

EKI TECHNICAL PRESENTATION

WHITE WOLF GSA BOARD OF DIRECTORS

5 MARCH 2024



OUTLINE

- Water Year (WY) 2023 Annual Report
- Update on Groundwater Sustainability Plan (GSP) implementation activities
 - February 2024 groundwater levels
 - Dedicated monitoring well siting

WY 2023 ANNUAL REPORT

WY 2023 ANNUAL REPORT OVERVIEW

- Focus is | October 2022 through 30 September 2023, but certain data and analysis required to extend from | January 2015
- Modified structure to address the new DWR guidance document
- **Key Take-Aways:**
 - No Undesirable Results
 - ~48,000 AF increase in groundwater storage
 - Decrease in groundwater pumping by ~62% compared to WY 2022
 - Increase in groundwater levels
 - Minimal to no subsidence
 - Water quality concentrations for constituents of concern all below MCLs
 - Recharge P/MAs resulted in 22,990 AF of applied water for infiltration

GROUNDWATER ELEVATION CONTOUR MAPS

Figure 2. Groundwater Elevations, Fall 2022

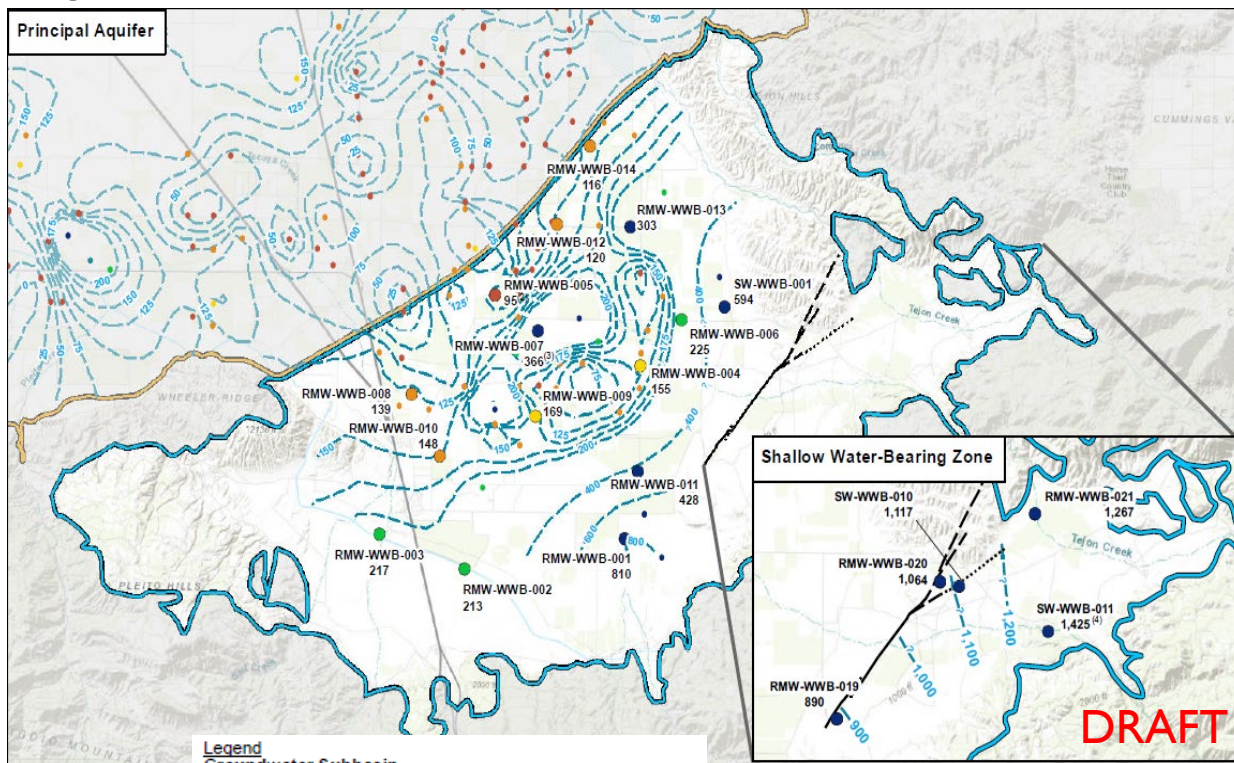
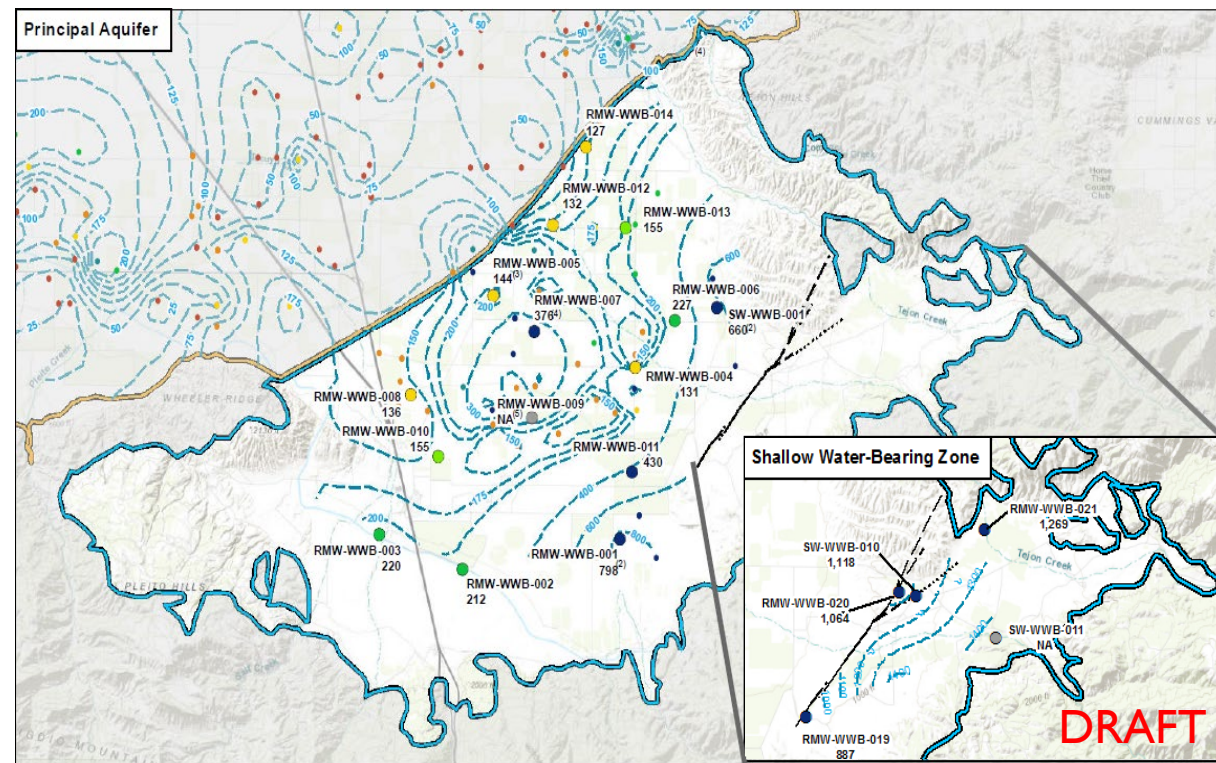


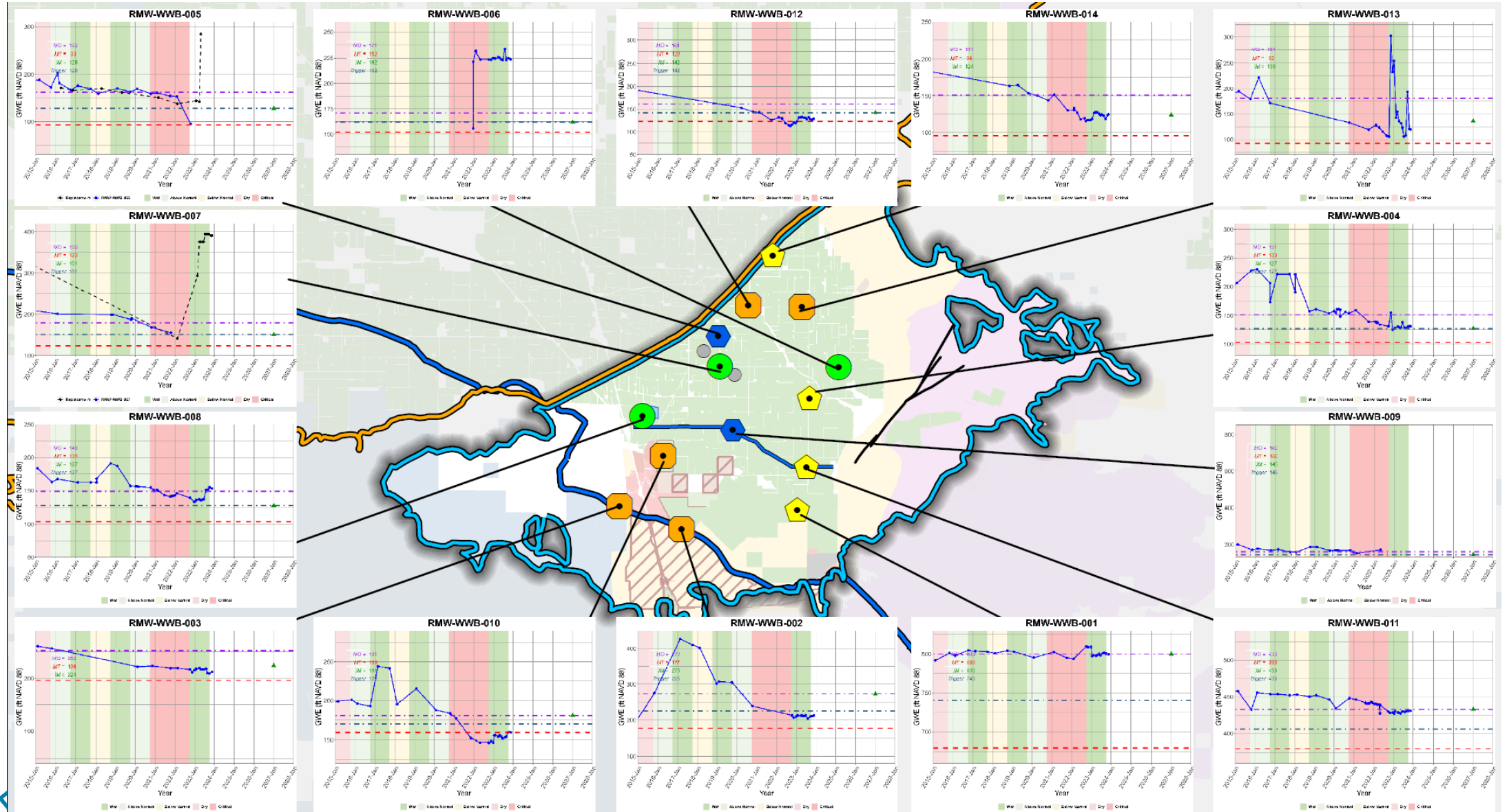
Figure 3. Groundwater Elevations, Spring 2023



■ Groundwater flow typically from Southeast to Northwest

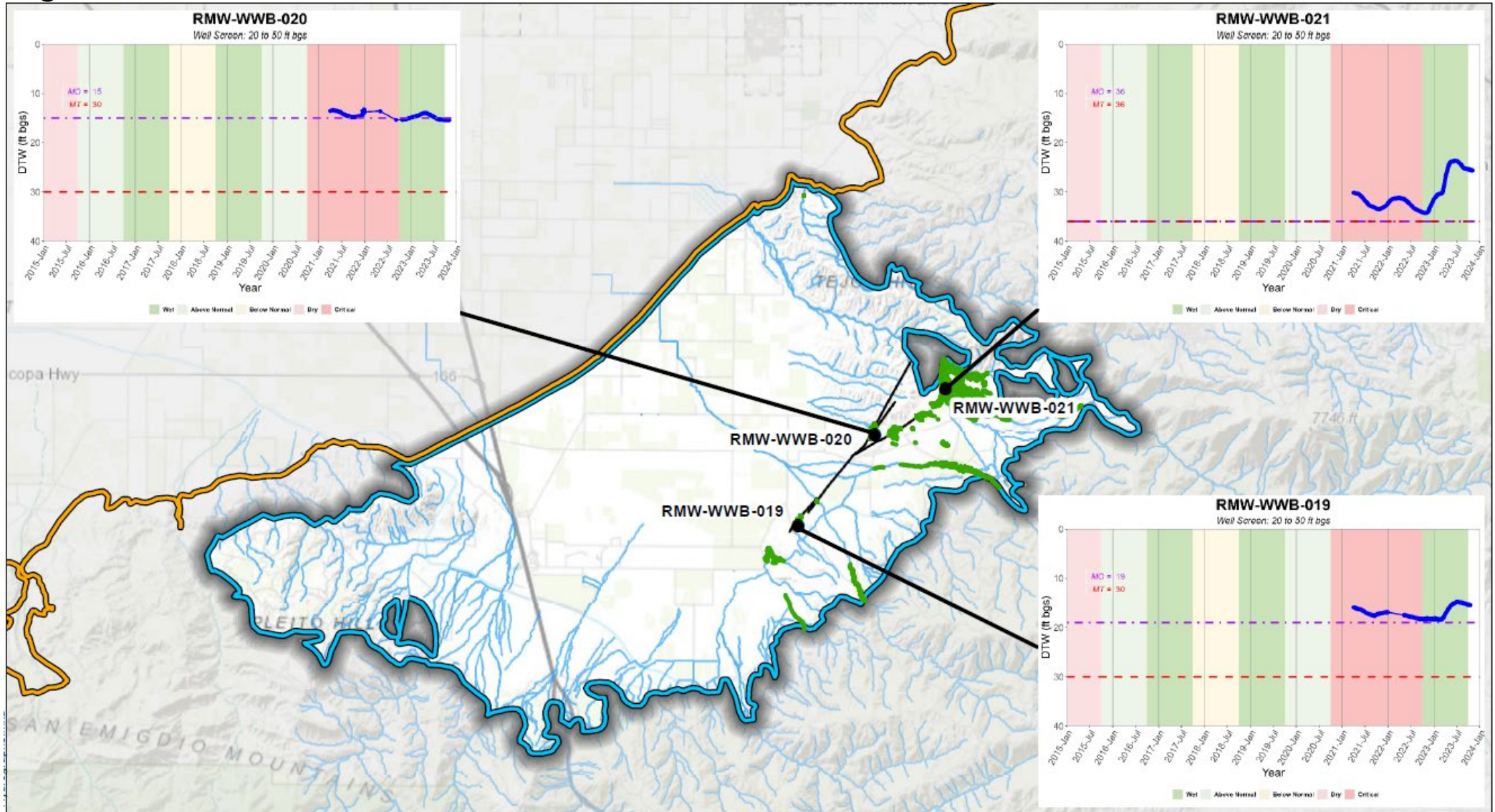
WATER LEVEL SMCs

Figure 4. Hydrographs of RMWs for Chronic Lowering of Groundwater Levels



INTERCONNECTED SURFACE WATER SMCs

Figure 5. Hydrographs of RMWs for Depletion of Interconnected Surface Water



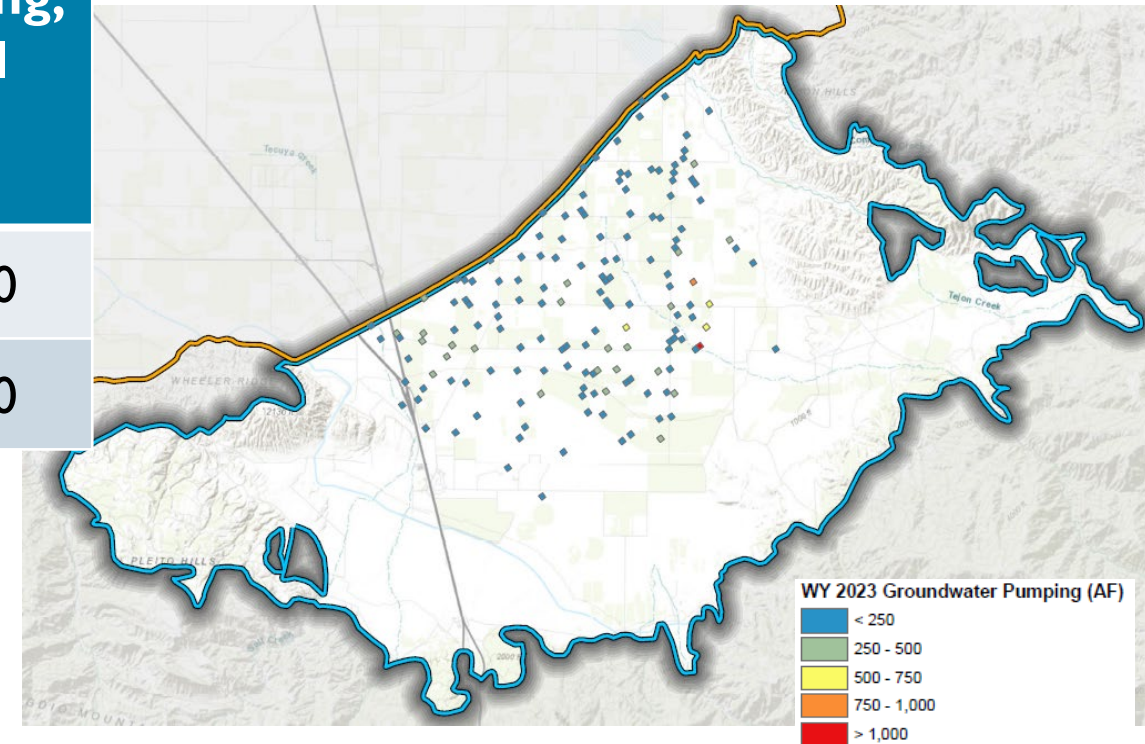
GROUNDWATER USE BY SECTOR AND SOURCE

Table 1. Summary of Groundwater Extraction Data by Sector and Source

Water Year	Pumping, Agricultural (AF)		Pumping, Municipal & Industrial (AF)	Pumping, Total (AF)
	Metered	Estimated		
2022	22,412	36,541	1,248	60,200
2023	3,516	17,779	1,405	22,700

- Agricultural pumping is estimated by the Basins’ Soil Moisture Budget (SMB) accounting model
- Municipal & Industrial (M&I) pumping for January – September 2023 is estimated, as reported values are not yet available
- Does not include domestic de minimus (< 2 AFY) pumping

Figure 6. General Location of Groundwater Extractions, WY 2023



SURFACE WATER USE BY SECTOR AND SOURCE

Table 2. Summary of Surface Water Supply by Sector and Source

WY	WRMWSD Imports (AF)			AEWSD Imports (AF)		TCWD Imports (AF)	Total Imports (AF)			Stream Diversions (AF)
	Ag	M&I	Recharge	Ag	Recharge	M&I	Ag	M&I	Recharge	Ag
2022	12,066	2,526	0	19,574	0	496	31,640	3,022	0	2,751
2023	60,149	3,046	22,220	16,428	771	471	76,577	3,517	22,990	5,427

- Imports are based on surface water deliveries to customers; actual imports may be greater due to conveyance system losses.
- WRMWSD agricultural deliveries are calculated based on the total water delivered by turnout, minus the total volume of groundwater pumped into the WRMWSD distribution system
- Imported surface water delivered by WRMWSD to M&I users are not included in the Soil Moisture Balance Accounting model (SMB). 94% of the M&I water was delivered to Pastoria Energy Facility. It is assumed that these M&I deliveries contributions to the groundwater system are negligible.
- For WY 2023, all stream diversions except for POD9 were diverted to storage.

TOTAL WATER USE BY SECTOR AND SOURCE

Table 3. Total Water Use by Sector

WY	Agricultural (AF)				M&I (AF)			Recharge (AF)		Total (AF)
	Metered Pumping	Estimated Pumping	Imported Water	Stream Diversions	Pumping	Imported Water	Recycled Water	Imported Water	Recycled Water	
2022	21,256	37,597	31,640	2,751	1,248	3,022	83	0	40	97,637
2023	3,516	17,779	76,577	5,427	1,405	3,517	88	22,990	34	131,333

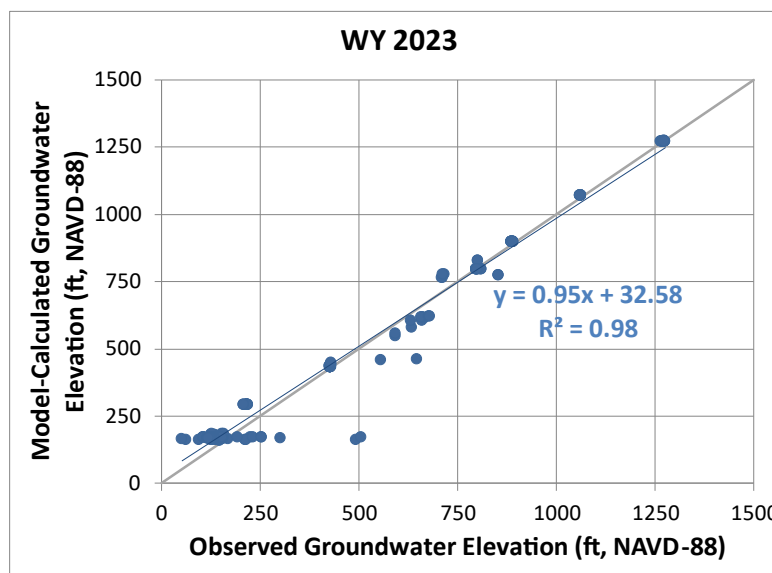
■ Recharge volumes are total applied water.

- Total water use in WY 2023: ~131,300 AFY
 - 79% is for agricultural use
 - 17% is from groundwater pumping
 - 18% is for recharge

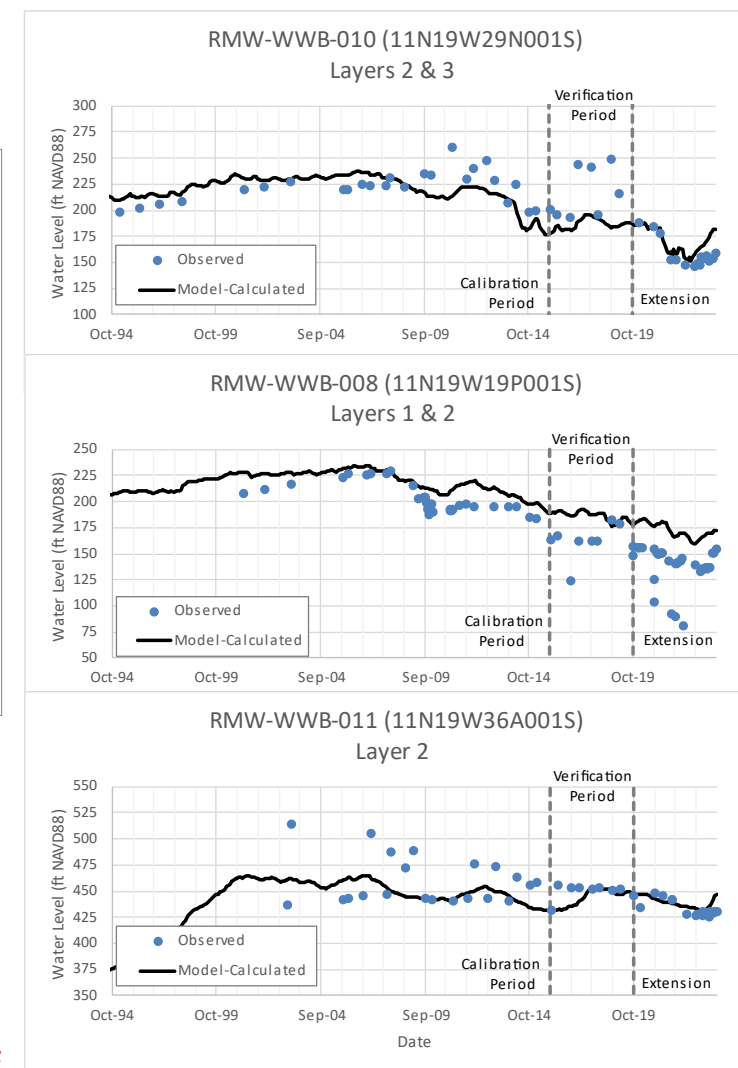
WWGFM EXTENSION THROUGH WY 2023

- Extended the White Wolf Groundwater Flow Model through WY 2023
 - Precipitation
 - Water delivery / pumping
 - ET from Land IQ
 - Seasonal land use
 - Boundary conditions
 - Confirmed model performance against measured water levels

Figure 7. Modeled versus Observed Water Level Elevation in Wells

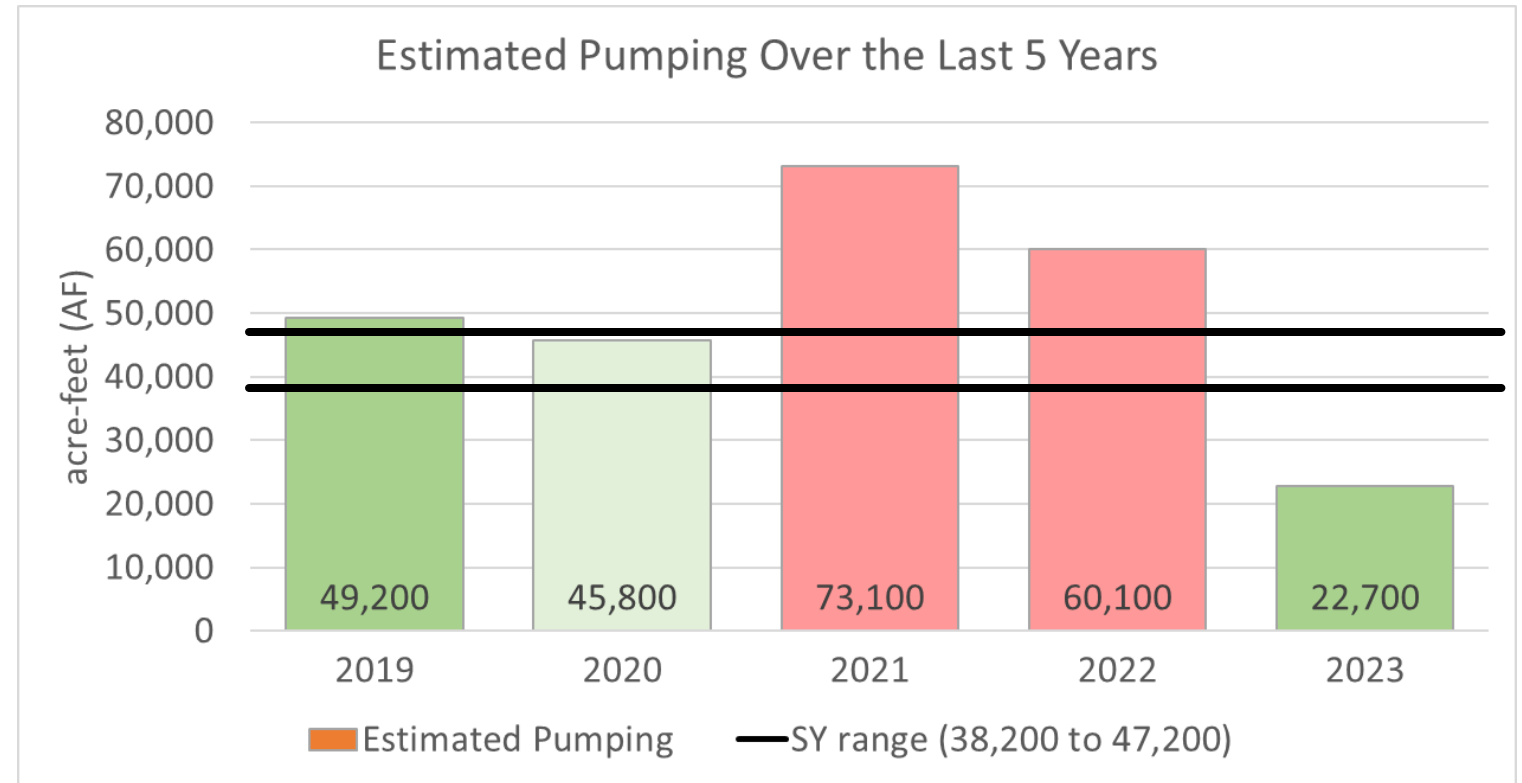


Example hydrographs:



ESTIMATED PUMPING DROPPED SIGNIFICANTLY IN WY 2023

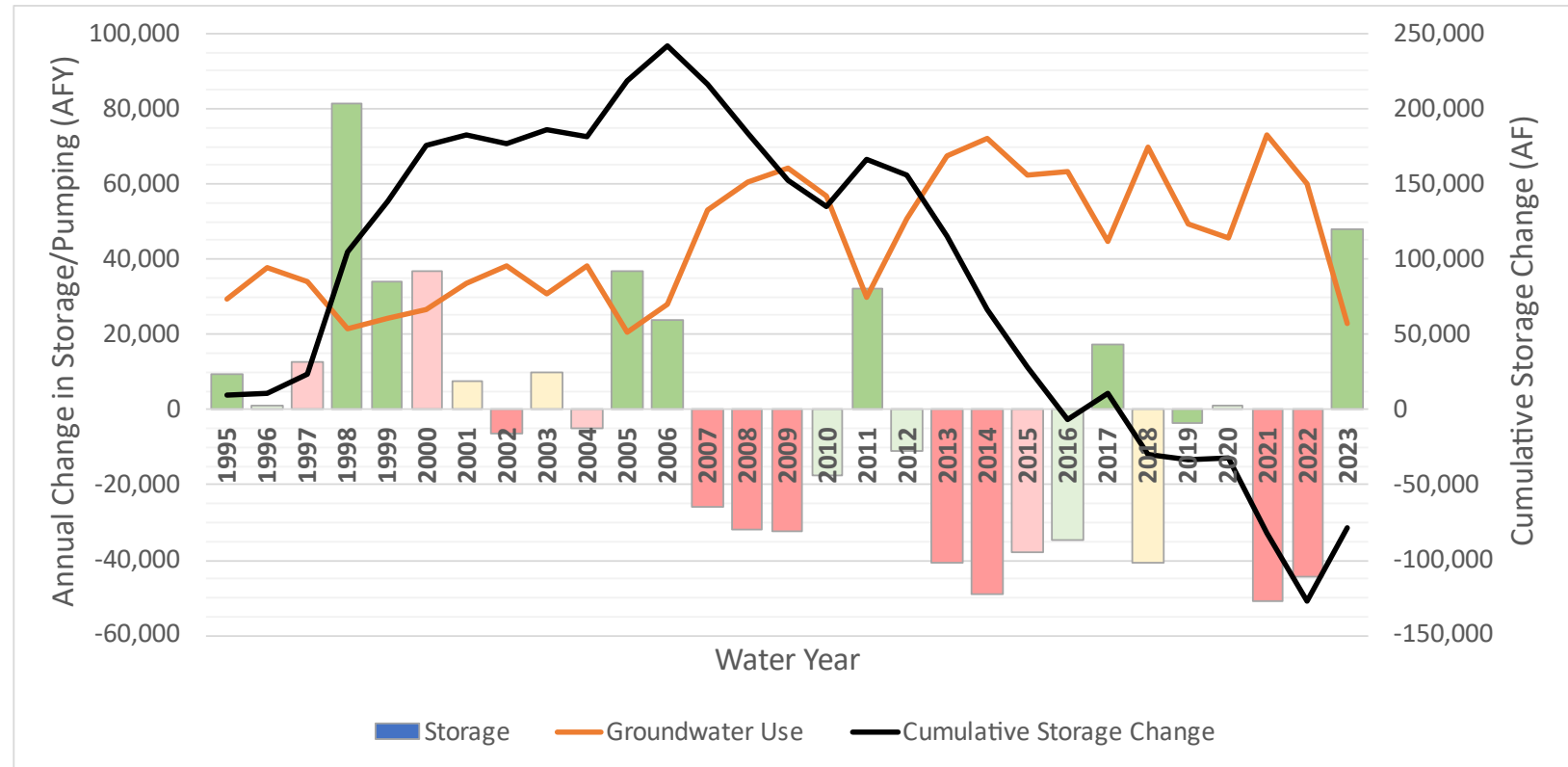
- WY 2023 pumping: 22,700 AFY
- Average pumping 2019-2022: 57,000 AFY
- Decrease of 62% from WY 2022
- WY 2023 pumping well within the estimated sustainable yield



CHANGE IN GROUNDWATER STORAGE

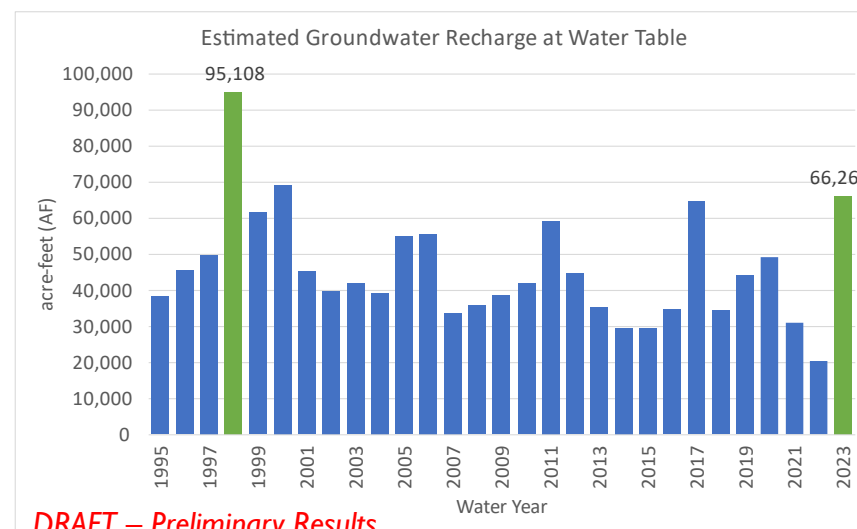
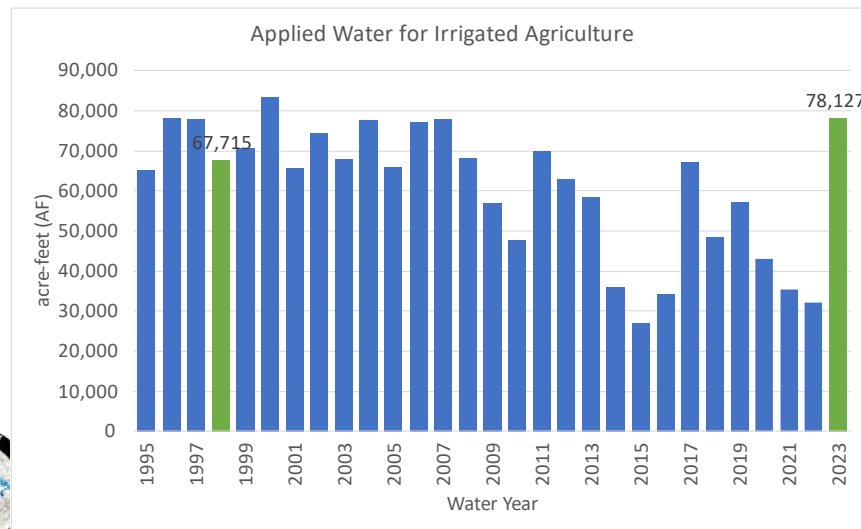
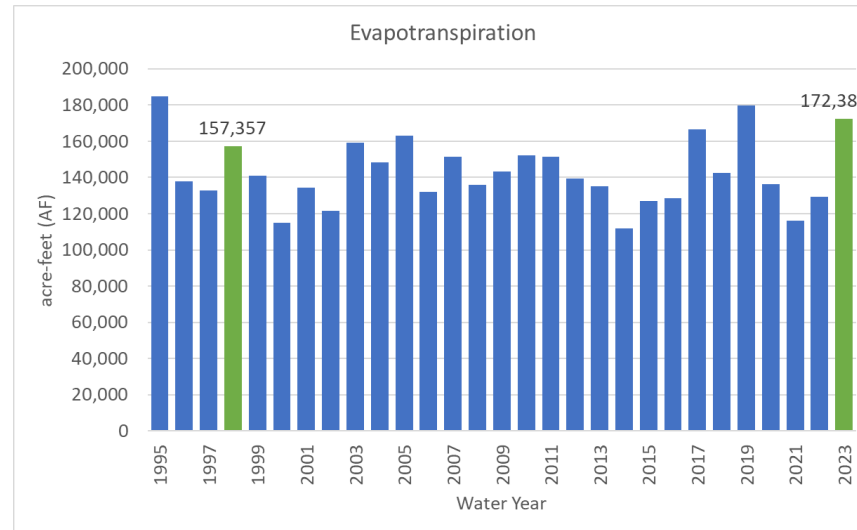
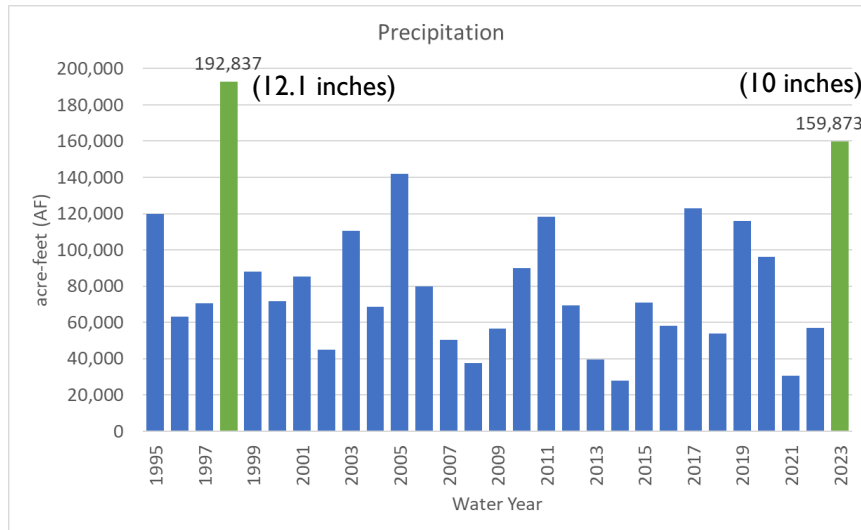
- WY 2023 Basin-wide change in storage: +48,200 AF
- Cumulative storage change since 2015: -144,900 AF
- Largest estimated storage increase since 1998

Figure 9. Annual Change in Groundwater Storage and DWR Water Year Type



DRAFT – Preliminary Results

COMPARISON OF LAND SURFACE PROCESSES BETWEEN 1998 AND 2023



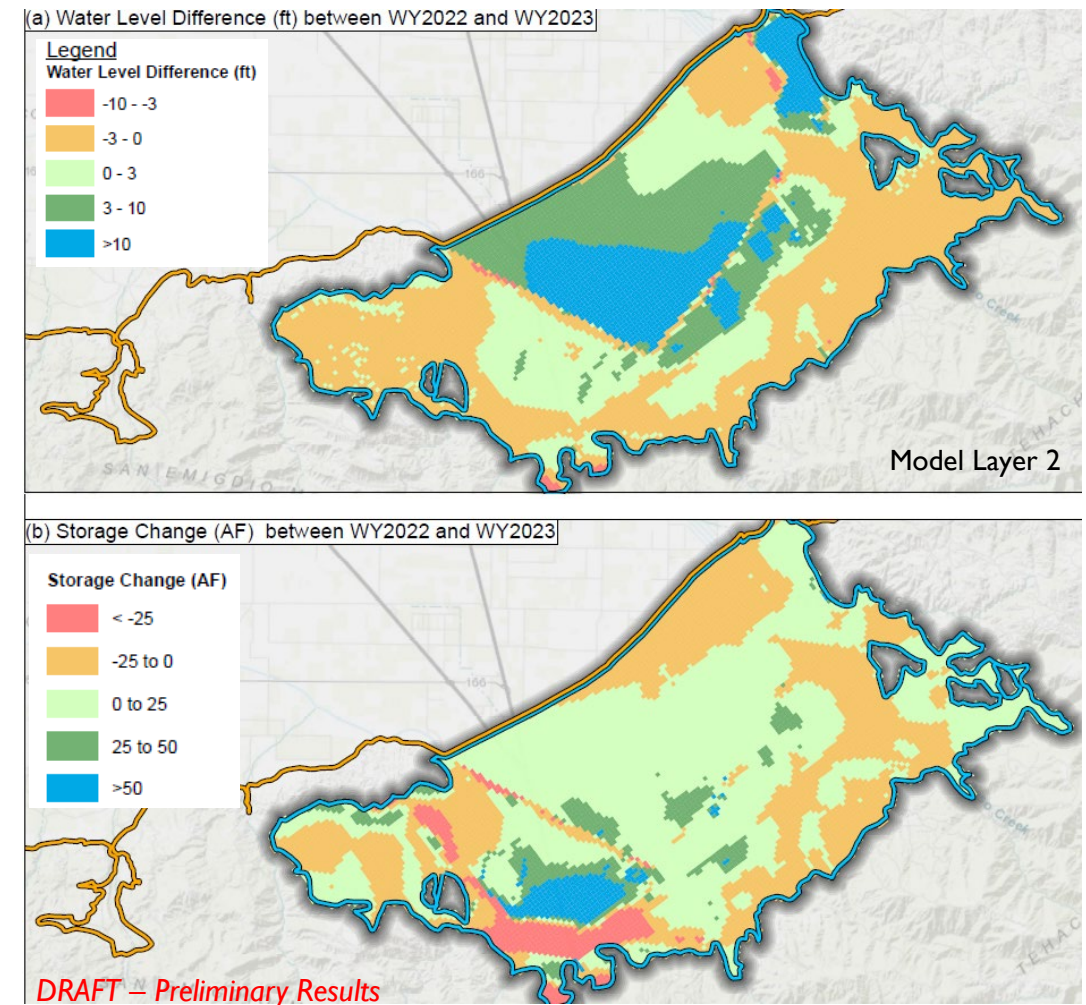
- Combination of more precipitation and less ET resulted in more groundwater recharge in 1998
- In general, depth to groundwater was shallower in 1998
- 2023 managed recharge has not yet reached the water table



CHANGE IN GROUNDWATER LEVELS AND STORAGE ACROSS THE WWB

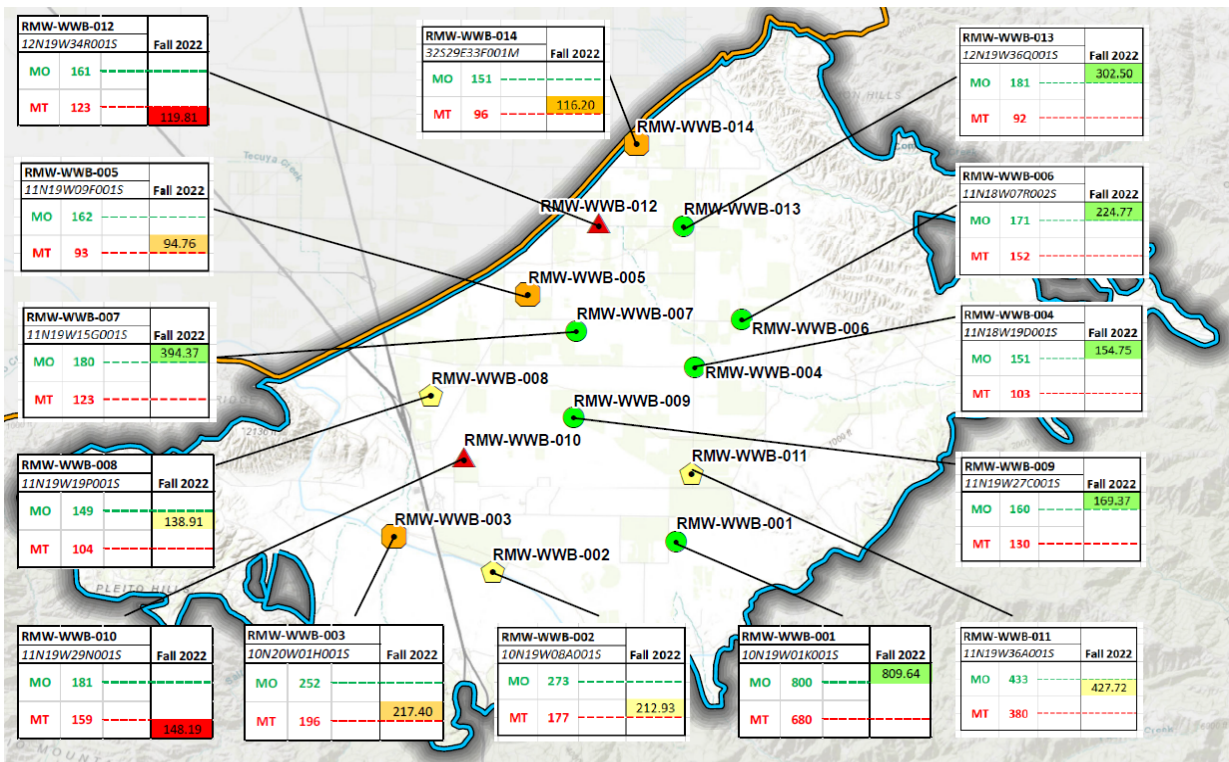
- Model-estimated storage change between WY 2022 and WY 2023 based on the change in water level and the calibrated storage properties of each model cell
- Model estimates increases in groundwater storage for the majority of the subbasin

Figure 8. Model Estimated Groundwater Storage Change between WY 2022 and WY 2023



GROUNDWATER LEVELS RELATIVE TO SMCs

Figure 10. Fall 2022



Legend

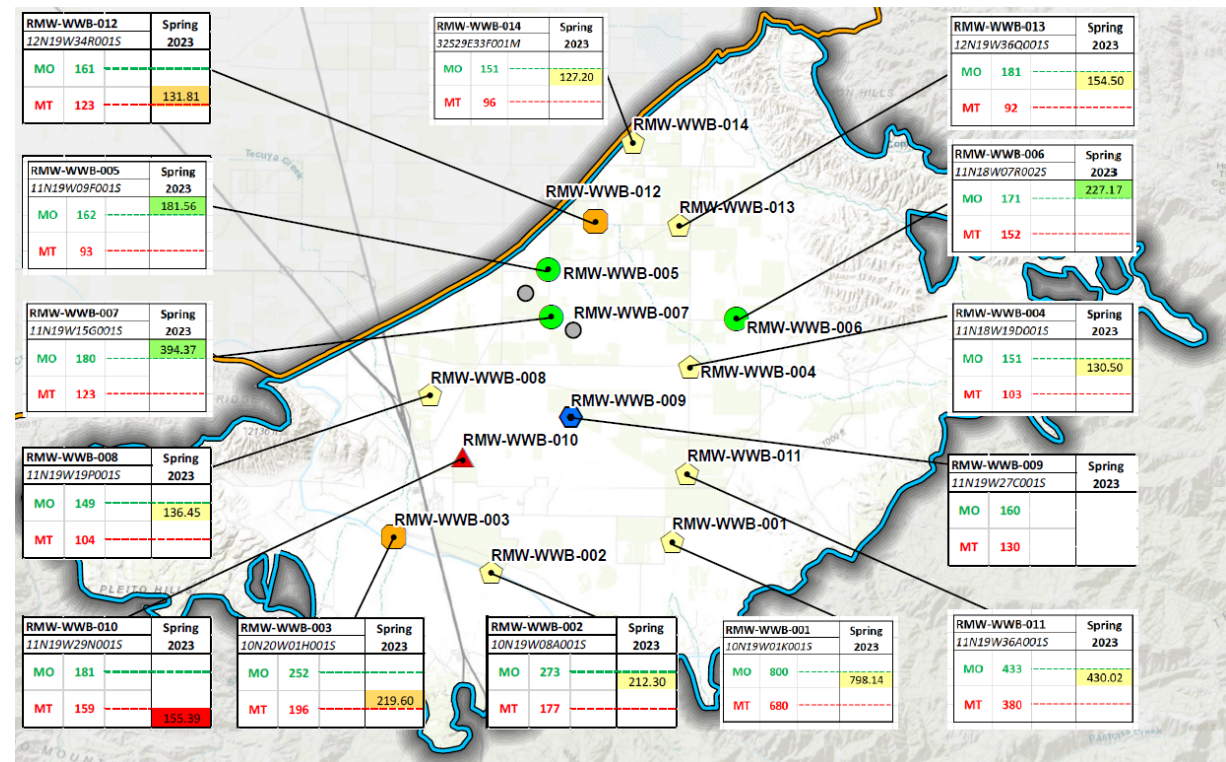
Representative Monitoring Well Status as of Fall 2022

- Water Level below MO (6 or 43%)
- ◐ Water Level between MO and MT but closer to MO (3 or 21.5%)
- ◐ Water Level between MO and MT but closer to MT (3 or 21.5%)
- ▲ Water Level below MT (2 or 14%)

Groundwater Subbasin

- White Wolf (DWR 5-022.18) (1)
- Kern County (DWR 5-022.14) (1)

Figure 11. Spring 2023



Legend

Representative Monitoring Well Status as of Spring 2023

- Water Level below MO (3 or 22%)
- ◐ Water Level Between MO and MT but closer to MO (7 or 50%)
- ◐ Water Level Between MO and MT but closer to MT (2 or 14%)
- No Water Level Measurement (1 or 7%)
- ▲ Water Level below MT (1 or 7%)
- Old RMW-WL

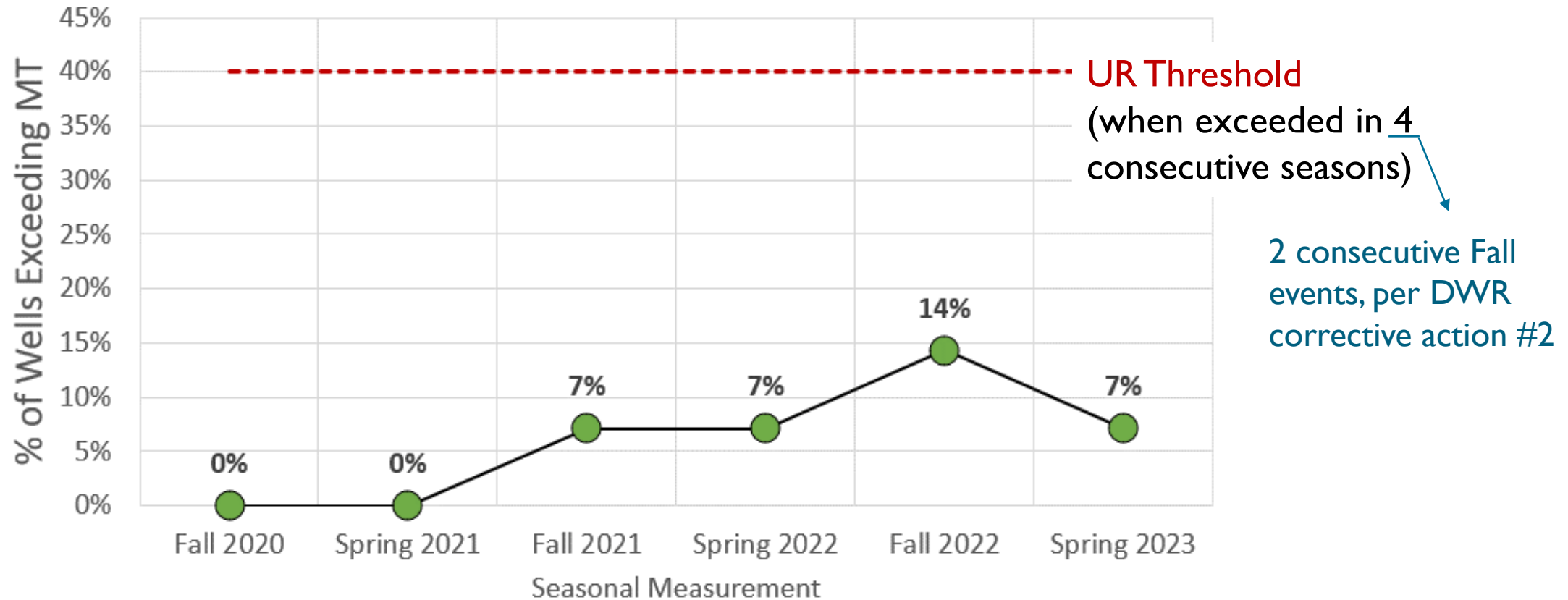
Groundwater Subbasin

- White Wolf (DWR 5-022.18)
- Kern County (DWR 5-022.14)



WL UNDESIRABLE RESULTS ARE NOT OCCURRING

Figure 12. Undesirable Results Tracking



WQ COC CONCENTRATIONS ALL BELOW MCL / MT

Table 6. Groundwater Quality and SMCs

Well Name	Arsenic (mg/L)			Nitrate as N (mg/L)			Selenium (mg/L)		
	MO = 0.0075	MT = 0.01	TT = 0.005	MO = 7.5	MT = 10	TT = 5	MO= 0.0375	MT= 0.05	TT = 0.025
RMW-WWB-015		0.002			4.6			0.002	
RMW-WWB-016		0.002			5.1			0.001	
RMW-WWB-017		ND			0.32			ND	
RMW-WWB-018		ND			ND			ND	

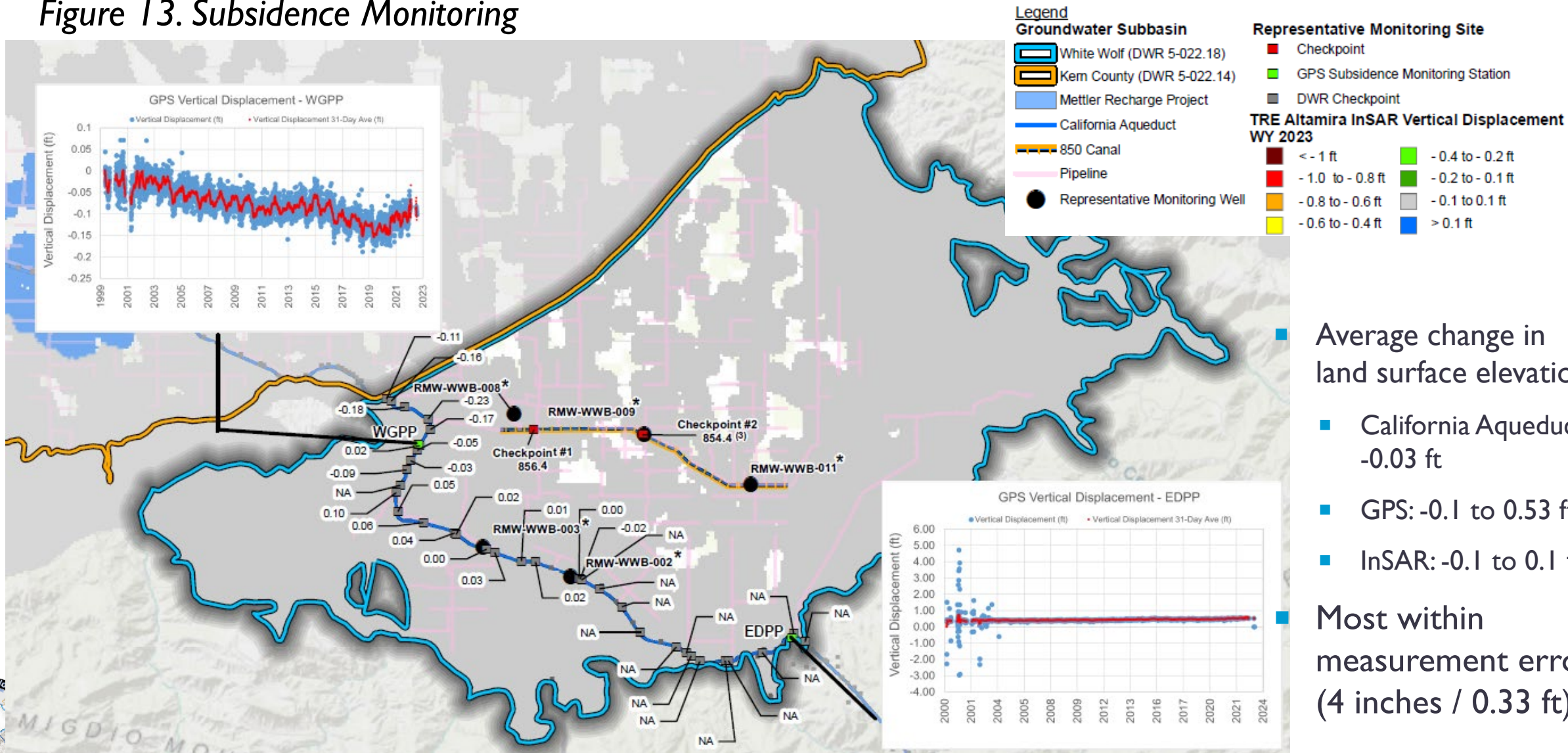
Notes:

(a) Trigger Thresholds (TT) are used in place of Interim Milestones.



LITTLE SUBSIDENCE MEASURED DURING WY 2023

Figure 13. Subsidence Monitoring



- Average change in land surface elevation:
 - California Aqueduct: -0.03 ft
 - GPS: -0.1 to 0.53 ft
 - InSAR: -0.1 to 0.1 ft
- Most within measurement error (4 inches / 0.33 ft)



PROGRESS TOWARDS INTERIM MILESTONES



Lowering
GW Levels

- Two wells exceeded (fell below) MTs in Fall 2022, only one well exceeded (fell below) MT in Spring 2023, with stable to increasing groundwater levels over the WY



Degraded
Quality

- All wells had constituent concentrations below MCLs and MTs



Land
Subsidence

- No specific SMCs set, minor average change in land surface elevation (within measurement error)



Surface Water
Depletion

- All wells remain above MTs

IMPLEMENTATION OF P/MAs

PMA	Status	Progress	Observed Benefit
#4 - Purchase Additional Surface Water Supplies	Active	In WY 2023, WRMWSD purchased an additional 145,000 AF for future surface water delivery in both the Kern County and White Wolf Subbasins	15% of the 145,000 AF used in Kern; remainder to WW and Kern Fan Banking Projects
#5 - WRMWSD “Thru Delta” Facility	Planning	WRMWSD continued to fund the planning phase of the Delta Conveyance Project (DCP).	None; still in planning phase.
#8 - WRMWSD Mettler Recharge Project	Active	In WY 2023, received 11,077 AF via the 850 Canal.	11,077 AF of applied water
#10 - AEWSD In-Lieu Banking Program	Planning	Successfully obtained grant funds	None; not funded in WY 2023
#12 - AEWSD South Canal WRMWSD 850 Canal Intertie	Planning	Successfully obtained grant funds	None; not funded in WY 2023
#14 - AEWSD Groundwater Subsidies for Land Conversion	Active	Applied for MLRP grant funds (not selected), provided financial incentives for landowner recharge	771 AF of landowner recharge in WY 2023
#15 - WRMWSD Land Retirement and/or Conversion	Active	Applied for MLRP grant funds (not selected), provided financial incentives for landowner recharge	11,142 AF of landowner recharge in WY 2023
#23 - AEWSD Groundwater Extraction Quantification Method	Active	Obtained Land IQ ET data, developed AEGFM-DST	Approved method to quantify the individual and aggregate groundwater extractions for annual reporting purposes.
#24 - WRMWSD Acreage Assessment	Planning	Approved Groundwater Service Charge (GWSC)	None; still under development in WY 2023



PROGRESS ON ADDRESSING DWR RECOMMENDED CORRECTIVE ACTIONS

- DWR approved White Wolf GSP on 26 October 2023
- Approval letter included four corrective actions
- Work addressing corrective actions will commence in WY 2024

Recommended Corrective Actions:

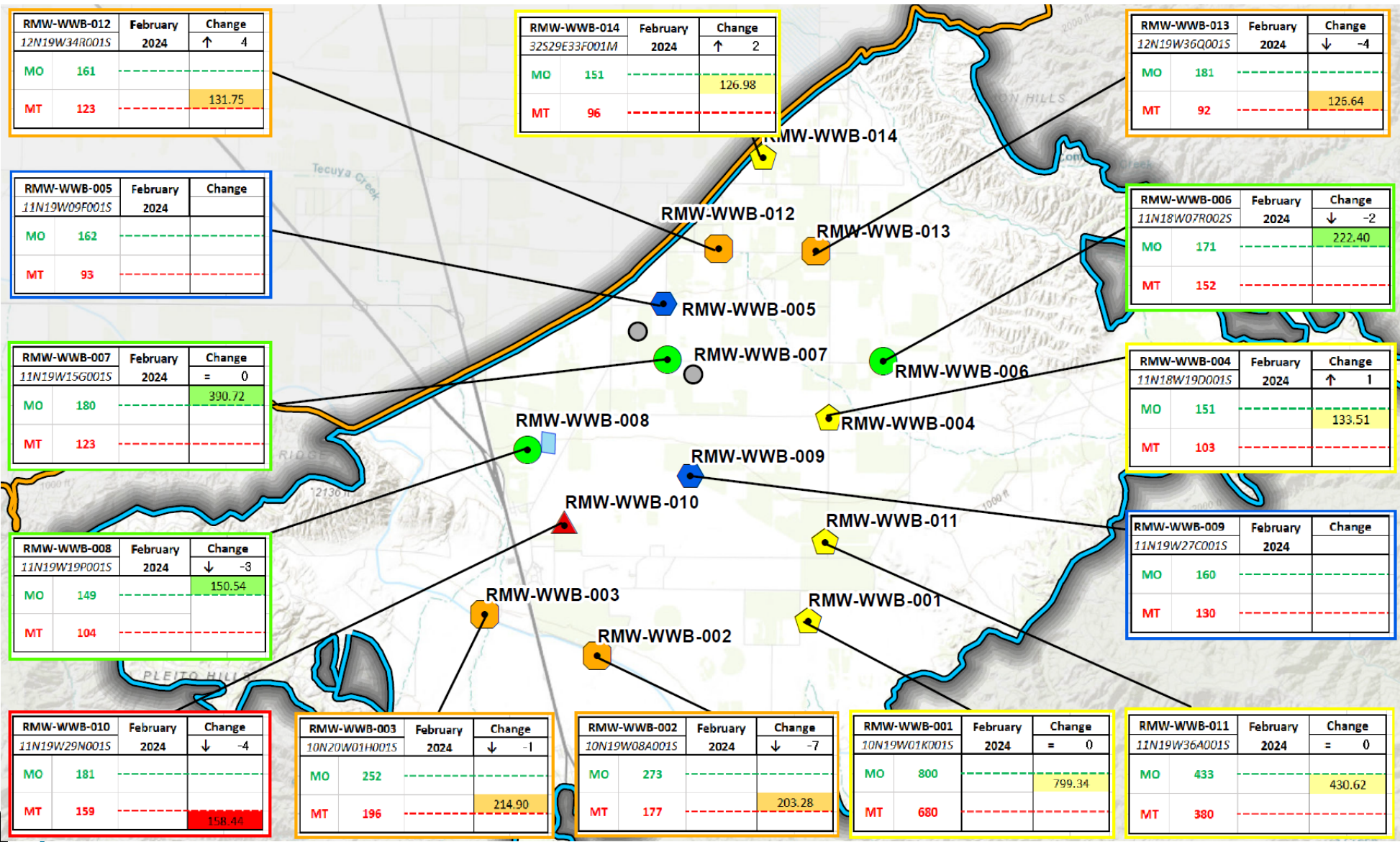
1. Develop and incorporate a projected water budget for the surface water system as required by the GSP Regulations.
2. Revise the sustainable management criteria to be based on seasonal low groundwater levels to ensure potential impacts to beneficial uses and users are considered.
3. Establish sustainable management criteria for land subsidence based on direct measurements of land elevation changes to assess and confirm that no significant and unreasonable land subsidence is occurring.
4. Expand the land subsidence monitoring network to provide sufficient coverage of the Subbasin. The GSA may consider the use of additional GPS stations, extensometers, or publicly available remote sensing data (e.g., InSAR) to expand the land subsidence monitoring network in the Subbasin.

RESPONSE TO NATURE ARTICLE

- Annual report will highlight the GSA is working to implement P/MAs, including recharge projects that will improve the declining water levels generally observed since 2015
- WY 2023 estimated groundwater storage increased substantially, and groundwater levels were stable to increasing over the water year
- Consideration for Board: request a “big check” ceremony with DWR for the SGMA Implementation Round 2 grant award?

UPDATE ON GSP IMPLEMENTATION ACTIVITIES

FEB. 2024 MEASUREMENTS COMPARED TO SMCs



Legend

Representative Monitoring Well Status as of February 2024

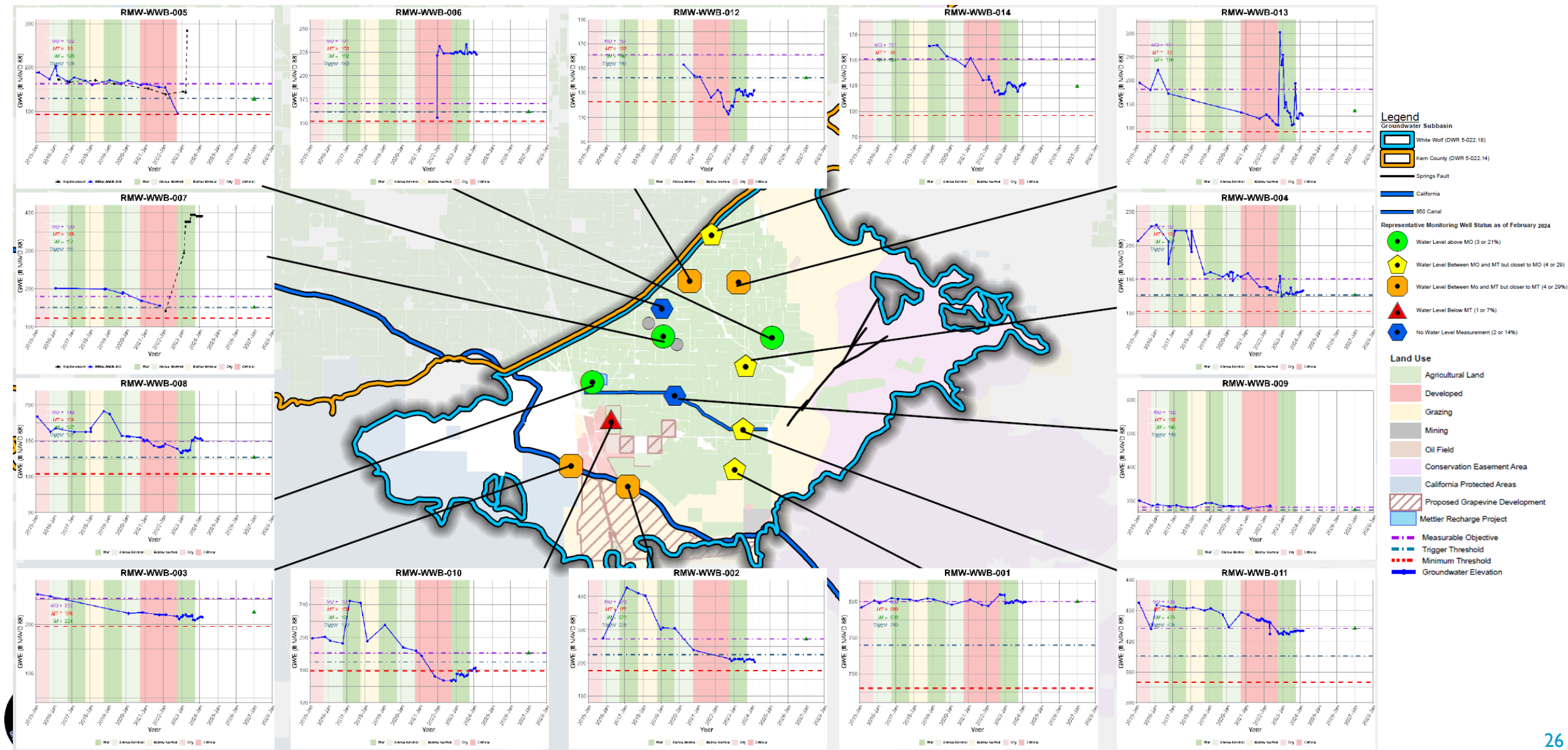
- Water Level above MO (3 or 21%)
- Water Level Between MO and MT but closer to MO (4 or 29%)
- Water Level Between MO and MT but closer to MT (4 or 29%)
- ▲ Water Level Below MT (1 or 7%)
- No Water Level Measurement (2 or 14%)
- Old RMW-WL

Metzler Recharge Project Groundwater Subbasin

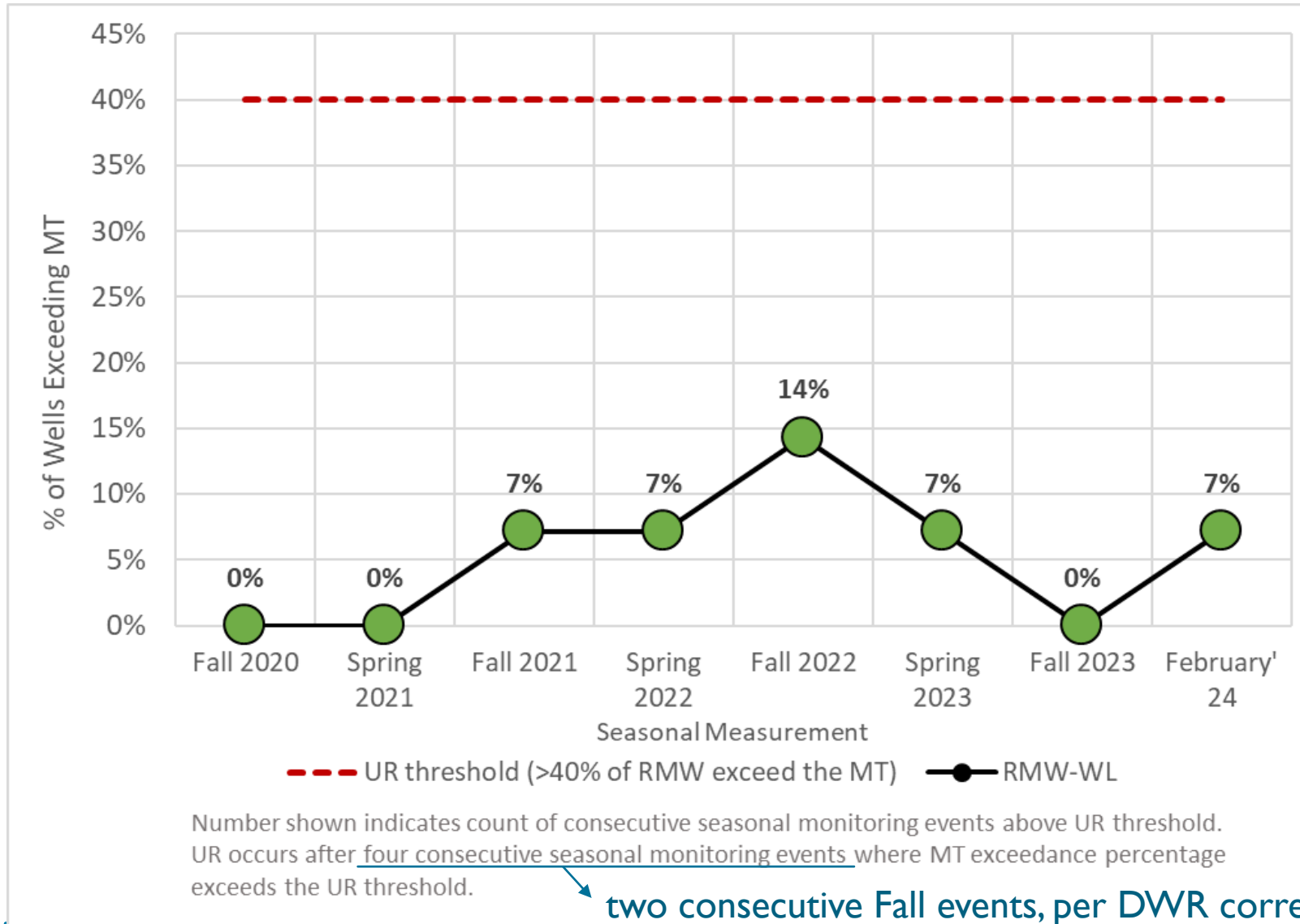
- White Wolf (DWR 5-022.18)
- Kern County (DWR 5-022.14)



RMW-WL HYDROGRAPHS



UNDESIRABLE RESULTS (UR) TRACKING



- WL UR not occurring
- Official “Spring” measurement is February or March
- If MT exceedance remains in March, will trigger investigation per MT exceedance policy



MONITORING WELL SITING UPDATE

- ✓ Well #1 – Replace RMW 009 on current APN /WVRM PB-I
- Well #2 – Replace RMW 005, near WWB boundary.
- Well #3 – Replace RMW 007
- For Well #2 and Well #3, exploring options, including:
 - Current APNs – private owner;AEWSD has initiated discussions
 - AEWSD pumping plants – investigating spatial limitations
 - Exploring other APNs / private landowners in the vicinity
- Final recommendation for locations will assess drill rig access, historical groundwater level trends, and ability to quantify cross-boundary flows.

