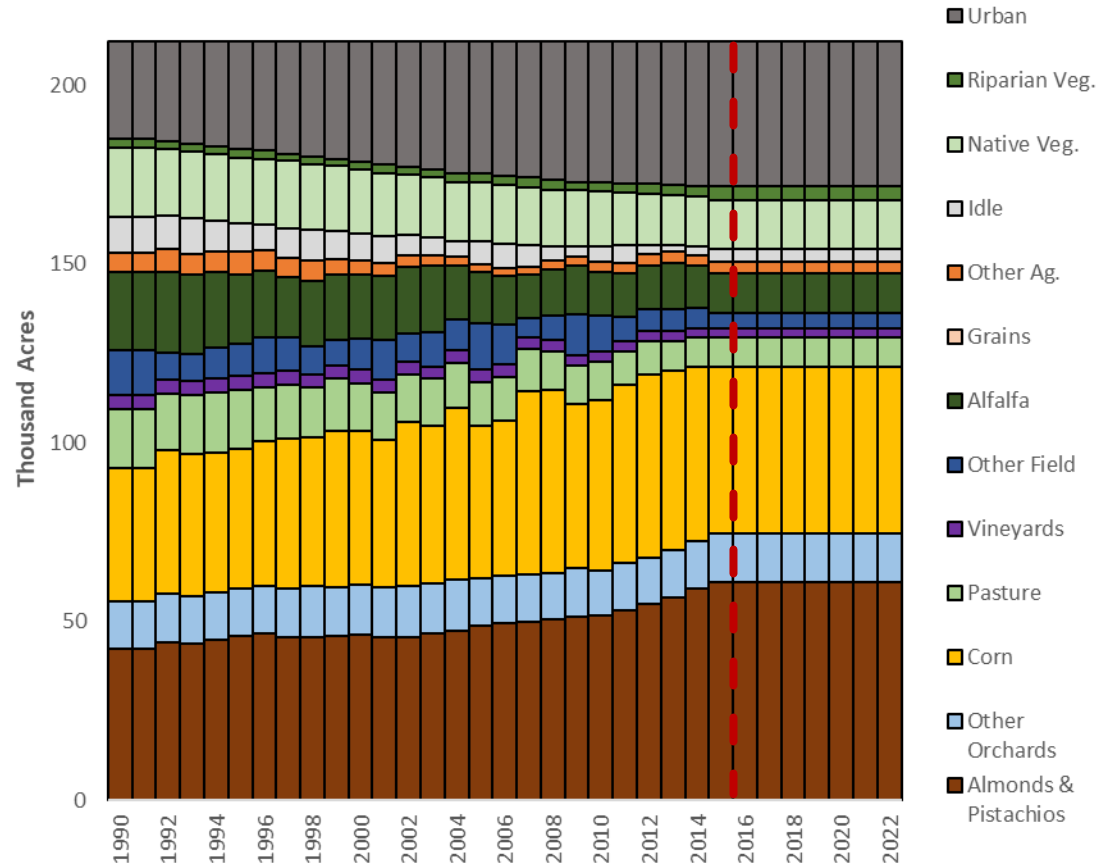


# LAND USE & CROPPING PATTERNS

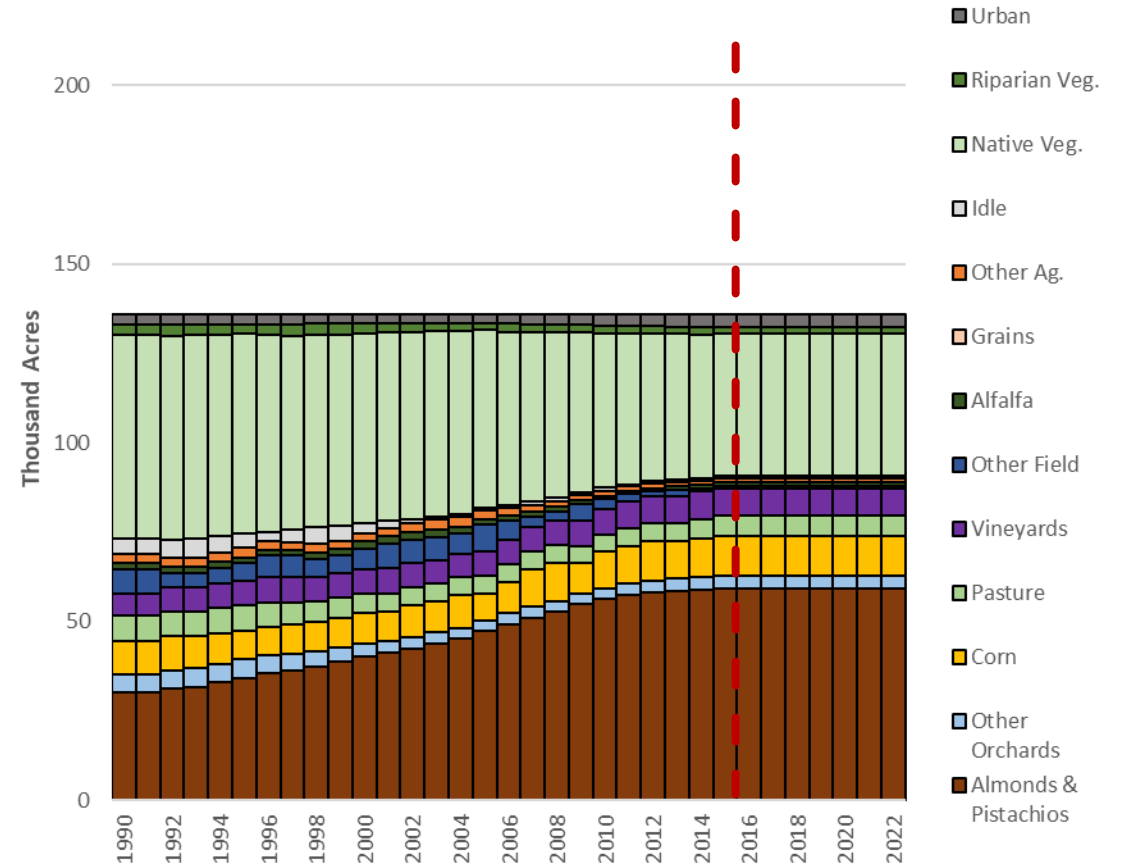


# LAND USE & CROPPING PATTERNS

## West Turlock



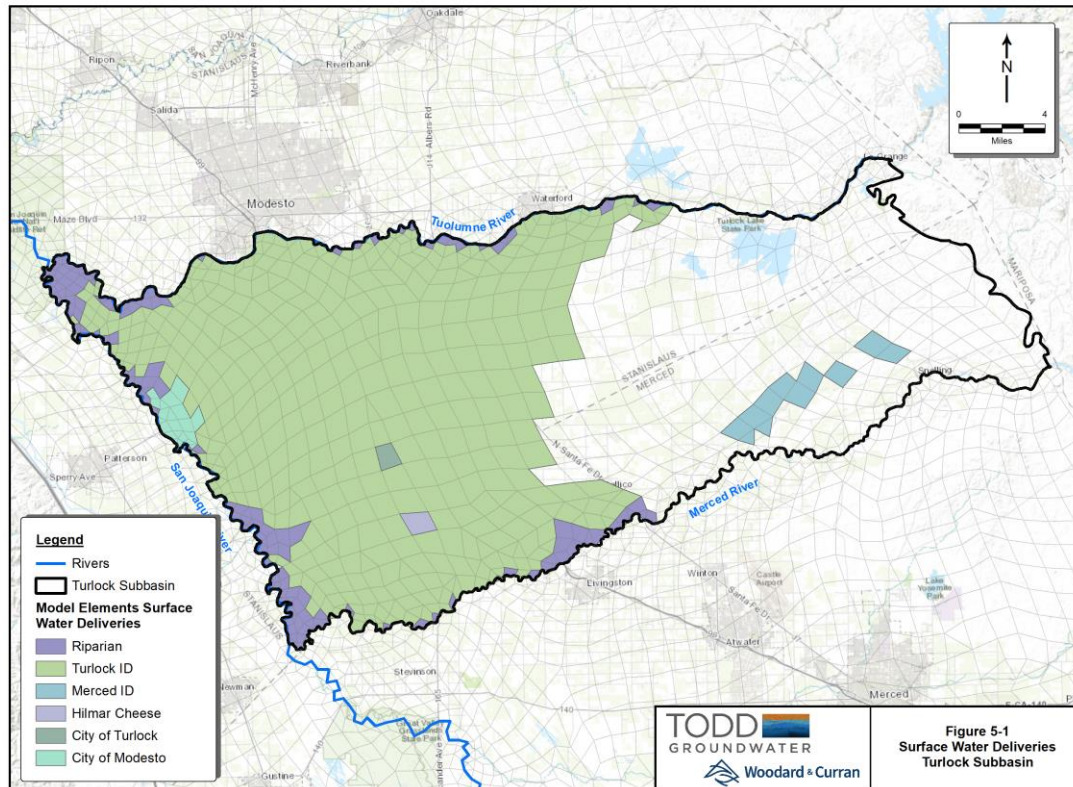
## East Turlock



# SURFACE WATER OPERATIONS

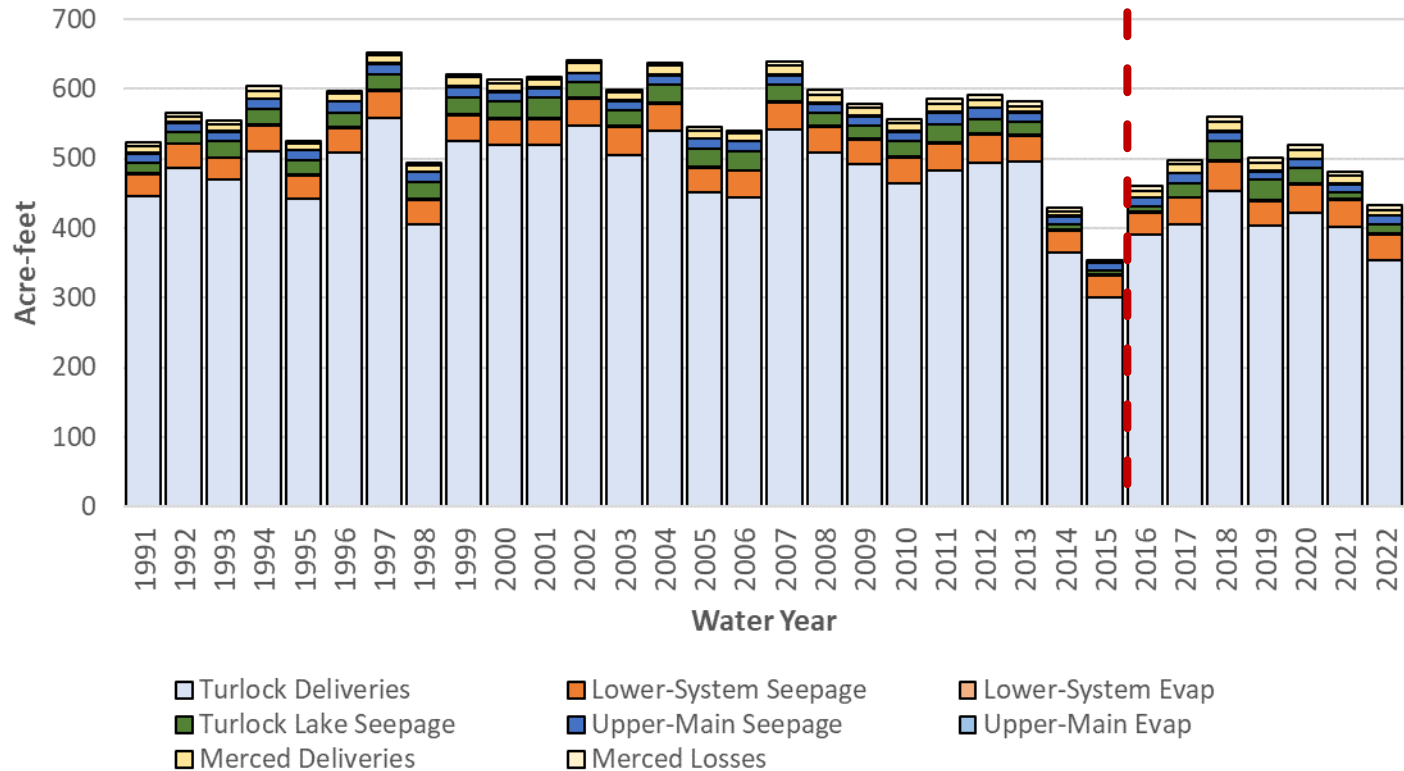
## Data Source:

- Turlock ID
- Merced ID
- City of Modesto
- Sate Board: eWRIMS



# SURFACE WATER OPERATIONS

Historical Deliveries and Seepage

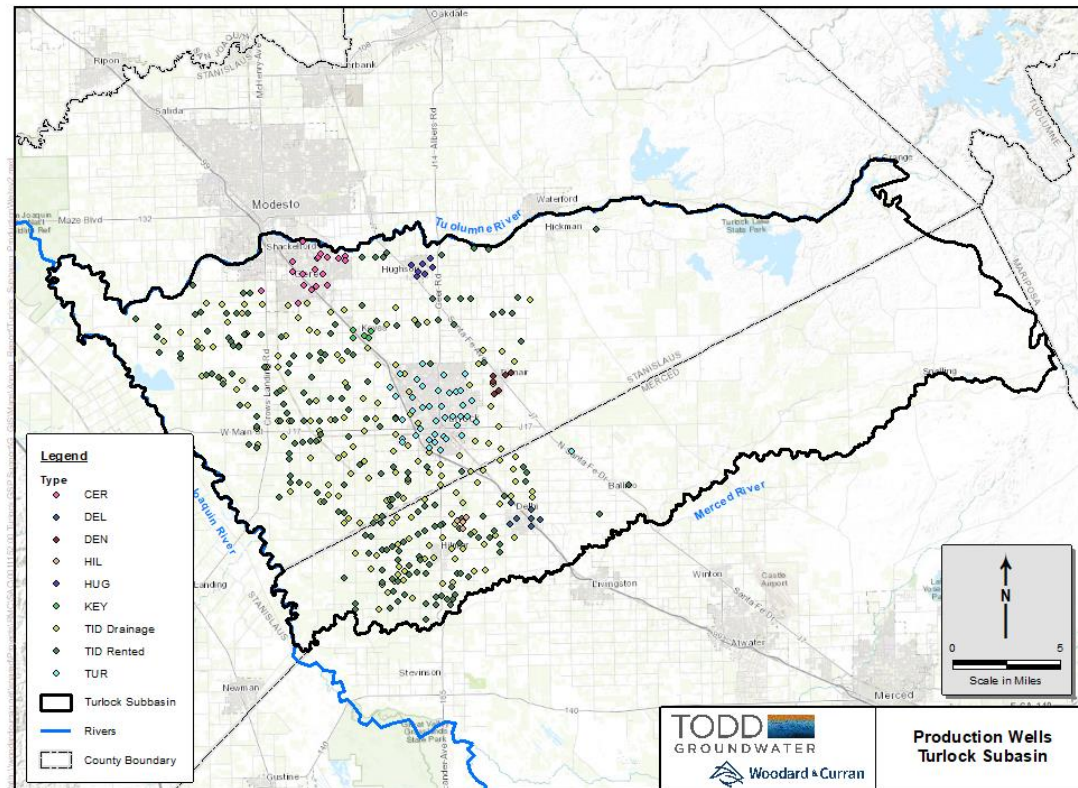


- Turlock ID
  - Tuolumne Diversions
  - Turlock Lake seepage
  - Conveyance seepage
  - Farm gate deliveries
  - Recycled water
- Merced – Northside
  - Merced Diversions
  - Conveyance seepage
  - Farm gate Deliveries
- Riparian Diversions

# GROUNDWATER PRODUCTION

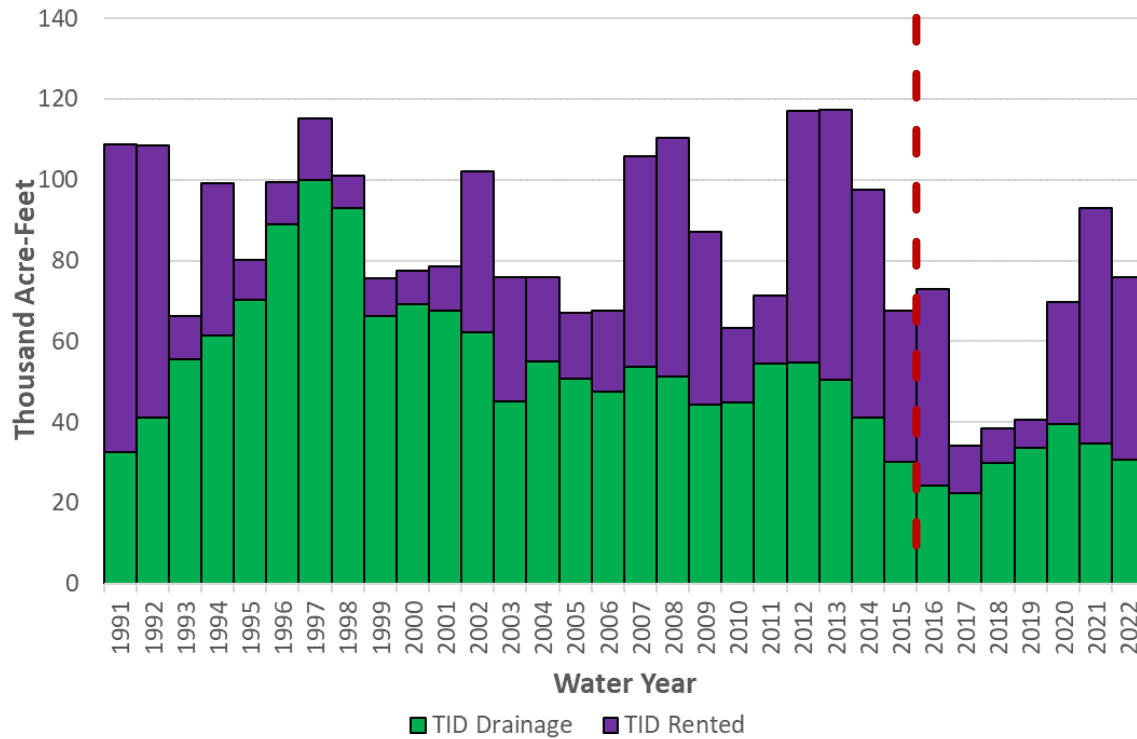
## Data Source:

- Turlock Irrigation District
- Merced Irrigation District
- Modesto, City of
- Turlock, City of
- Ceres, City of
- Hughson, City of
- Denair
- Delhi
- Hilmar
- Keyes
- Hickman

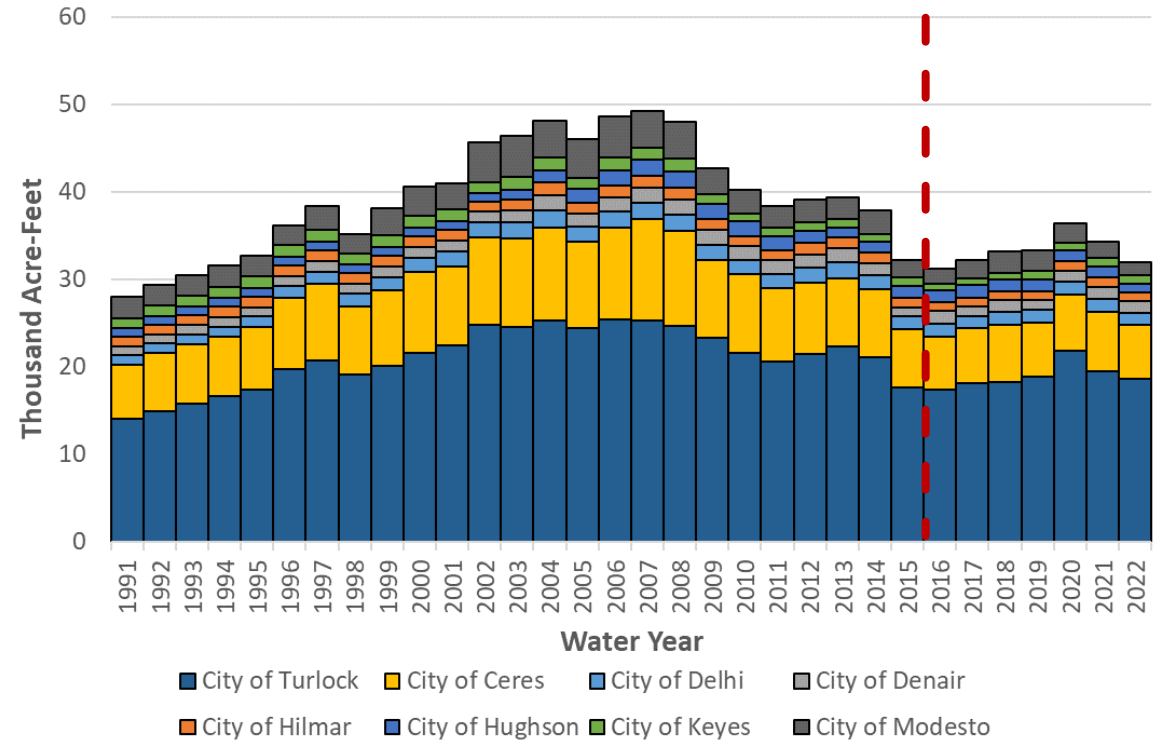


# GROUNDWATER PRODUCTION

## Agricultural Agency Pumping



## Urban Agency Pumping



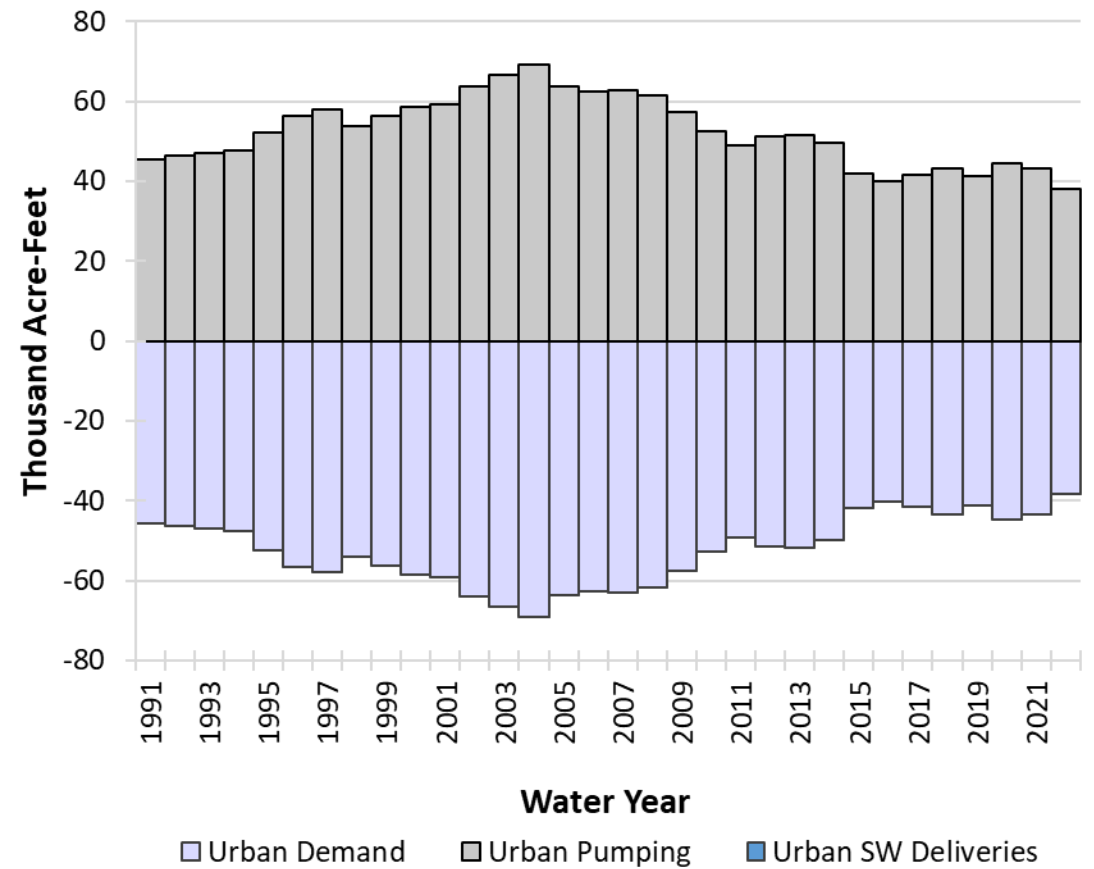
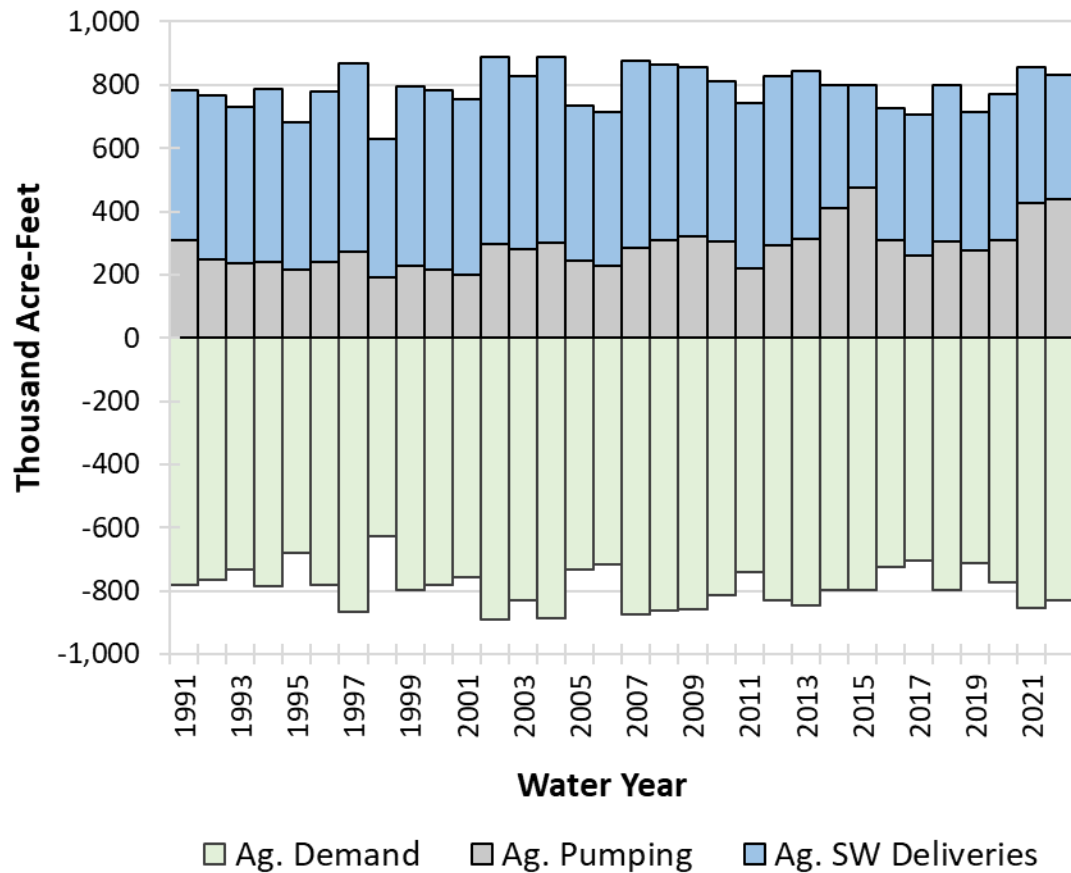


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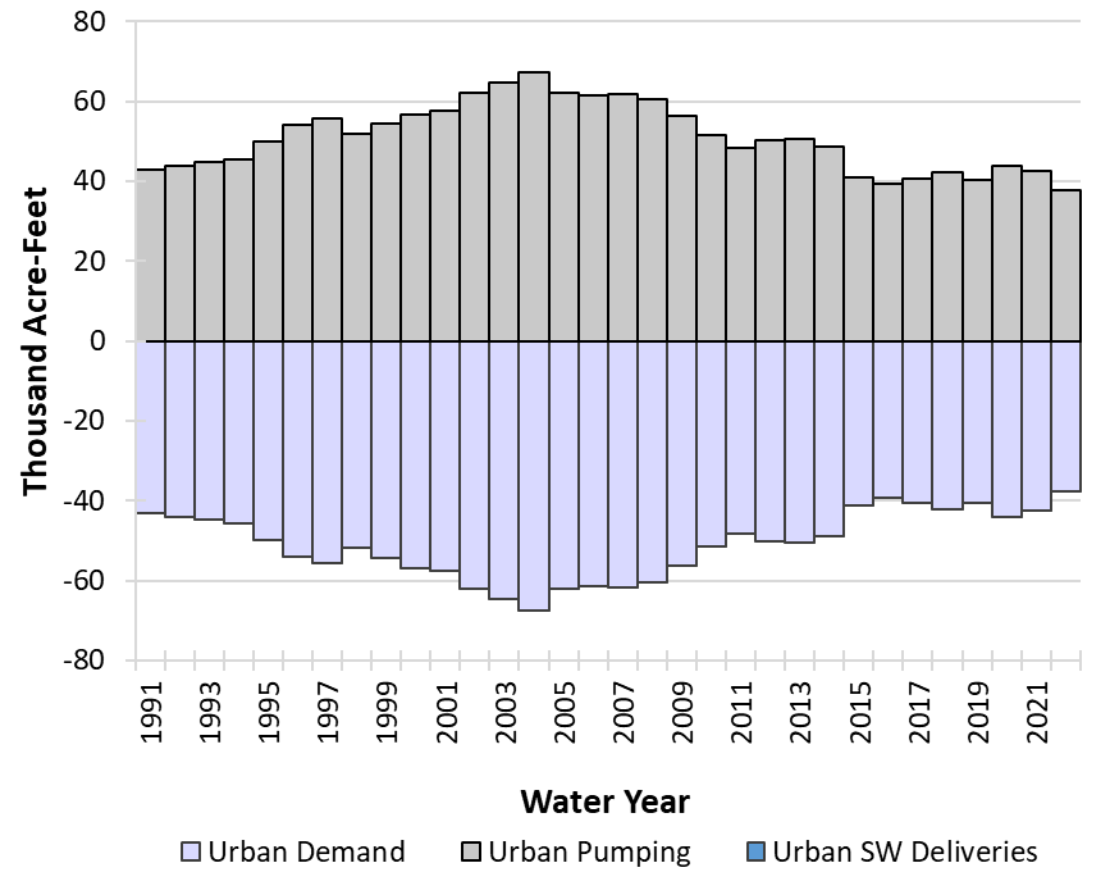
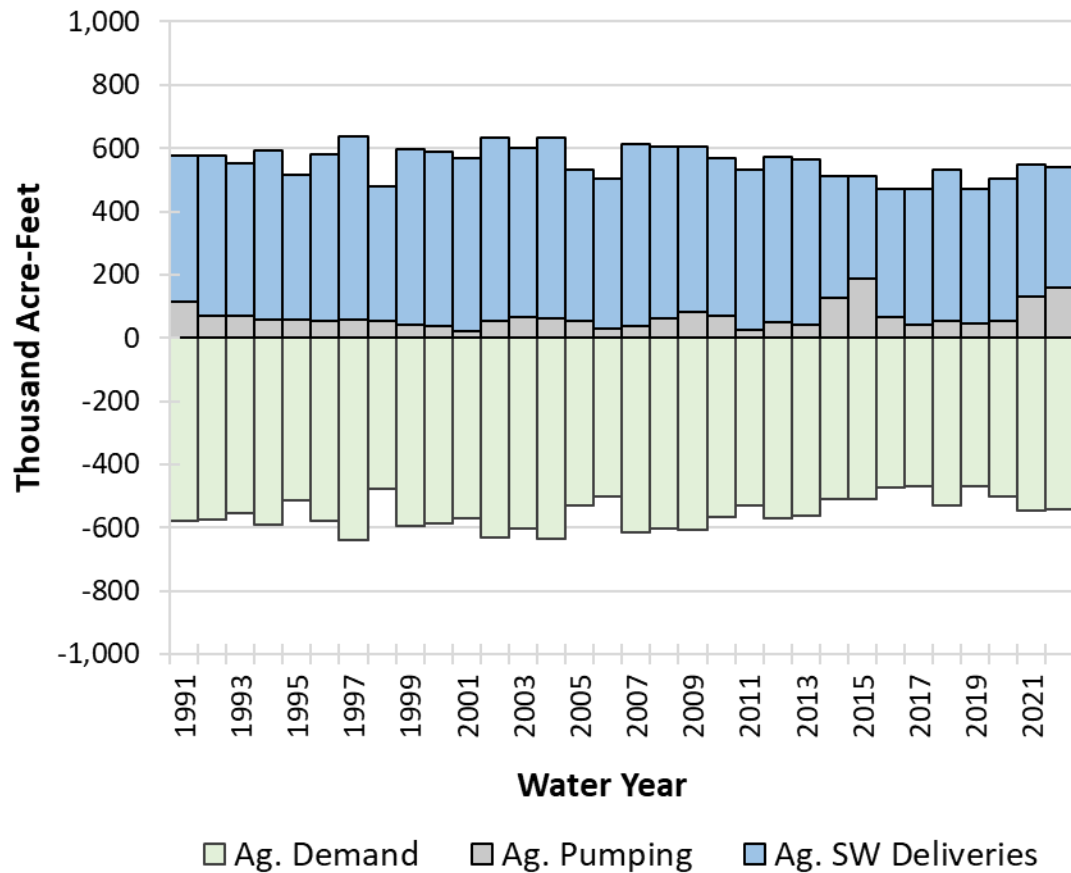
# MODEL RESULTS

WATER BUDGETS

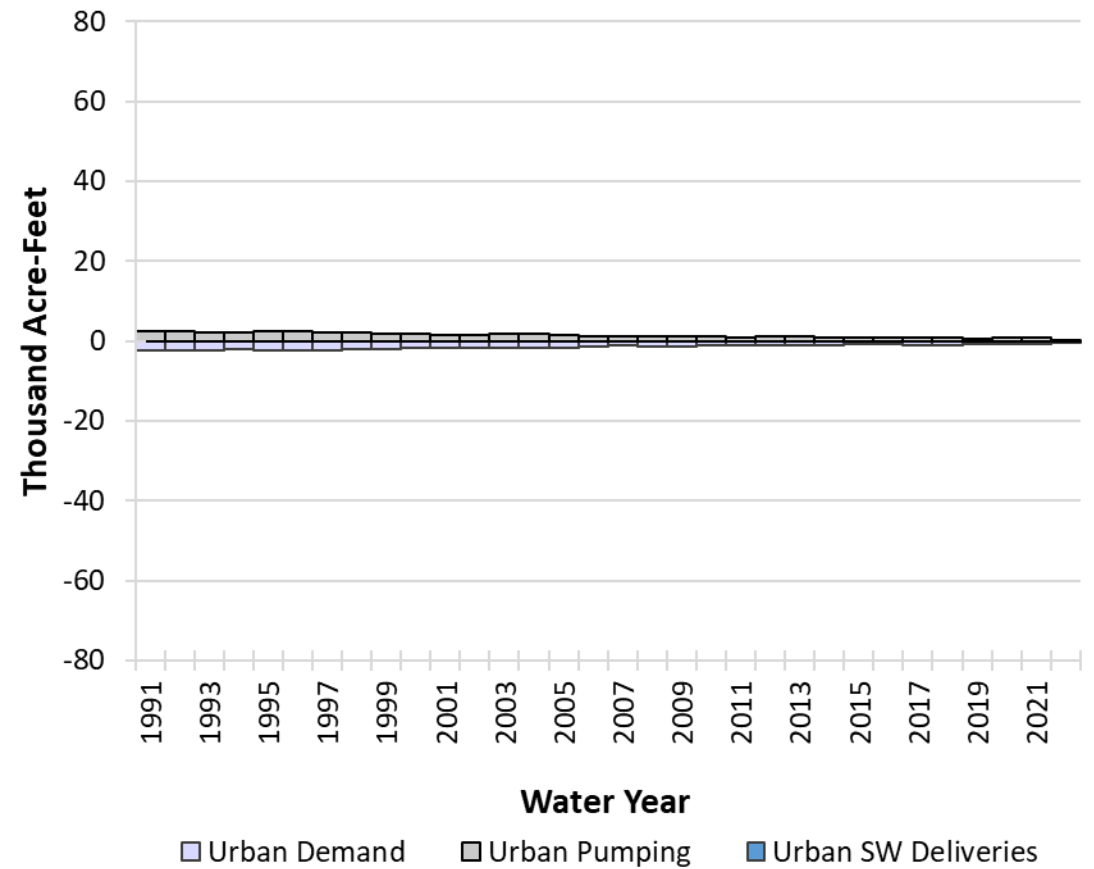
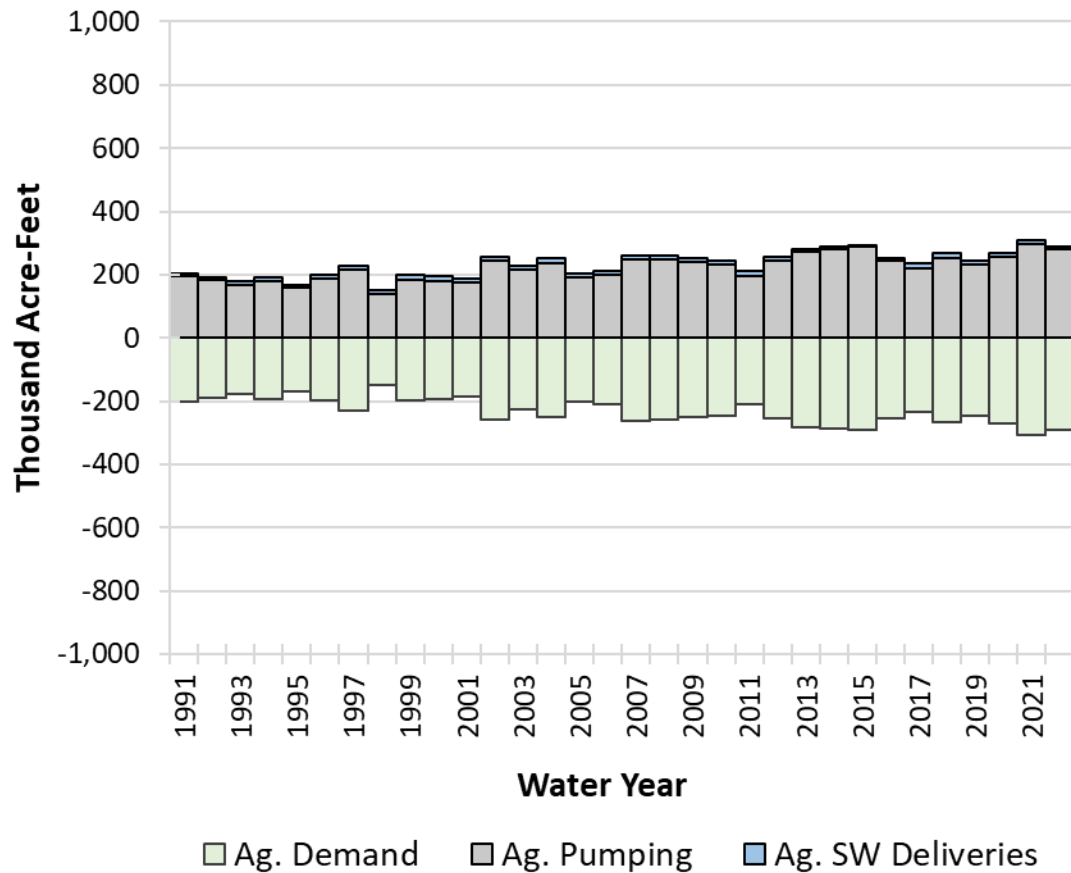
# TURLOCK SUBBASIN: LAND AND WATER USE



# WTSGSA: LAND AND WATER USE



# ETSGSA: LAND AND WATER USE

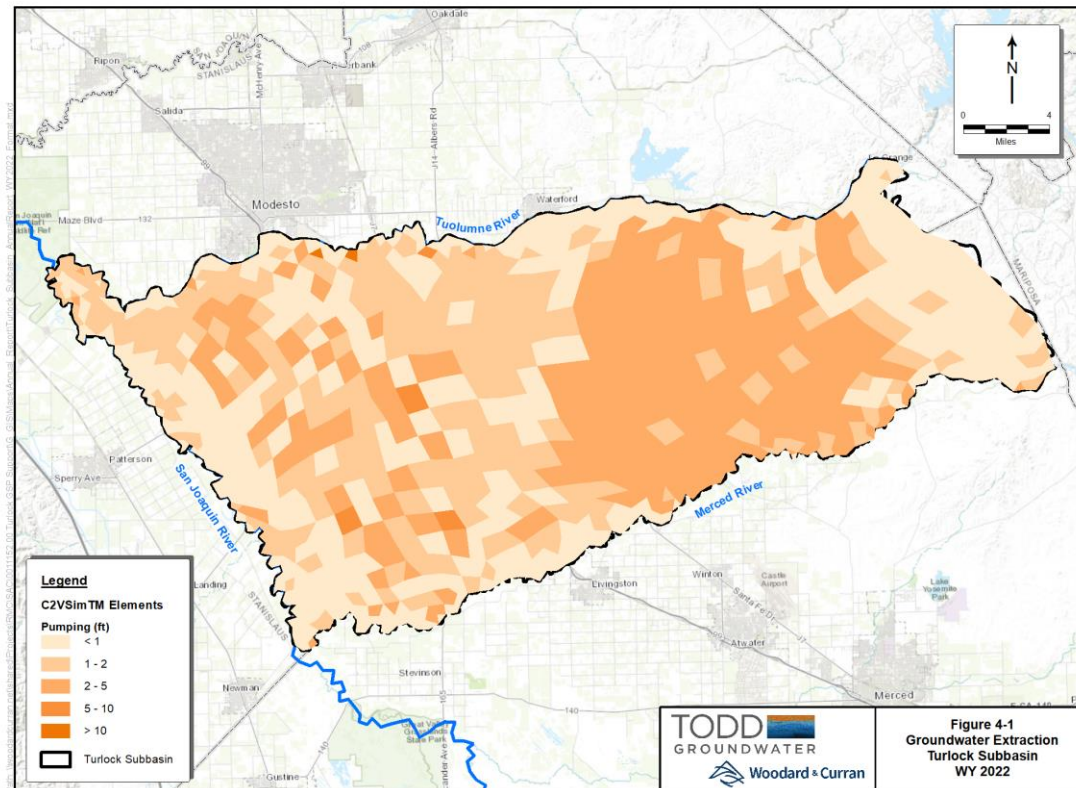


# TURLOCK SUBBASIN: GROUNDWATER PUMPING

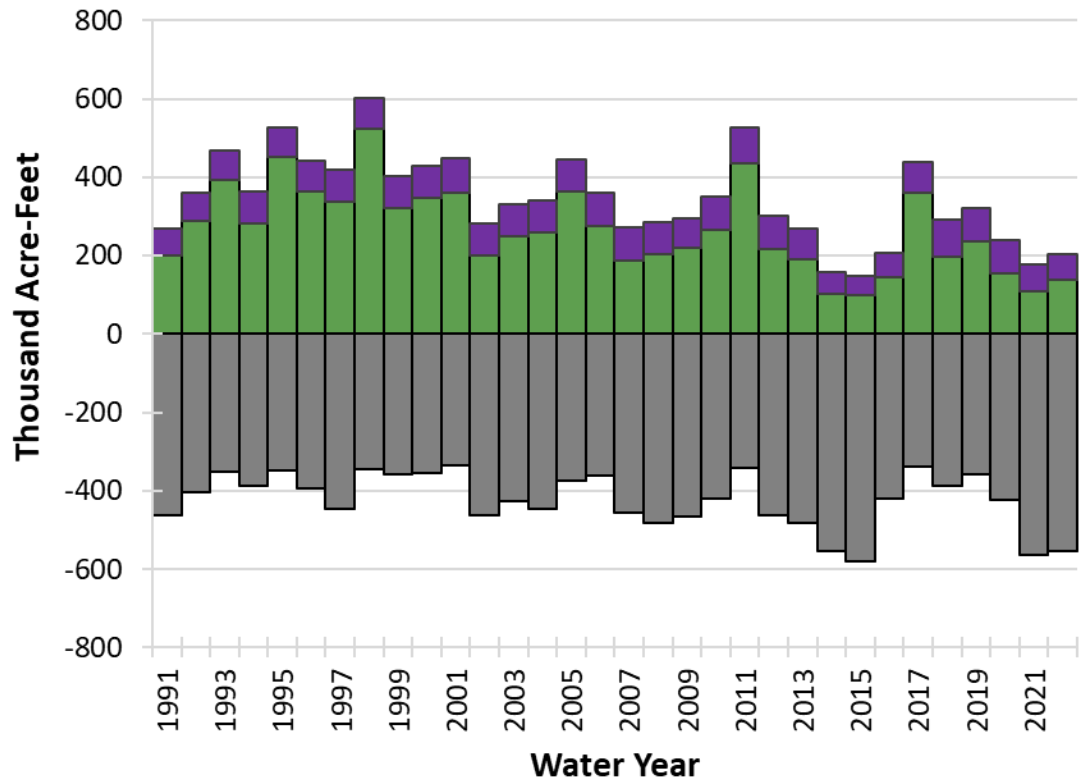
## Water Year 2022

### ■ Pumping

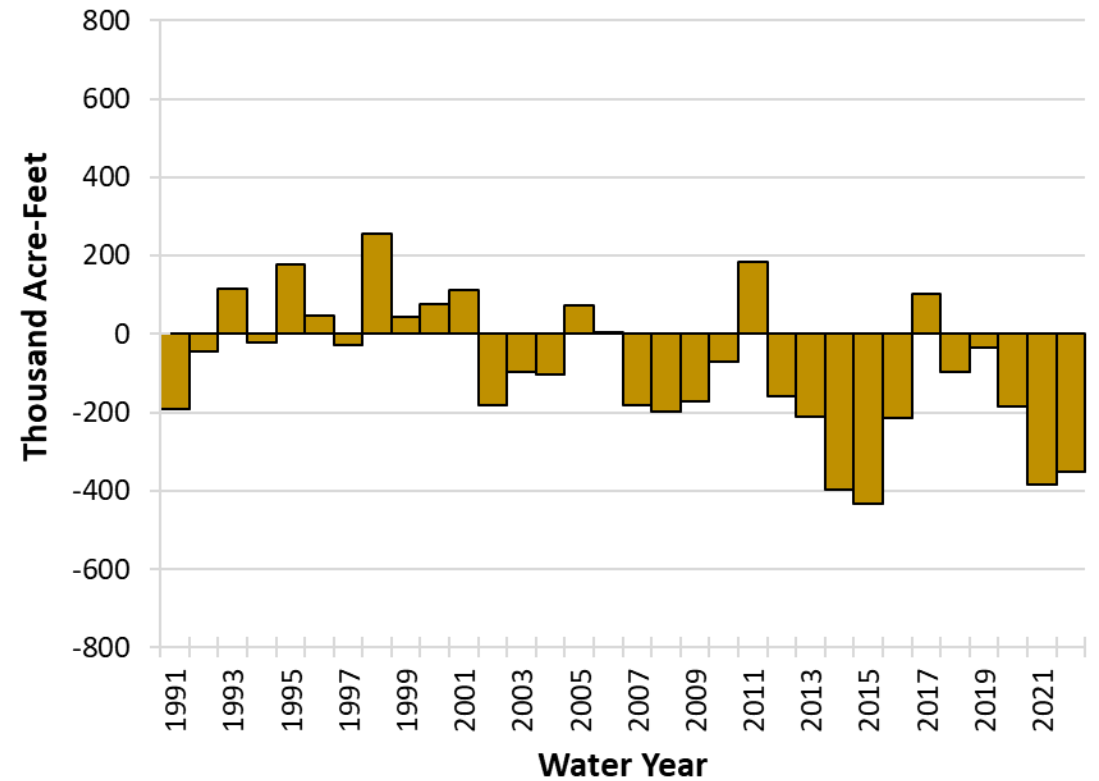
■ Ag Agency	75,900 AF
■ Ag Private	440,300 AF
■ Urban Agency	32,000 AF
■ Urban Private	6,200 AF
■ Total	554,400 AF
	1.6 ft



# TURLOCK SUBBASIN: OPERATIONAL BUDGET

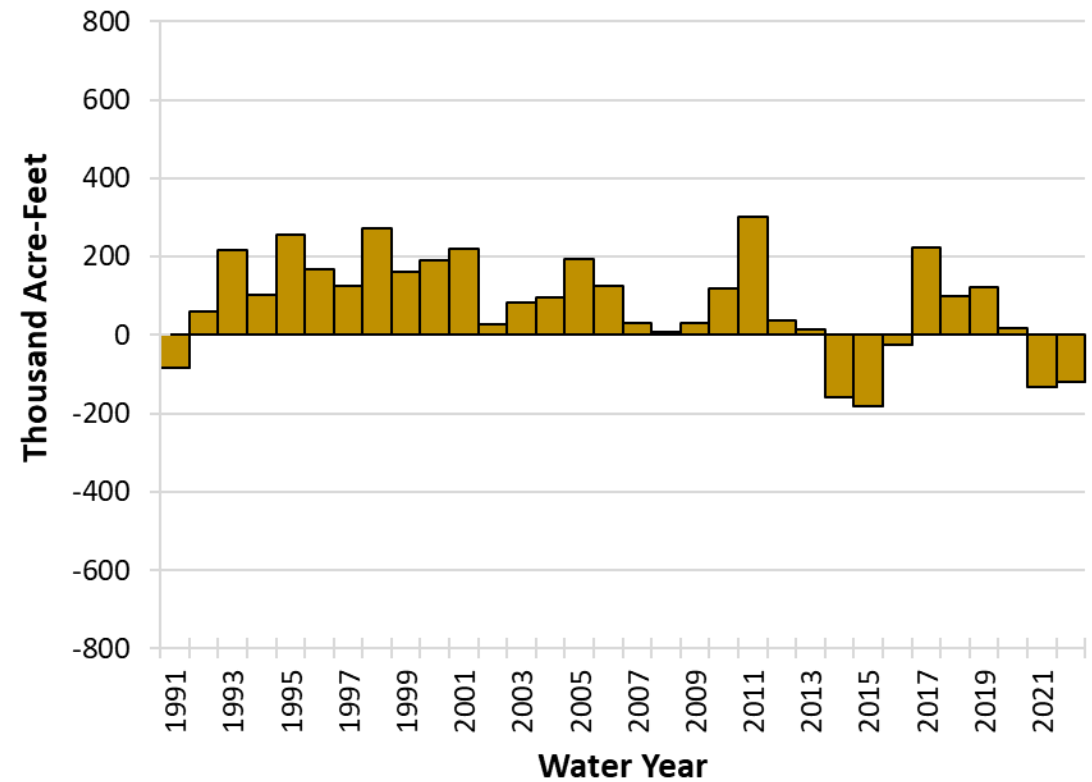
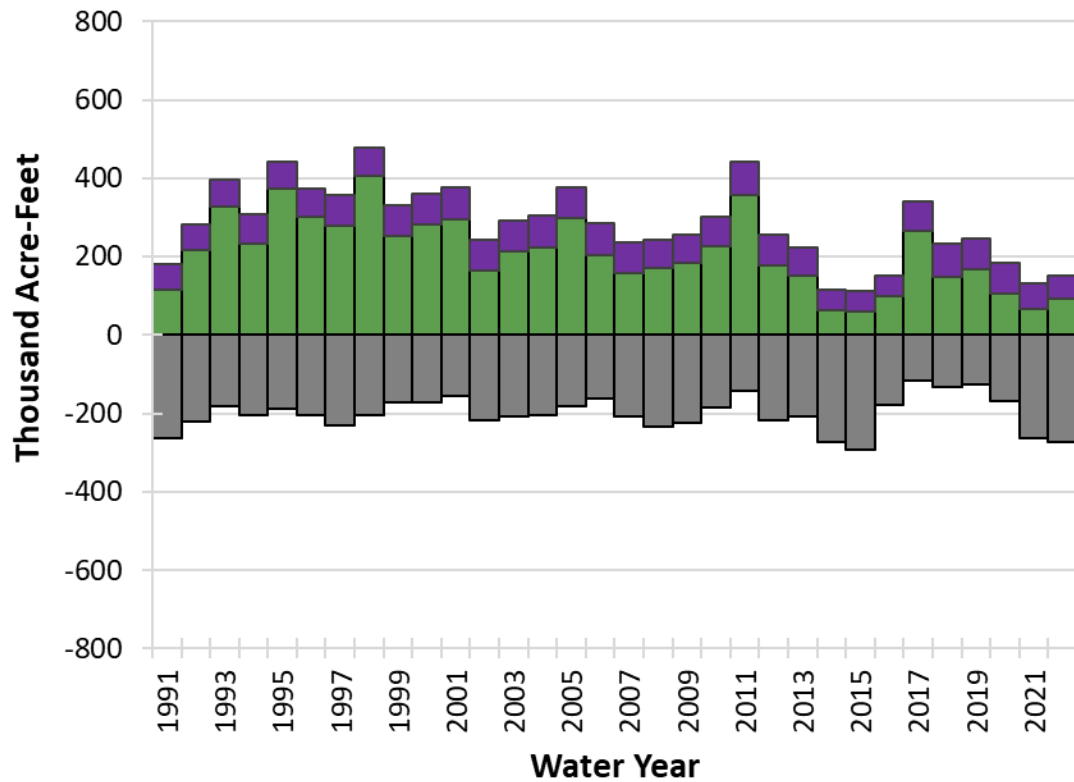


Groundwater Pumping
  Deep Percolation
  Canal and Reservoir Recharge



Net Recharge

# WTSGSA: OPERATIONAL BUDGET

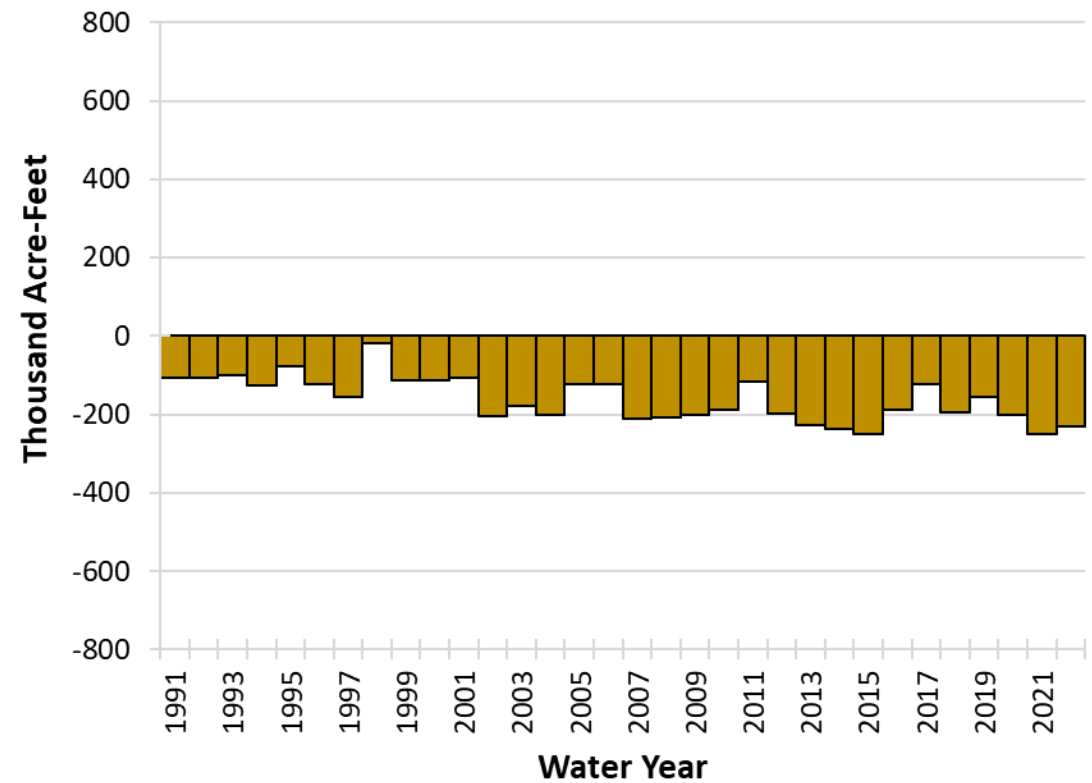
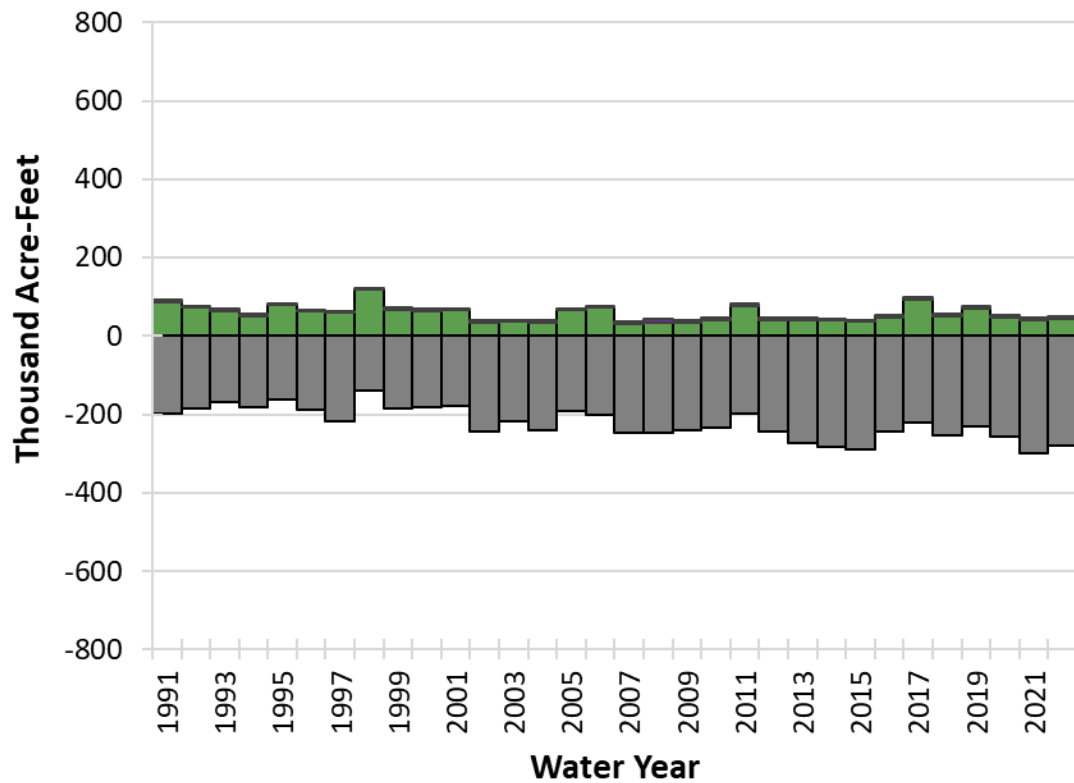


■ Groundwater Pumping ■ Deep Percolation ■ Canal and Reservoir Recharge

■ Net Recharge

**Note:** Operational water budgets are based on the jurisdictional boundaries of each GSA and do not represent the area overlying each principal aquifer

# ETSGSA: OPERATIONAL BUDGET



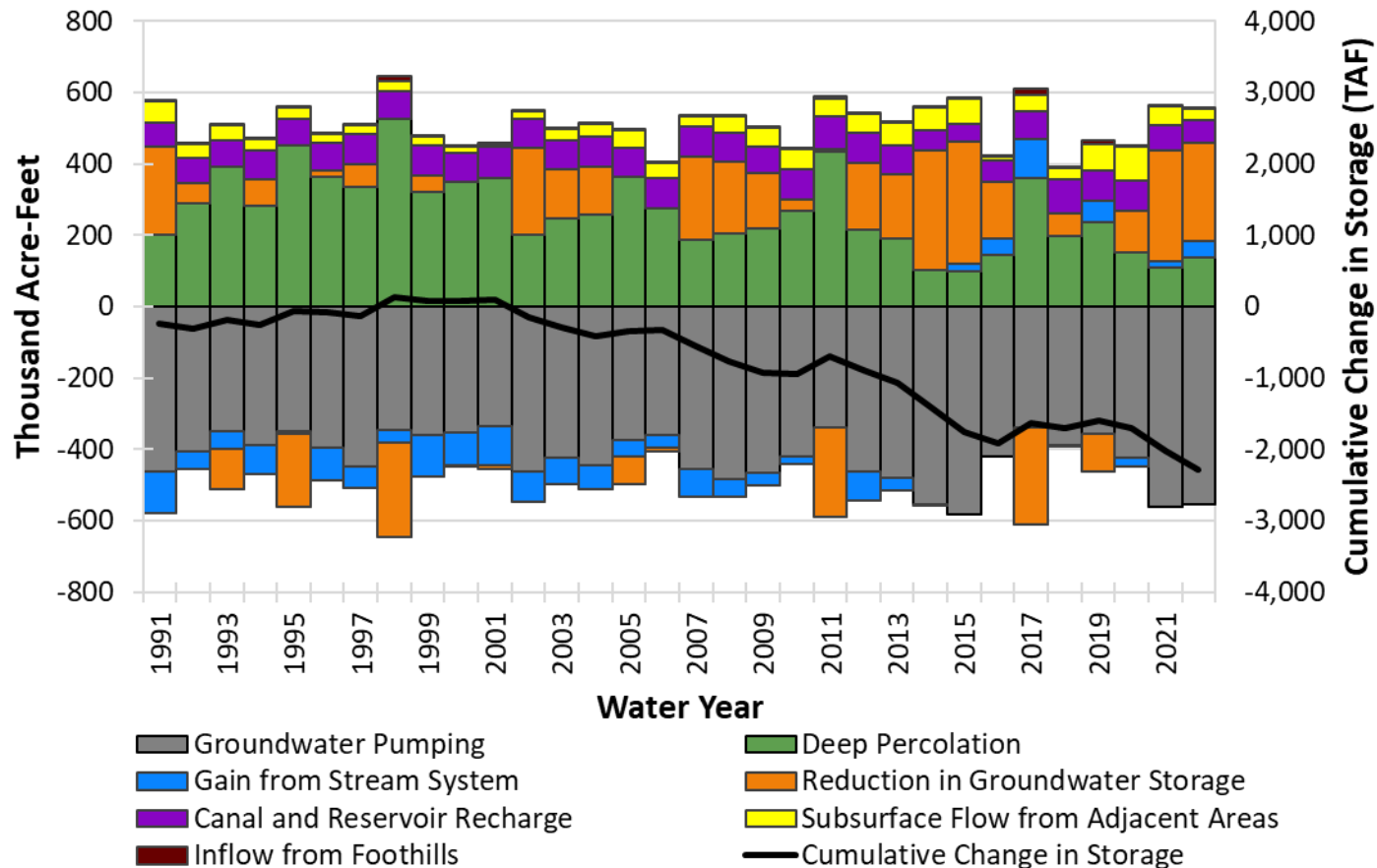
■ Groundwater Pumping ■ Deep Percolation ■ Canal and Reservoir Recharge

■ Net Recharge

**Note:** Operational water budgets are based on the jurisdictional boundaries of each GSA and do not represent the area overlying each principal aquifer



# TURLOCK SUBBASIN: GROUNDWATER BUDGET



## Water Year 2022

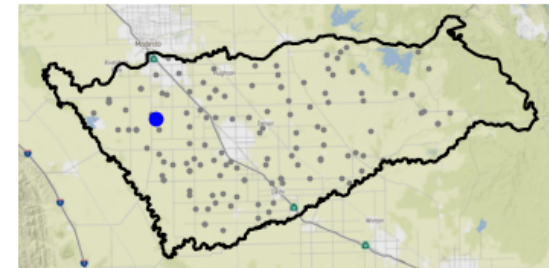
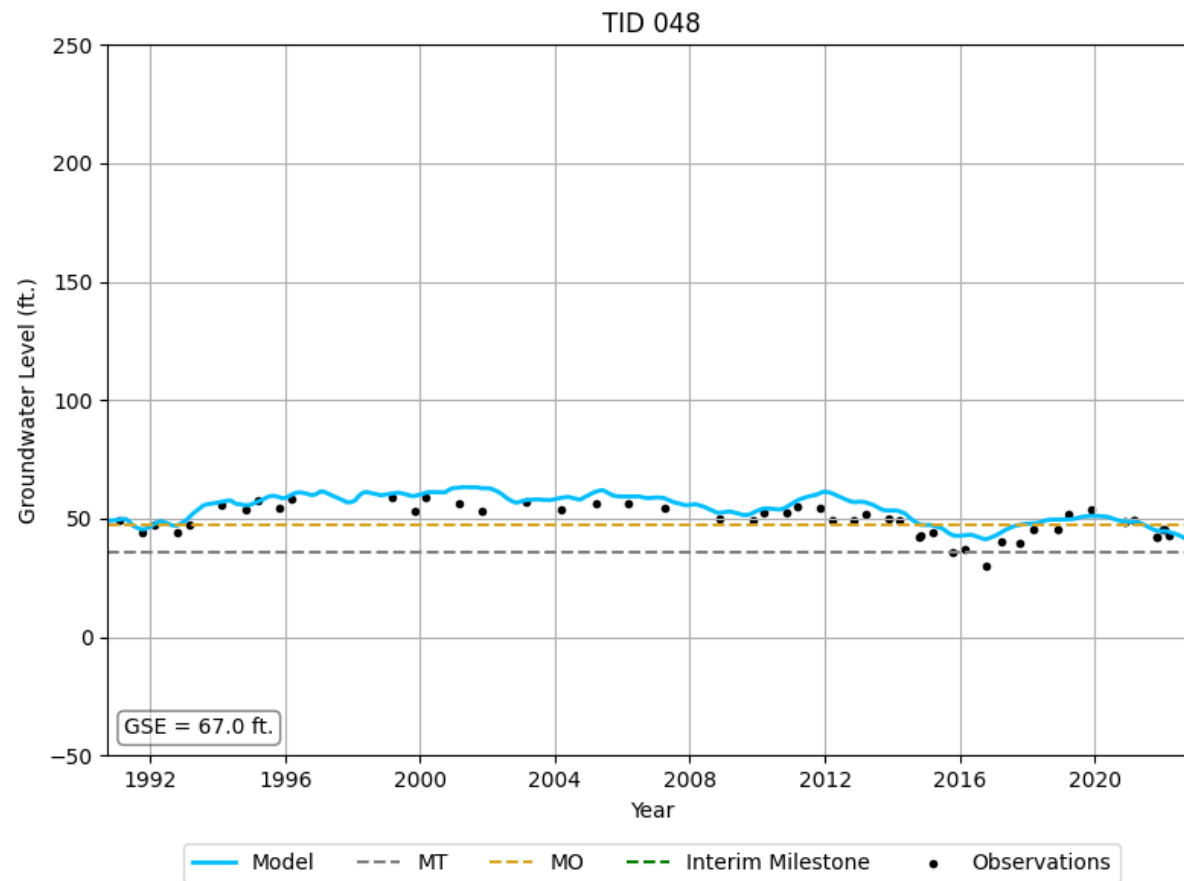
Groundwater Budget	
■ Pumping	-554,400
■ Deep percolation	138,100
■ Canal recharge	65,900
■ Gain from stream	44,700
■ Subsurface inflow	30,100
■ Foothill inflow	1,000
■ Δ Storage	-274,600

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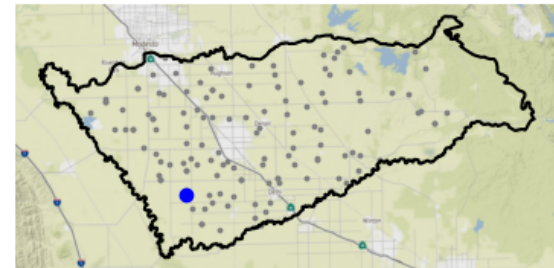
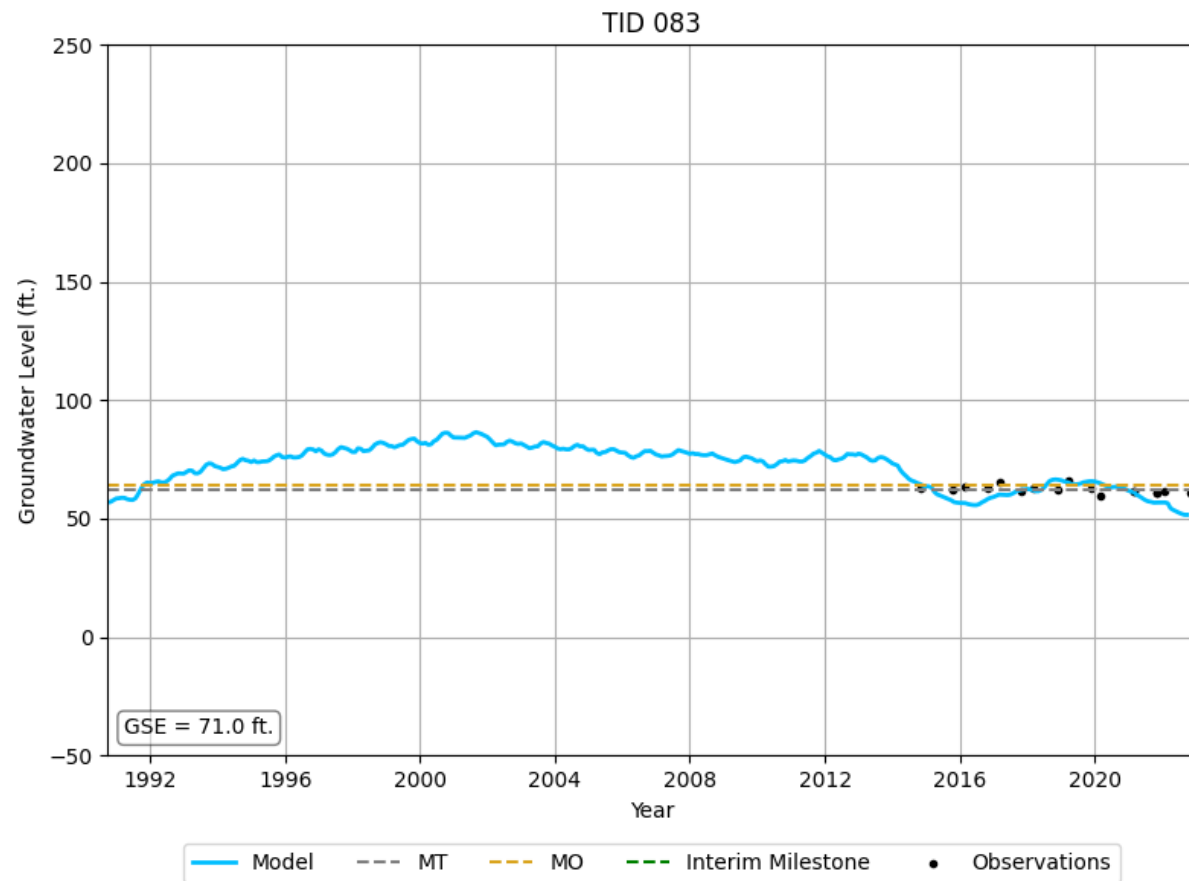
# MODEL RESULTS

HYDROGRAPHS

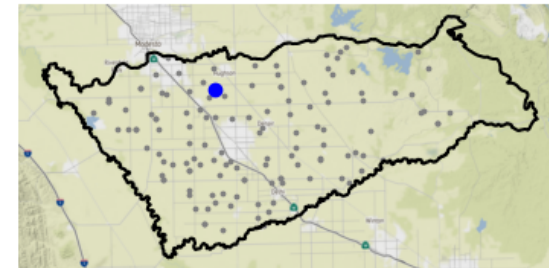
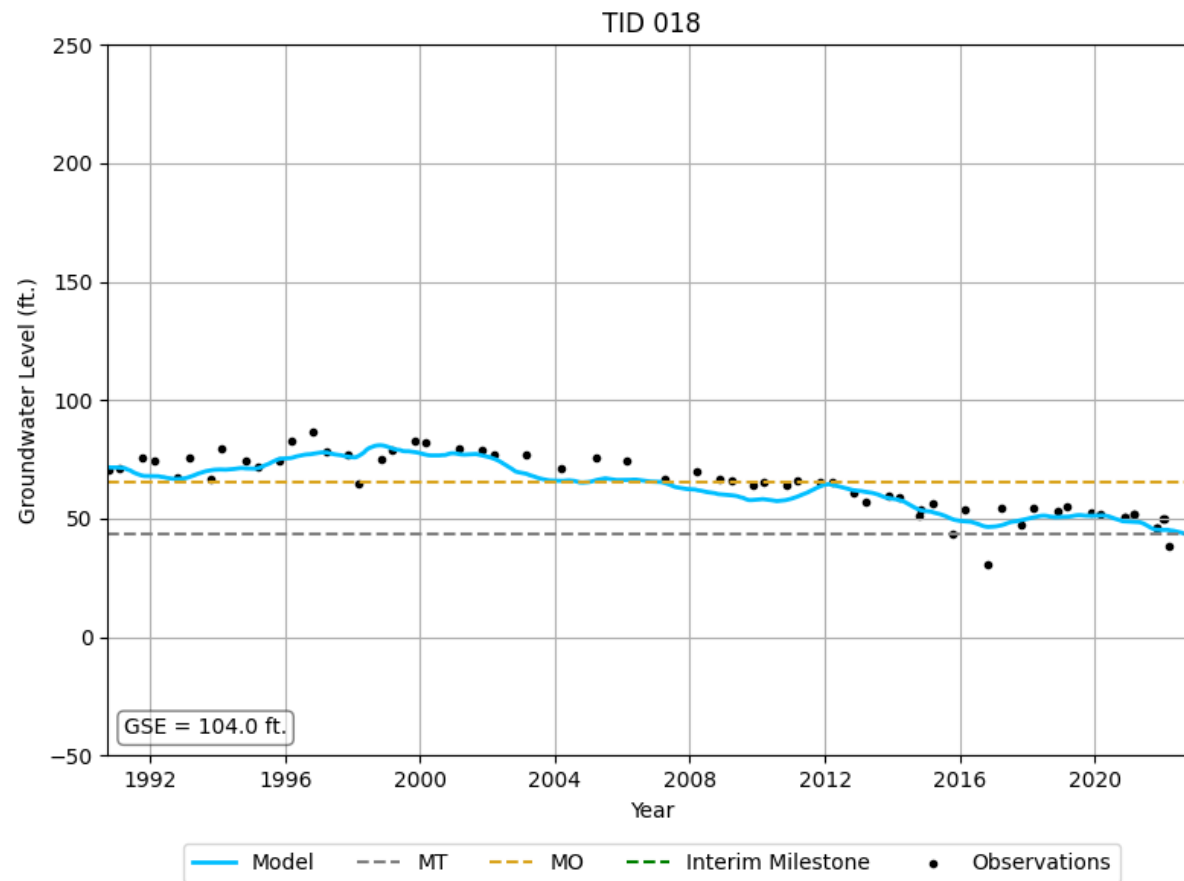
# GROUNDWATER LEVEL HYDROGRAPHS



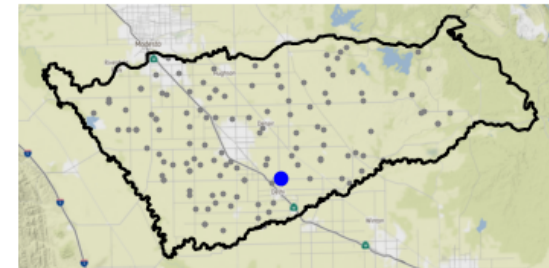
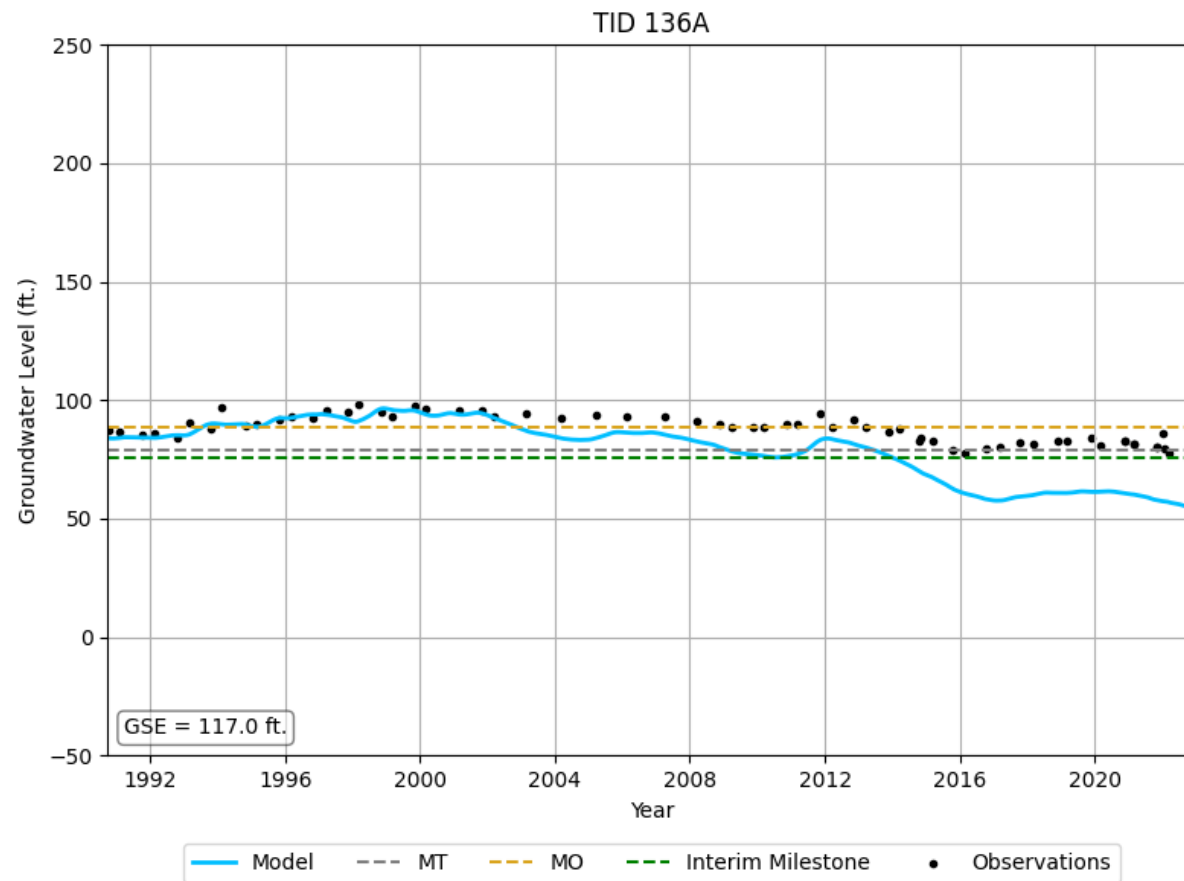
# GROUNDWATER LEVEL HYDROGRAPHS



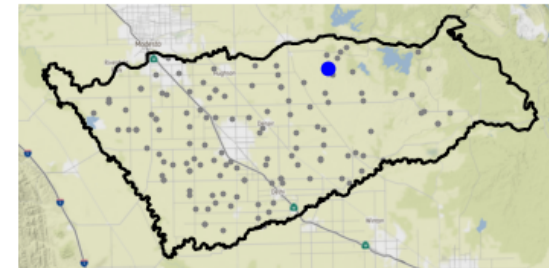
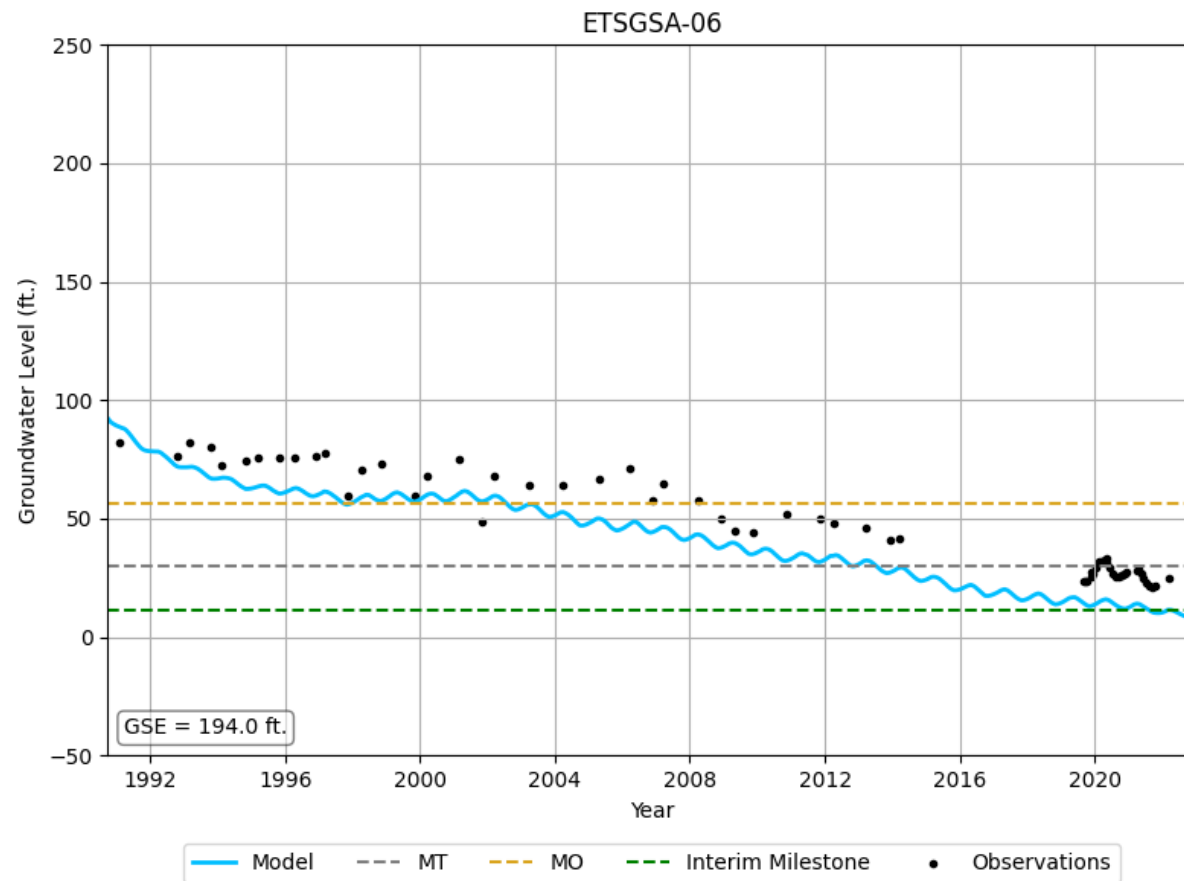
# GROUNDWATER LEVEL HYDROGRAPHS



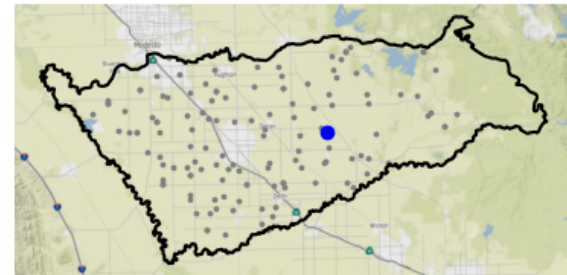
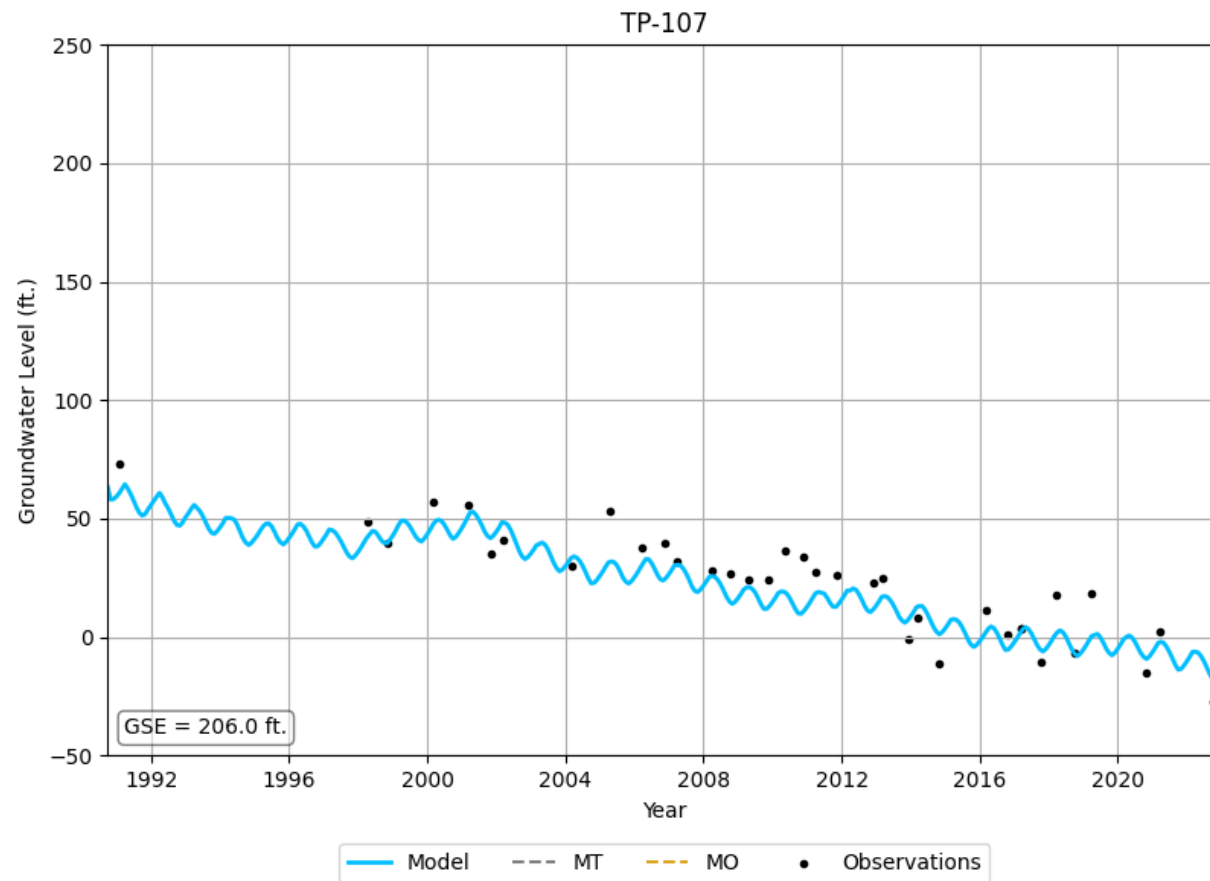
# GROUNDWATER LEVEL HYDROGRAPHS



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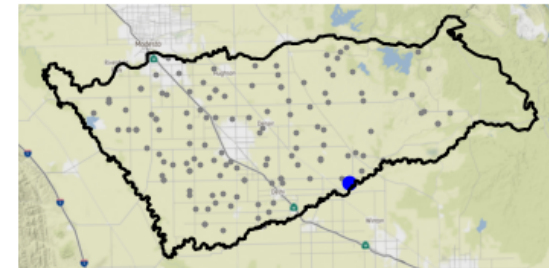
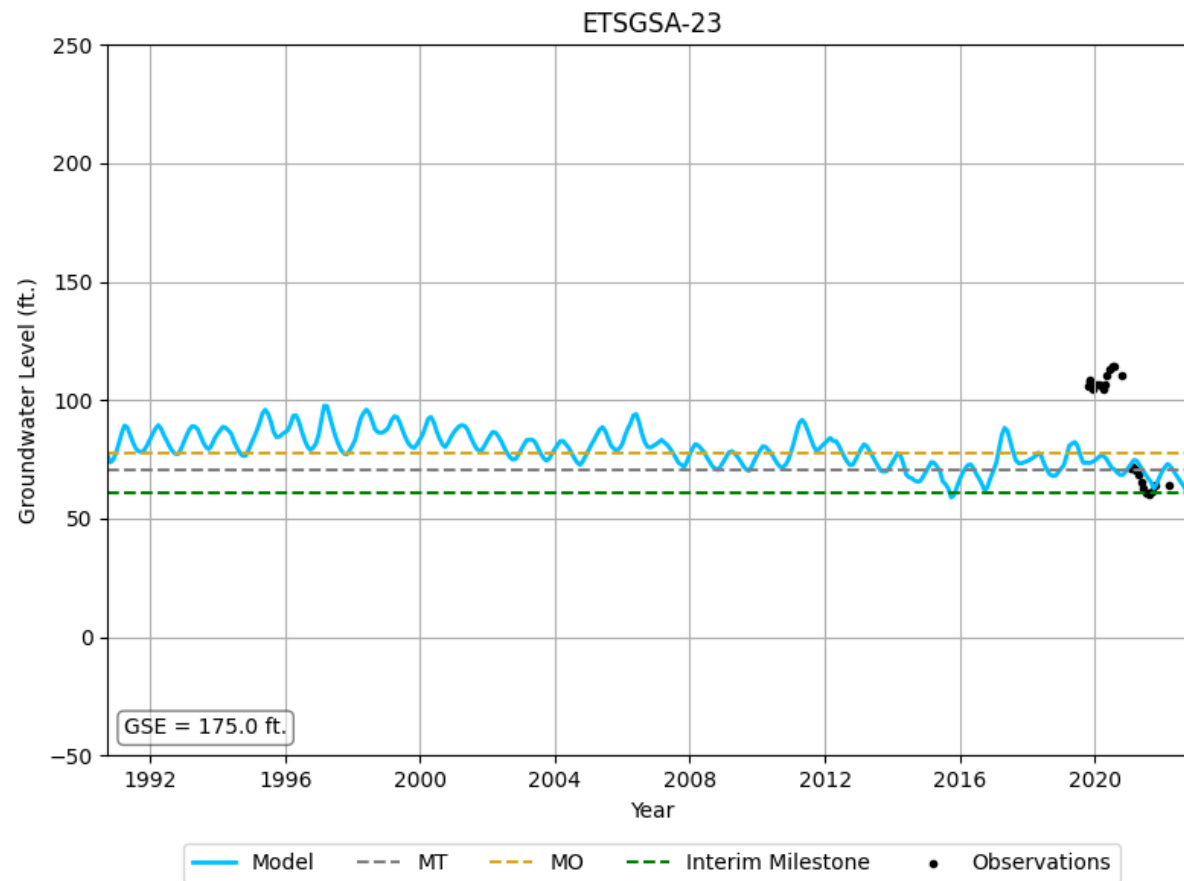


# GROUNDWATER LEVEL HYDROGRAPHS

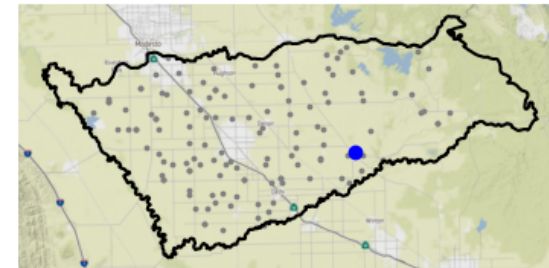
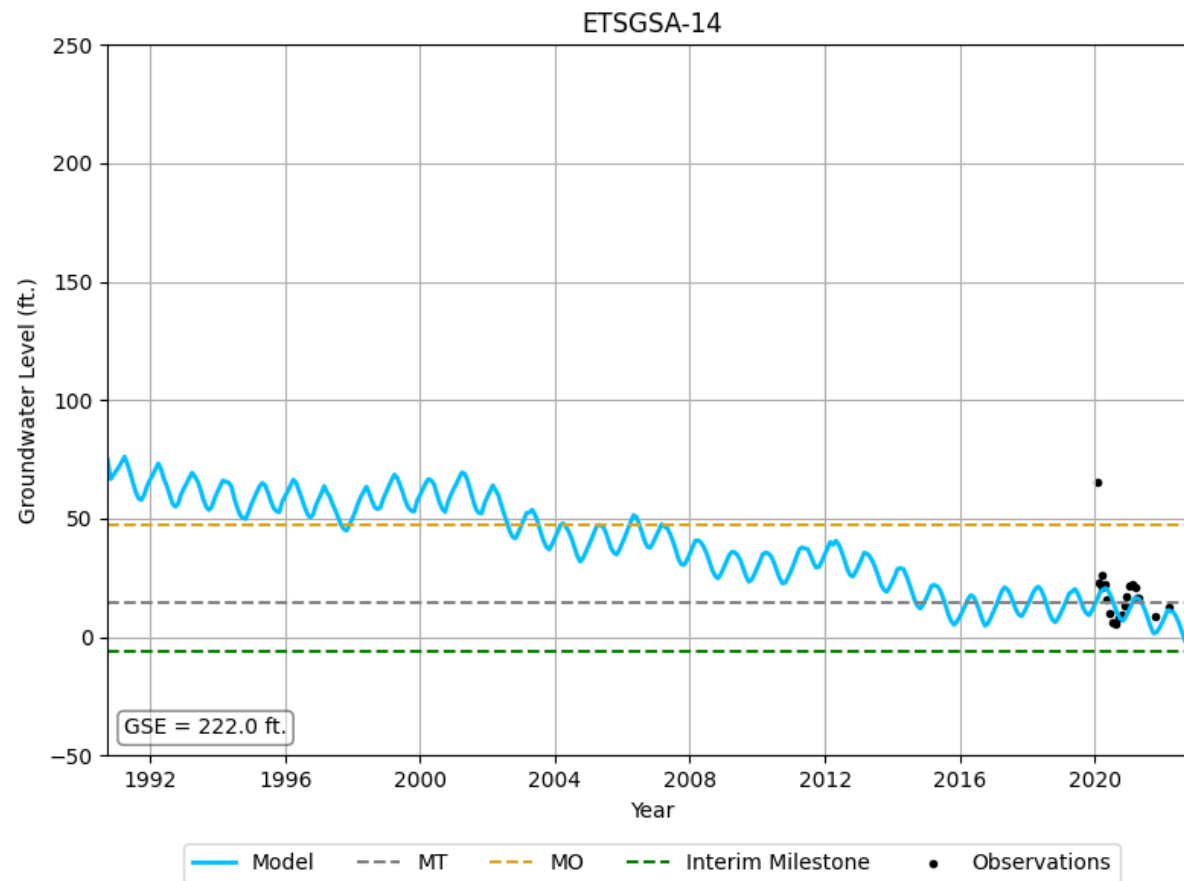




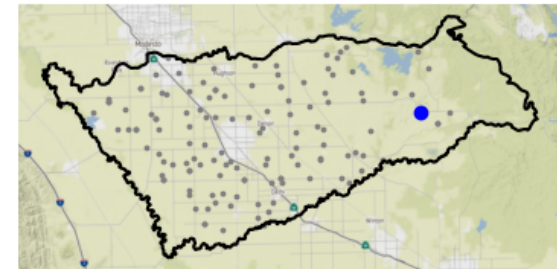
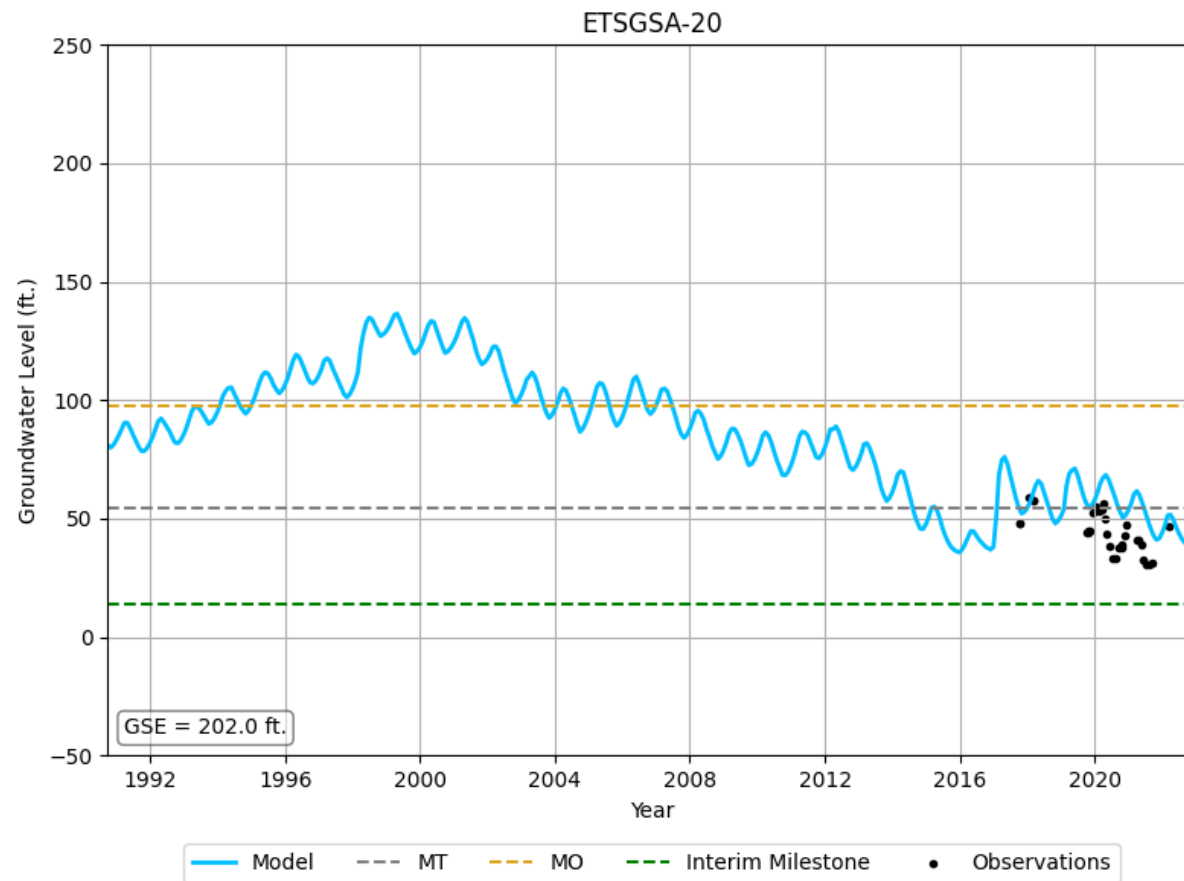
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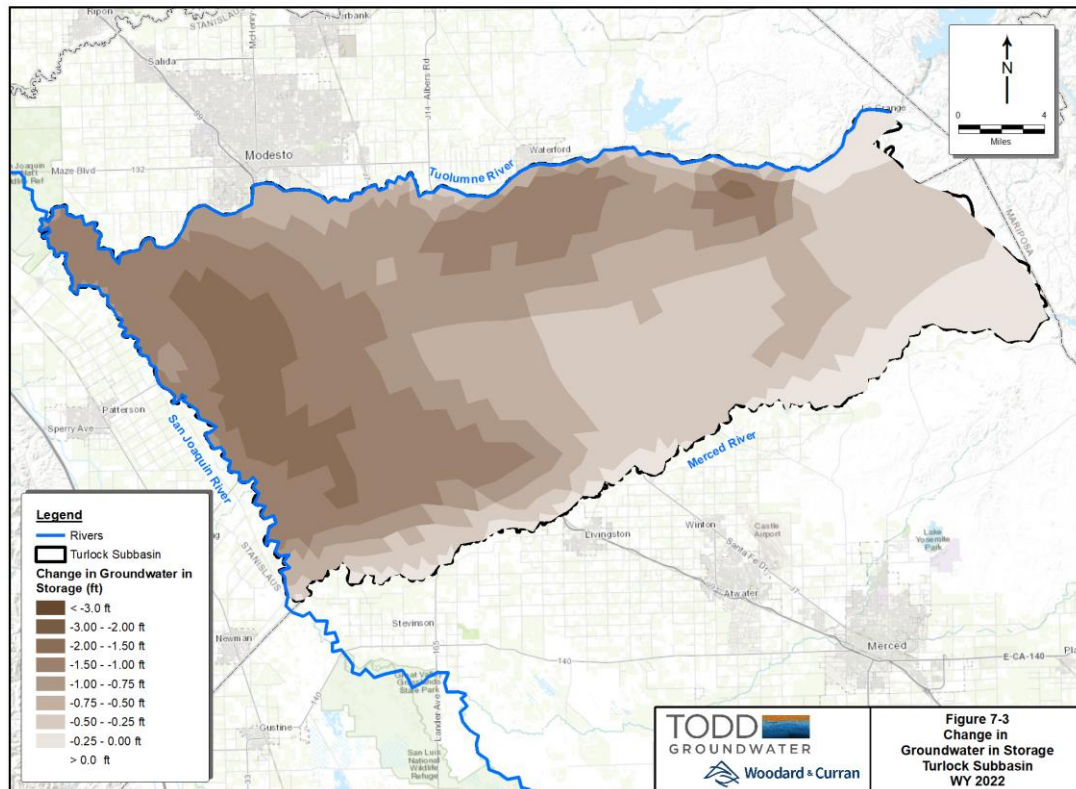


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# MODEL RESULTS

CHANGE IN STORAGE

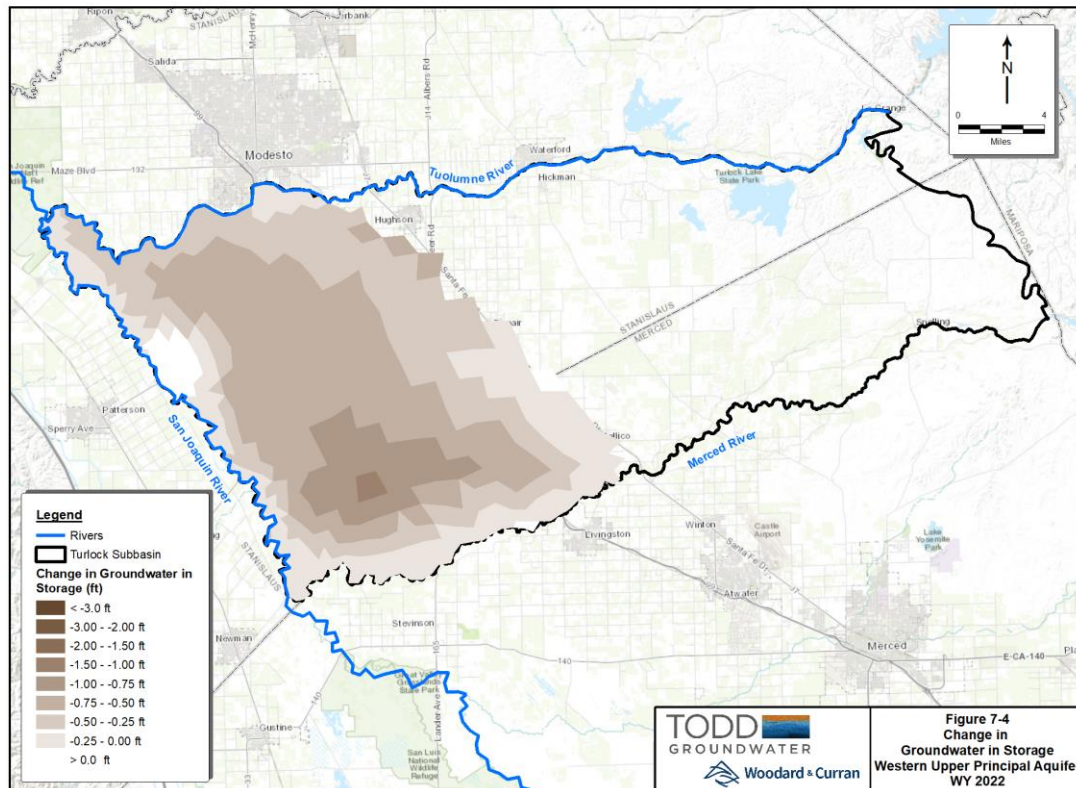
# CHANGE IN STORAGE – SUBBASIN



## Water Year 2022

- Change in Storage (AF)
  - Subbasin -274,600
  - Western Upper -76,100
  - Western Lower -102,400
  - Eastern -96,100
- Change in Storage (ft)
  - Subbasin -0.8
  - Western Upper -0.4
  - Western Lower -0.6
  - Eastern -0.5

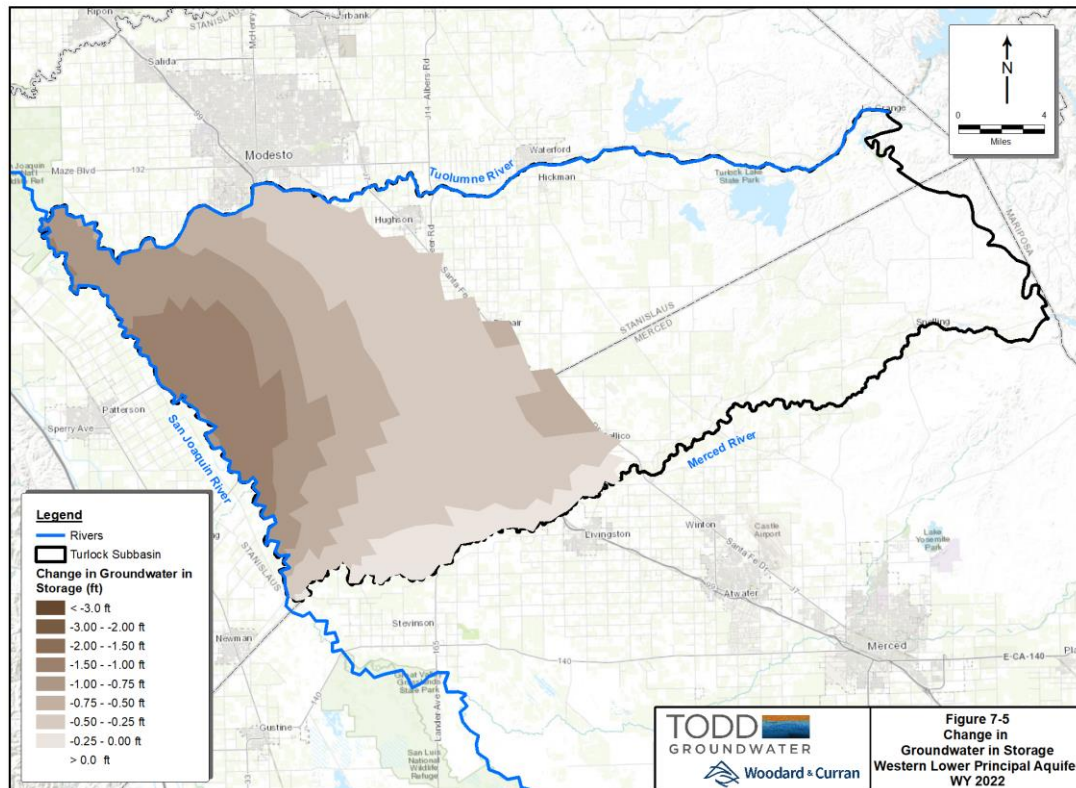
# CHANGE IN STORAGE – UPPER WESTERN PRINCIPAL AQUIFER



## Water Year 2022

- Change in Storage (AF)
  - Subbasin -274,600
  - Western Upper -76,100
  - Western Lower -102,400
  - Eastern -96,100
- Change in Storage (ft)
  - Subbasin -0.8
  - Western Upper -0.4
  - Western Lower -0.6
  - Eastern -0.5

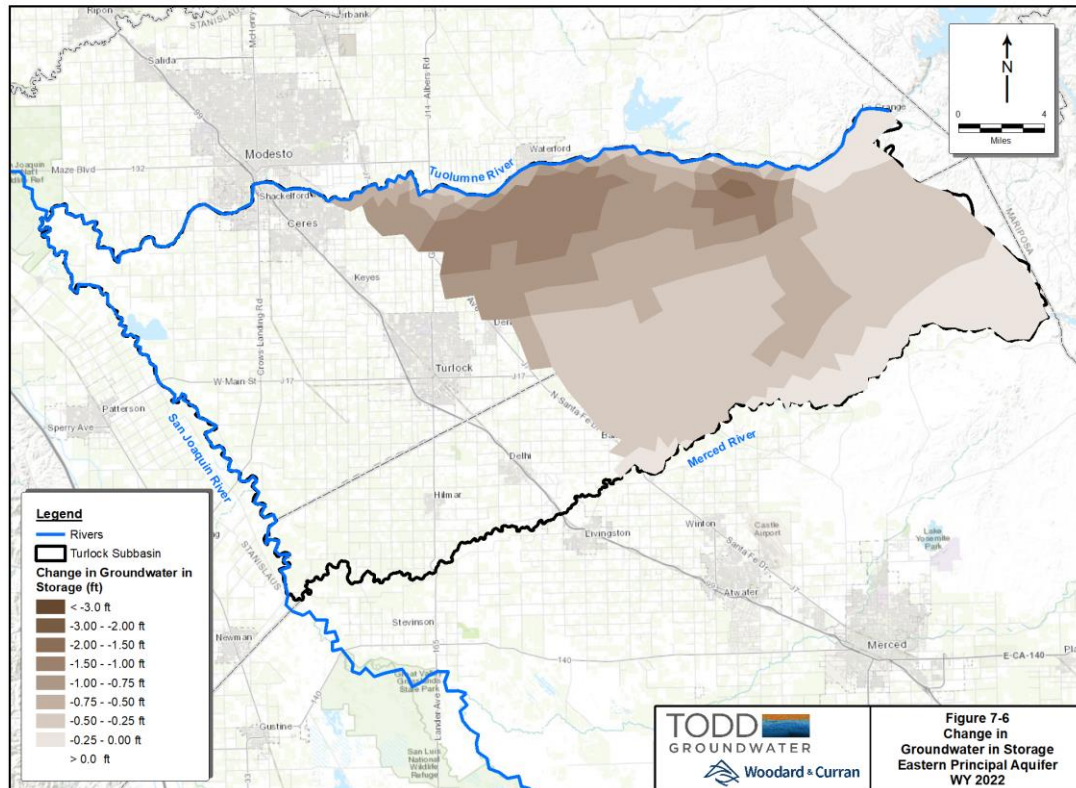
# CHANGE IN STORAGE – LOWER WESTERN PRINCIPAL AQUIFER



## Water Year 2022

- Change in Storage (AF)
  - Subbasin -274,600
  - Western Upper -76,100
  - Western Lower -102,400
  - Eastern -96,100
- Change in Storage (ft)
  - Subbasin -0.8
  - Western Upper -0.4
  - Western Lower -0.6
  - Eastern -0.5

# CHANGE IN STORAGE – EASTERN PRINCIPAL AQUIFER



## Water Year 2022

- Change in Storage (AF)
  - Subbasin -274,600
  - Western Upper -76,100
  - Western Lower -102,400
  - Eastern -96,100
- Change in Storage (ft)
  - Subbasin -0.8
  - Western Upper -0.4
  - Western Lower -0.6
  - Eastern -0.5



# SPRING 2022 MONITORING EVENT

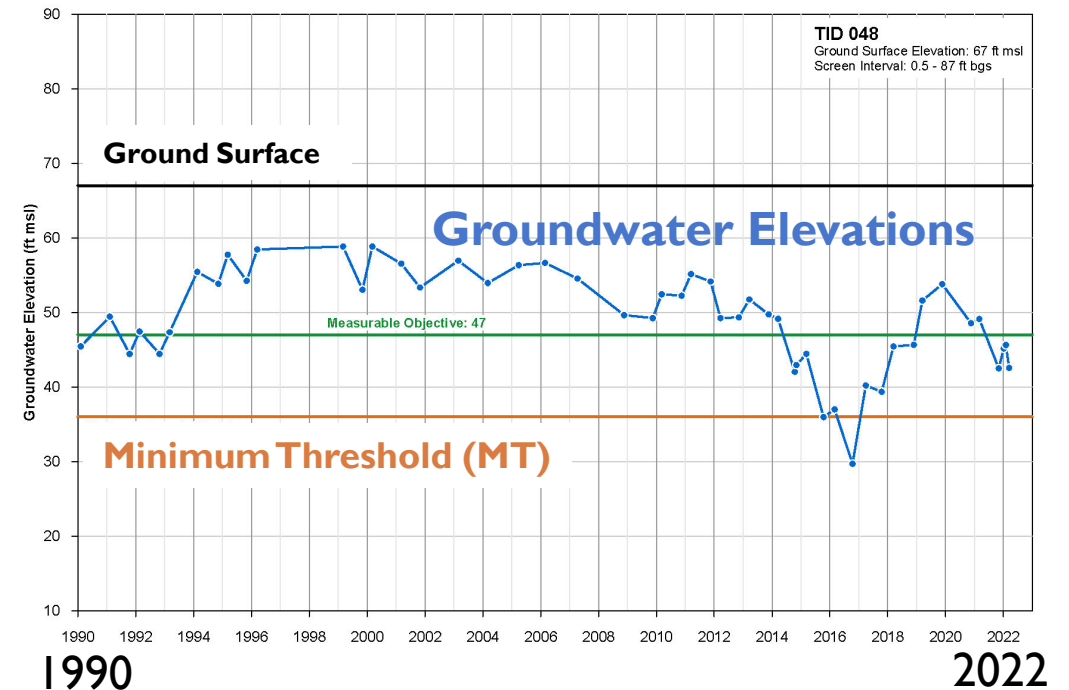
- First GSP monitoring event
- Most water levels measured in March 2022
- Measured elevations in 46 representative monitoring wells (RMWs)
- No measurement in 2 RMWs:
  - USGS Blum 3-1: GSAs working with USGS on access
  - ETSGSA-12: well casing collapsed, ETSGSA searching for replacement
- Updated hydrographs for the RMWs



*Representative Monitoring Well (RMW) MW-68B*

# SPRING 2022 – MINIMUM THRESHOLDS (MTs)

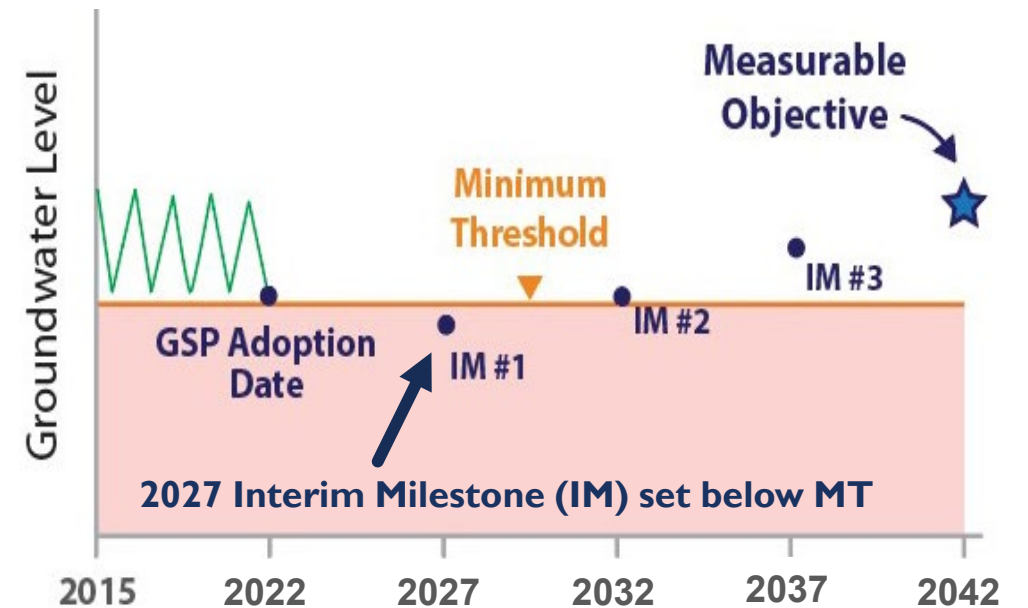
- **Chronic Lowering of Water Levels**
  - Above MT: 16 wells
  - Below MT: 19 wells
  - Not measured: 2 wells (Blum 3-1, ETSGSA-12)
  - Without MT: 7 wells (Prop 68)
- **Interconnected Surface Water**
  - Above MT: 5 wells
  - Below MT: 6 wells



# INTERIM MILESTONES (IMs)

- MT exceedances were anticipated
  - Water levels declining in most RMW wells
  - Drought conditions have persisted into 2022
- Projects and MAs will take time to stabilize water levels and support recovery to MTs
- Wells with significant declining trends were expected to continue to decline to 2027, IMs assigned below the MTs

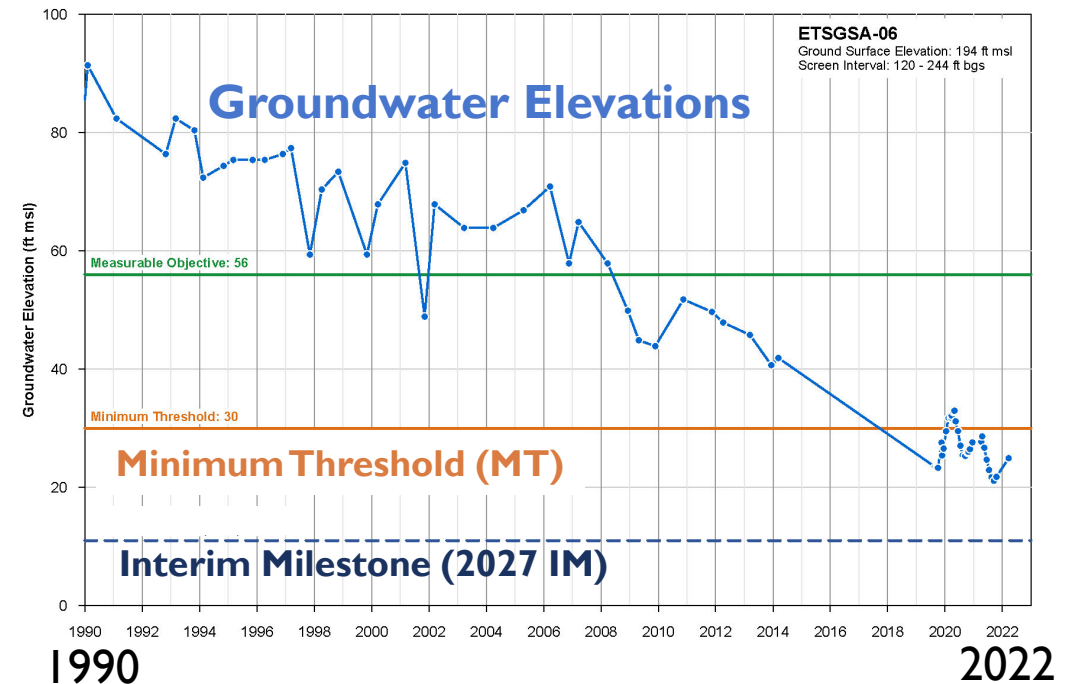
SGMA allows GSAs to define *Interim Milestones* as a “glide path” to sustainable management



*DRAFT*

# SPRING 2022 – IM EXCEEDANCE SUMMARY

- **Chronic Lowering of Water Levels**
  - 19 wells with Interim Milestones (IMs)
  - Only 1 well at or below IM
    - TID-010 Western Upper Principal Aquifer
    - Additional wells within a few feet of IM
- **Interconnected Surface Water**
  - 7 wells with IMs
  - No wells exceeded their IM



# DEFINITION OF UNDESIRABLE RESULTS

## Chronic Lowering of Water Levels



An undesirable result for each principal aquifer will occur when at least 33% of representative monitoring wells exceed the MT for that Principal Aquifer in three (3) consecutive Fall monitoring events.

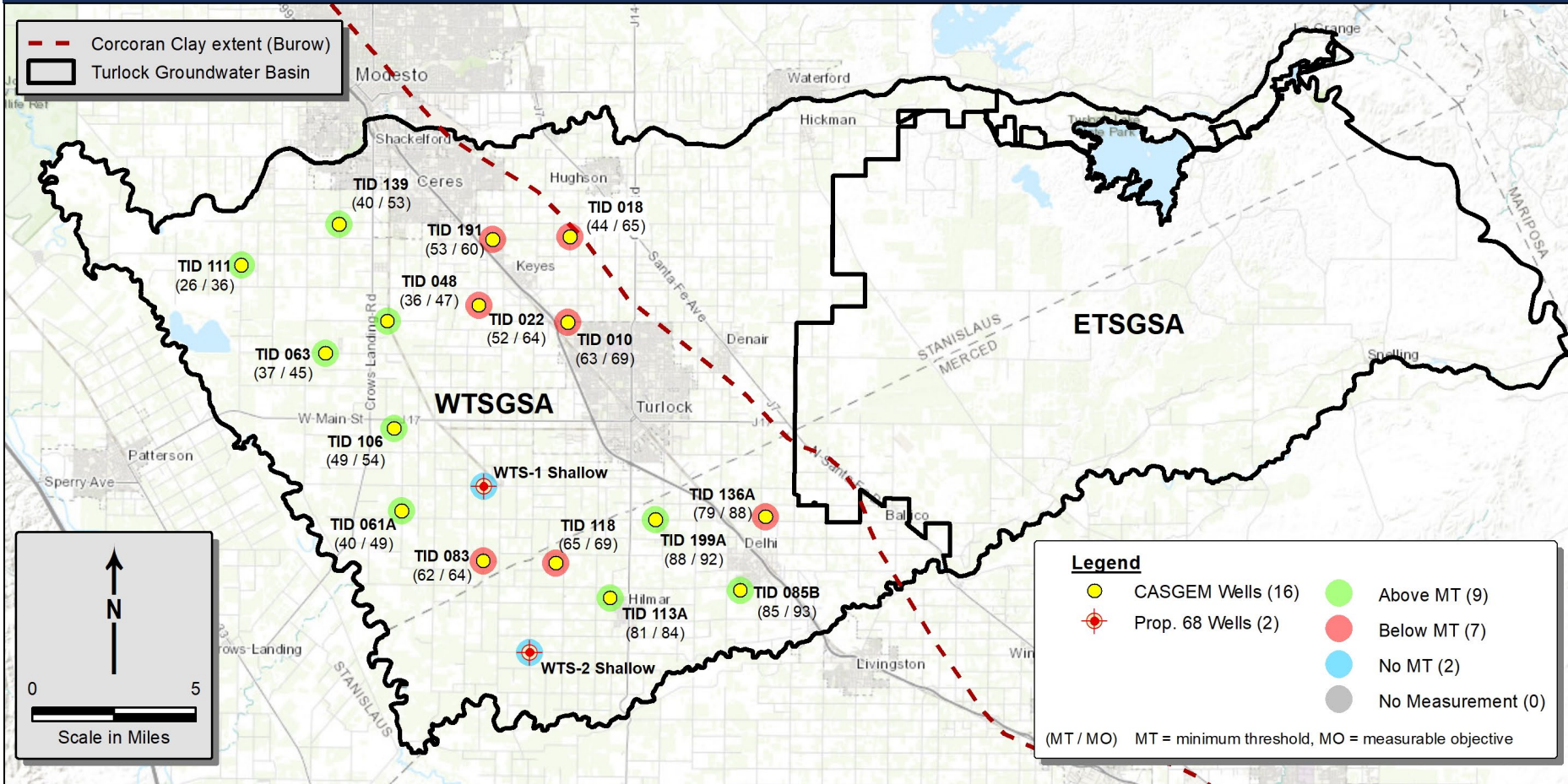
## Interconnected Surface Water



An undesirable result will occur on one of the three monitored rivers when 50% of the representative monitoring sites for that river exceed the MT in two (2) consecutive Fall monitoring events.

# SPRING 2022

## WESTERN UPPER PRINCIPAL AQUIFER

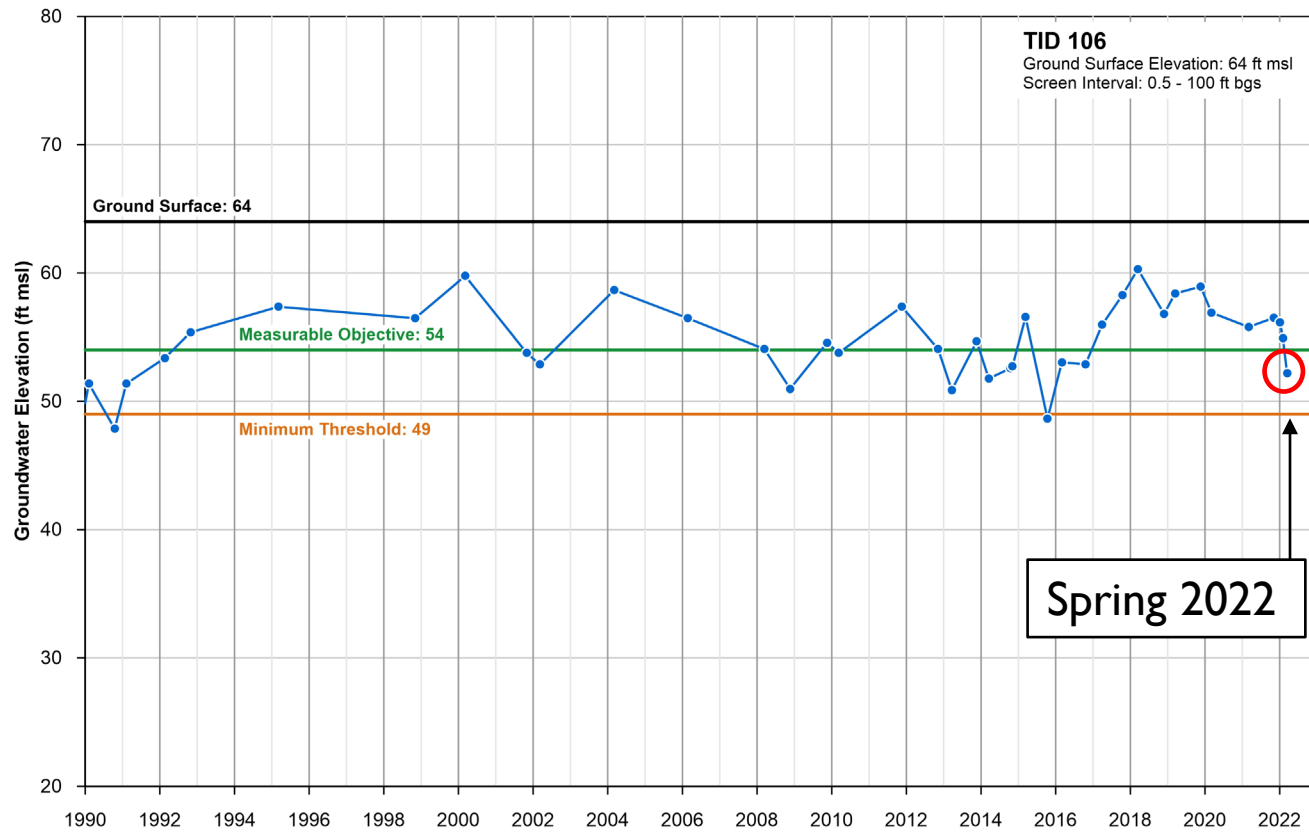


- 44% of RMWs below MT
  - 9 wells > MT
  - 7 wells < MT
- 2 Prop 68 RMWs do not have an MT yet (not enough data)

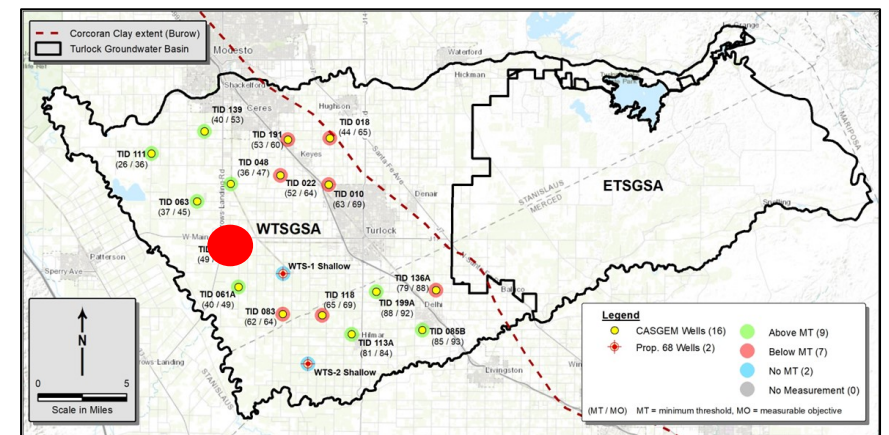
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# HYDROGRAPHS

## WESTERN UPPER PRINCIPAL AQUIFER

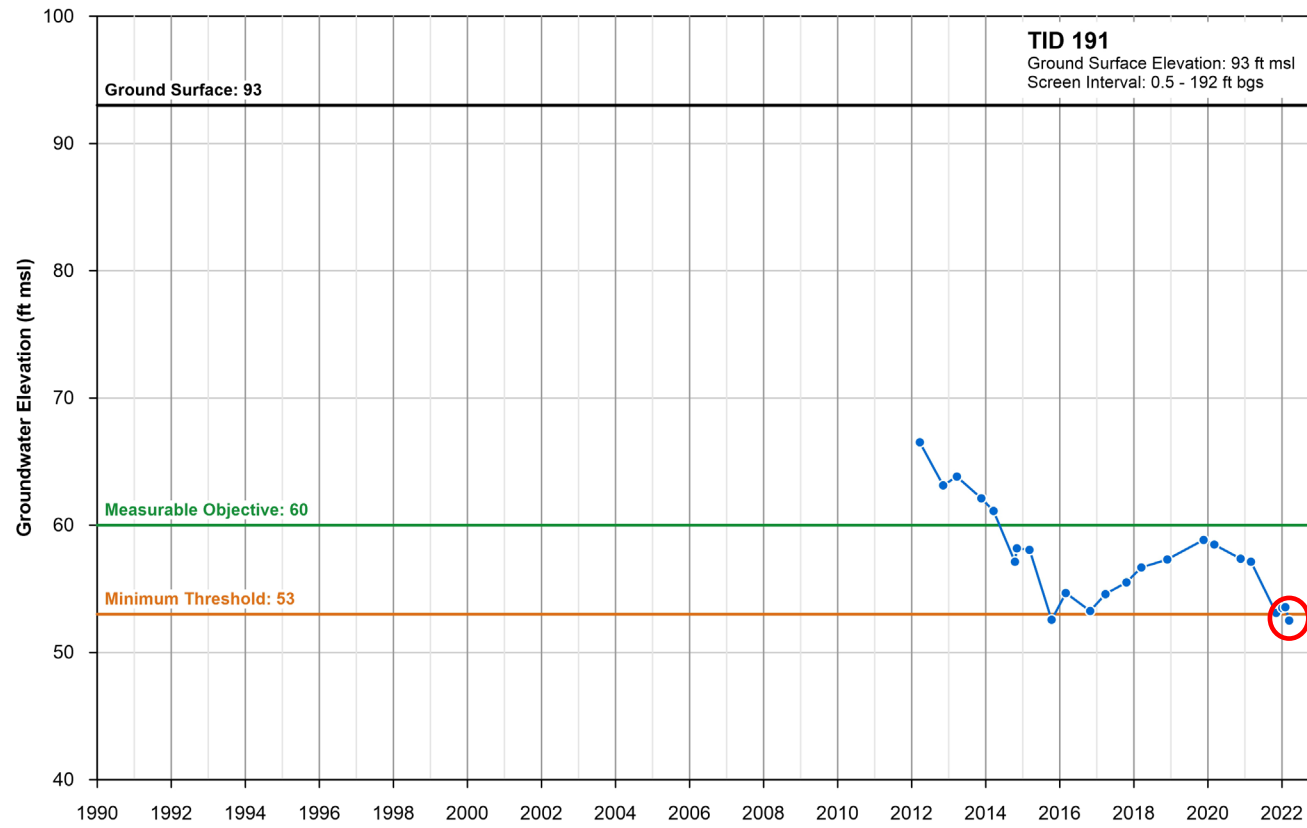


- Spring 2022 water level is above the MT
- Water levels continue to decline since recovery from 2012-2016 drought

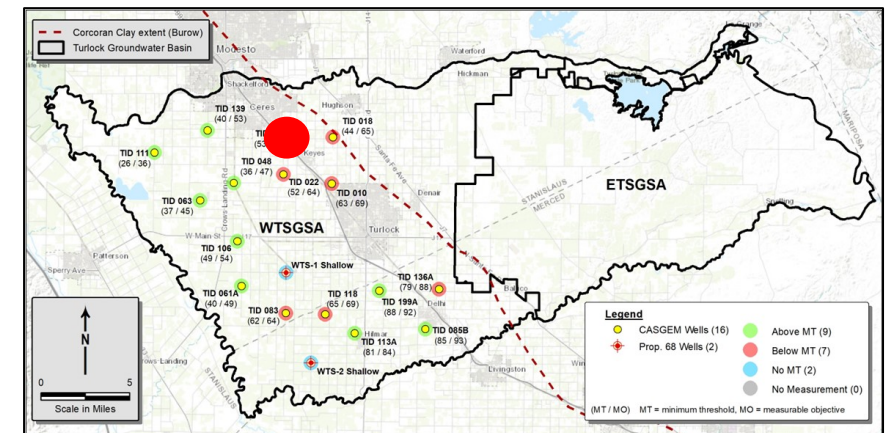


# HYDROGRAPHS

## WESTERN UPPER PRINCIPAL AQUIFER



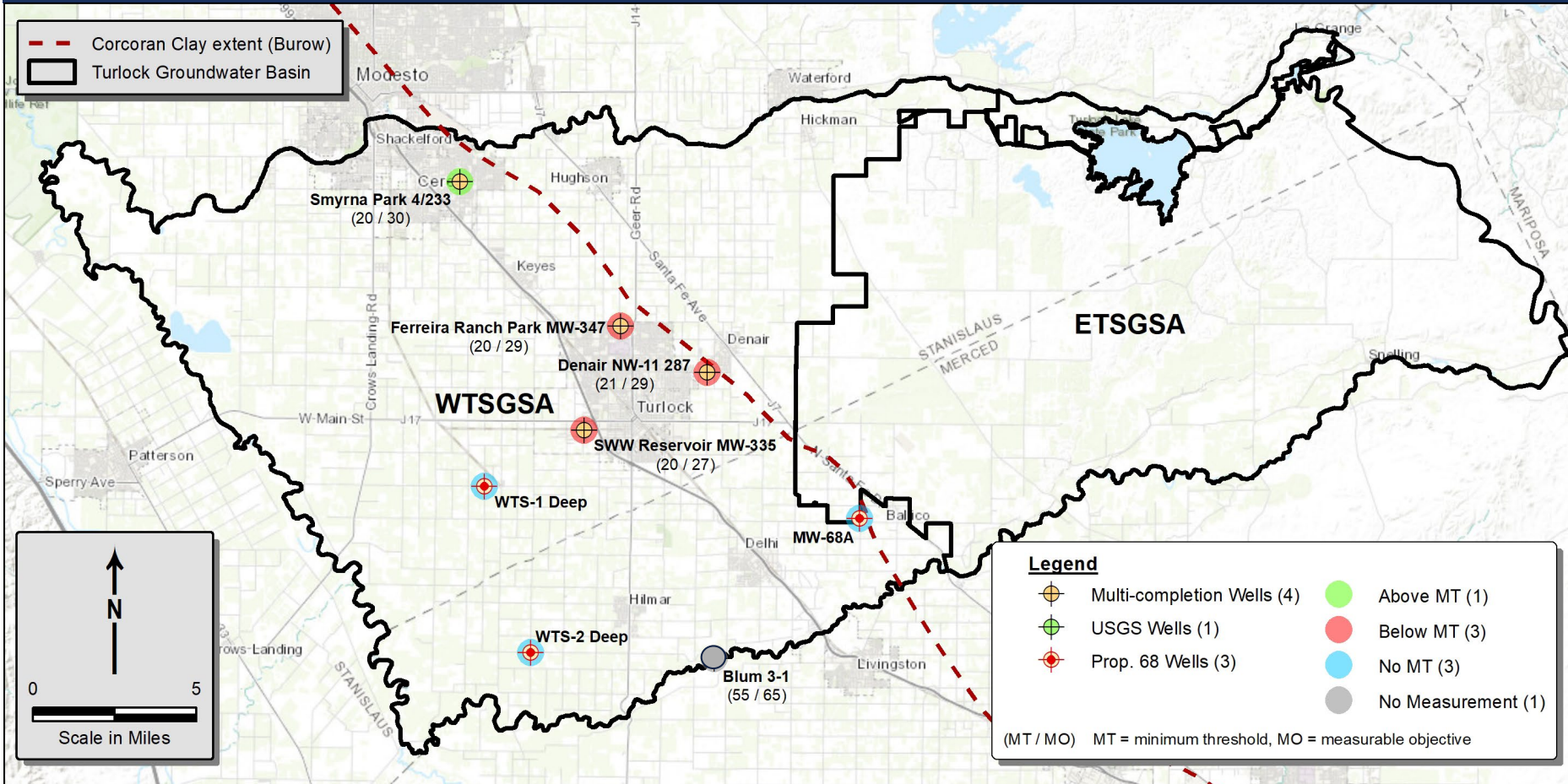
- Spring 2022 water level is below the MT
- Similar pattern throughout the Western Upper Principal Aquifer





# SPRING 2022

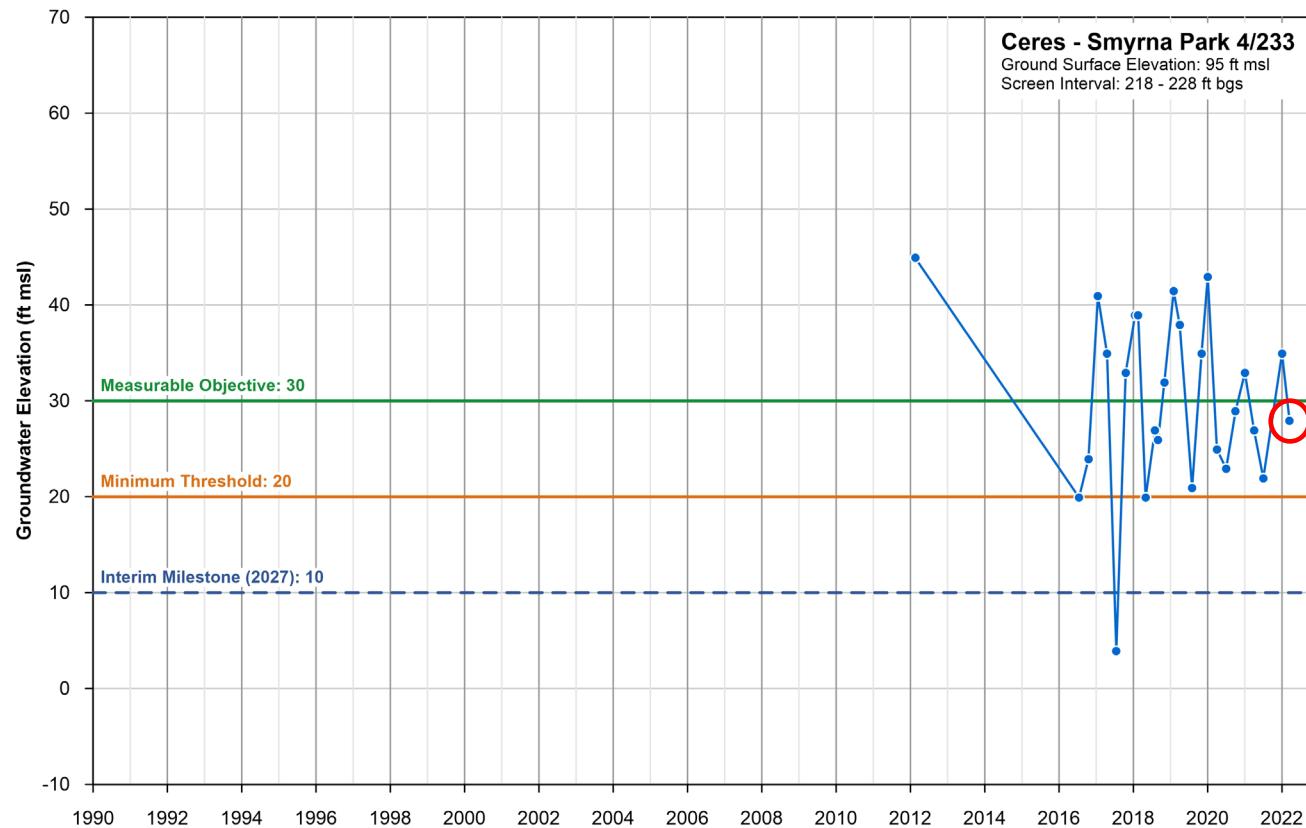
## WESTERN LOWER PRINCIPAL AQUIFER



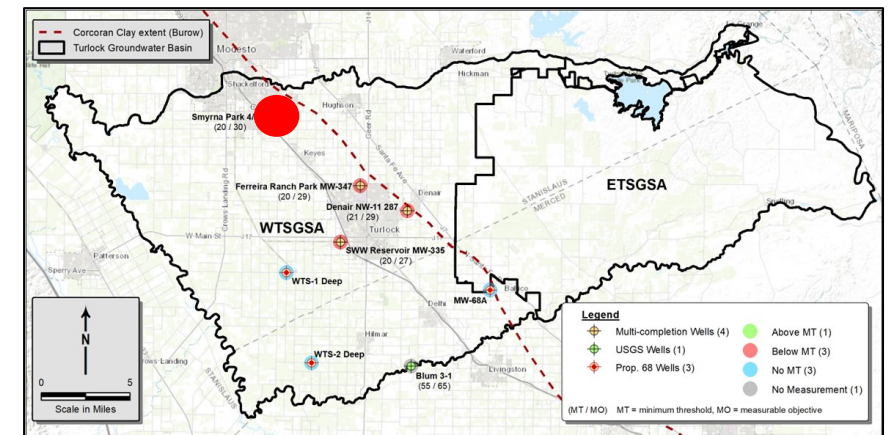
- 75% of RMWs below MT
  - 1 well > MT
  - 3 wells < MT
- 1 well not measured (USGS Blum 3-1)
- 3 wells do not have an MT yet (Prop 68 wells)

# HYDROGRAPHS

## WESTERN LOWER PRINCIPAL AQUIFER

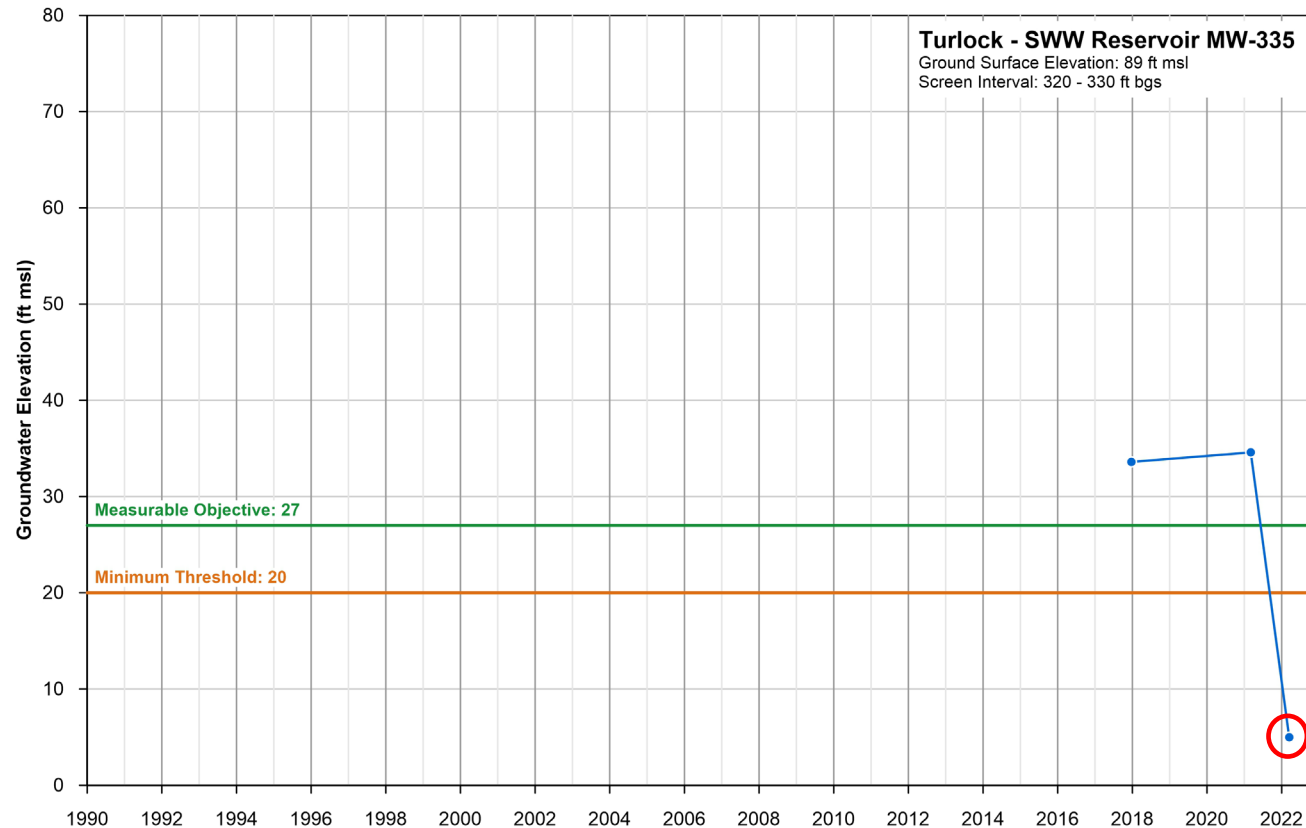


- Spring 2022 water level is above the MT
- Seasonal fluctuations have been fairly consistent over the last few years

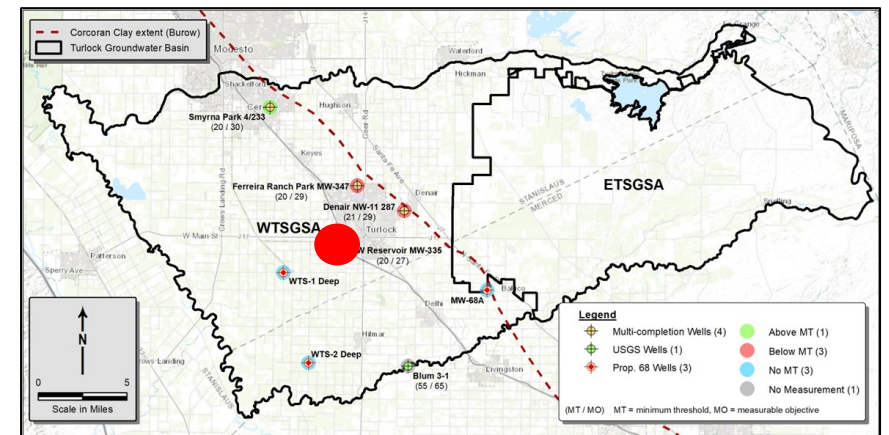


# HYDROGRAPHS

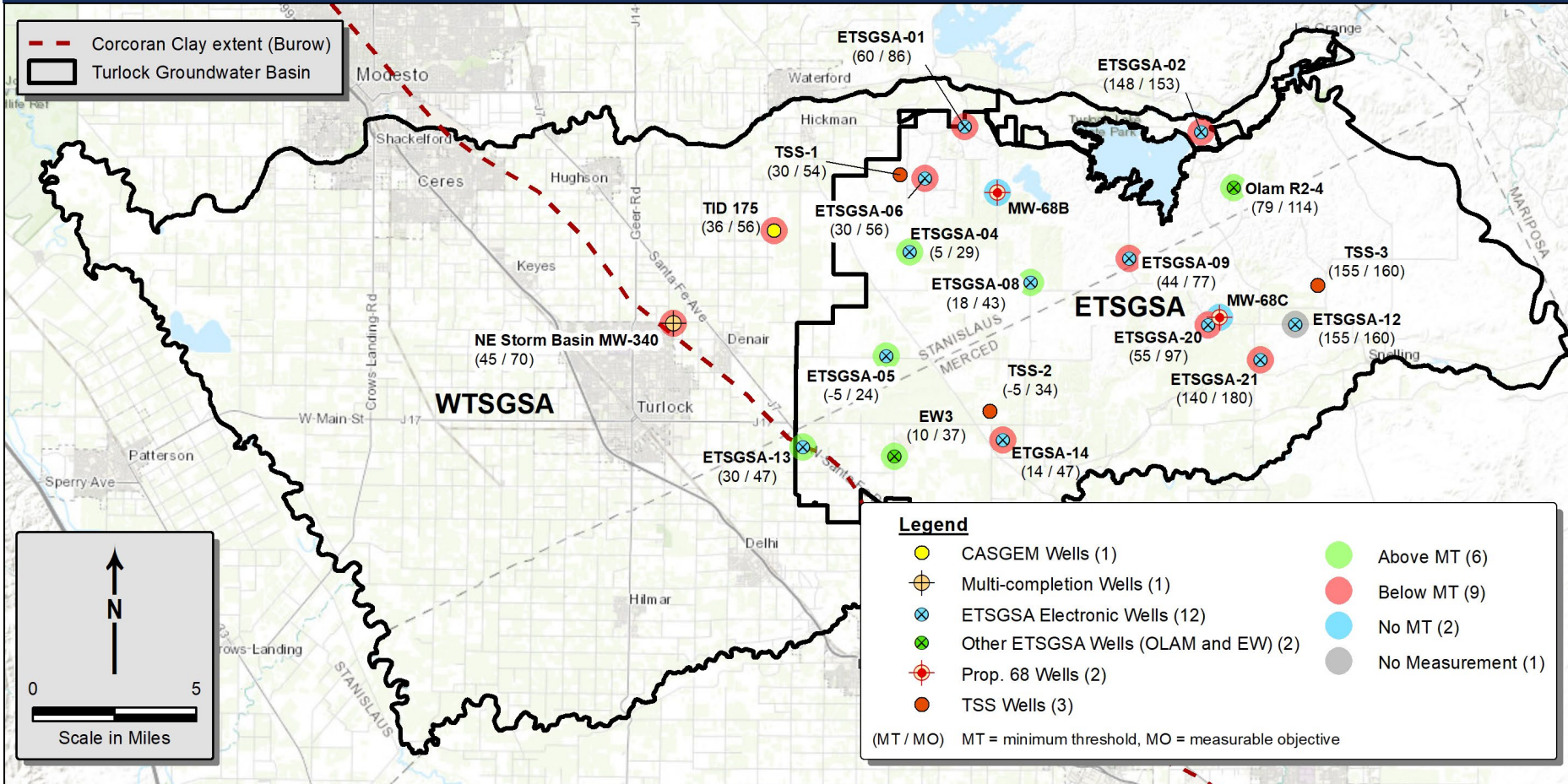
## WESTERN LOWER PRINCIPAL AQUIFER



- Spring 2022 water level is below the MT
- Water level declined ~30 feet within the last year (since Spring 2021)



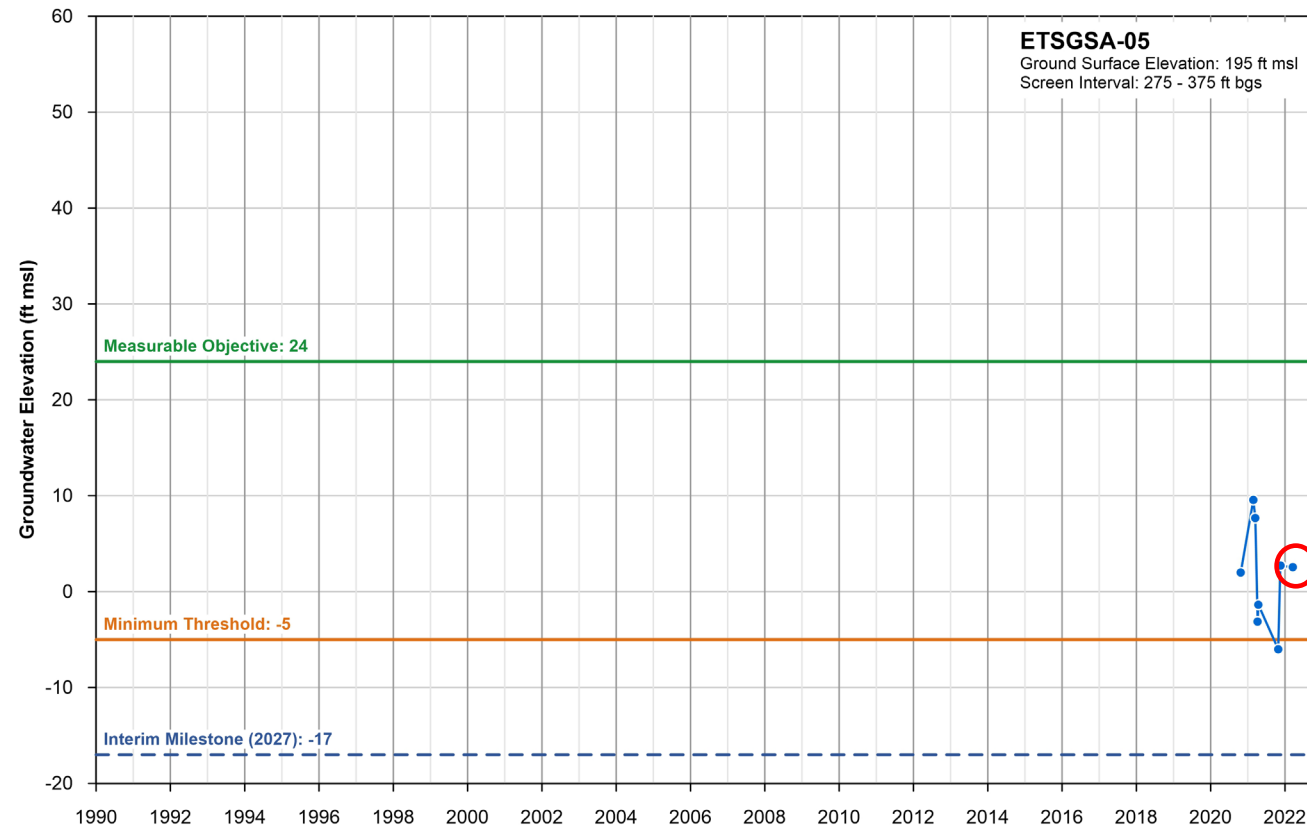
# SPRING 2022 EASTERN PRINCIPAL AQUIFER



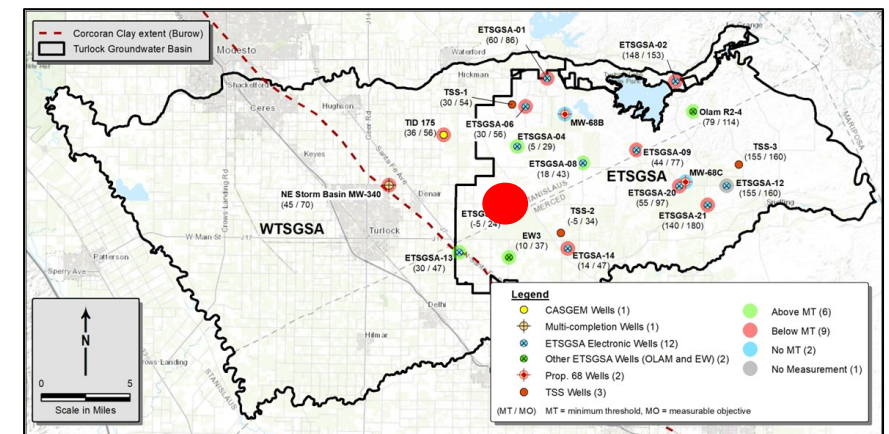
- 60% of RMWs are below MT
  - 6 wells > MT
  - 9 wells < MT
- 1 well not measured (ETSGSA-12)
- 2 wells do not have an MT yet (Prop 68 wells)

# HYDROGRAPHS

## EASTERN PRINCIPAL AQUIFER

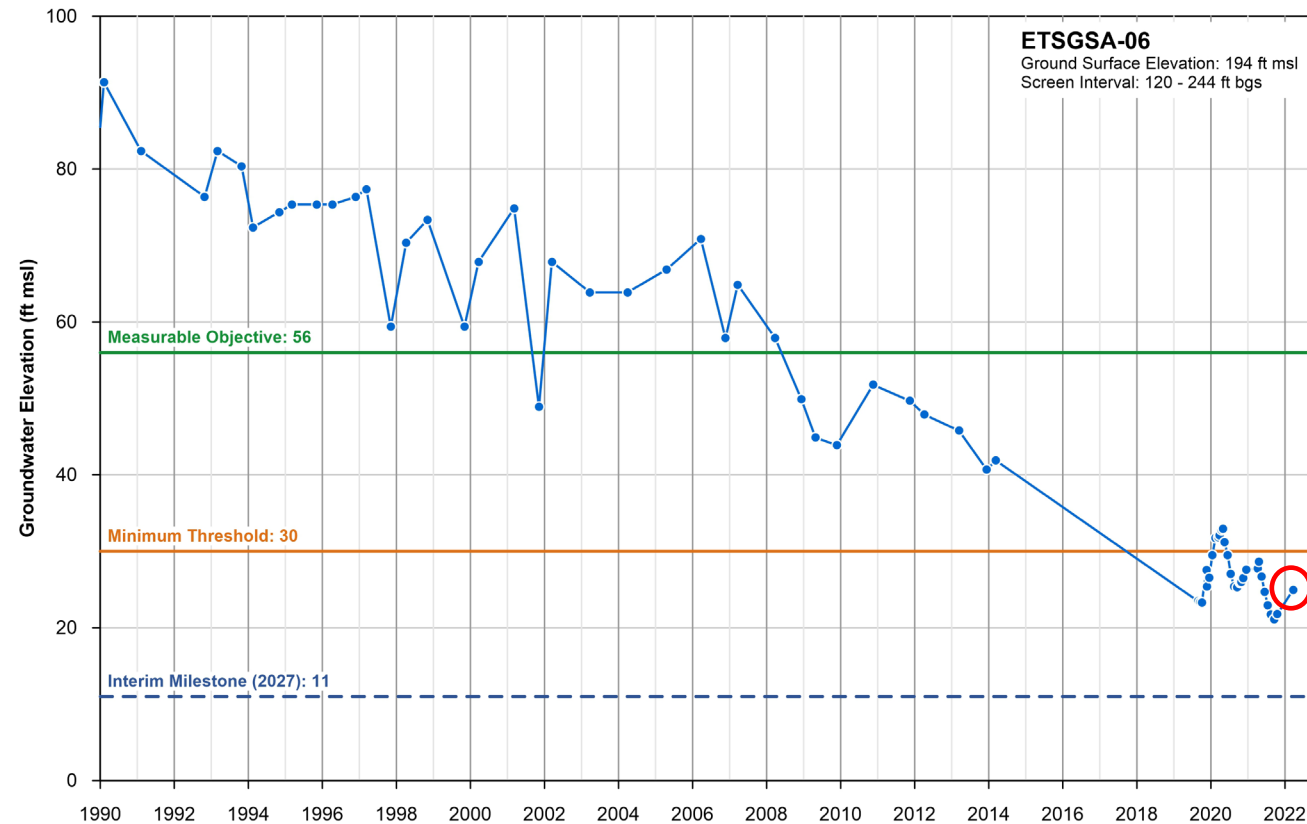


- Water levels measured since October 2020
- Seasonal fluctuations
- Spring 2022 is above the MT

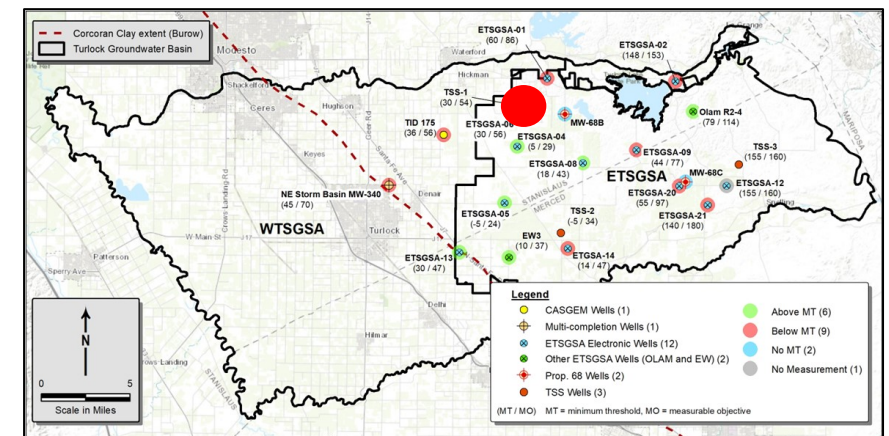


# HYDROGRAPHS

## EASTERN PRINCIPAL AQUIFER

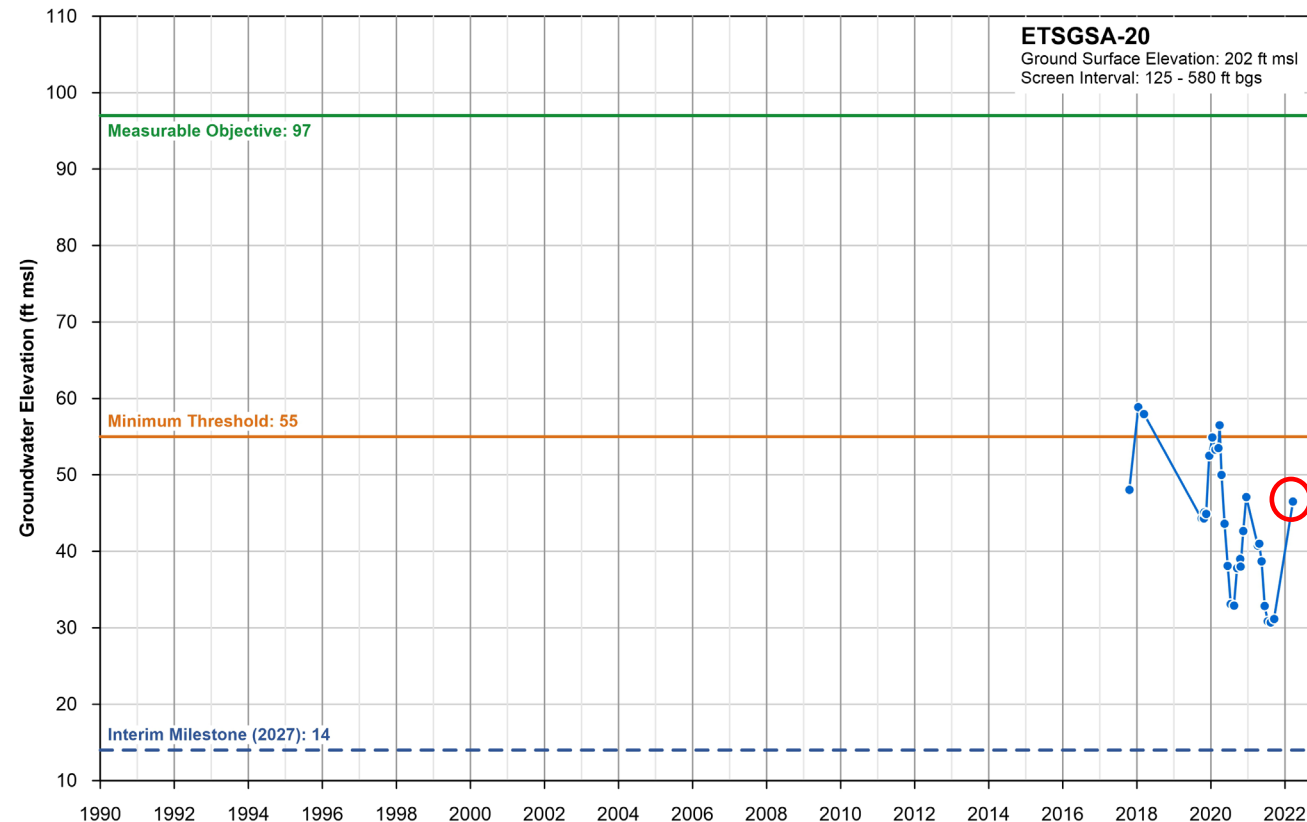


- Long term declining trend
- Seasonal fluctuations apparent in recent years because of frequent measurements
- Below the MT since June 2020

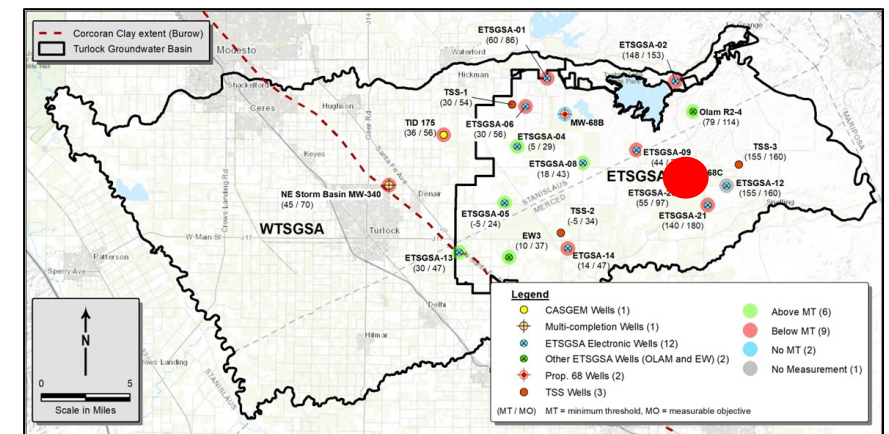


# HYDROGRAPHS

## EASTERN PRINCIPAL AQUIFER

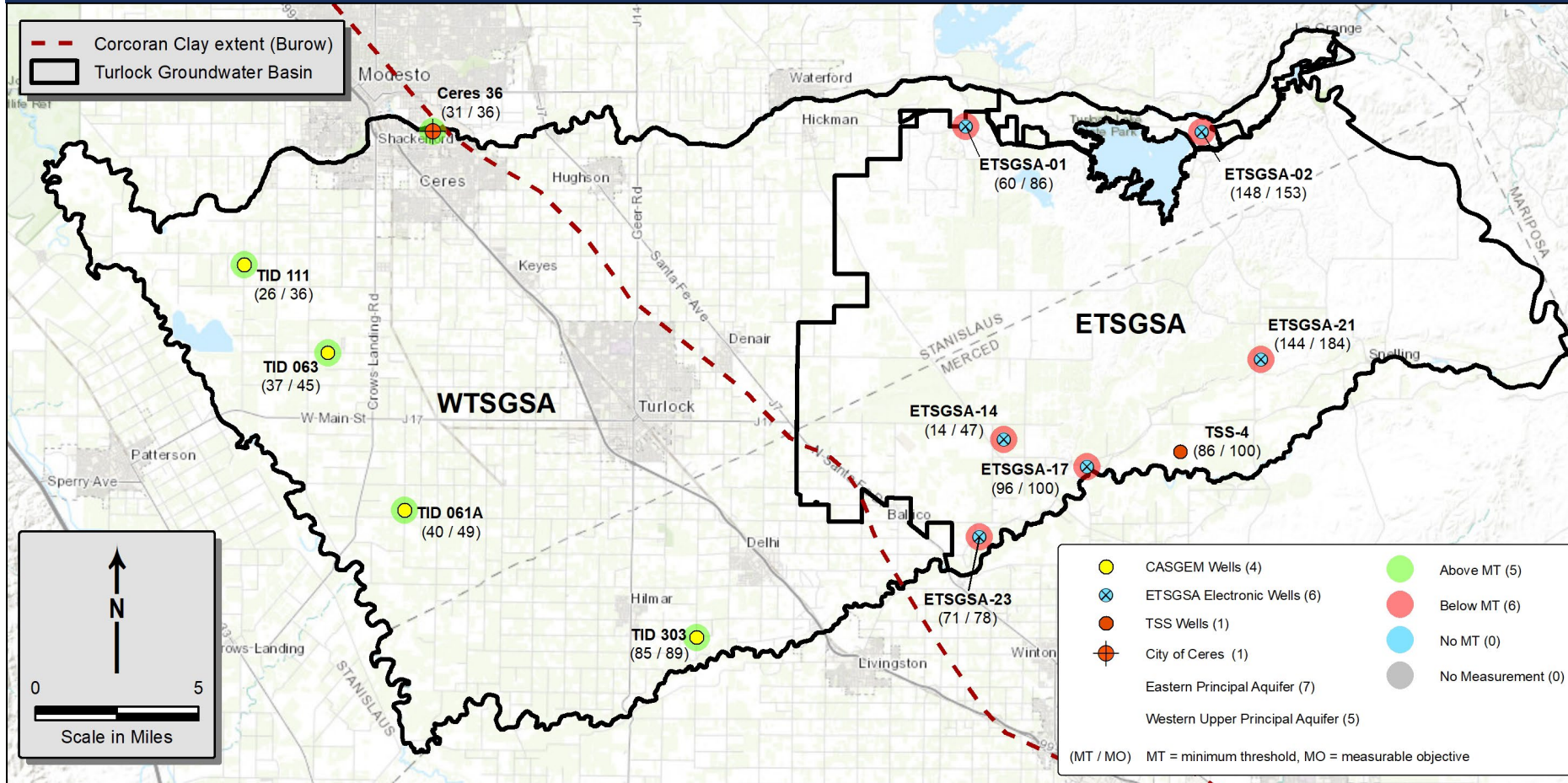


- Water levels measured since October 2017
- Declining trends with seasonal fluctuations
- Below MT since April 2020



# SPRING 2022

# INTERCONNECTED SURFACE WATER



## San Joaquin River

- 0 of 3 below MT (0% exceed MT)

## Tuolumne River

- 2 of 3 below MT (67% exceed MT)

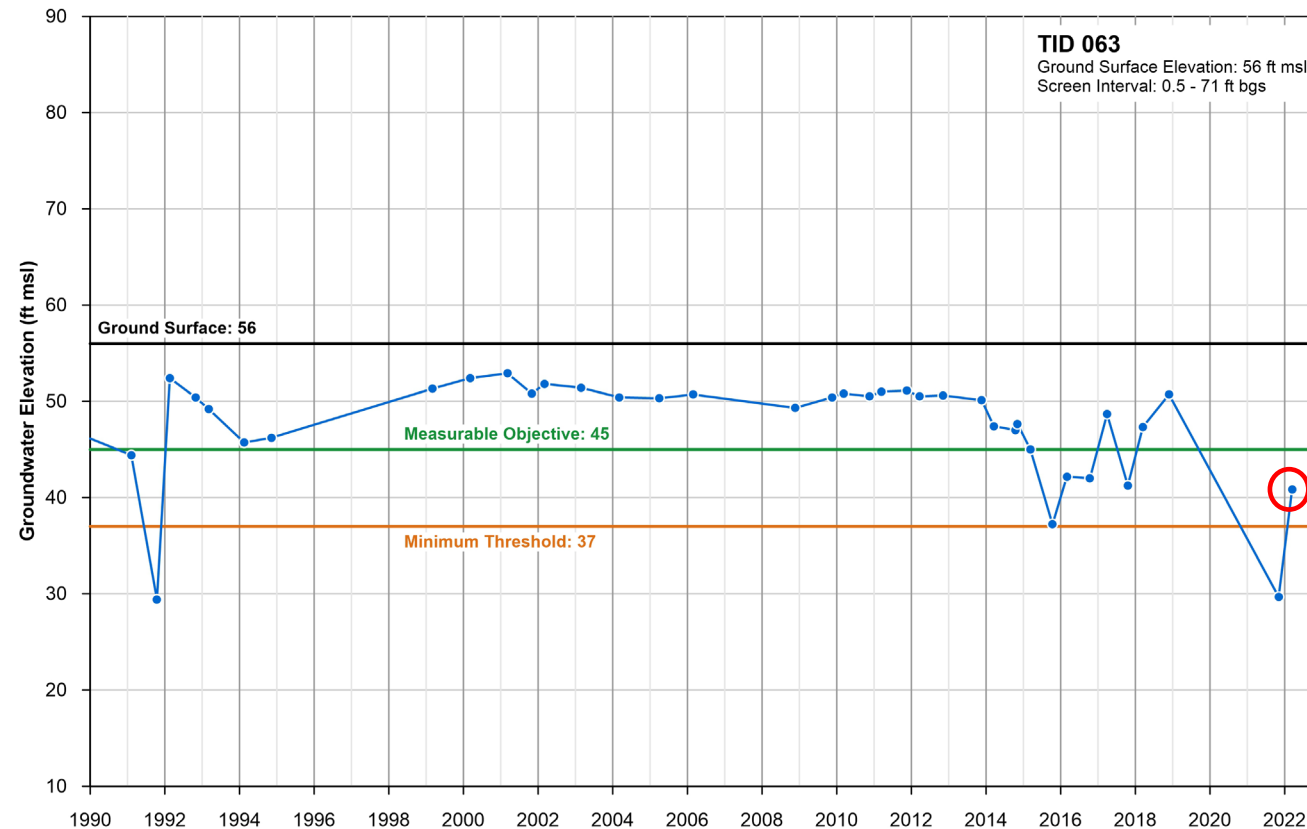
## Merced River

- 4 of 5 below MT (80% exceed MT)

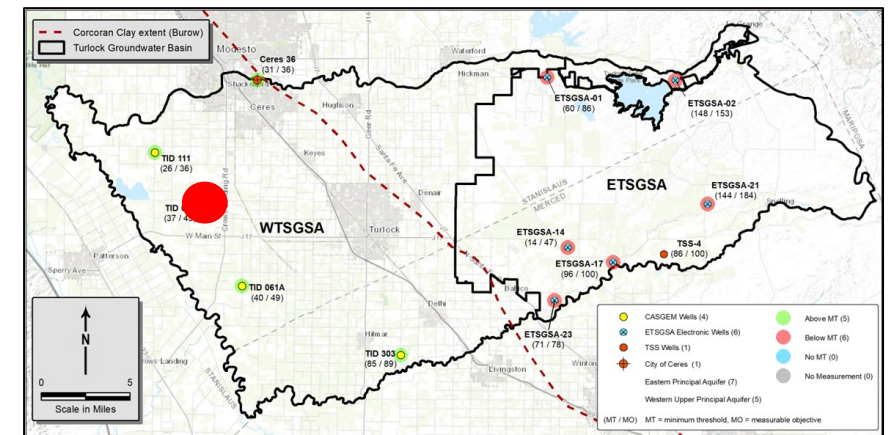


# HYDROGRAPHS

## INTERCONNECTED SURFACE WATER

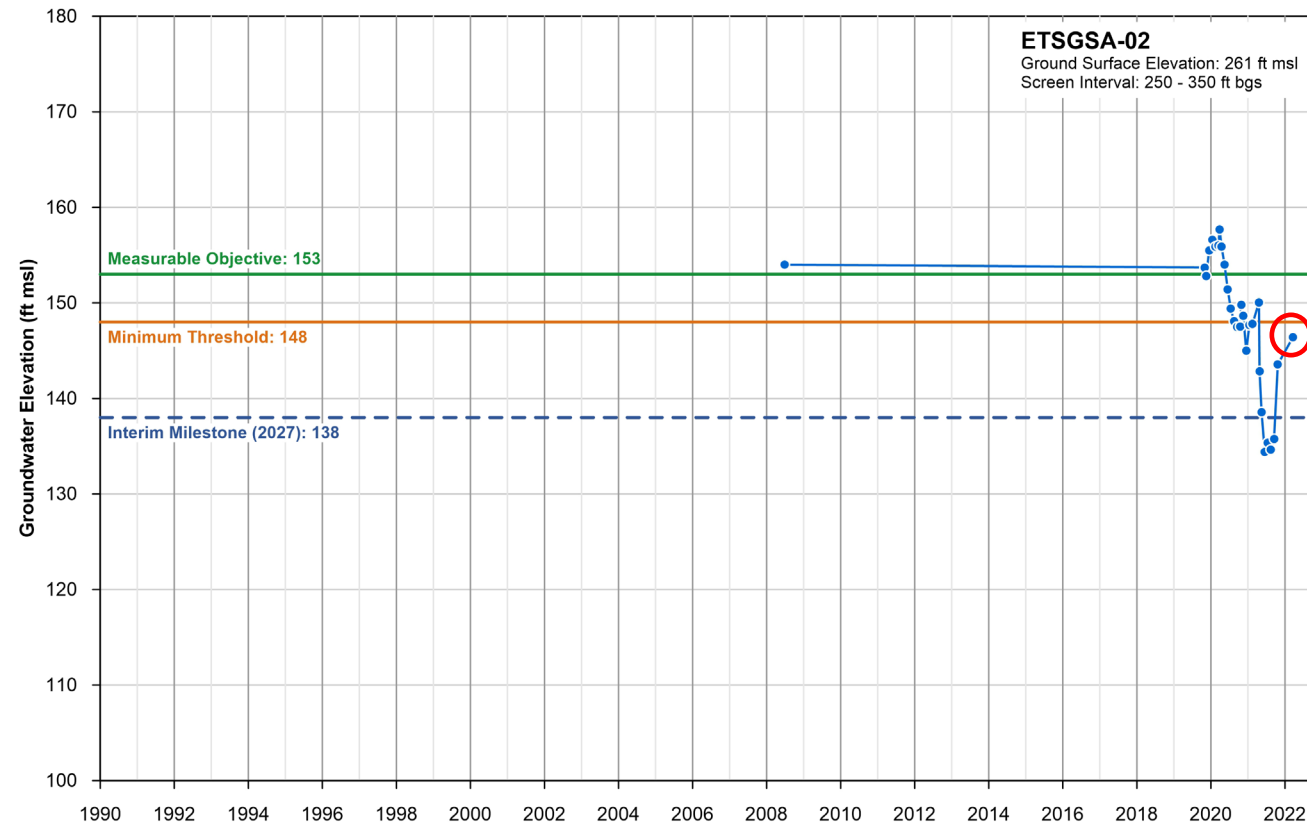


- Spring 2022 water level is above the MT
- Water level recovered ~11 feet since Fall 2021

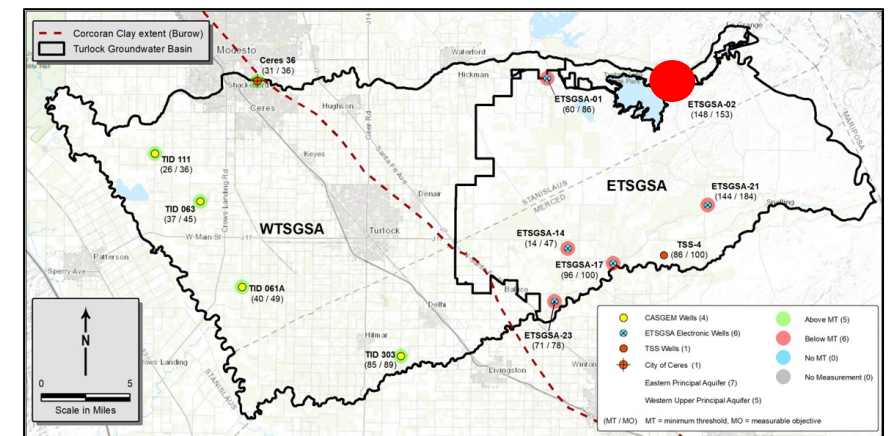


# HYDROGRAPHS

## INTERCONNECTED SURFACE WATER

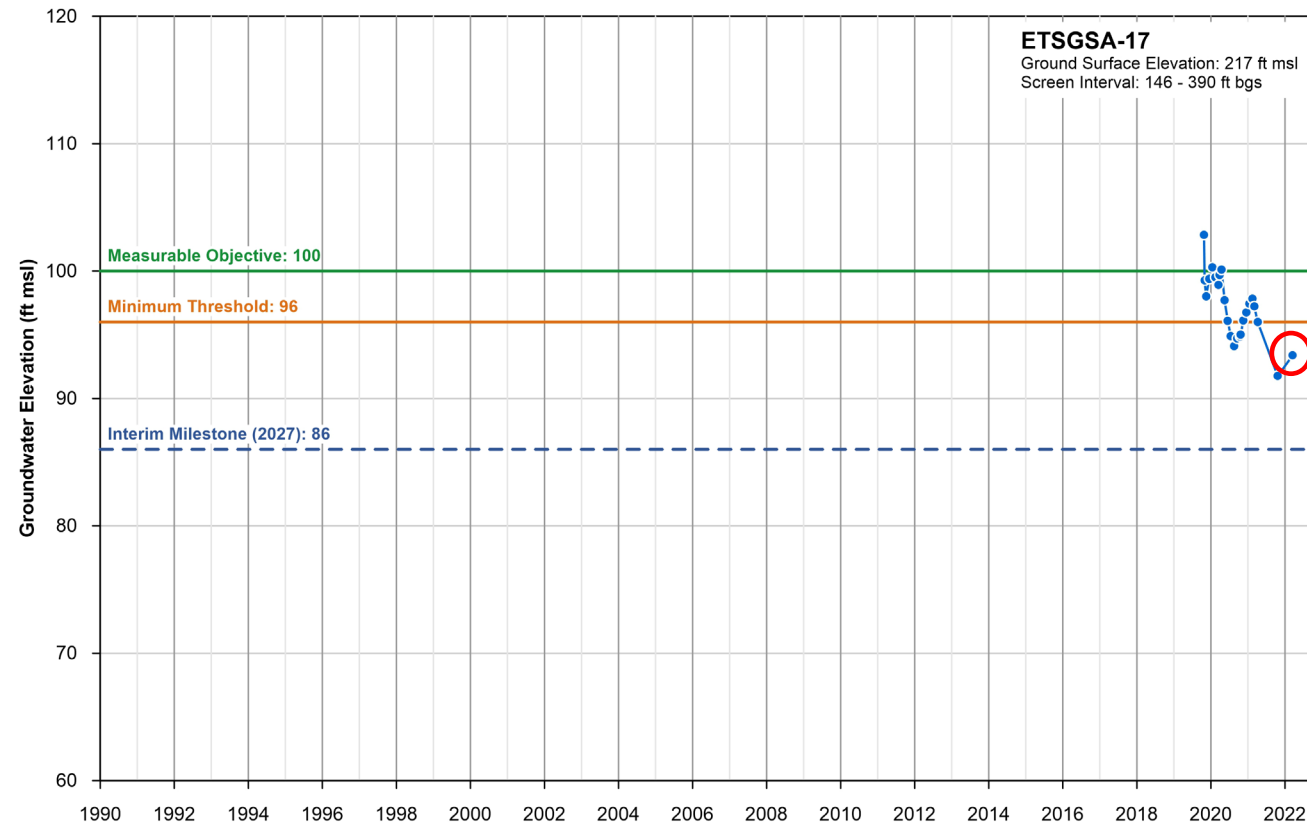


- Water level recovered since June 2021
- Spring 2022 ~2 feet below MT

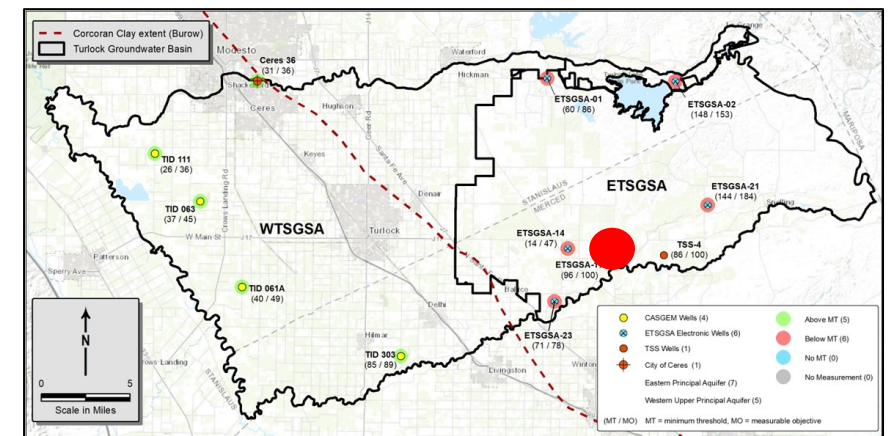


# HYDROGRAPHS

## INTERCONNECTED SURFACE WATER



- Water levels measured since October 2019
- Declining trend with seasonal fluctuations
- Spring 2022 water level is below the MT



# PUTTING THESE RESULTS IN PERSPECTIVE

- Water levels are below the MTs in more than half of the RMWs in Spring 2022 and are continuing to decline in response to ongoing drought conditions
- First monitoring event since the GSP was submitted, projects and management actions will need time to be implemented
- Only one well is possibly at or below IMs, several are within a few feet
- Todd Groundwater is developing an action plan regarding how to respond to exceedances of MTs

Spring 2022 MT exceedances do not count towards triggers for Undesirable Results

- Requires 3 consecutive Fall measurements for Chronic Lowering of GW
- Requires 2 consecutive Fall measurements for Interconnected SW

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# GROUNDWATER ELEVATION CONTOUR MAPS

4 new groundwater elevation contour maps based on data at RMWs and SGMA wells:

## Fall 2021

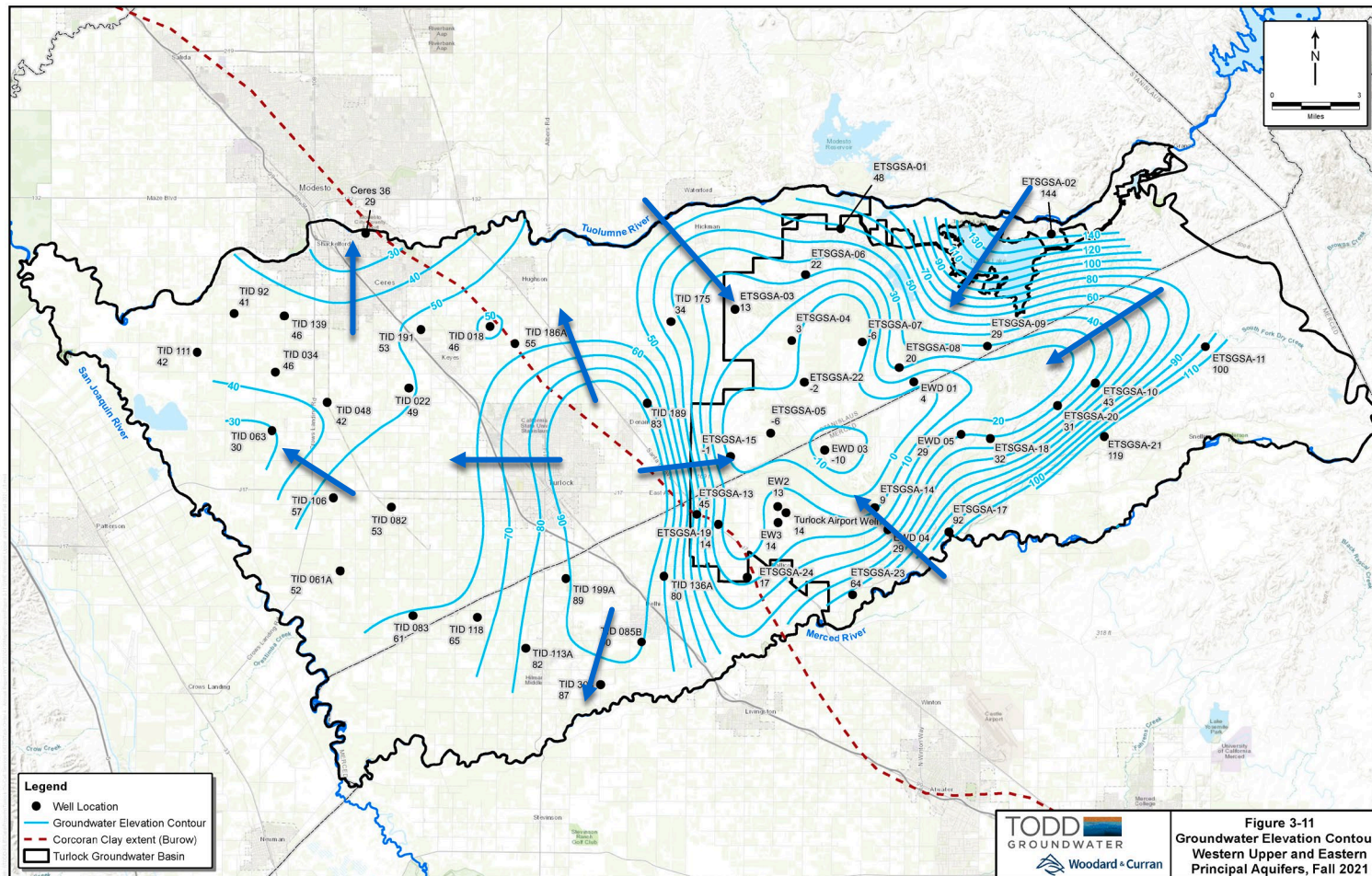
- Western Upper and Eastern Principal Aquifers
- Western Lower Principal Aquifer

## Spring 2022

- Western Upper and Eastern Principal Aquifers
- Western Lower Principal Aquifer

# FALL 2021

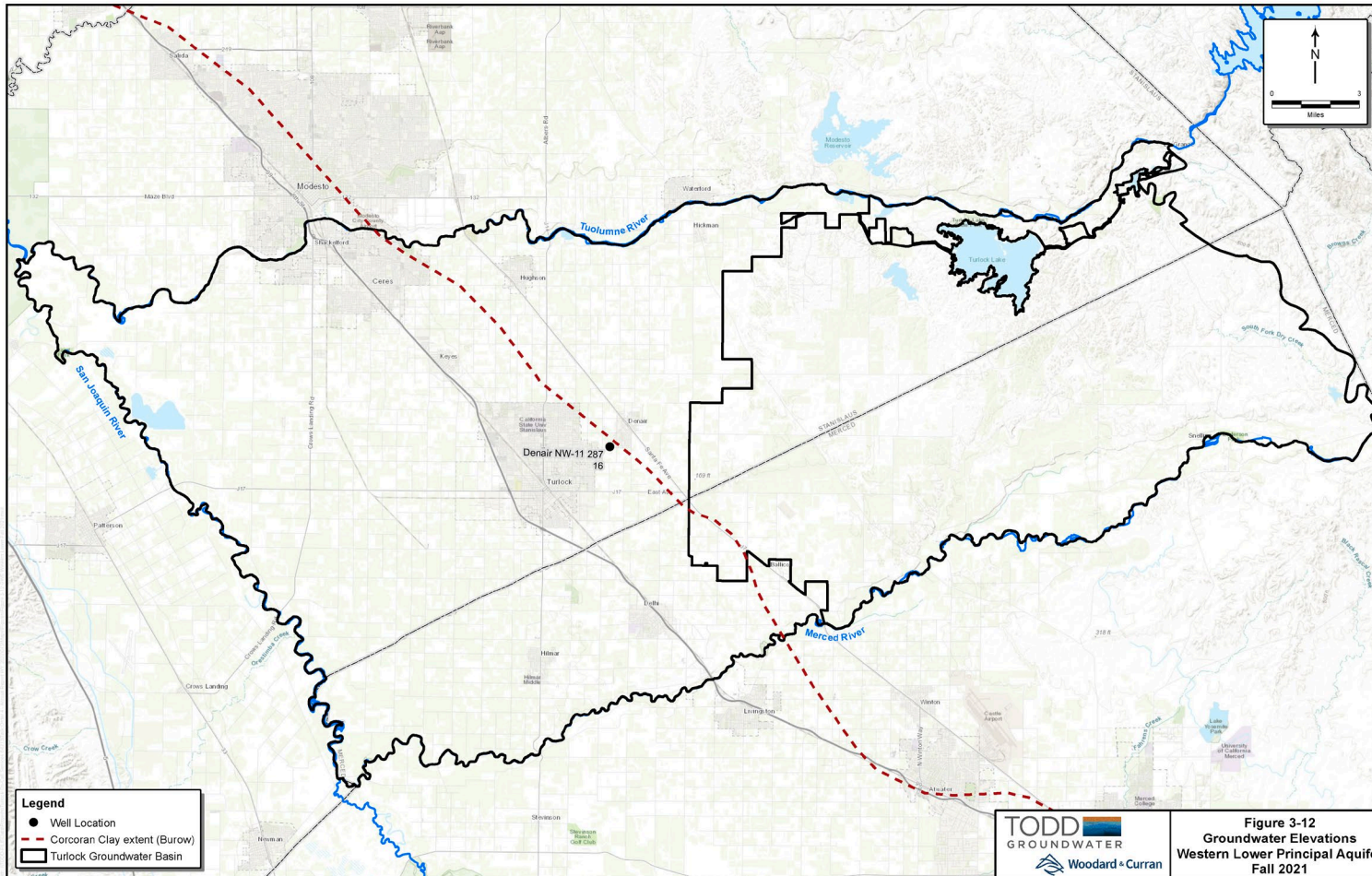
## WESTERN UPPER AND EASTERN PRINCIPAL AQUIFERS



- GWE ranges from 30 to 144 ft msl
- Center of pumping depression -10 ft msl
- Flow is towards the pumping depression in the eastern and central Subbasin
- Flow is to the north in vicinity of Ceres and Modesto
- Groundwater mound in vicinity of Hilmar & Delhi extends north to Turlock & Denair
- Flow to the west and northwest in western Subbasin

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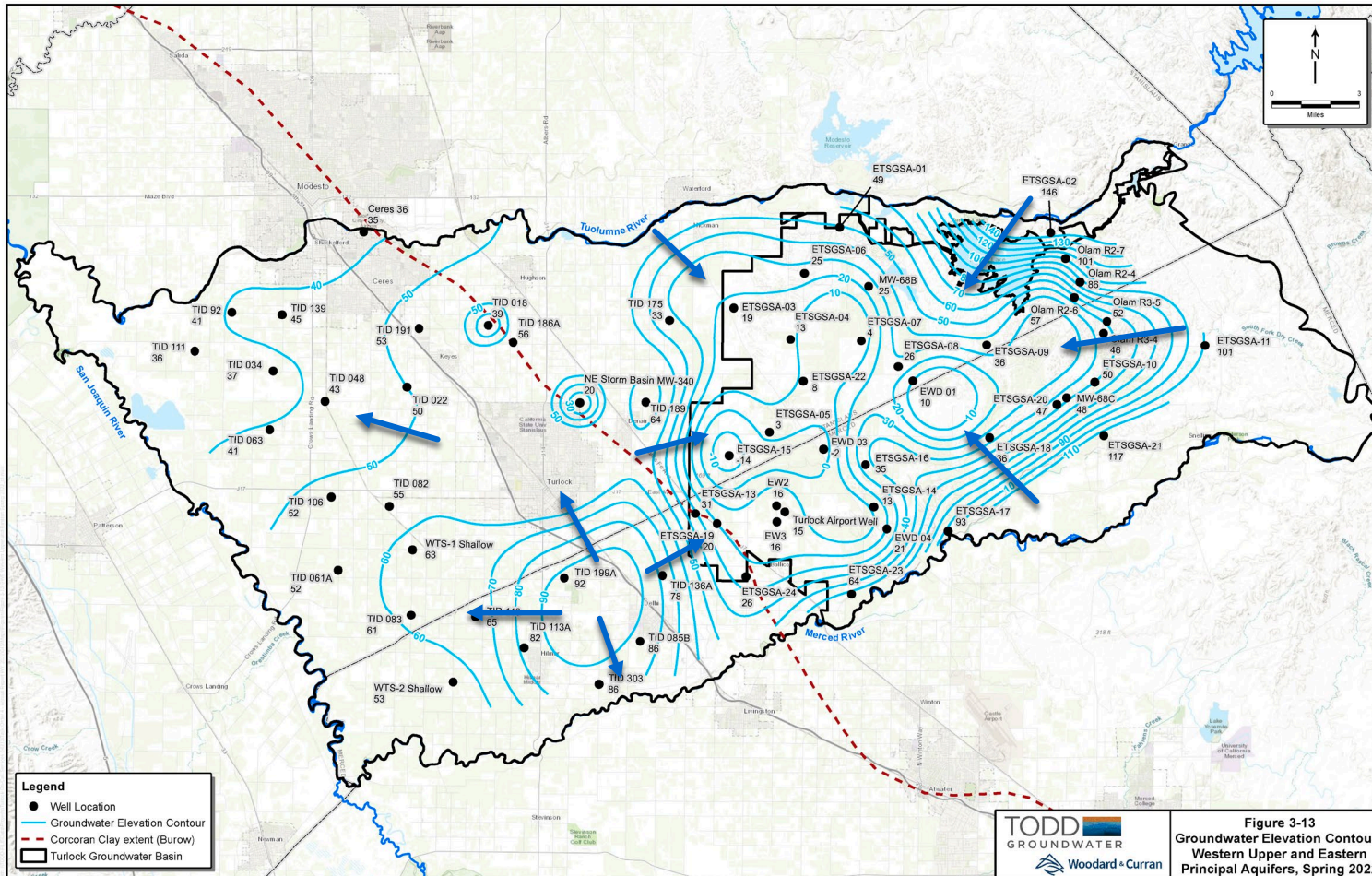
# FALL 2021 WESTERN LOWER PRINCIPAL AQUIFER



- Data available in only one well (Denair NW-11 287, 16 ft msl)
- Insufficient amount of data to generate groundwater elevation contours
- Fall 2021 monitoring event occurred before GSP adoption and installation of Prop 68 monitoring wells

# SPRING 2022

## WESTERN UPPER AND EASTERN PRINCIPAL AQUIFERS



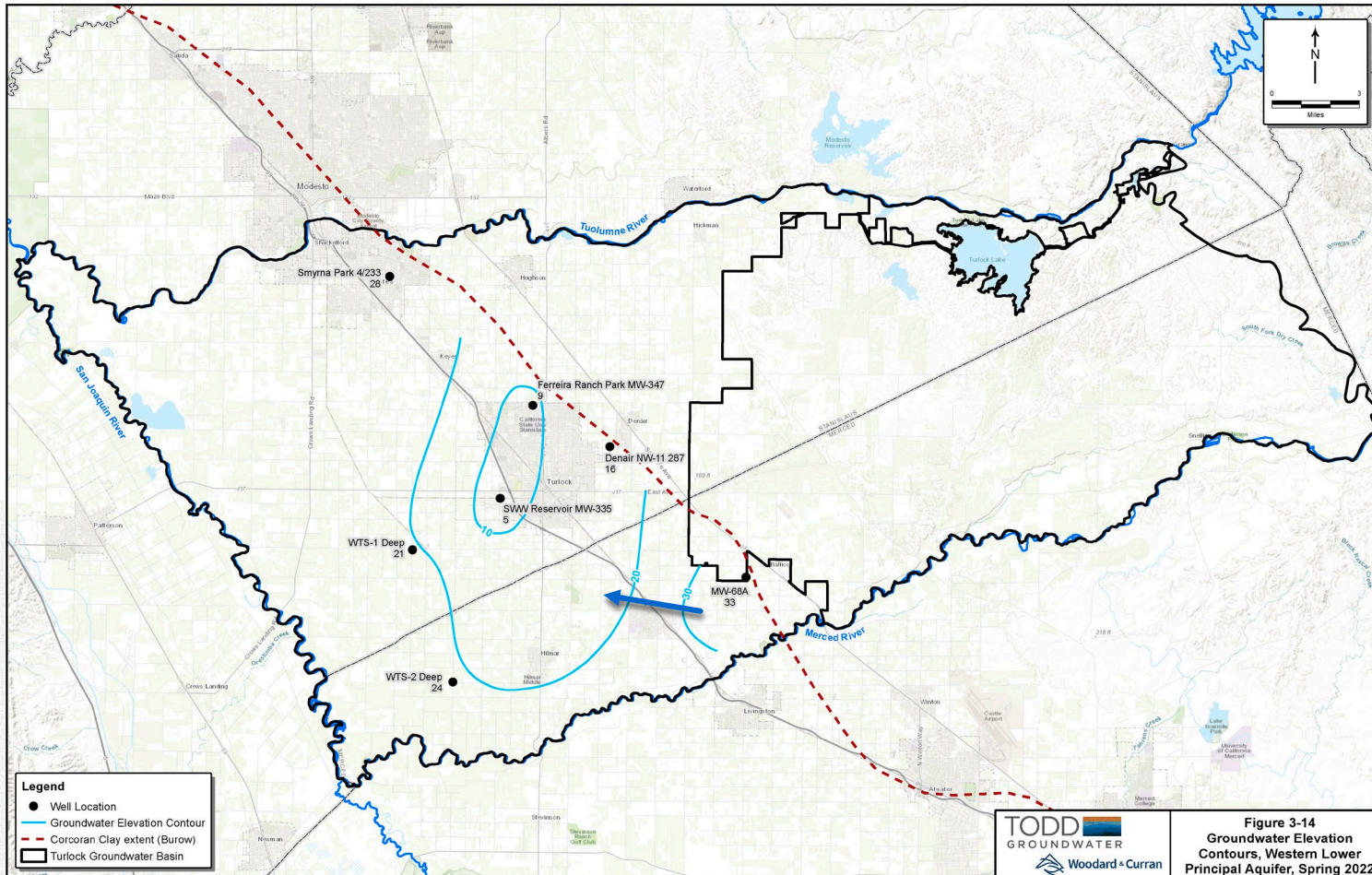
- Similar flow pattern as Fall 2021
- Elevations range from 36 to 146 ft msl
- Center of pumping depression -14 ft msl
- Groundwater elevations increased from Fall 2021 (average 1.1 ft).
  - Eastern Principal Aquifer (average 2.8 ft)
  - Western Upper Principal Aquifer (average -0.3 ft)
- More measured data in eastern Subbasin

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# SPRING 2022

## WESTERN LOWER PRINCIPAL AQUIFER



- Data available in 7 wells
- Based on limited data, flow is to northwest with pumping depression around Turlock
- Between Spring 2021 and Spring 2022, three monitoring wells in Turlock/Denair had sharp water level declines between 20 and 30 ft

# WATER QUALITY ANALYSIS



- The MT is a new (first-time) exceedance of an MCL in a potable supply well in the representative monitoring network.
- Undesirable results occur if the MT results in a well owners increase on operational costs and is caused by GSA management activities.

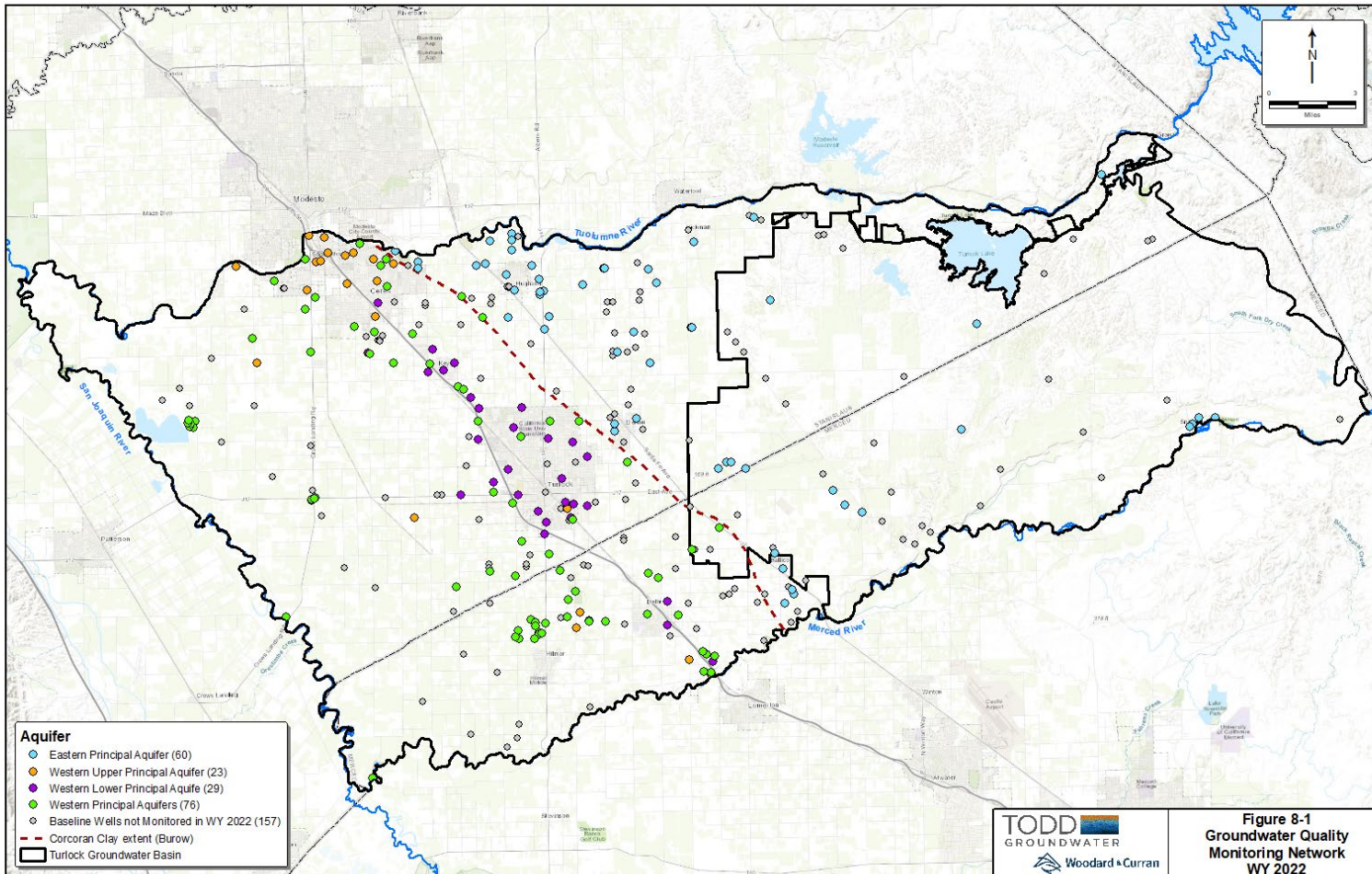
## Baseline monitoring network established in WY 2021 Annual Report

- 345 wells
- 6 constituents of concern: As, NO<sub>3</sub>, U, TDS, 1,2,3-TCP, and PCE
- Identified maximum concentration from WY 1991 to WY 2021
- Compared data to baseline wells, which were monitored for each constituent of concern in WY 2021

# WATER QUALITY ANALYSIS

- WY 2022 Water quality data downloaded from GAMA database (GeoTracker)
- Compared to the baseline to identify any new MCL exceedances
- Wells individually examined to determine if increased concentrations could be related to GSA management
- 6 maps for 6 constituents– wells with data in each principal aquifer during WY 2022

# WATER QUALITY ANALYSIS



- 188 wells in WY 2022 monitoring network
  - 137 municipal
  - 29 domestic
  - 22 monitoring wells at regulated facilities (157 baseline wells not monitored during WY 2022)
- Nitrate only COC with new (first time) MCL exceedance

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# ARSENIC

- Arsenic measured in 53 RMWs during WY 2022
- No wells reported first-time MCL exceedances

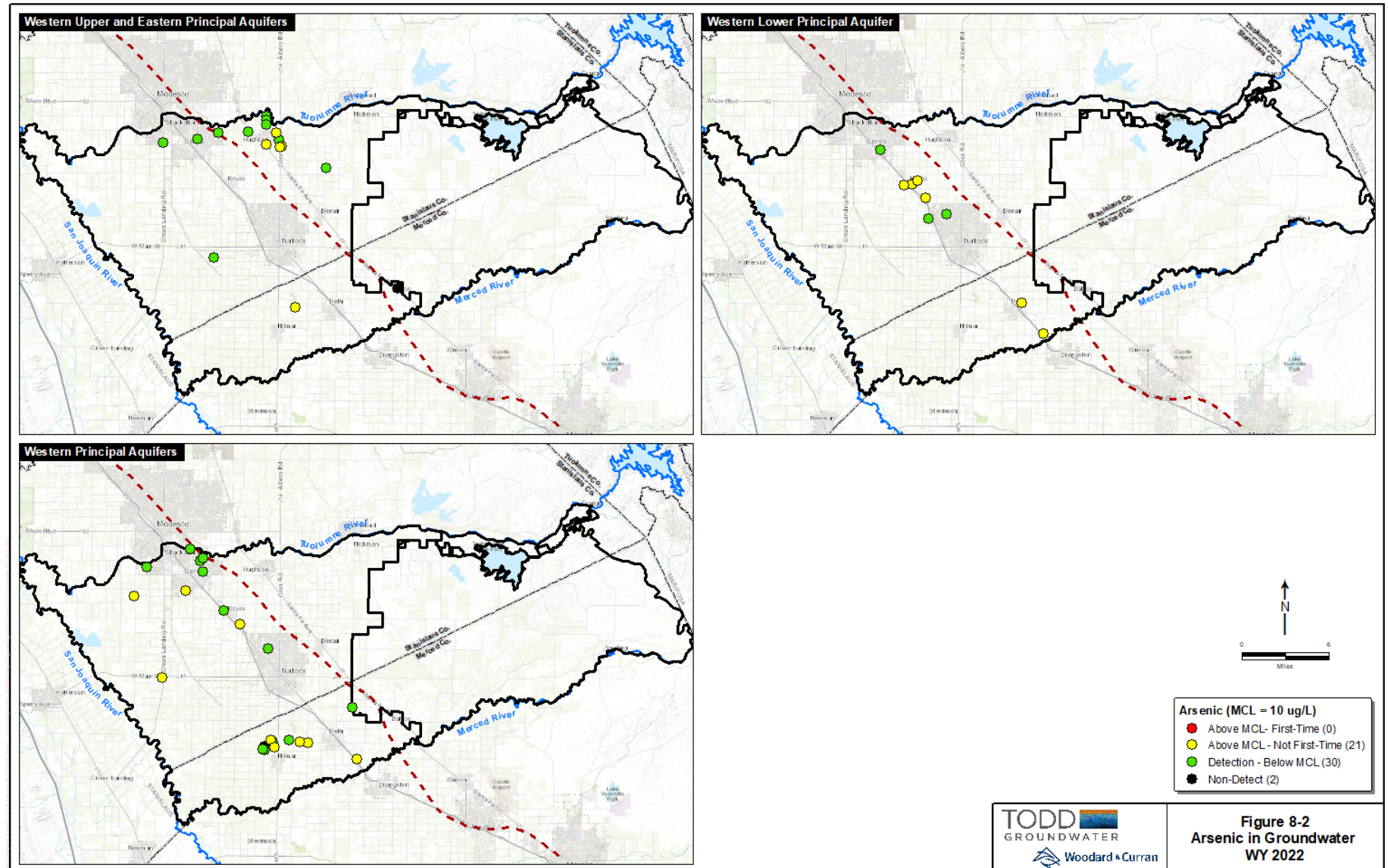
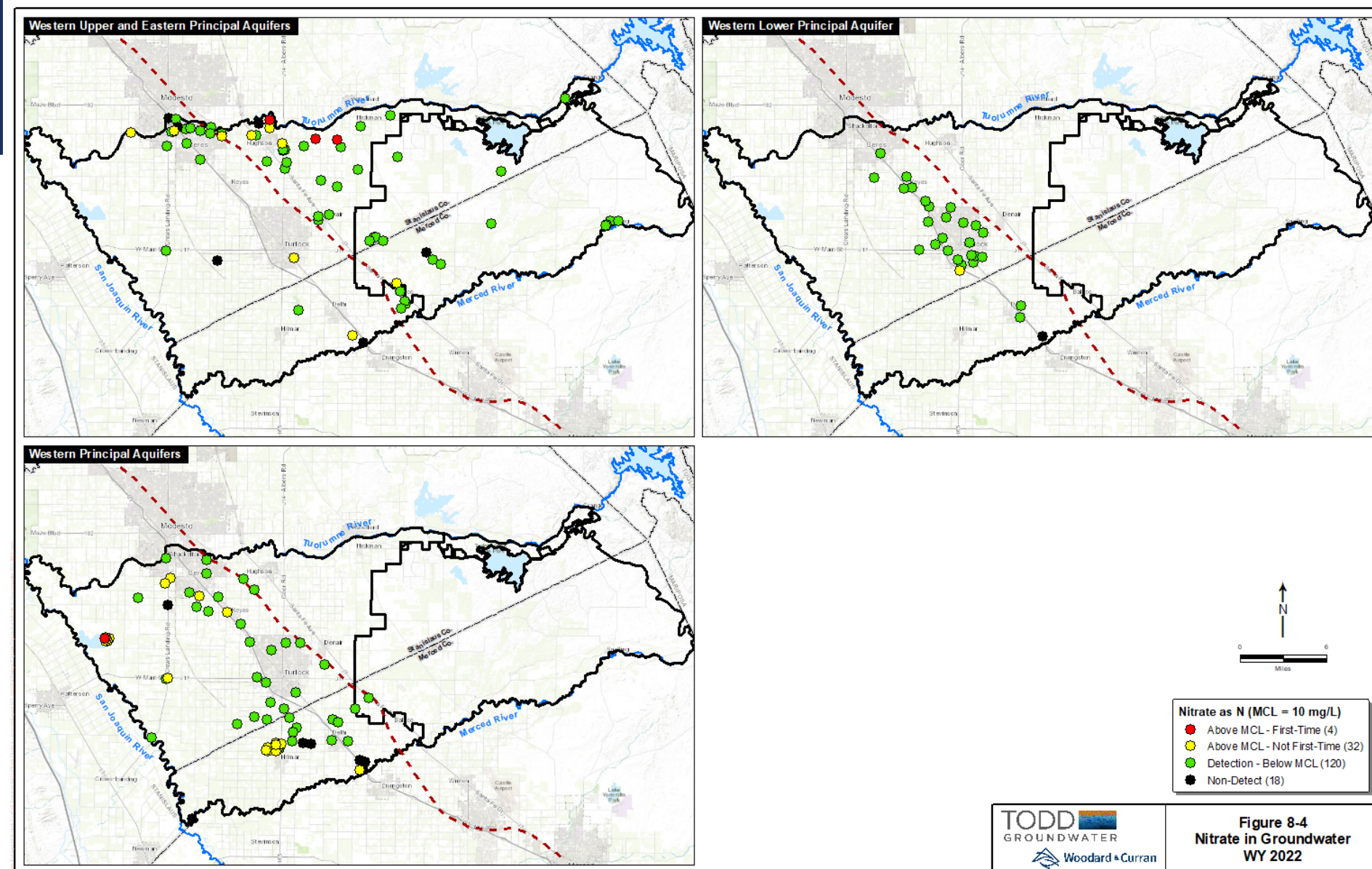


Figure 8-2 Arsenic in Groundwater WY 2022

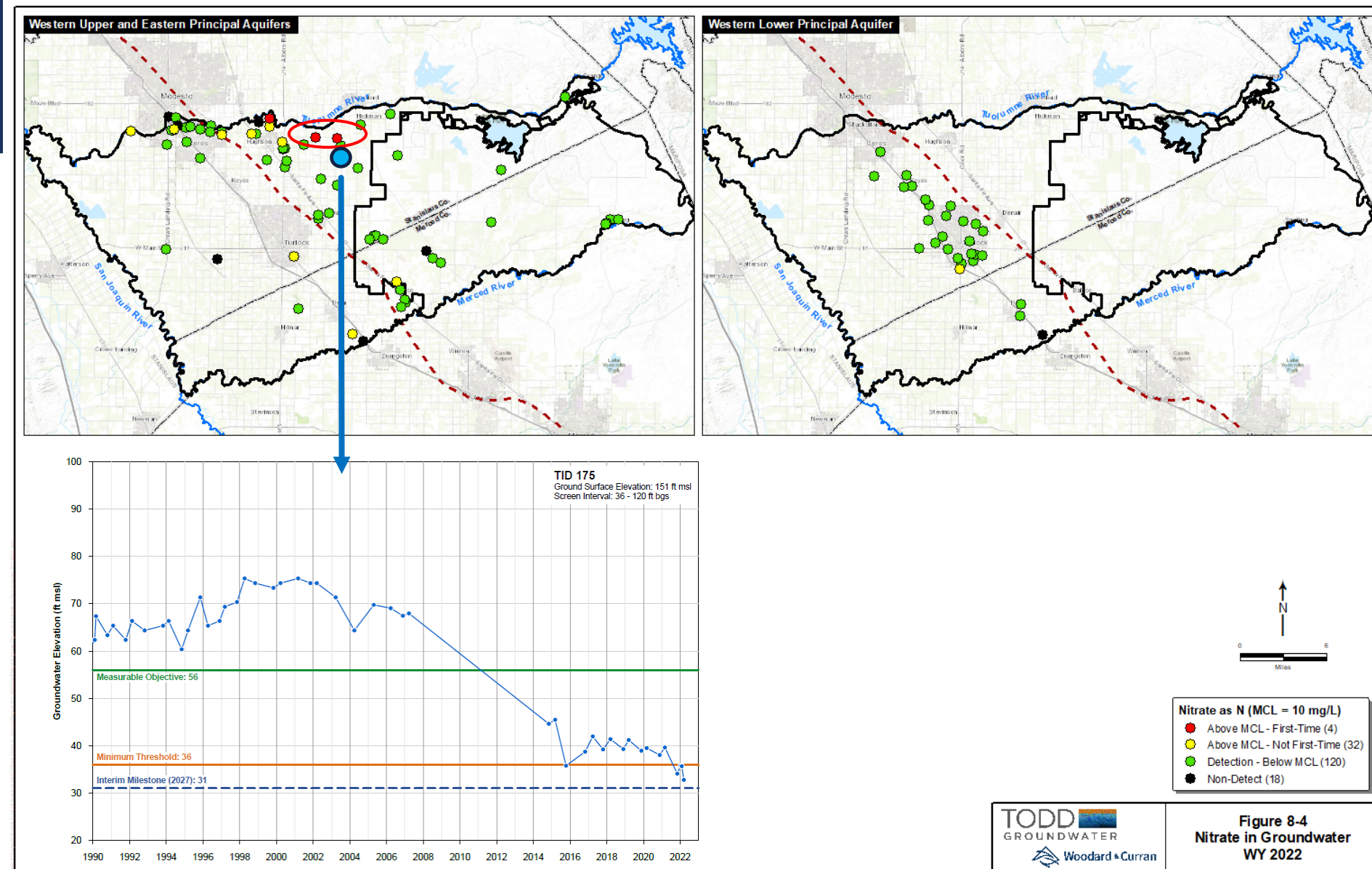
# NITRATE

- Nitrate measured in 174 RMWs during WY 2022
- 2 potable water supply wells reported first-time MCL exceedances
  - Public supply well in Hughson (west) had increasing concentrations since 2017
  - Domestic well (east) had increasing concentrations since monitoring began in 2019



# NITRATE

- Nitrate measured in 174 RMWs during WY 2022
- 2 potable water supply wells reported first-time MCL exceedances
  - Public supply well in Hughson (west) had increasing concentrations since 2017
  - Domestic well (east) had increasing concentrations since monitoring began in 2019
- Nearby monitoring well TID175 shows declining water levels



# SUBSIDENCE ANALYSIS

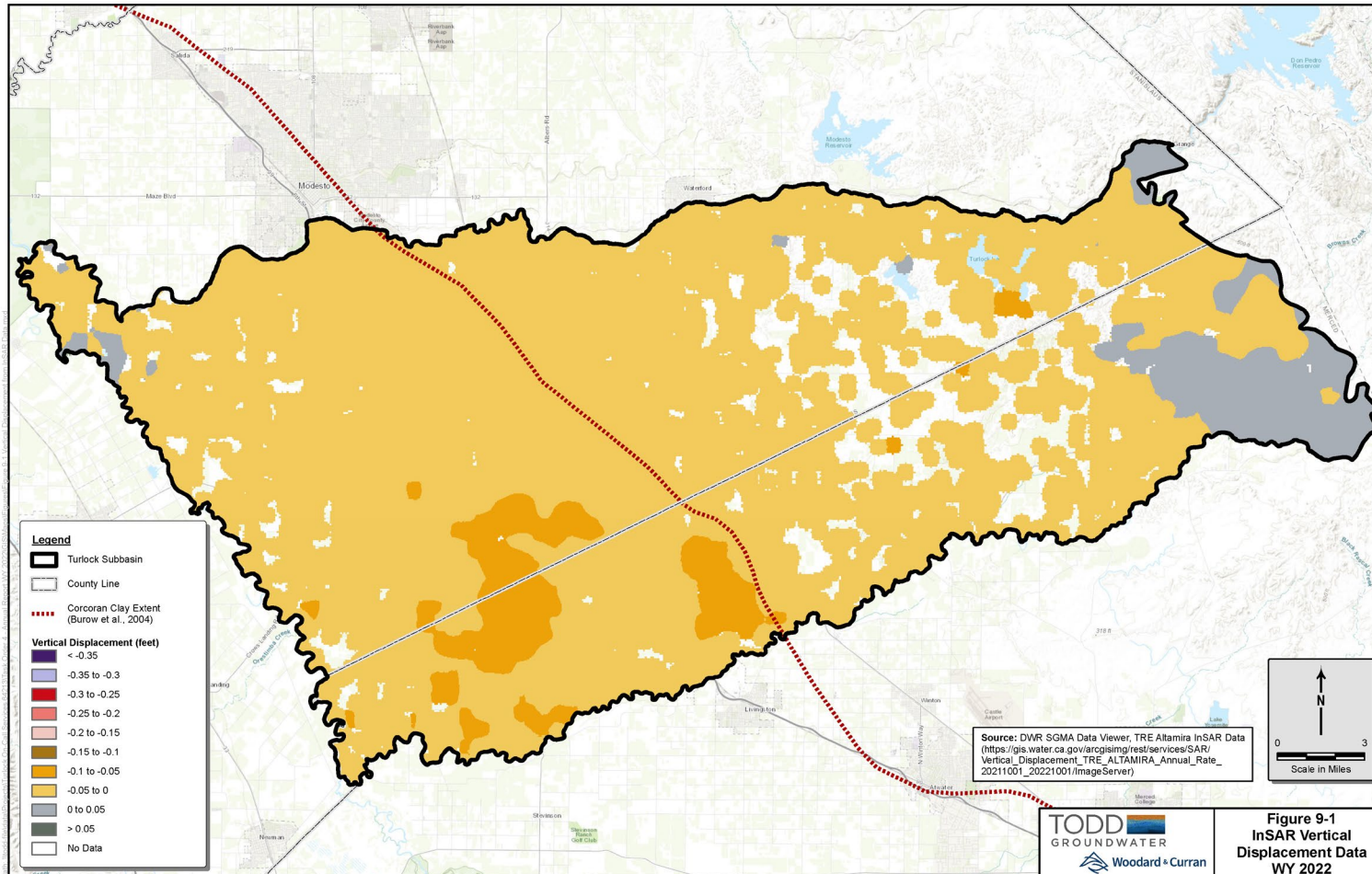


Figure 9-1  
InSAR Vertical  
Displacement Data  
WY 2022

- WY 2022 land subsidence analysis based on DWR InSAR vertical displacement data
- Minor negative vertical displacement during WY 2022 throughout the Subbasin, between 0 and 0.1 feet (1.2 inches)
- Consistent with historical rates



# TURLOCK ANNUAL REPORT REMAINING SCHEDULE

Red: Annual Report Deliverable

Green: Ad-Hoc Meeting

Blue: Joint TAC Meeting

- March 21: Joint TAC Meeting
- March 24: Final Annual Report to TACs
- Week of March 27: submit Annual Report to DWR  
(due April 1)

March							2023
Sun	Mon	Tue	Wed	Thu	Fri	Sat	
			1	2	3	4	
5	6	7	8	9	10	11	
12	13	14	15	16	17	18	
19	20	21	22	23	24	25	
26	27	28	29	30	31		

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# QUESTIONS

