



# EVALUATING WELL PRODUCTION SUSTAINABILITY IN AN EXTENSIVELY DEVELOPED GROUNDWATER BASIN

Presented to:  
**ARIZONA HYDROLOGICAL SOCIETY**  
**2021 ANNUAL SYMPOSIUM**  
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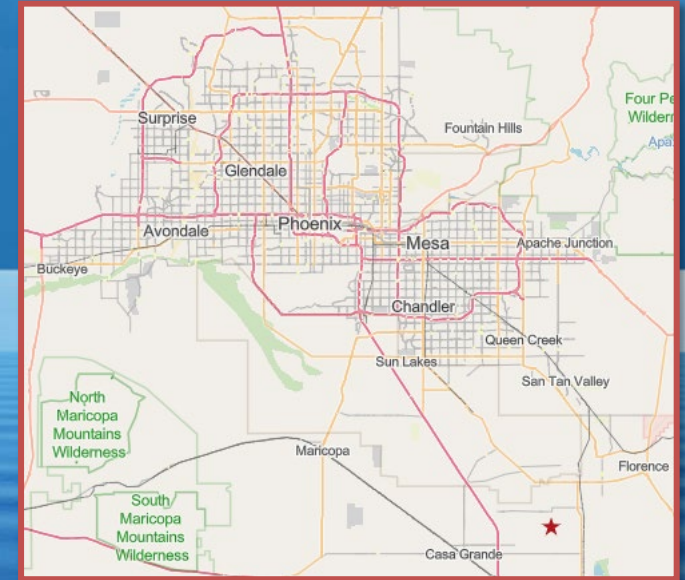


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# SUNDANCE GENERATING STATION



# POWER GENERATION SUPPORTED BY CAP WATER



# REVERSE OSMOSIS REJECT BLENDED WITH GROUNDWATER TO IRRIGATE CROPS



# PLANT OPERATIONAL WATER USE

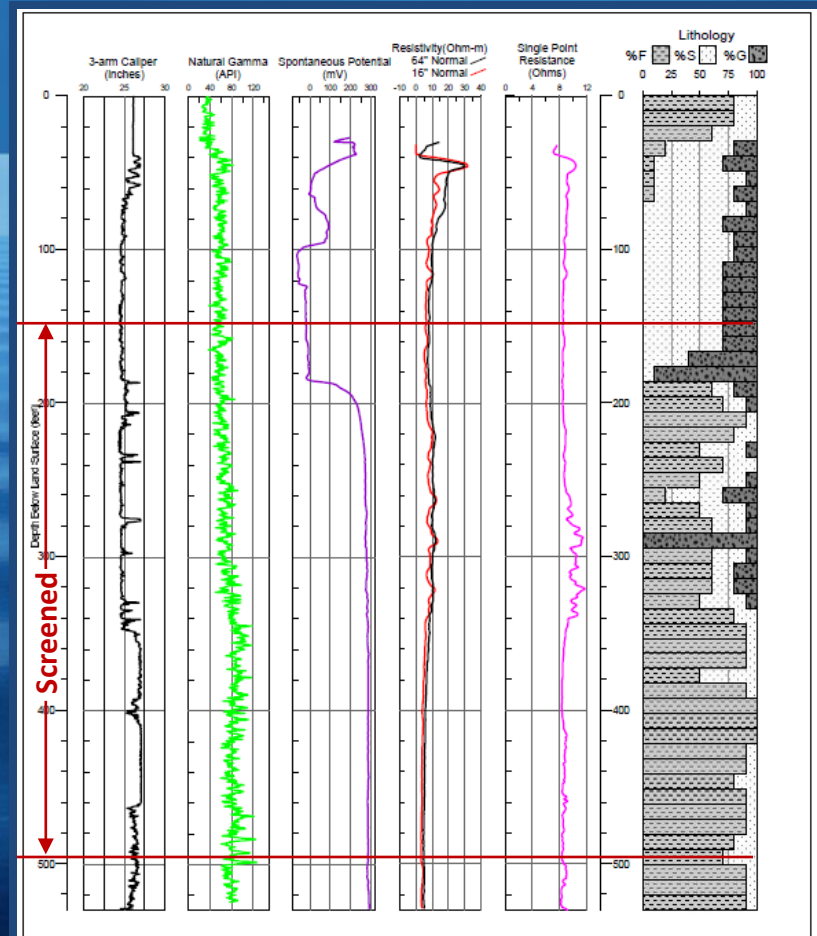
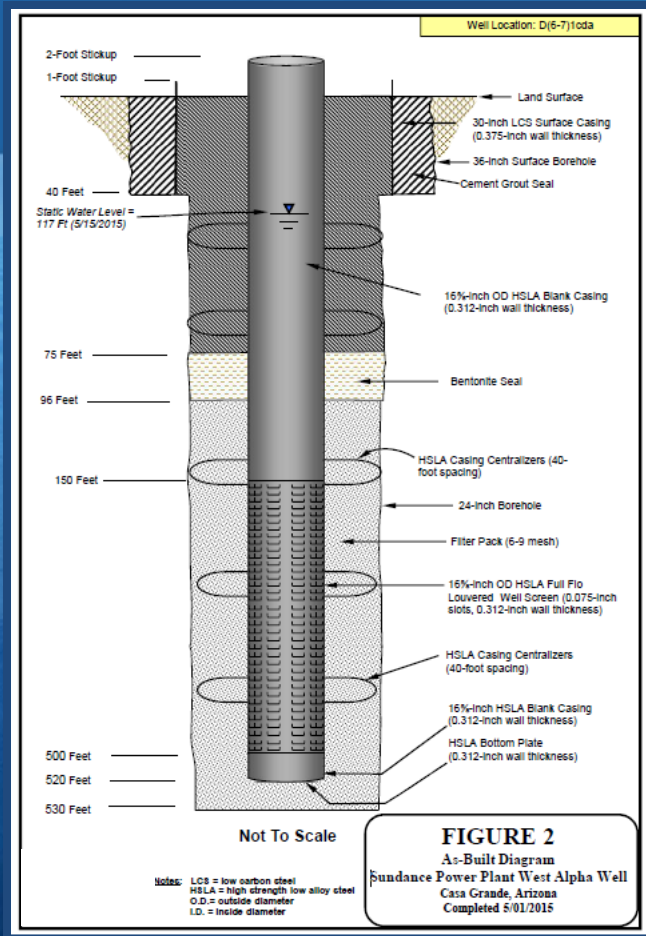
Year	CAP (acre-ft)	Reuse (acre-ft)	Groundwater (acre-ft)	Generation (MWH)
2010	118	27	237	107,797
2011	128	22	253	117,820
2012	157	53	271	134,675
2013	103	98	90	134,676
2014	73	y	197	52,856
2015	52	y	318	56,518
2016	159	15	320	234,920
2017	241	93	335	381,338
2018	254	64	579	364,134
2019	194	34	775	303,178
2020	282	52	663	419,319



# MAINTAINING GROUNDWATER PUMPING IS CRITICAL TO PLANT OPERATIONS



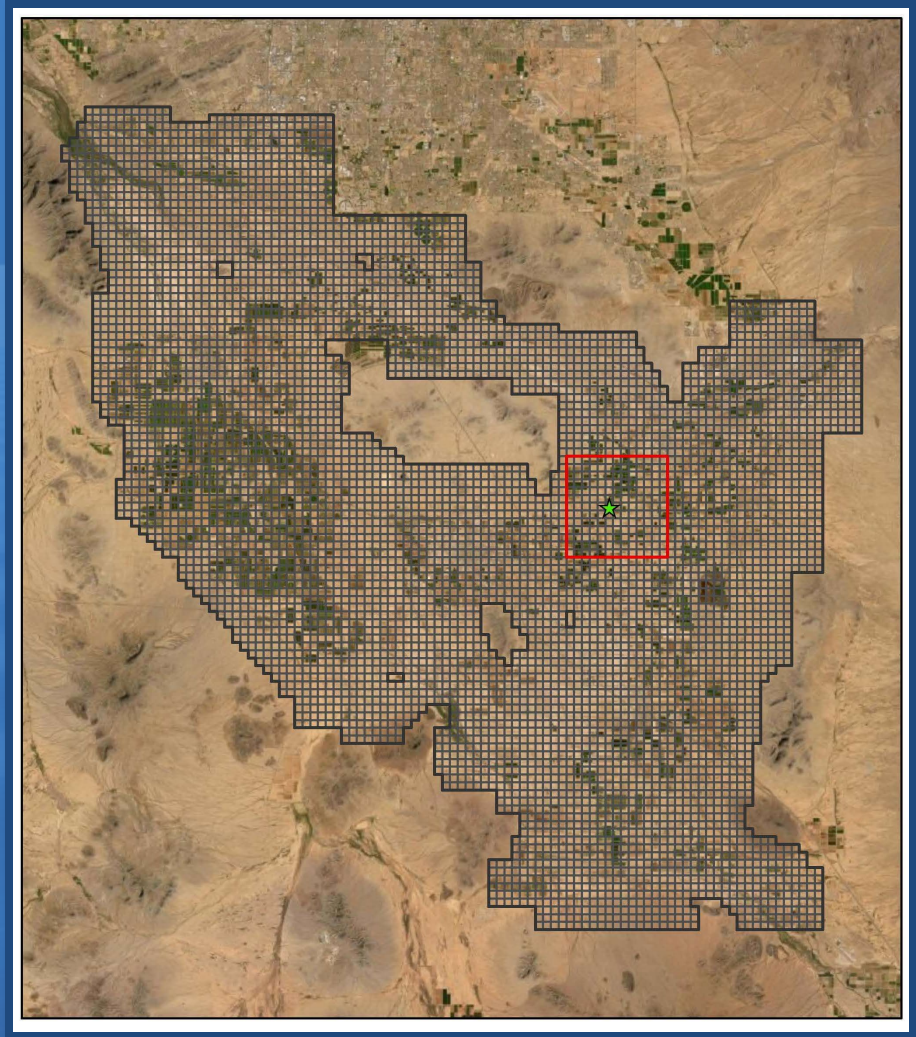
# WEST ALPHA IRRIGATION WELL





# ADWR MODEL

- Started with Pinal AMA model (1,500 mi<sup>2</sup>)
- 2014, updated in 2019



# APS SUNDANCE MODEL

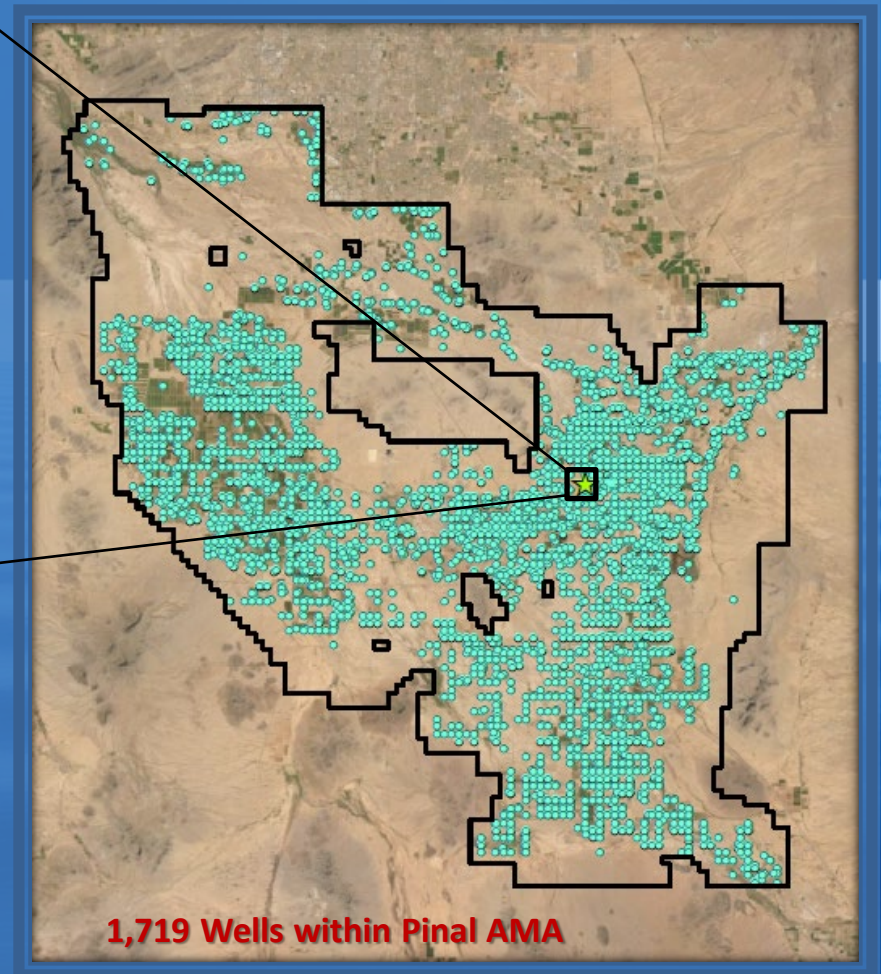
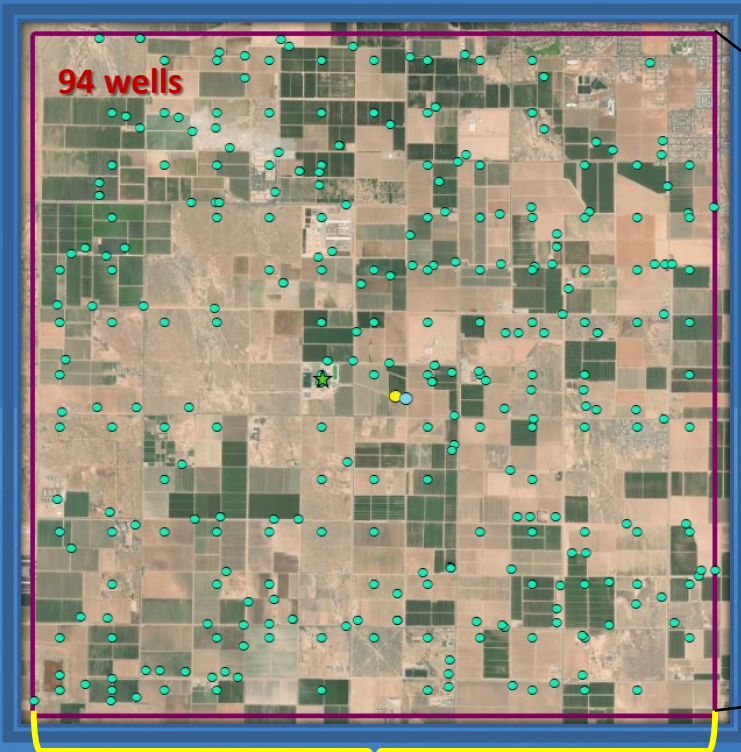
## MODFLOW 2005

- Developed refined model in vicinity of Sundance power plant
- Used 2019 ADWR model historic simulation from 1923-2015 to develop starting head distribution for future transient model
- Developed future 50-yr predictive scenarios

## MNW2 package

- All wells in model included
- Prediction of water level drawdown at APS wells
- Simulate well completions across multiple hydrogeologic units
- Calibrate well response to drawdown data
- Simulate continued pumping at non-APS wells for worst-case aquifer decline. No dry wells.





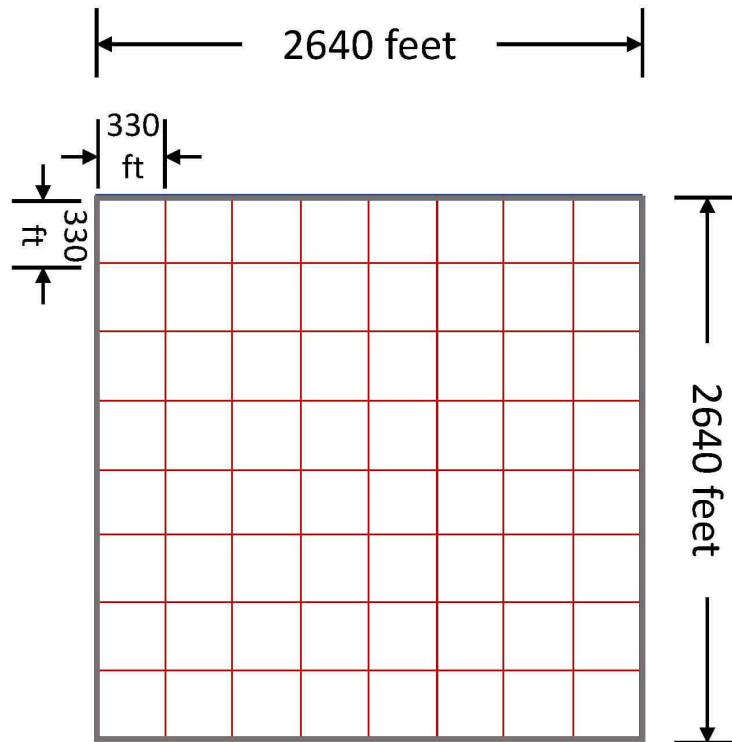
★ Sundance Power Station

APS Pumping is less than 0.2 % of pumping within Pinal AMA



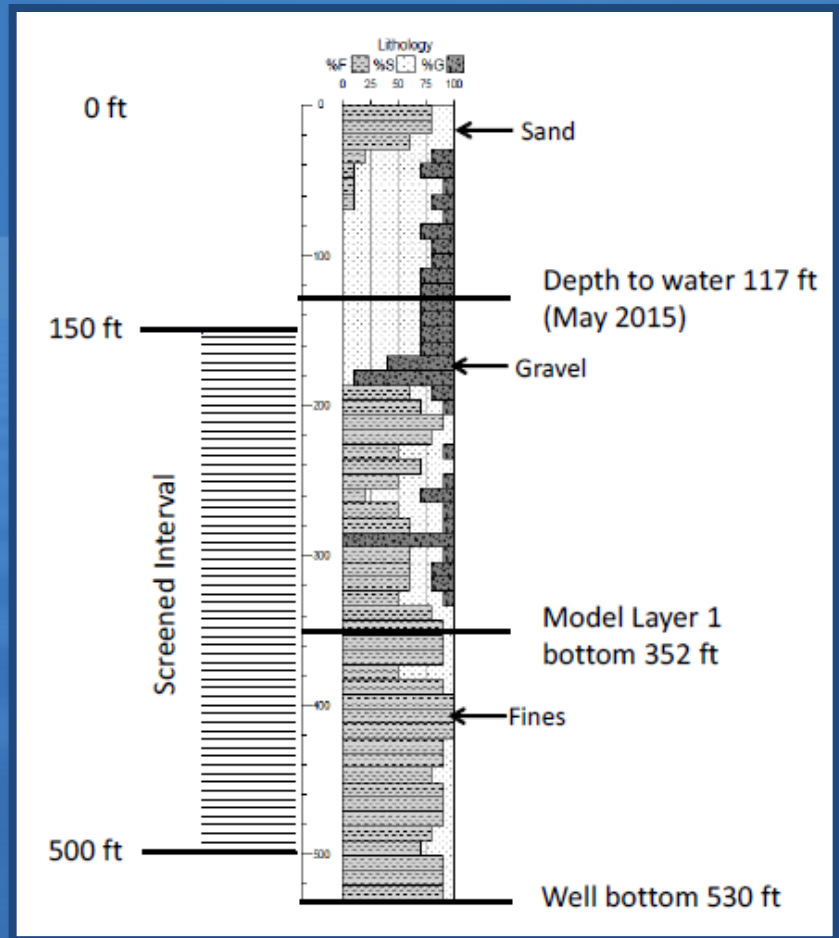
# SUNDANCE MODEL DISCRETIZATION

Pinal model grid cell size is 2640 ft x 2640 ft  
Sundance model grid cell size is 330 ft x 330 ft



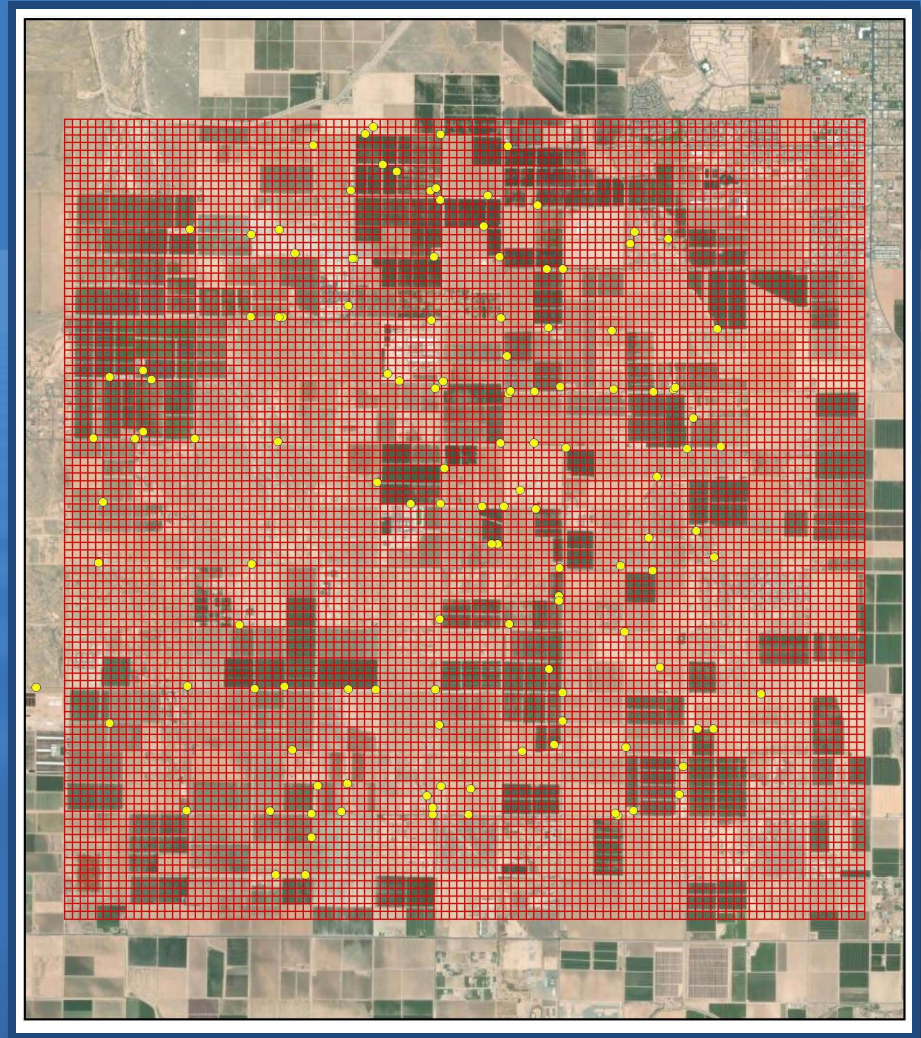
# MODEL LAYERS

- Upper alluvial unit  
( $k = 2-100$  ft/day)
- Middle silt and clay unit  
( $k = 2-30$  ft/day)
- Lower conglomerate unit  
( $k = < 5$  ft/day)

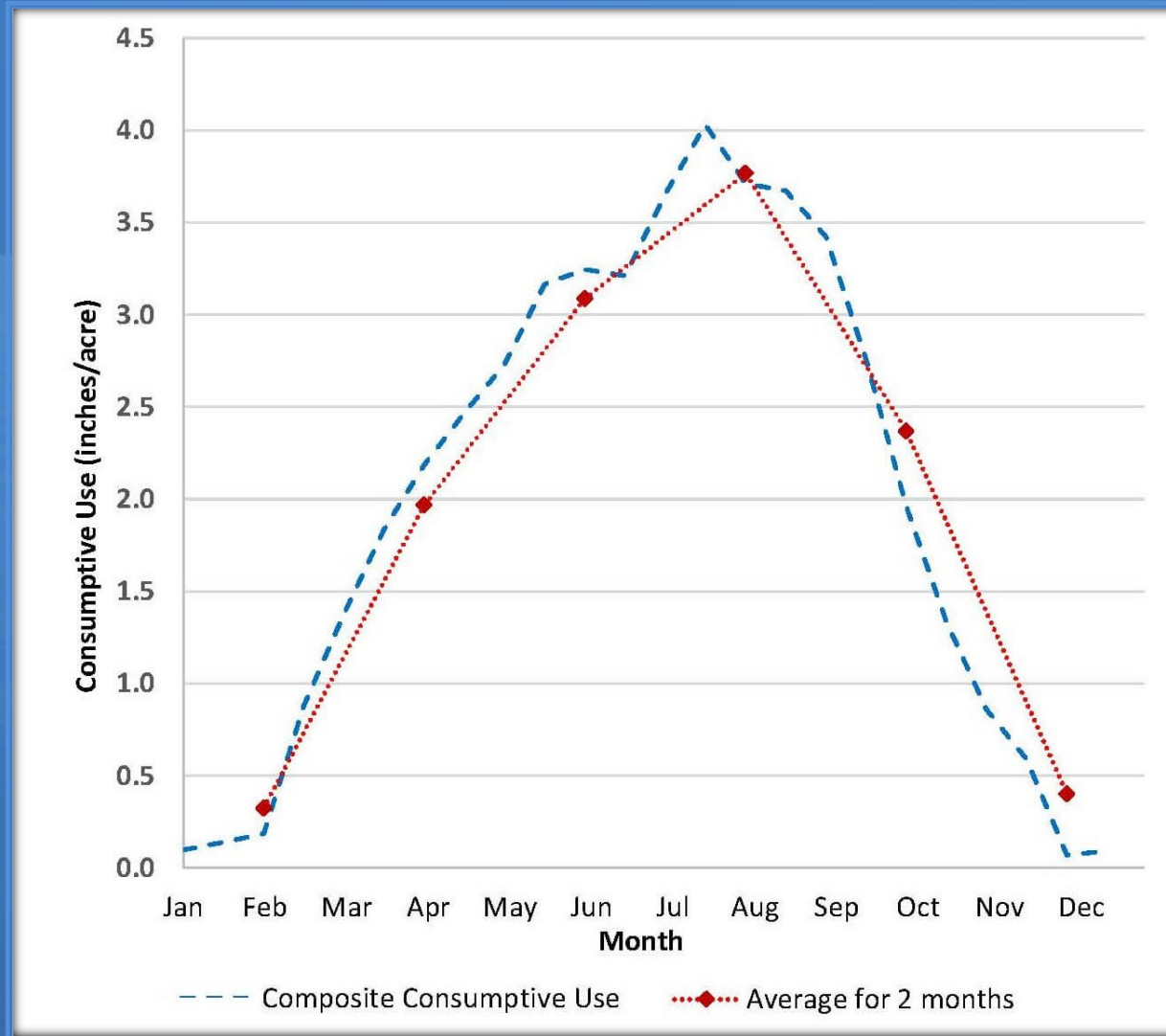


# MODEL WELLS

- 94 total wells
- Most in Layers 1 and 2 (27% in Layer 3)
- Pumping rates can be reduced with time with increased pumping



# PINAL COUNTY COMPOSITE CONSUMPTIVE USE 2017



# GROUNDWATER PUMPING and CAP WATER

District	Average 2011-2015 (af/yr)		Total	% Increase in Ag pumping
	CAP delivery <sup>1)</sup>	Ag pumping		
CAIDD <sup>2)</sup>	116,514	143,837	260,351	1.81
MSIDD <sup>3)</sup>	119,015	115,579	234,594	2.03
HIDD <sup>4)</sup>	37,950	35,782	73,732	2.06
SCIDD <sup>5)</sup>	13,708	15,628	29,336	1.88

1) CENTRAL ARIZONA PROJECT TO EACH DISTRICT

2) CENTRAL ARIZONA IRRIGATION DRAINAGE DISTRICT

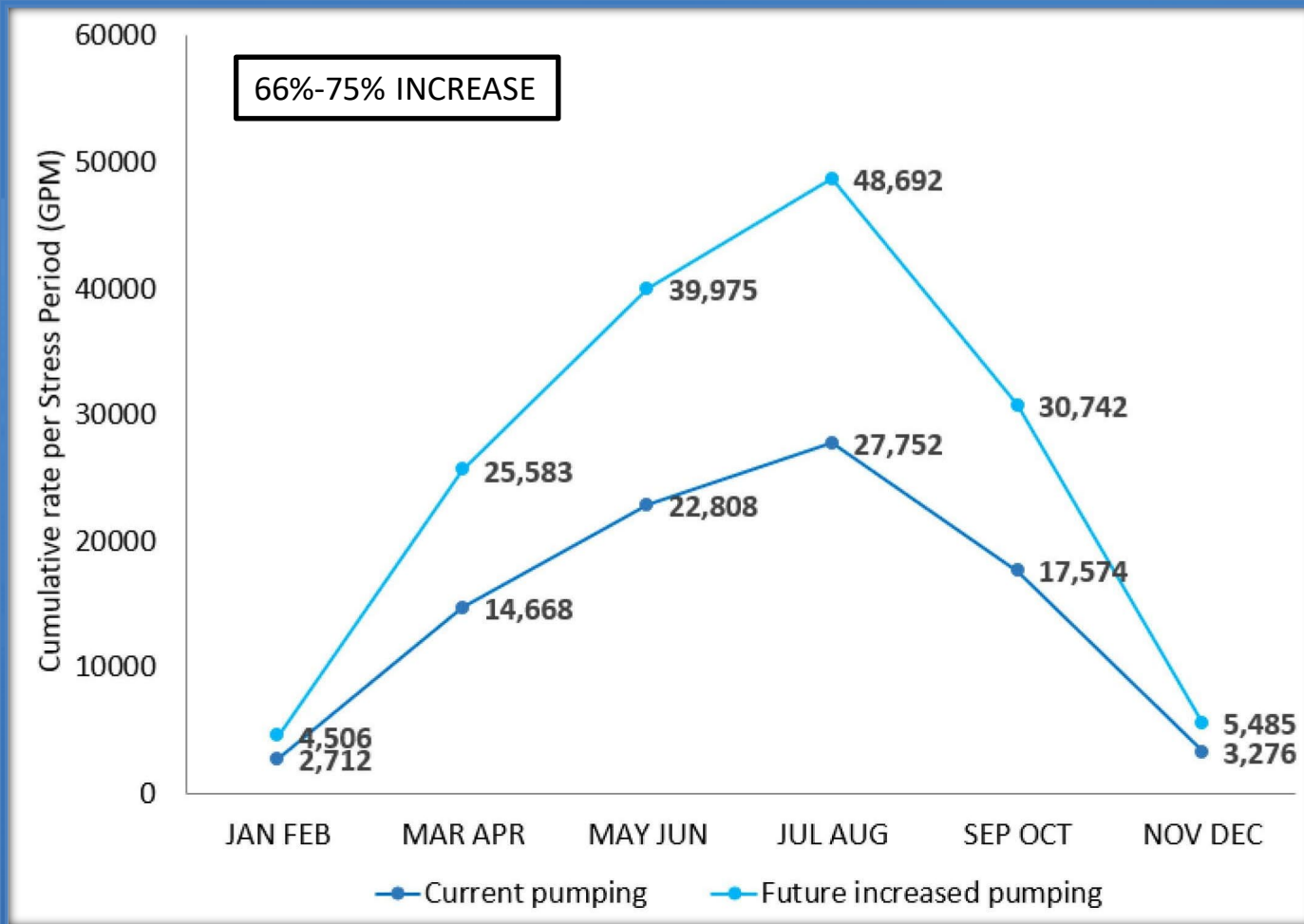
3) MARSTAN IRRIGATION DRAINAGE DISTRICT

4) HOHOKAM IRRIGATION DRAINAGE DISTRICT

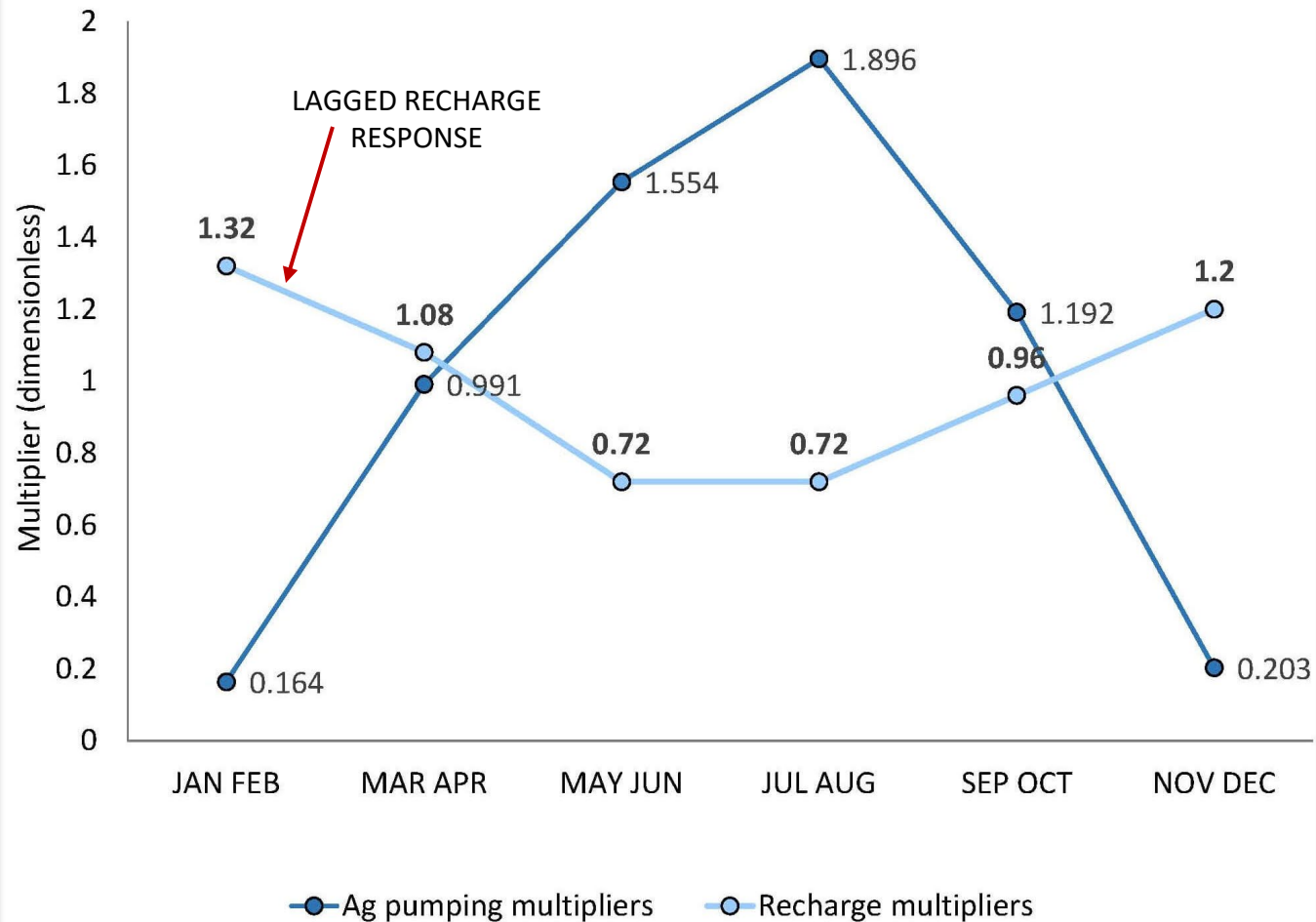
5) SAN CARLOS IRRIGATION DRAINAGE DISTRICT



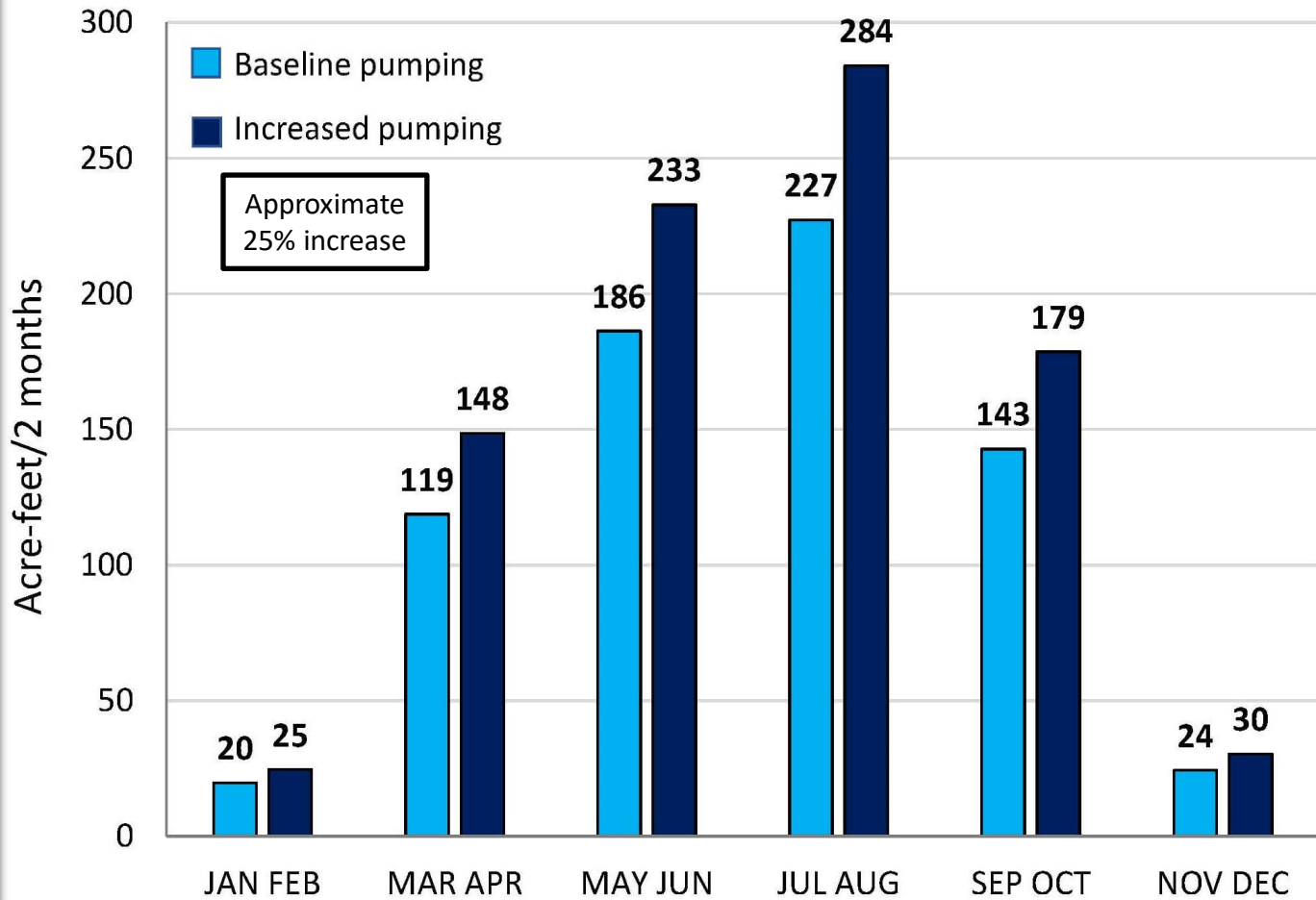
# CUMULATIVE PUMPING BY STRESS PERIODS IN ONE YEAR



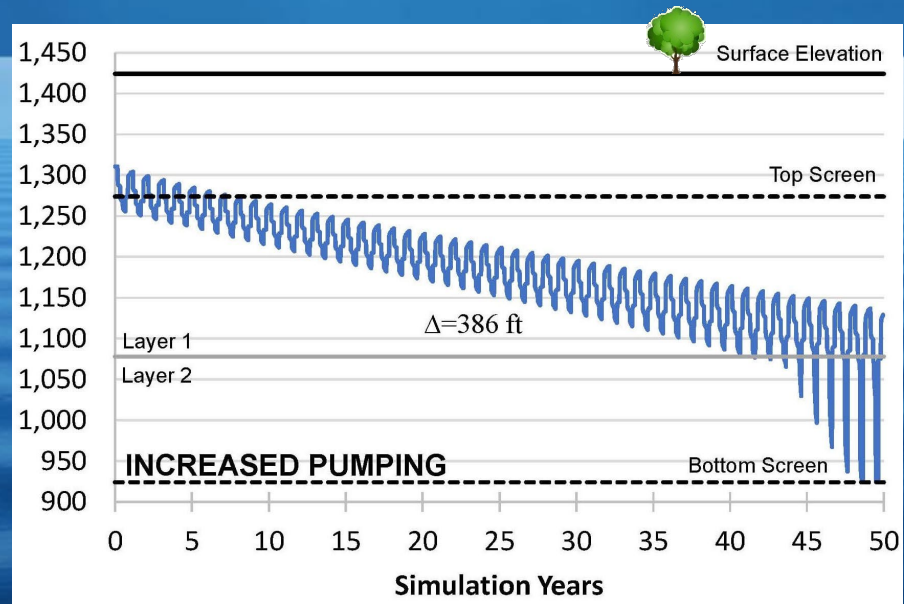
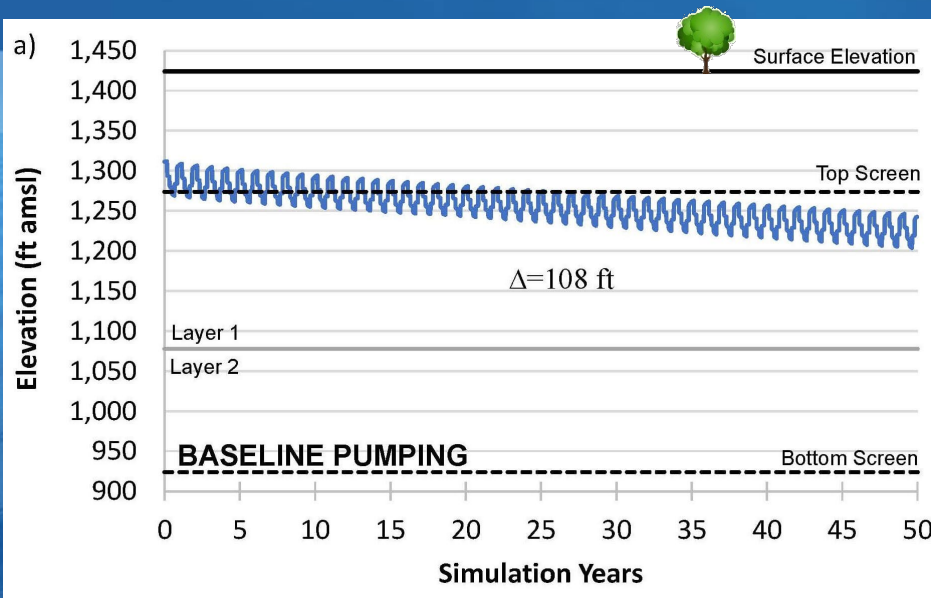
# STRESS PERIOD MULTIPLIERS



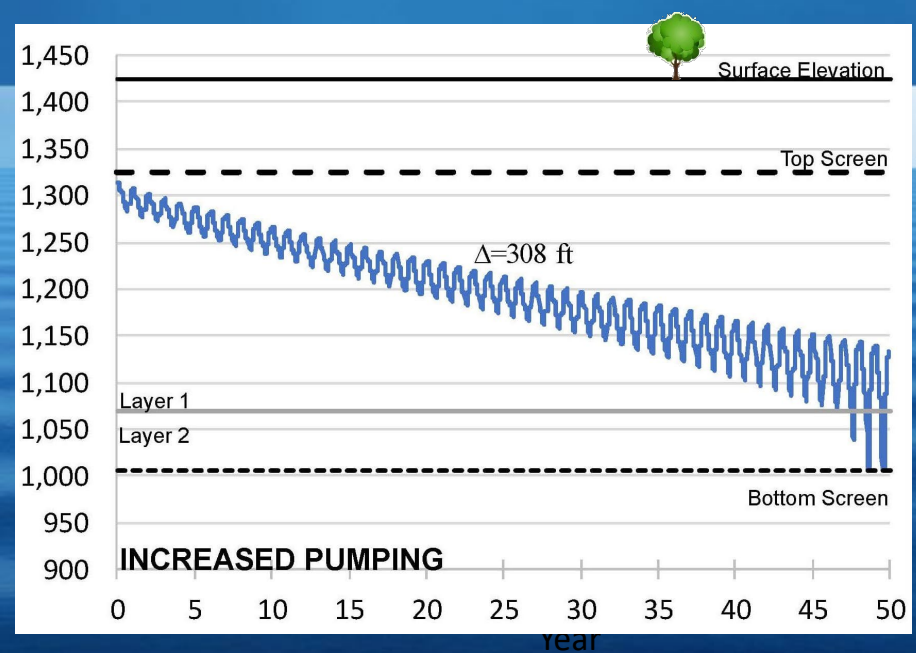
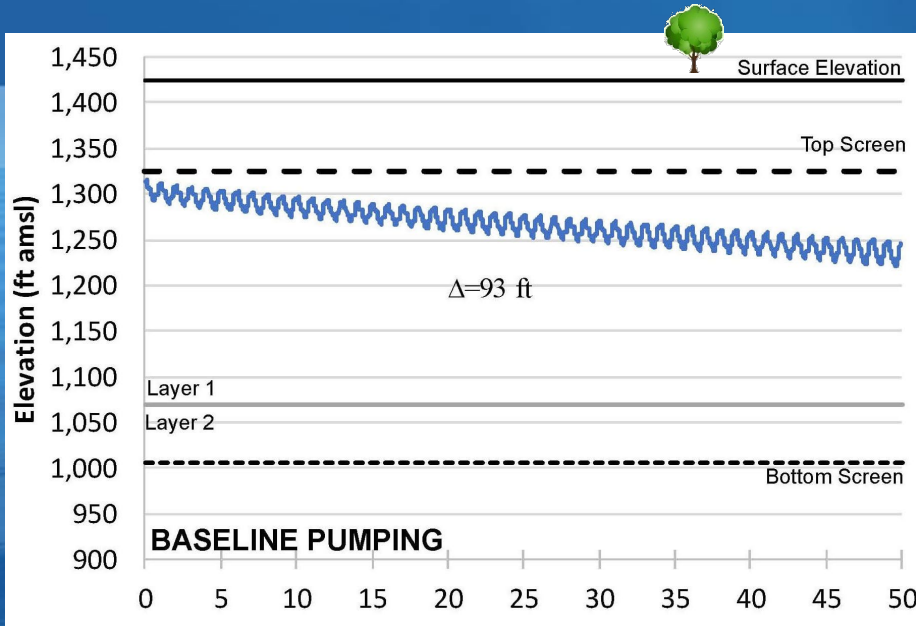
### APS Wells Total Simulated Pumping rate



# WATER LEVELS – WEST ALPHA WELL



# WATER LEVELS – EAST WELL



# CONCLUSIONS

- ✓ Aquifer overdrafted some now based on gradually declining water levels
- ✓ Overdraft will likely increase in the future with loss of CAP water
- ✓ APS well production is sustainable at current rates and volumes at least 50 years into future
- ✓ Some minor loss of production (2-7%) estimated in last 2 years of the 50-yr simulation in July-August period
- ✓ Uncertainty in future stresses on the aquifer related to subsidence, CAP water availability, future irrigation practices, changes in cropping, and/or changes in land uses.

# THANK YOU!



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