Livermore Valley Hydrogeological Investigations and Groundwater Model Update Project

Zone 7 Board Meeting

September 17, 2025

Strategic Goals and Initiatives

Strategic Goals

Initiatives

# 5	Develop a diversified water supply plan and implement supported projects and programs
# 9	Implement the PFAs Management Strategy
# 11	Manage the Groundwater Sustainability Agency and implement the Groundwater Sustainability Plan

ZONE 7 WATER AGENCY

Project Goals and Objectives

Project Goal:

To refine and upgrade the Basin groundwater model using best available data and methodologies to support Zone 7's sustainable groundwater management and operational decision making.

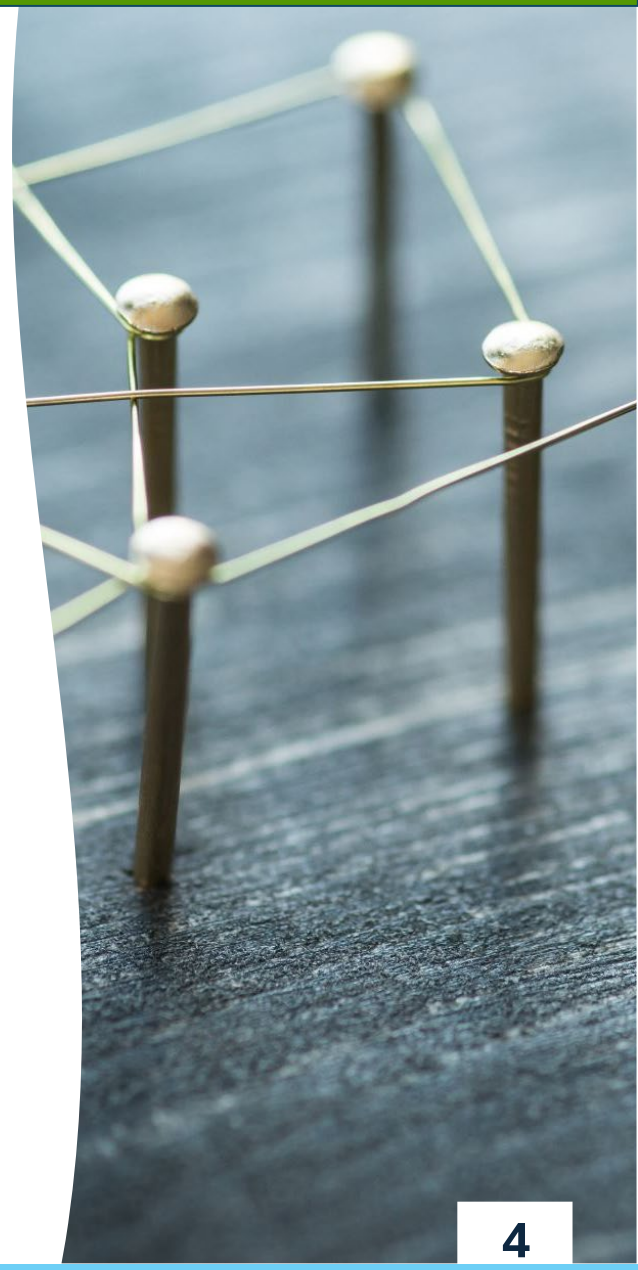
Project Objectives:

- To define Basin characteristics and fill data gaps.
- To refine the Basin Hydrogeologic Conceptual Model (HCM)
- To rebuild, extend, and recalibrate the Basin groundwater model.
- To analyze the Regional Groundwater Facilities Project alternatives and groundwater sustainability and PFAS mobilization
- To develop a Decision Support Tool to assist with Zone 7's well permitting and sustainable groundwater management

ZONE 7 WATER AGENCY

Discussion Topics

1. **Model Update Process**
   - Hydrogeologic Field Investigations
   - Hydrogeologic Conceptual Model Updates
   - Groundwater Model Update and Calibration
2. **Putting the updated model to use**
   - Modeling analysis of Regional Groundwater Facilities Project Alternatives (Regional Project)
3. **Conclusions and Next Steps**
4. **Questions and Answers**



ZONE 7 WATER AGENCY

Model Update Process:
Hydrogeologic Field Investigations

ZONE 7 WATER AGENCY

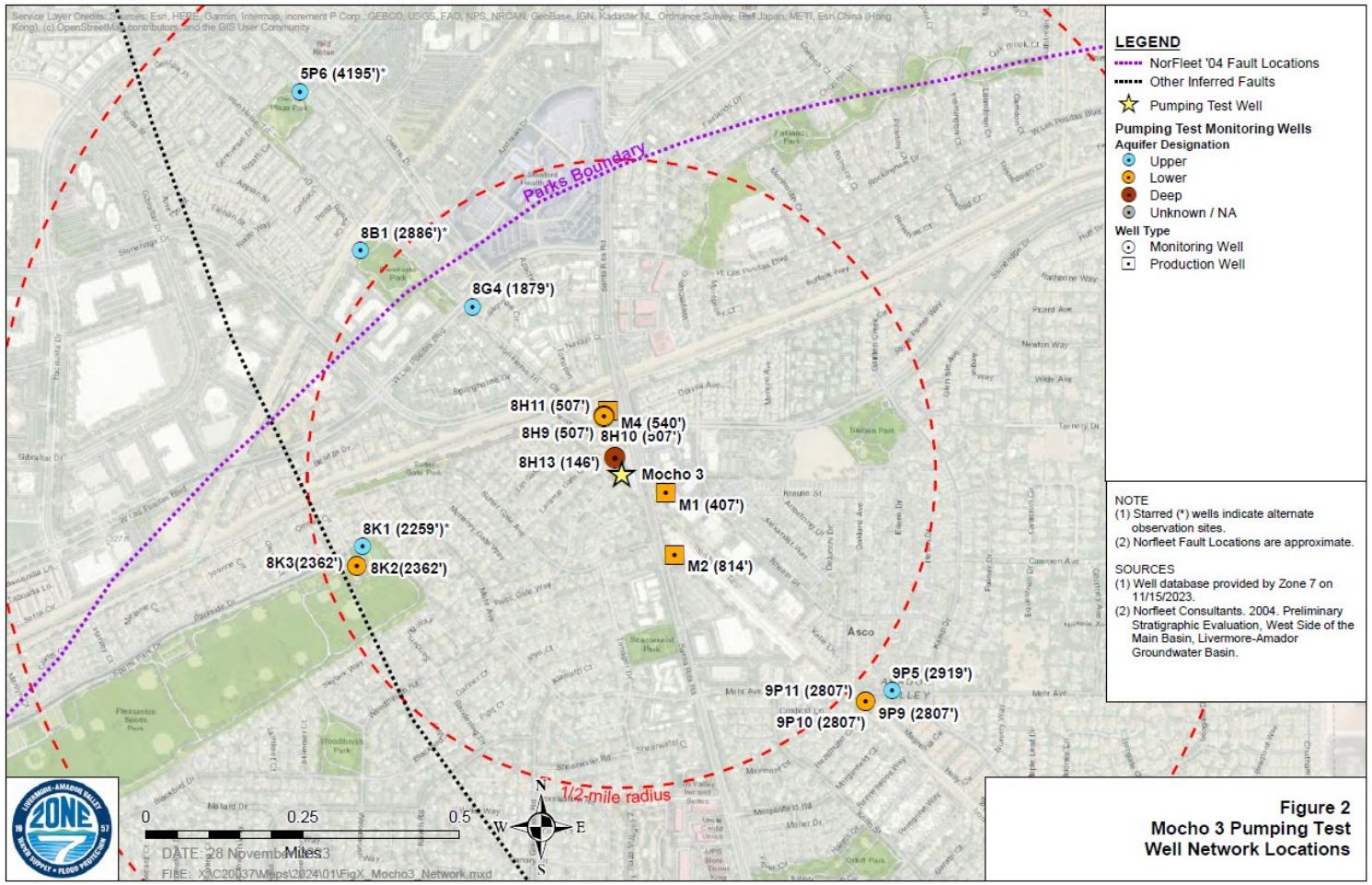
HYDROGEOLOGIC FIELD INVESTIGATIONS

Conduct field investigations to define ***Basin characteristics and to fill data gaps.***

- **Aquifer pumping tests** at Zone 7 and California Water Service wells
- New **geophysical surveys** including:
  - Seismic Refraction
  - Electrical Resistivity Tomography (ERT)
  - Stationary Time-Domain Electromagnetics (sTEM)
- New DWR **Airborne Electromagnetic (AEM)** surveys

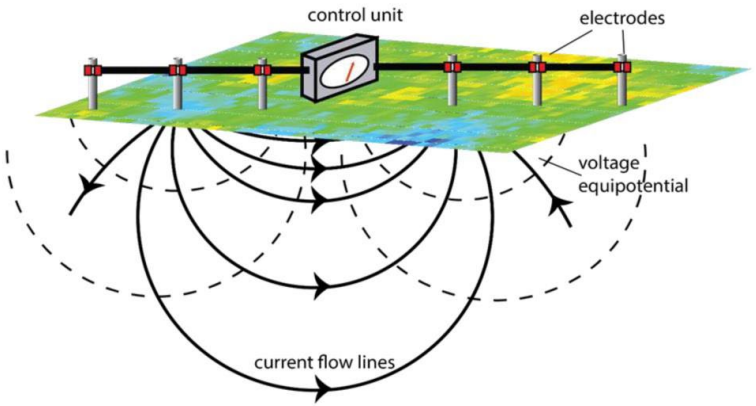
MOCHO 3 AQUIFER PUMPING TEST DESIGN

- **72-hour** constant rate test (+ 72-hour recovery), completed in February 2024
- Monitored **15 wells** within and surrounding Zone 7's Mocho production wellfield, including new PFAS sentinel wells (8K2 & 8K3)
- Used to: (1) improve estimates of aquifer storage and transmissivity, (2) improve understanding of hydraulic connectivity and heterogeneity underlying Mocho wellfield vicinity

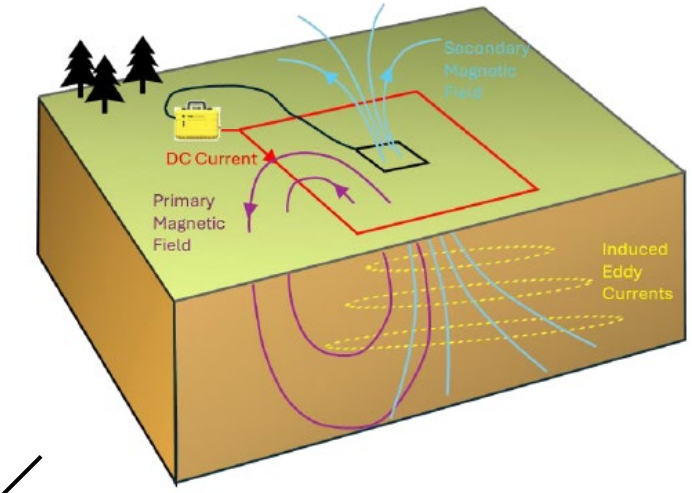


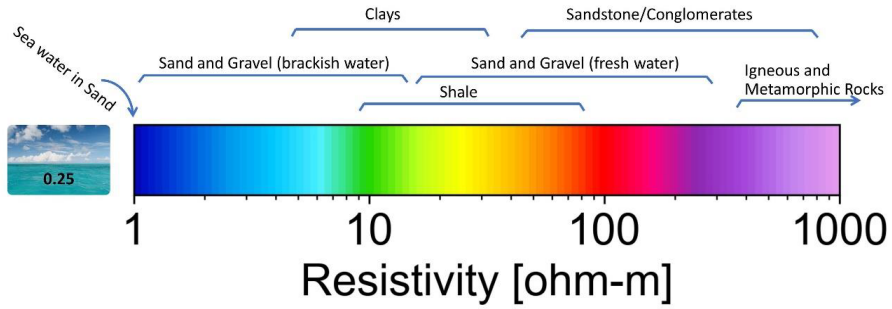
GEOPHYSICAL SURVEY METHODS

Electrical Resistivity Tomography (ERT)

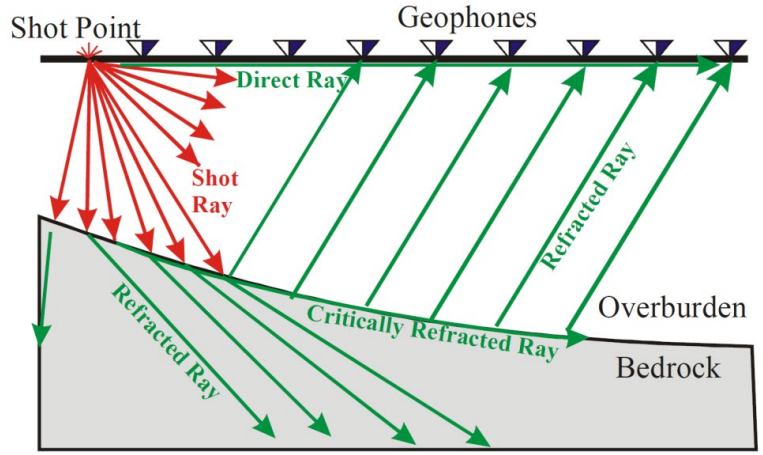


Stationary Time-Domain Electromagnetics (sTEM)





Seismic Refraction



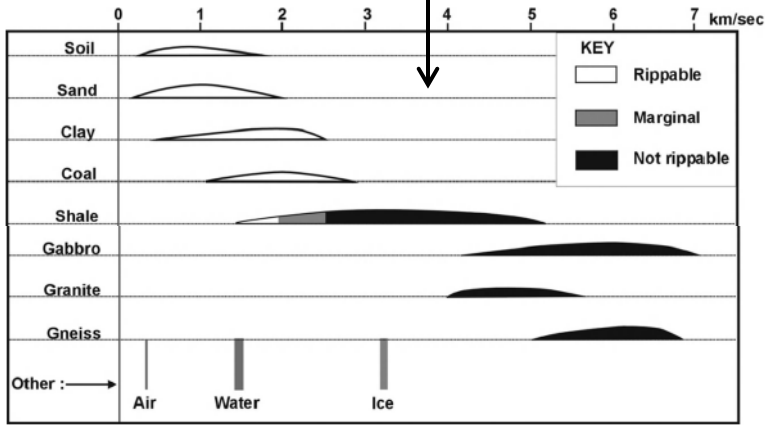
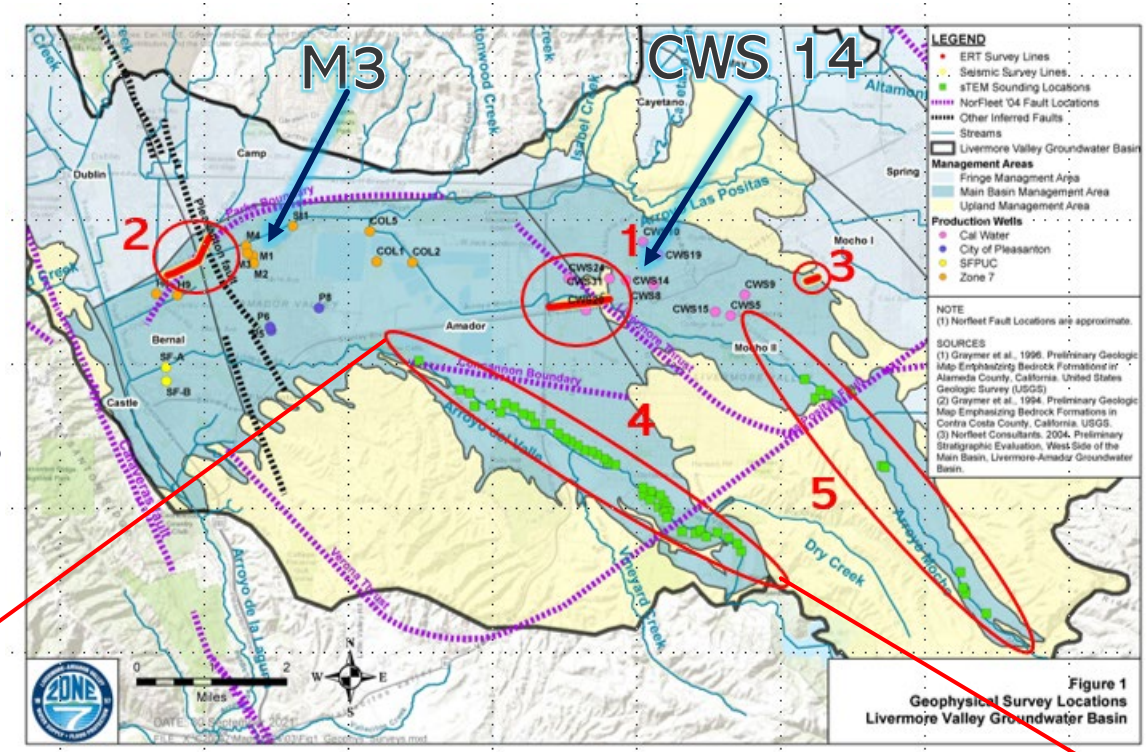


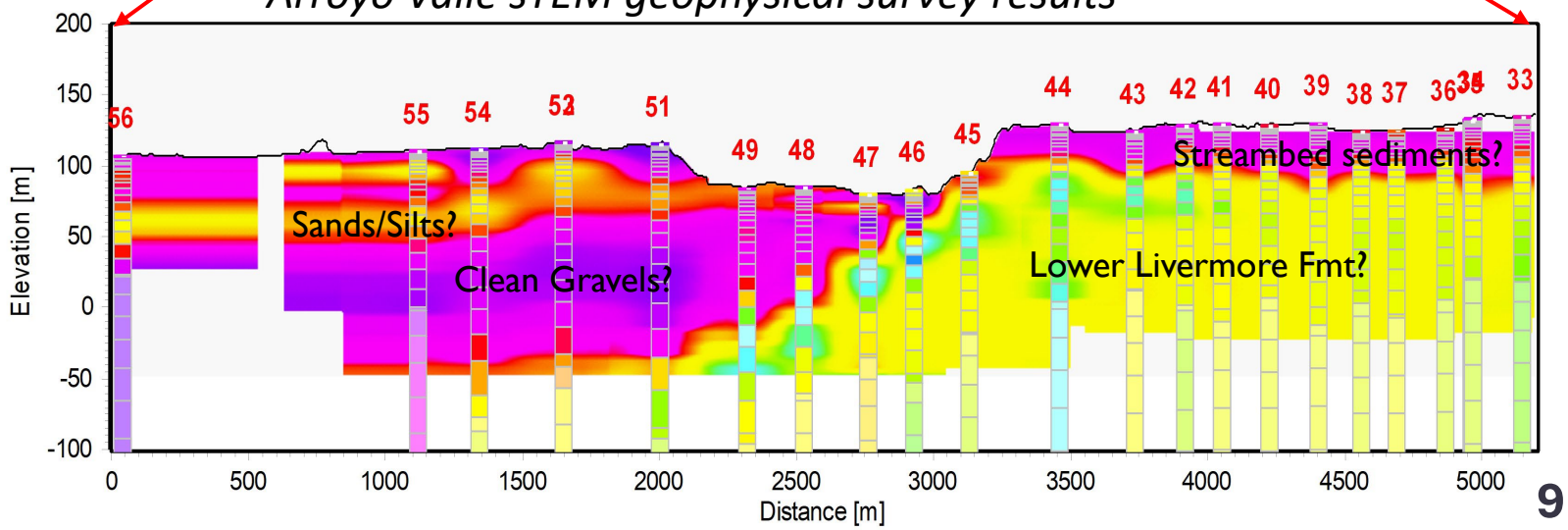
Figure 12 Ranges of P-wave velocities (in km/s) in common sediments and rocks (after Milsom and Eriksen, 2011). 1 km/s equals 3,280 ft/s.

HYDROGEOLOGIC FIELD INVESTIGATIONS

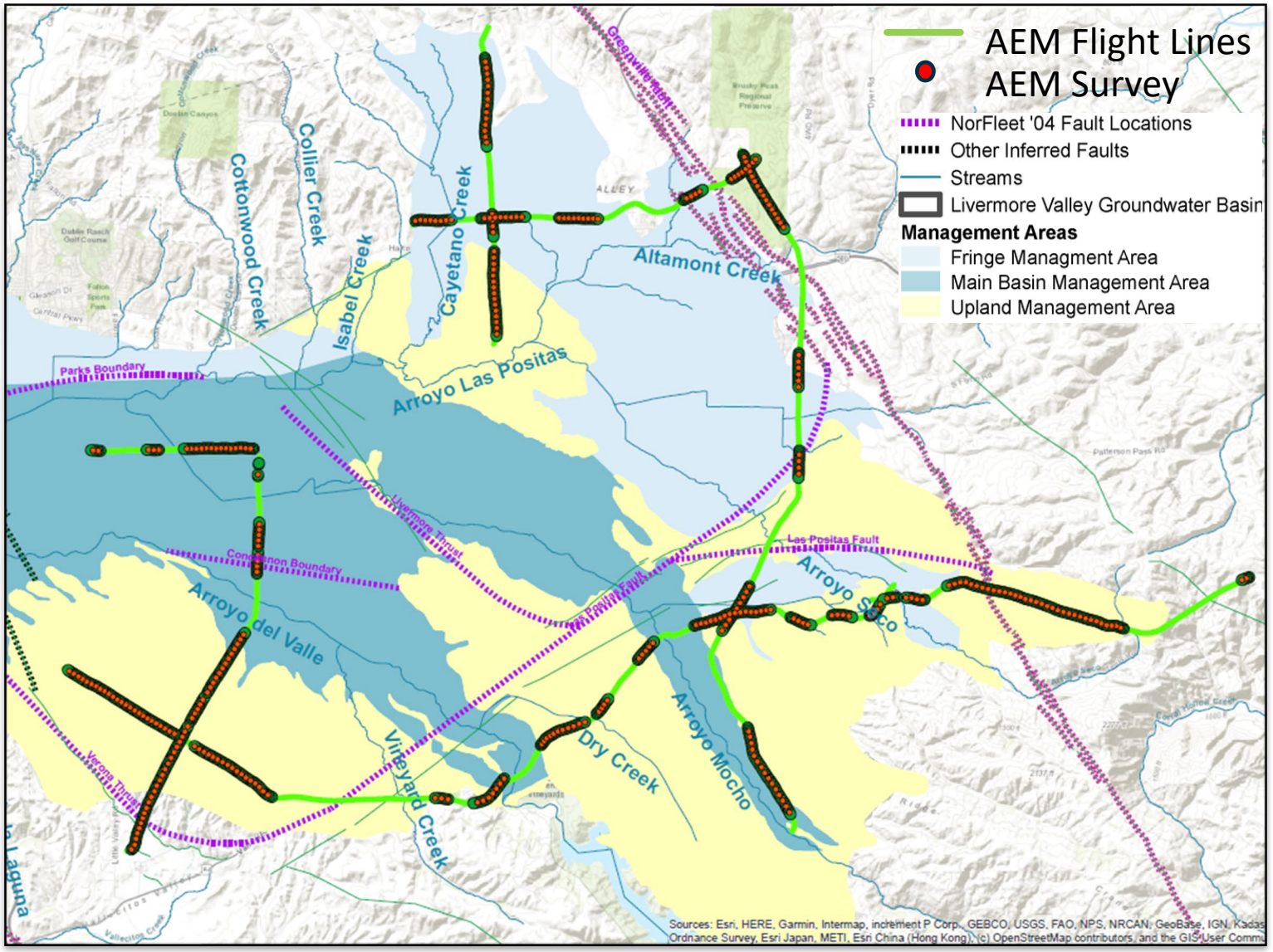
- Completed **5 new geophysical surveys** to improve conceptual understanding and geometric representation of major hydraulic features that influence groundwater conditions within the Basin
- Completed two aquifer pumping tests at Zone 7 **Mocho 3** and Cal Water **CWS-14** production wells to improve understanding of aquifer hydraulic properties and heterogeneity

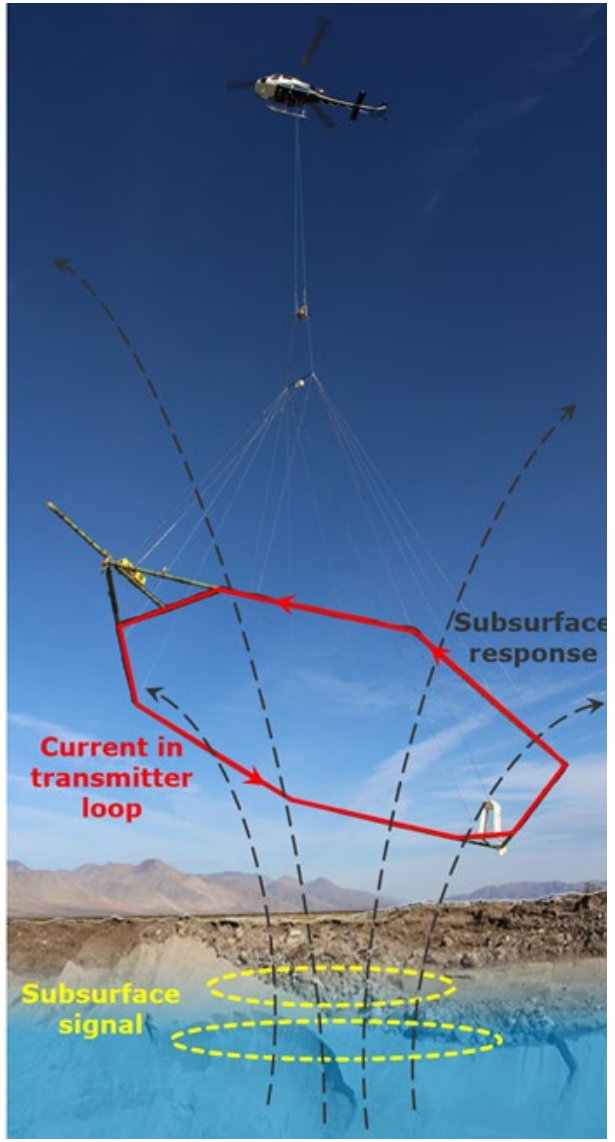


Arroyo Valle sTEM geophysical survey results



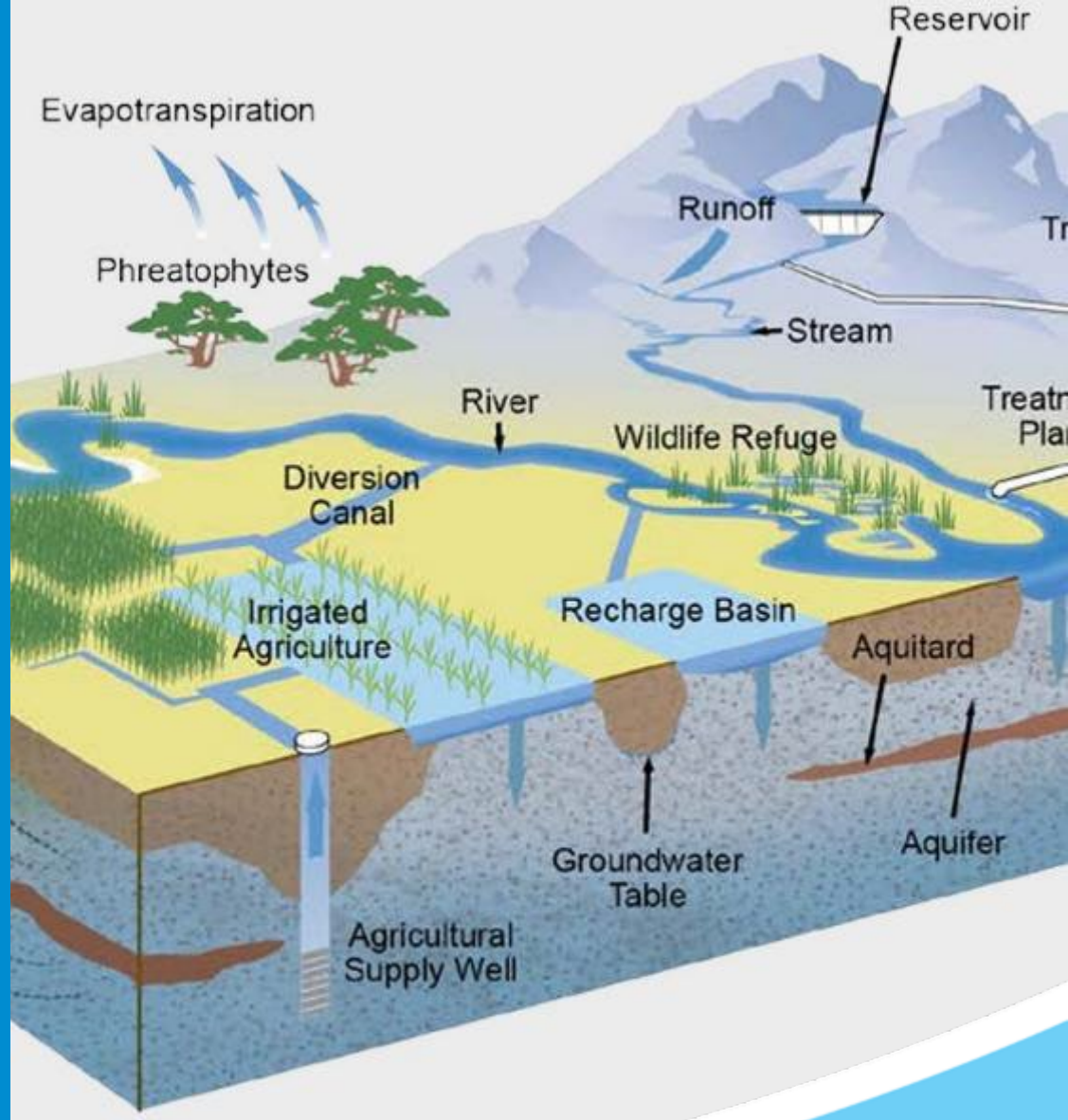
DWR'S AERIAL ELECTROMAGNETIC (AEM) SURVEYS





eki GEOPHYSICAL IMAGING PARTNERS

Model Update Process: Hydrogeologic Conceptual Model (HCM) Update

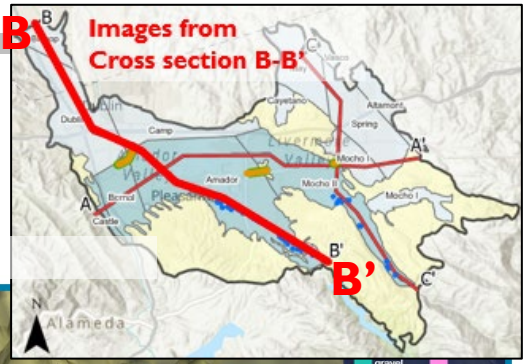


Credit: DWR

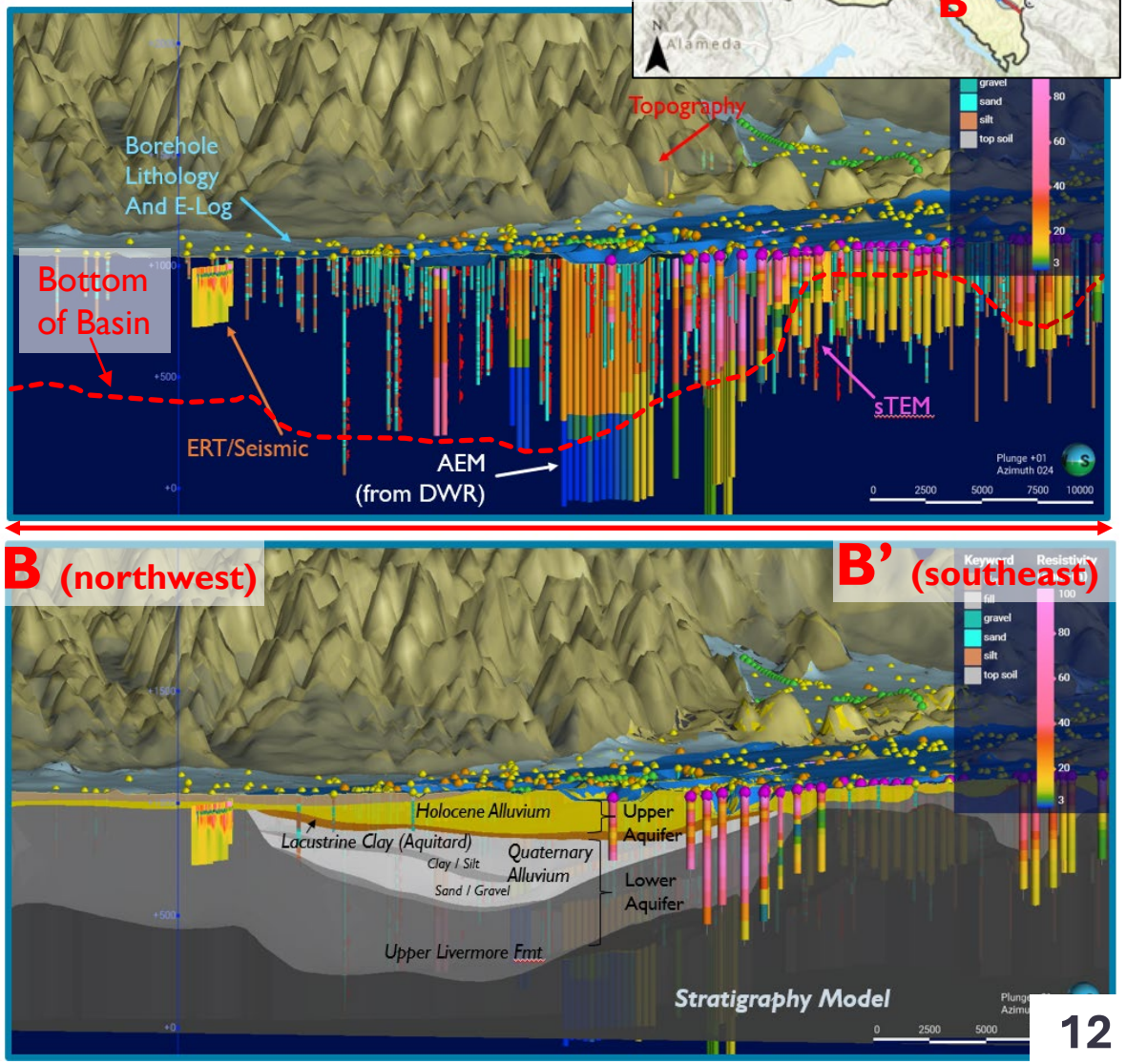
ZONE 7 WATER AGENCY

HYDROGEOLOGIC CONCEPTUAL MODEL UPDATES

- Developed 3D Leapfrog geologic model of the **major hydrogeologic features** and **principal aquifers and aquitards** in the Basin
- Data sources incorporated into HCM include:
  - Lithology, E-log, grain size distribution, and well construction data from >**1,070 boreholes**
  - **Geophysical data** from five local ERT + seismic refraction surveys, two local sTEM surveys, eight DWR AEM surveys
  - **Geospatial data** representing surface topography, inferred fault lines / hydraulic barriers, subarea boundaries, surface water features, etc.
  - Over **20 cross sections** of the Basin from prior Zone 7, LLNL, USGS, and DWR studies



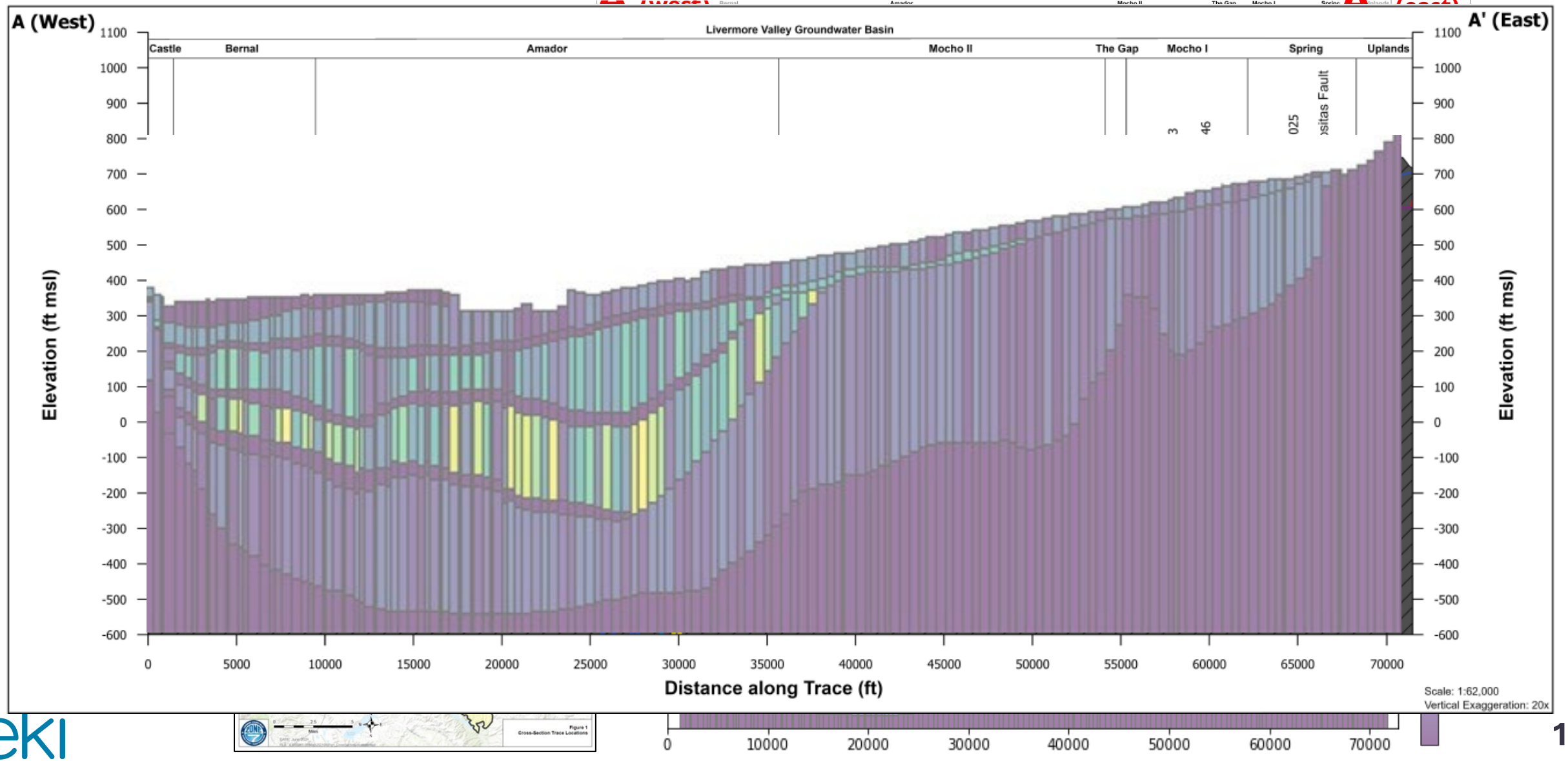
Vertical exaggeration = 20x



HCM = Hydrogeologic Conceptual Model

MODEL LAYERING MATCHES GEOLOGIC FRAMEWORK

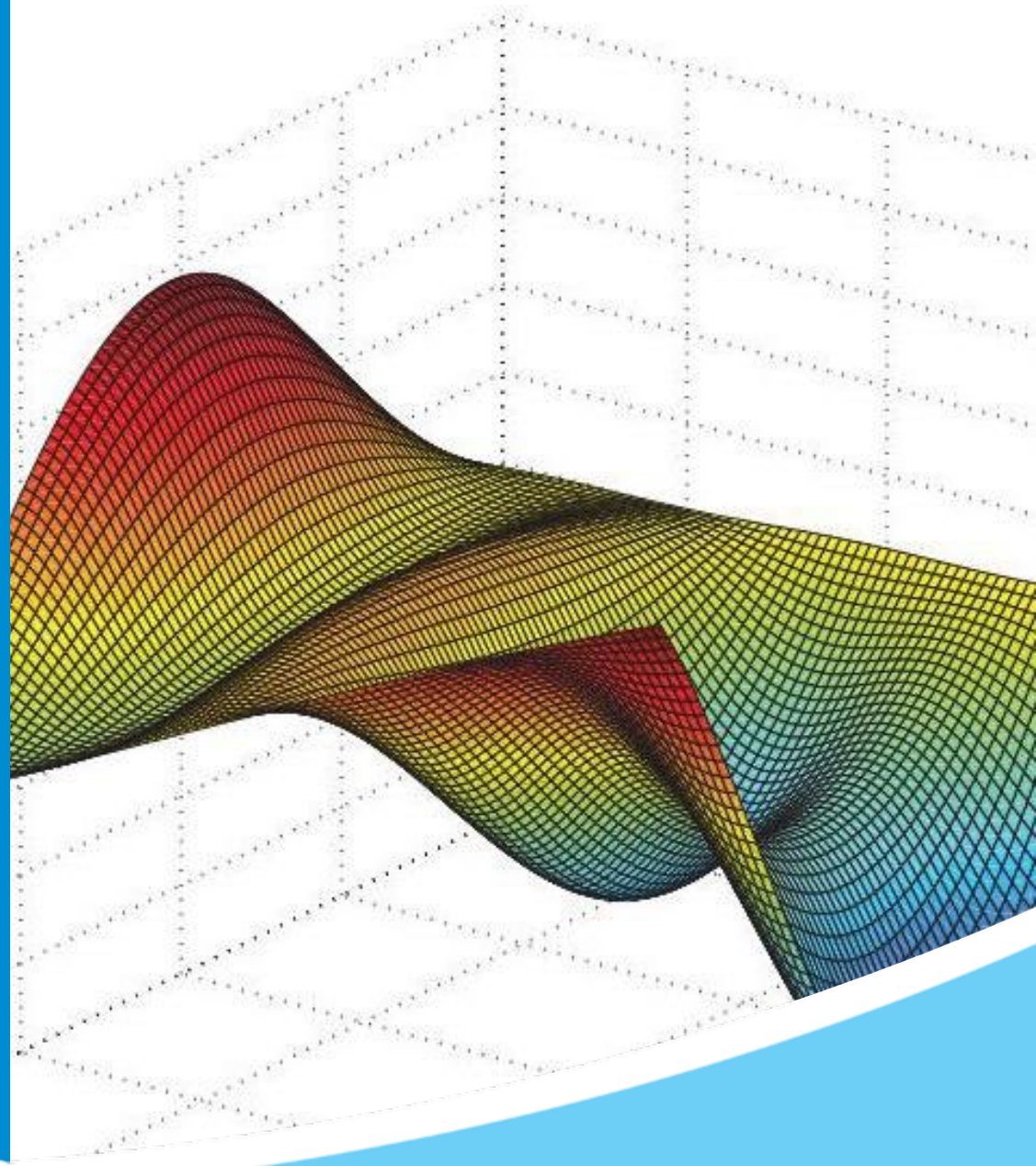
Vertical exaggeration = 20x



MODEL UPDATE PROCESS:

GROUNDWATER MODEL UPDATE AND CALIBRATION

Credit: USGS



ZONE 7 WATER AGENCY

GROUNDWATER MODEL UPDATES

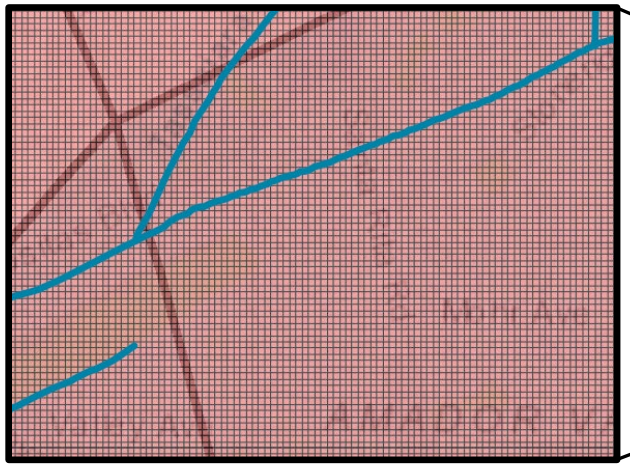
- **Redesigned and rebuilt** groundwater flow and transport model to reflect the latest data and understanding of Basin hydrogeologic conditions
- **Recalibrated** model to the latest water level, streamflow, and Total Dissolved Solids data for Water Years (WY)s 2004 - 2023
- New model markedly improves Zone 7's ability to reliably simulate and adaptively plan ongoing **conjunctive use operations** and **groundwater management strategies**

Model Design Feature	2016 Model	2025 Model
Calibration Period	WY 1973 - 2014	WY 2004 - 2023
Spatial Coverage	Main Basin and NW Fringe Only	Entire Basin
Grid Cell Size	500' x 500'	100' x 100' (Main) 500' x 500' (Fringe/Uplands)
Layering and Conceptual Stratigraphy	10 layers of uniform thickness and extent based primarily from Norfleet, 2004 study in Lake H / I areas of Main Basin	9 layers of variable thickness and extent derived from 3D Leapfrog HCM modeling across entire Basin
Hydraulic Property and Flow Barrier Representation	Uses faults to delineate subareas; each subarea calibrated uniquely using pilot point method	**No faults**; uses borehole grain size texture distribution and zonation to reflect heterogeneity in aquifer properties

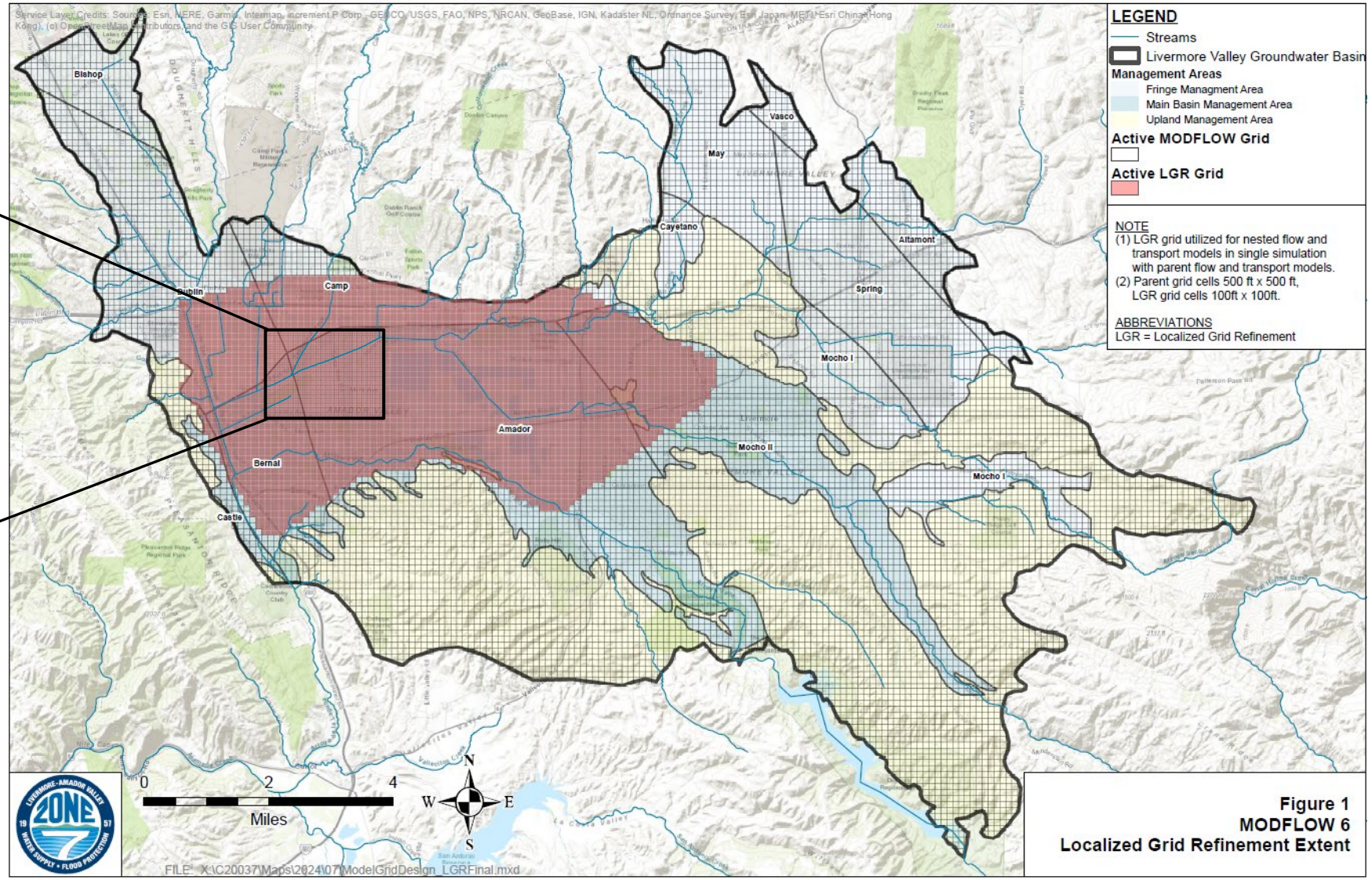
HCM = Hydrogeologic Conceptual Model
WY = Water Year

FOCUSED GRID REFINEMENTS TO ADD PRECISION IN MAIN BASIN

Model Grid



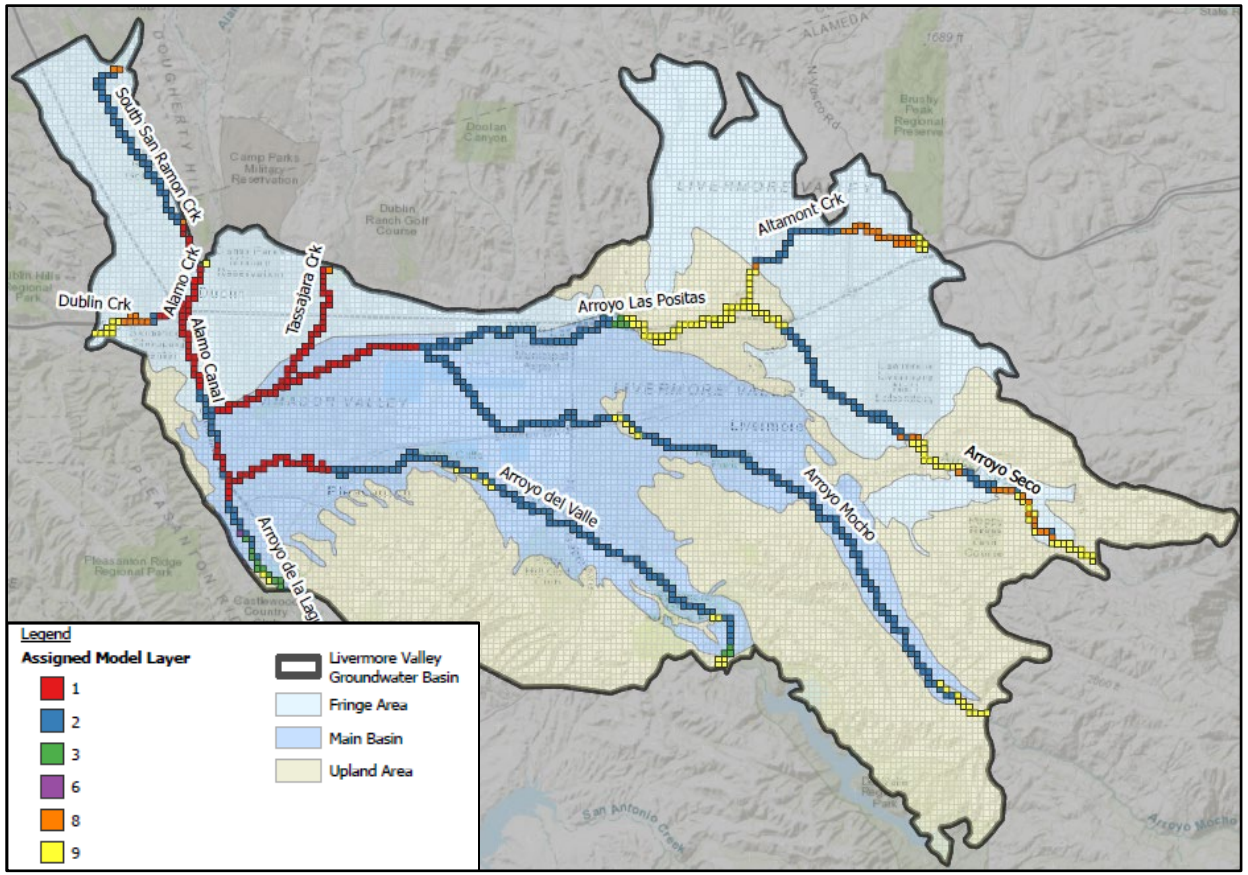
100’ x 100’ grid refinement in groundwater production center



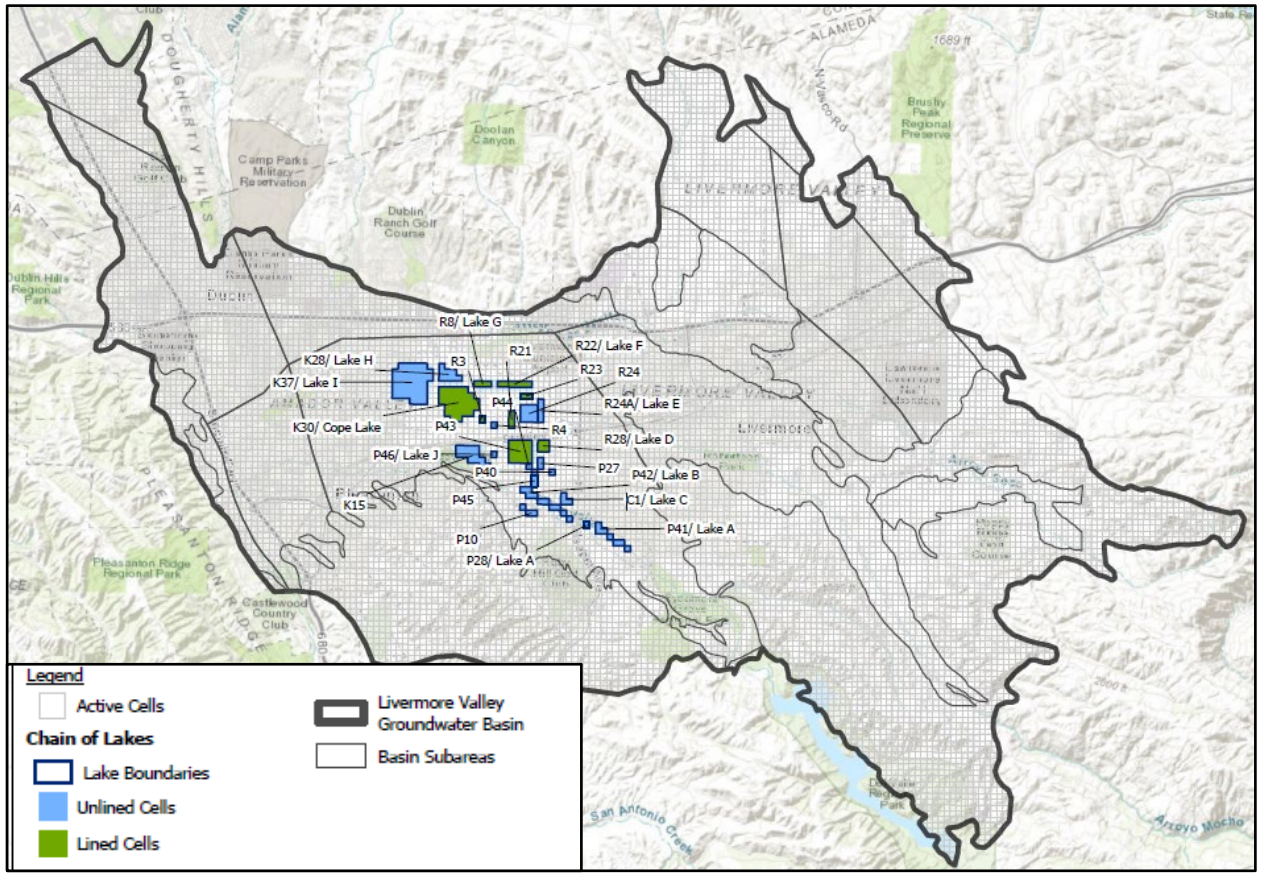
500’ x 500’ regional model grid covers entirety of Livermore Basin

IMPROVED REPRESENTATION OF SURFACE WATER FEATURES…

Streams

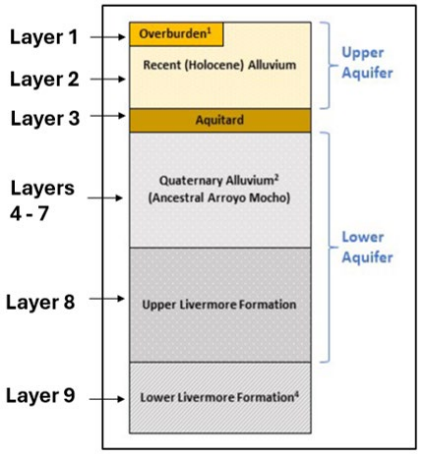


Mining Pits / Chain of Lakes



… AND AQUIFER PROPERTIES

Model Layering

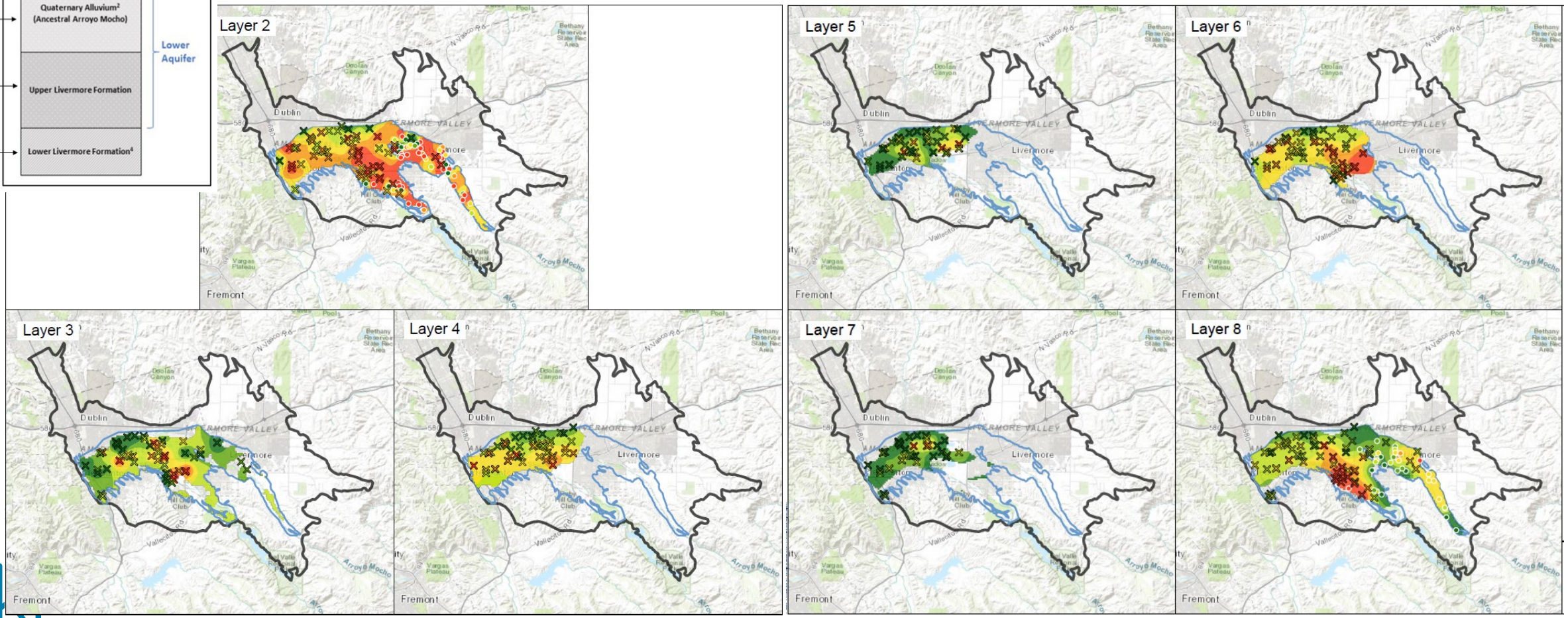


Distribution of Coarse and Fine Grained Material

Legend
Livermore Valley Groundwater Basin
Main Basin
Elogs Coarse Fraction
0-20%
20-30%
30-40%
40-50%
50-60%
60-100%

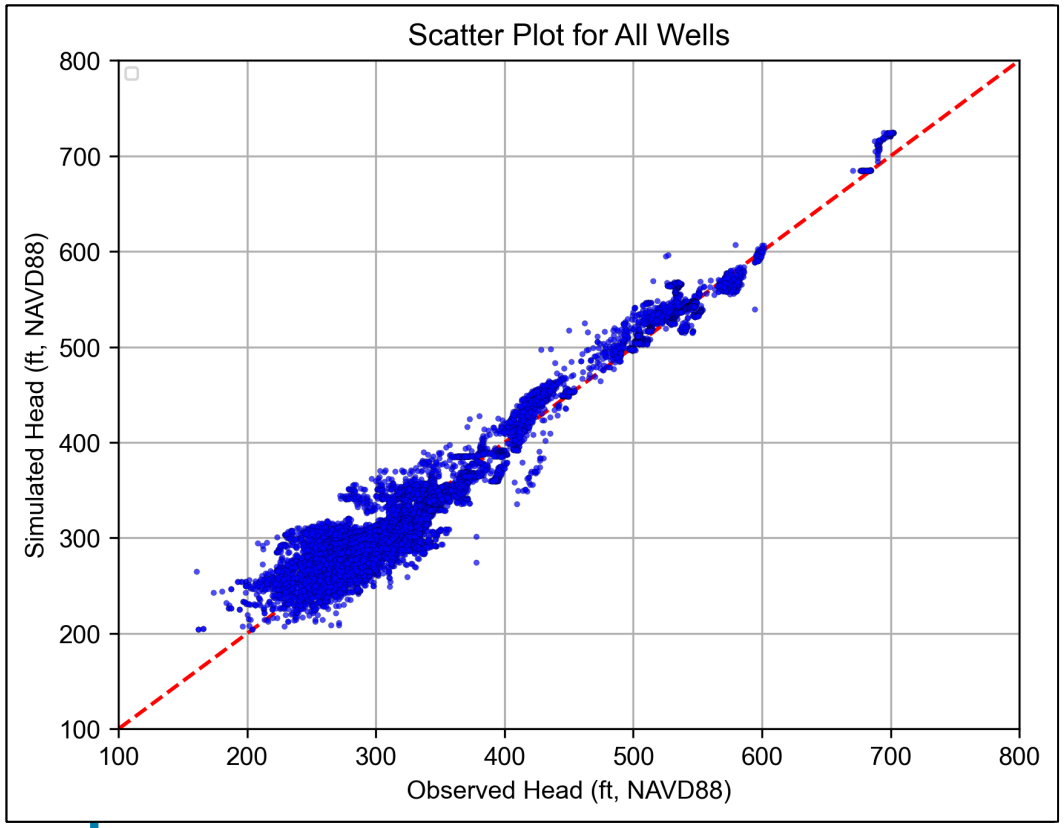
Borelogs Coarse Fraction
0-20%
20-30%
30-40%
40-50%
50-60%
60-100%

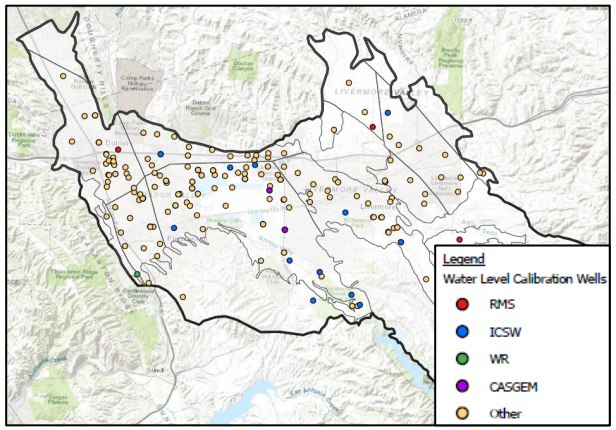
Layer Coarse Fraction
0% 20% 30% 40% 50% 60% 100%



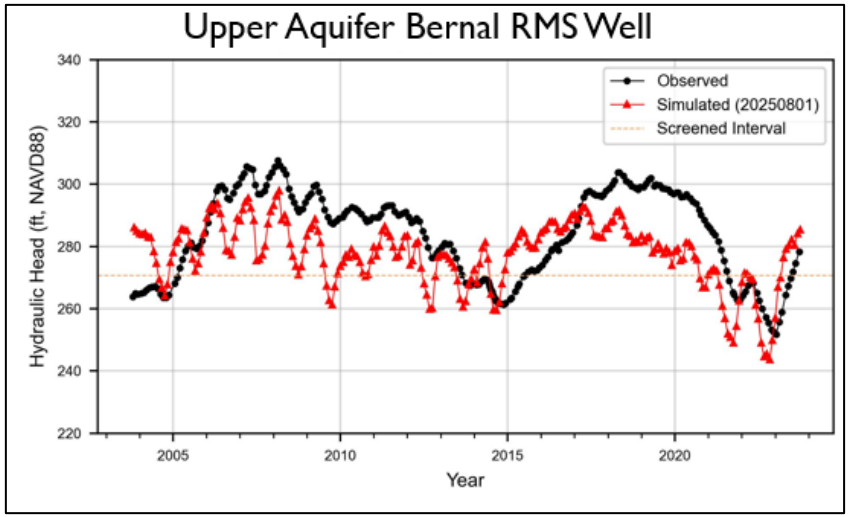
MODEL IS WELL CALIBRATED TO WATER LEVELS AND STREAM FLOWS

AT THE BASIN LEVEL …

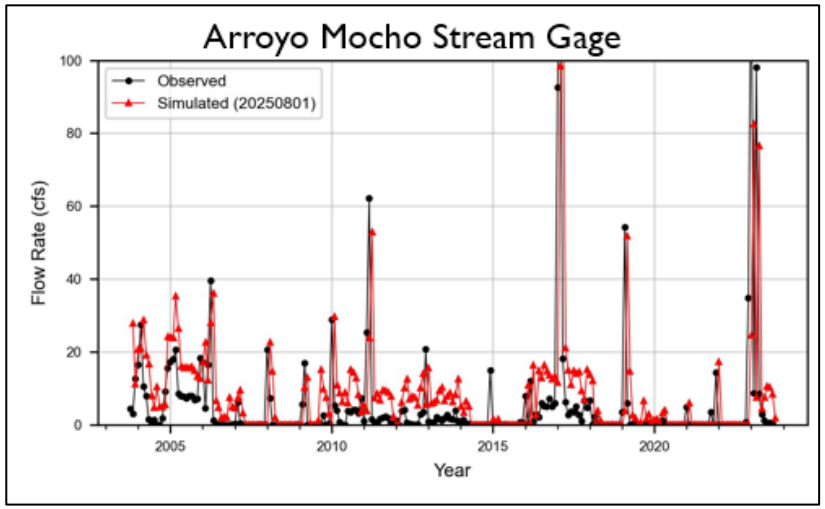




… AT THE WELL LEVEL

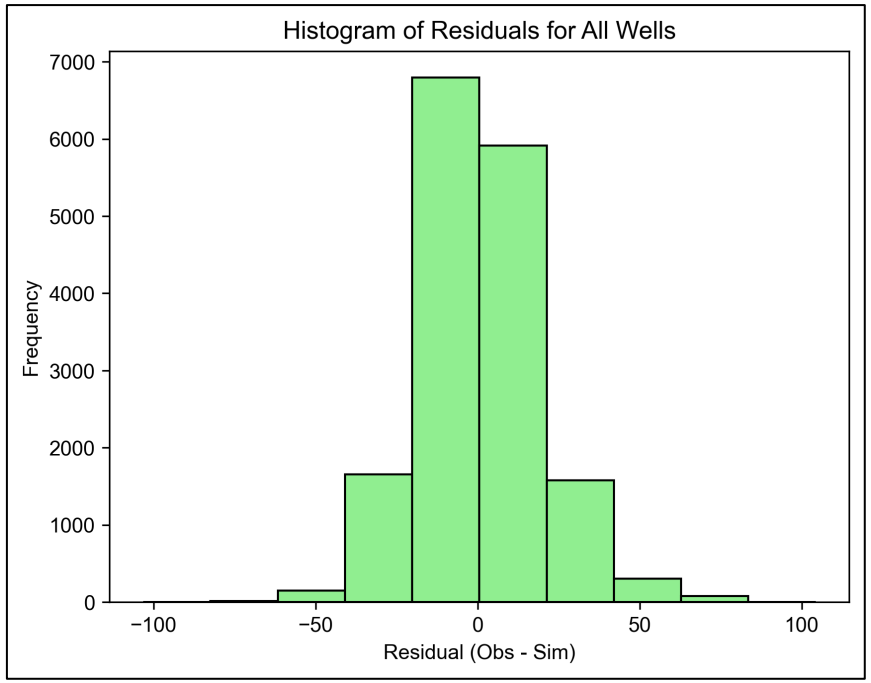


… AT THE STREAM LEVEL



… AND ON A STATISTICAL BASIS

Calibration Statistic	'Perfect' Value	Benchmark Value	Model Value (All Wells)
Normalized Root Mean Squared Error	0%	5% - 10%	**0.2%**
Normalized Mean Absolute Error	0%	5% - 10%	**2.6%**
R-squared	100%	80% - 90%	**98%**
Kling-Gupta Efficiency	1.0	0.7 - 0.8	**0.97**



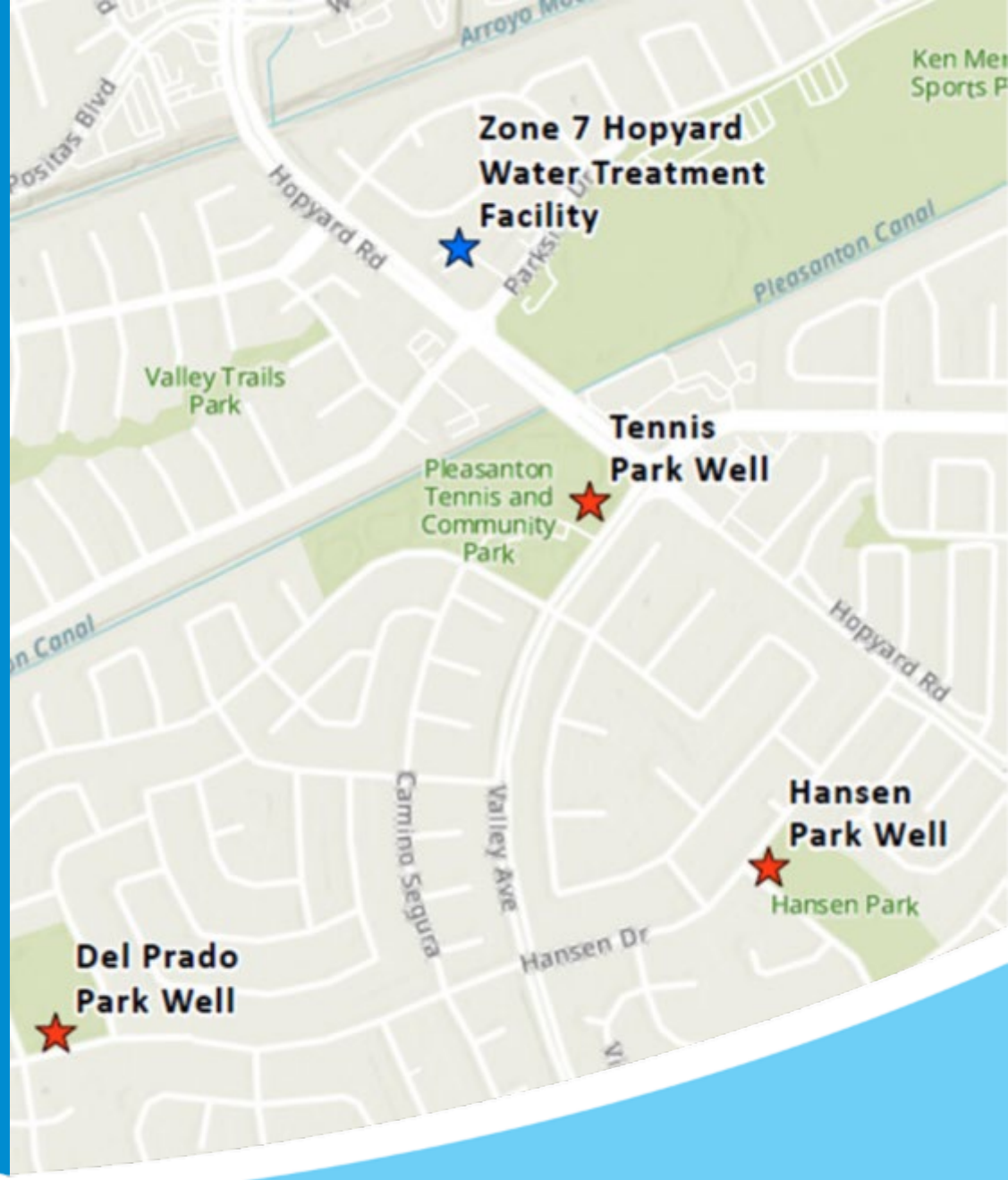
Benchmark value typical standard of a well calibrated model.
'Perfect' value indicates theoretical ideal fit.
Each value for the model far exceeds benchmark.

KEY OUTCOMES FROM MODEL UPDATE

- Updated Basin model provides up to date tool using best available technology and methods
- We have high confidence in the model's performance and utility
  - High quality, recent, and widely distributed data utilized to build model
  - Well calibrated and validated to observed groundwater conditions across Basin
  - Excellent statistical performance relative to observed conditions provides high confidence in predictive simulations
- The model is ready for future SGMA and operational decision-making related analyses

Putting the updated model to use:

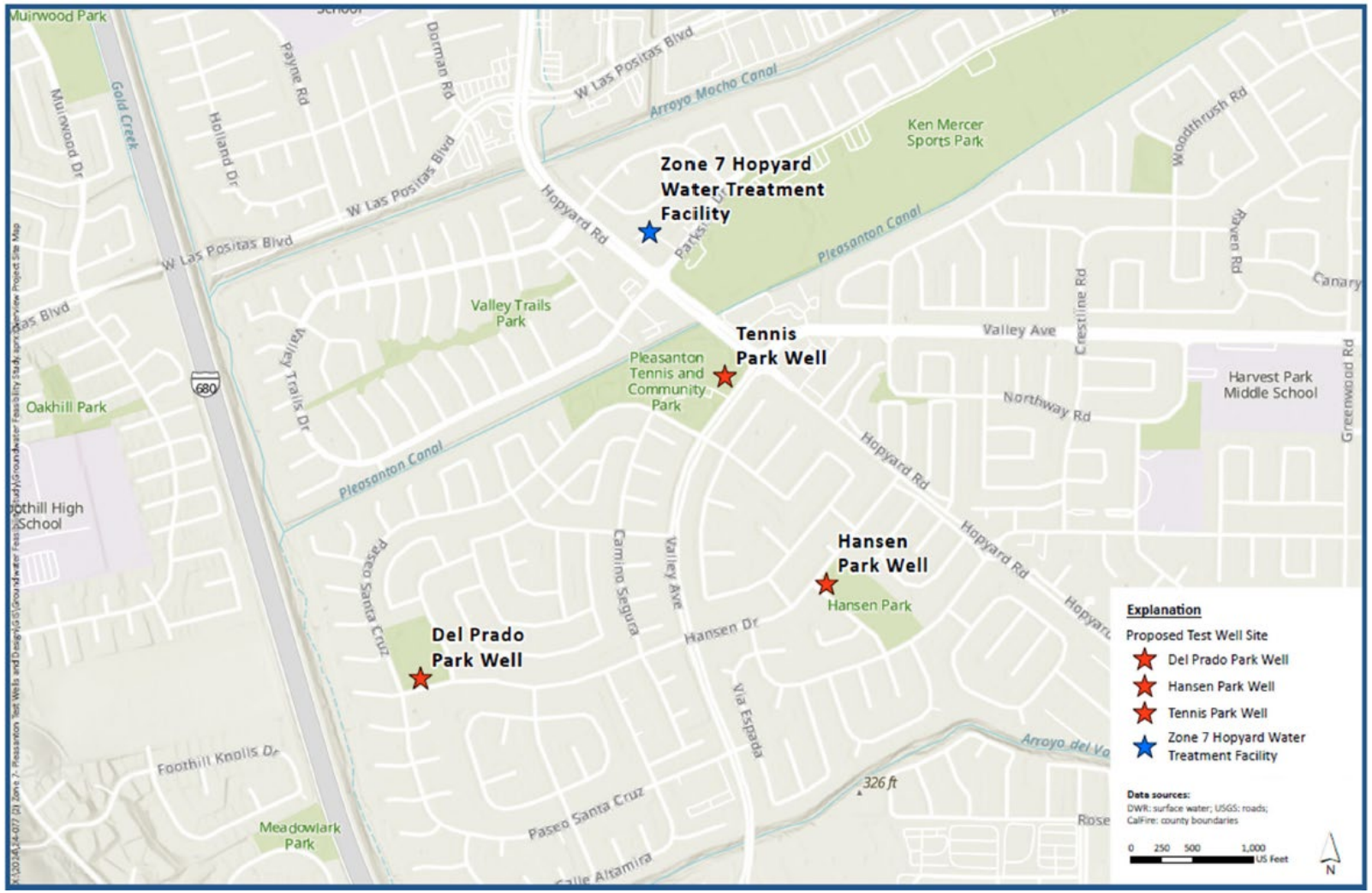
Modeling Analysis of Regional Groundwater Facilities Project Alternatives



ZONE 7 WATER AGENCY

Regional Groundwater Facilities Project Scope

- Drill exploratory bore holes and construct three test wells at:
  1. Del Prado Park
  2. Pleasanton Tennis & Community Park
  3. Hansen Park
- Conduct Yield and Water Quality Testing at all sites
- Run Model Scenarios to analyze sustainability and PFAS mobilization
- Basis of Design
- Feasibility Study



Regional Project Modeling Scenarios

- Multiple model scenarios were developed to simulate groundwater flow and PFOS transport conditions under varying Project pumping conditions:
  - **Baseline:** Predictive scenario without new wells
  - **Scenarios 1 – 3:** Continuous pumping up to maximum estimated project yields
    - *Scenario 1:* Pumping at all three sites (Tennis, Hansen, Del Prado)
    - *Scenario 2:* Pumping at Tennis and Hansen only
    - *Scenario 3:* Pumping at Tennis and Del Prado only
  - **Scenario 4:** Optimized pumping to align with PFAS Management Strategy

Evaluating Regional Project Wells

1. Groundwater Sustainability

Will the groundwater basin continue to be sustainable with the new wells?

2. Well interference

Will pumping new wells interfere with existing wells significantly?

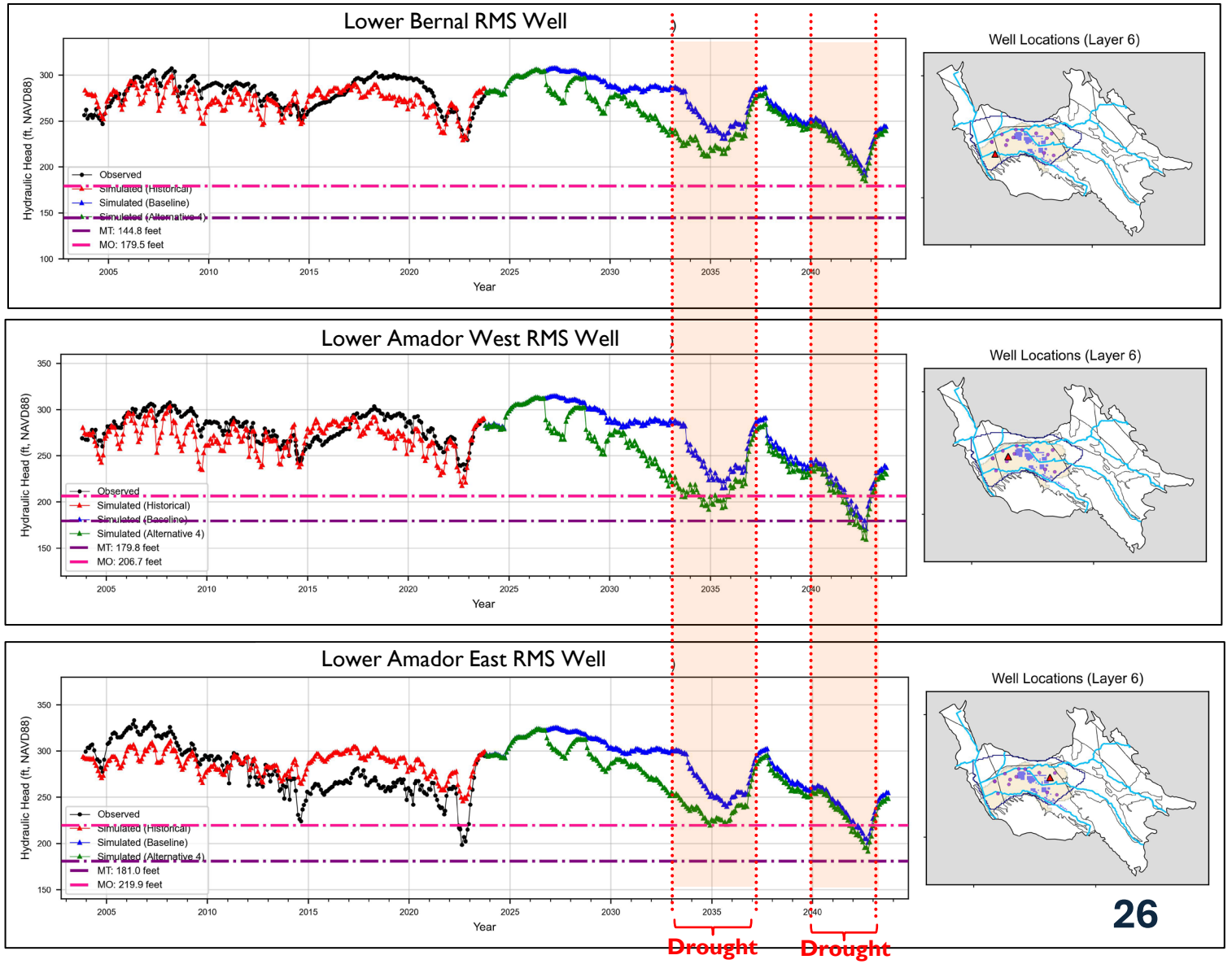
3. PFAS mobilization

Will the known PFAS footprint be further mobilized by pumping new wells?

ZONE 7 WATER AGENCY

GROUNDWATER LEVEL MODELING RESULTS

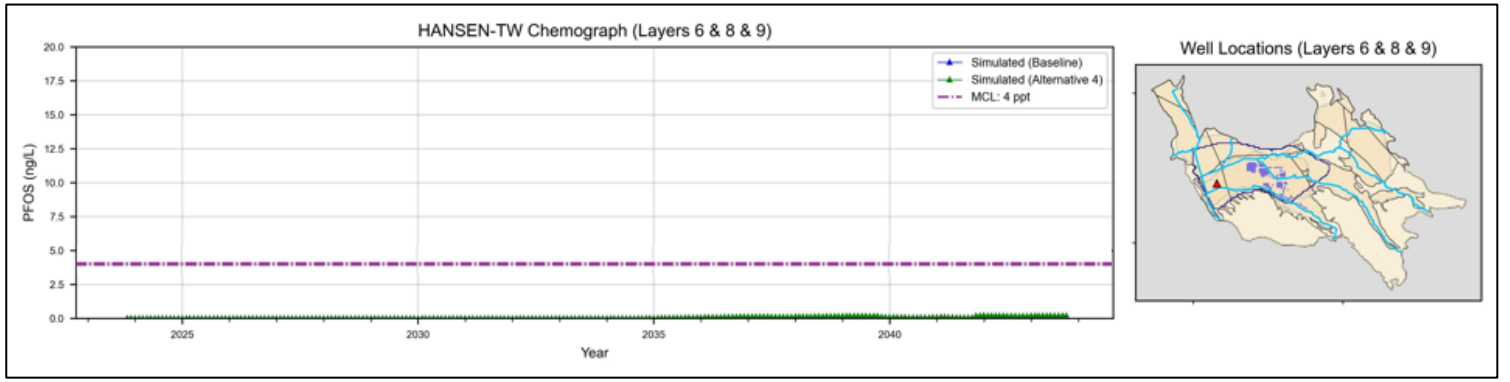
- Results from modeling analyses **do not indicate the occurrence of Undesirable Results** for Chronic Lowering of Groundwater Levels throughout the 20-year predictive simulation period, under the current set of predictive modeling assumptions.
- Water level drawdowns resulting from project operations **do not pose significant well interference concerns** at other existing groundwater production wells within the Basin
- Groundwater Levels are used as the proxy for basin storage conditions and subsidence

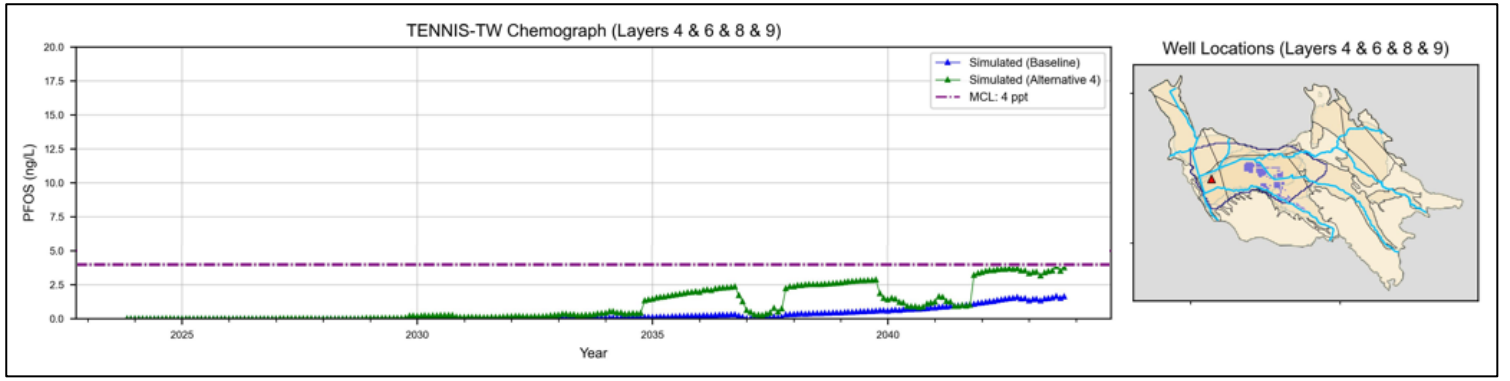


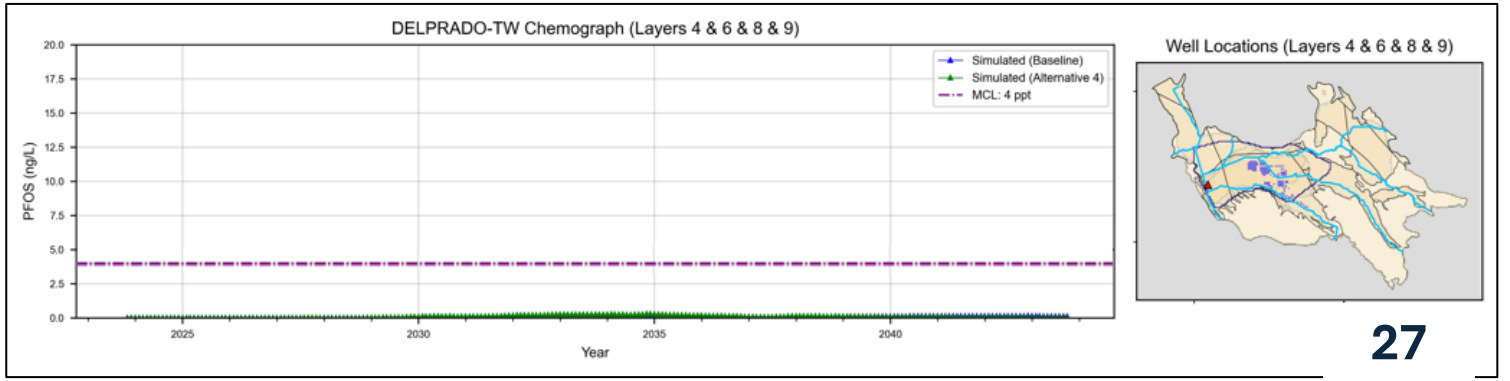
RMS = Representative Monitoring Site

PFAS MOBILIZATION MODELING RESULTS

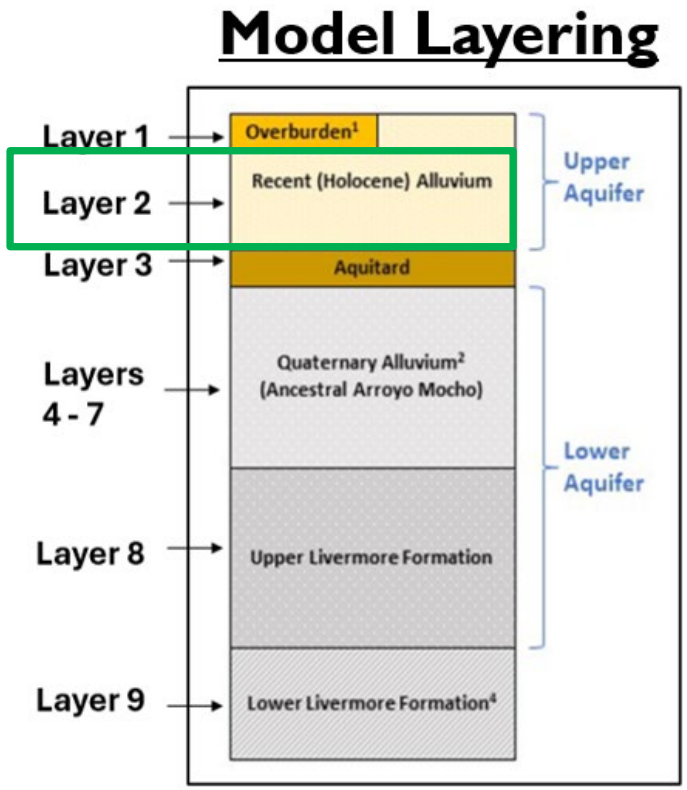
- Regional Project modeling evaluations **do not indicate the occurrence of PFOS concentrations in excess of the 4 ppt MCL at any of the Regional Project wells** throughout the 20-year predictive simulation period based on the current representation of the existing PFOS footprint, source locations and loading in the model.

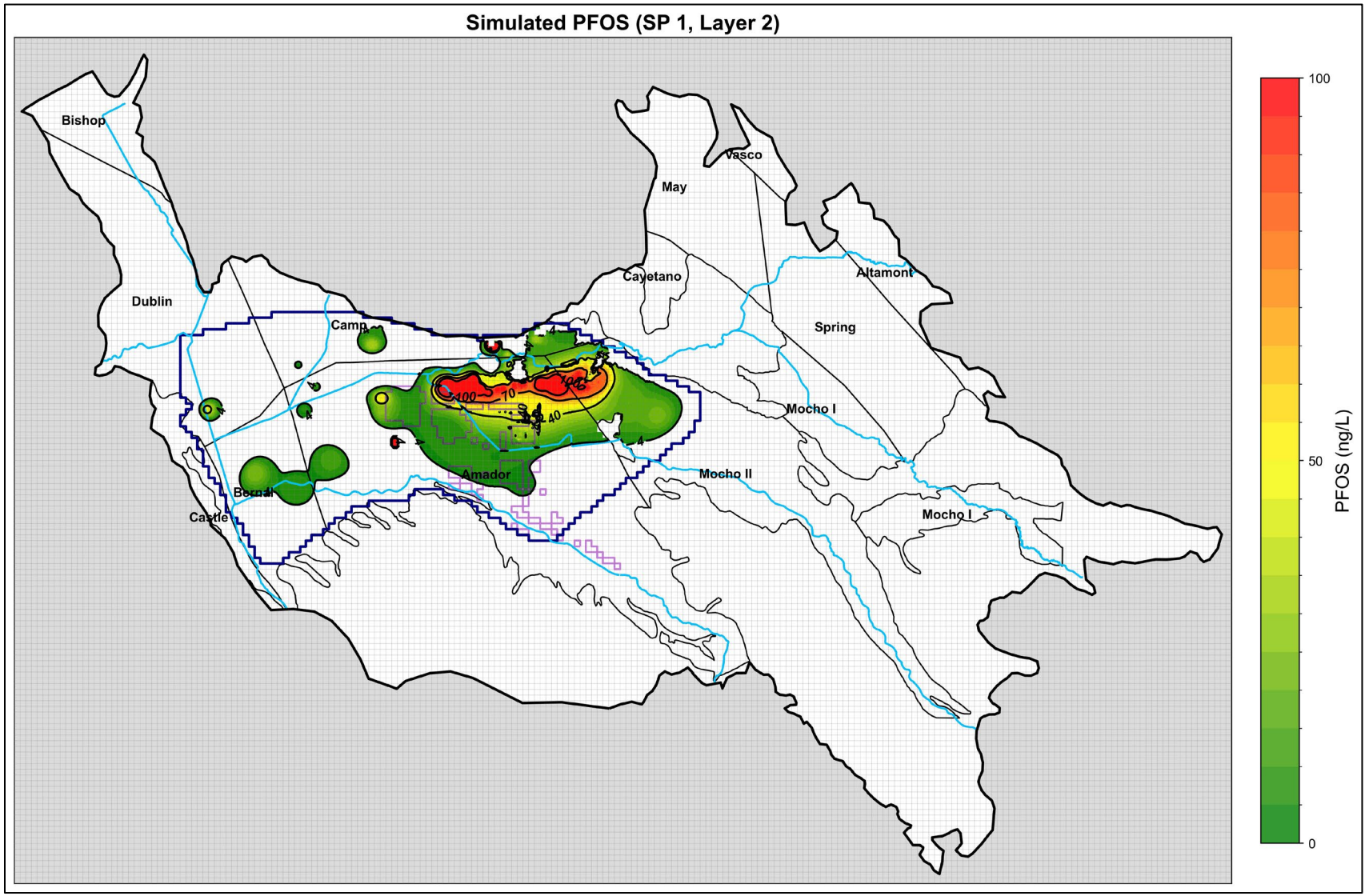




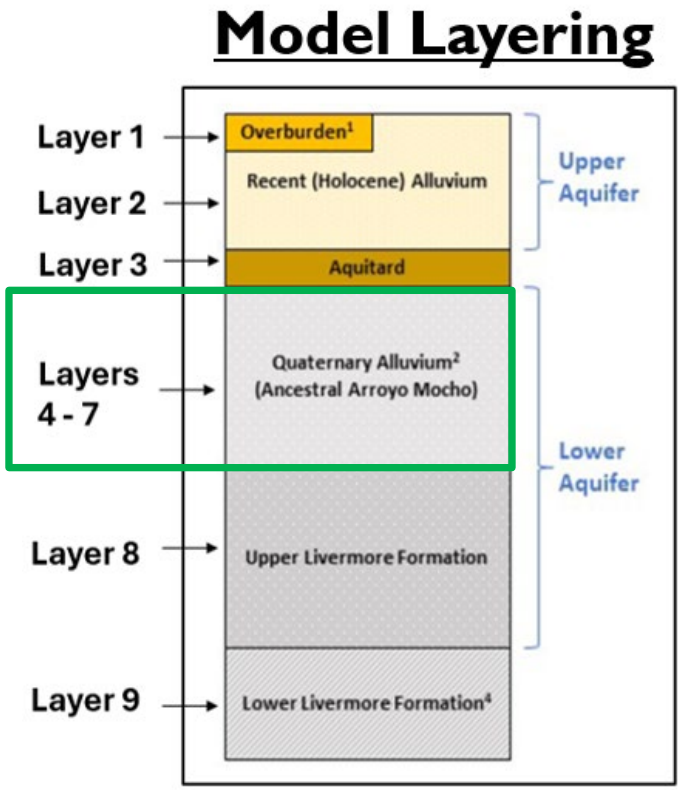


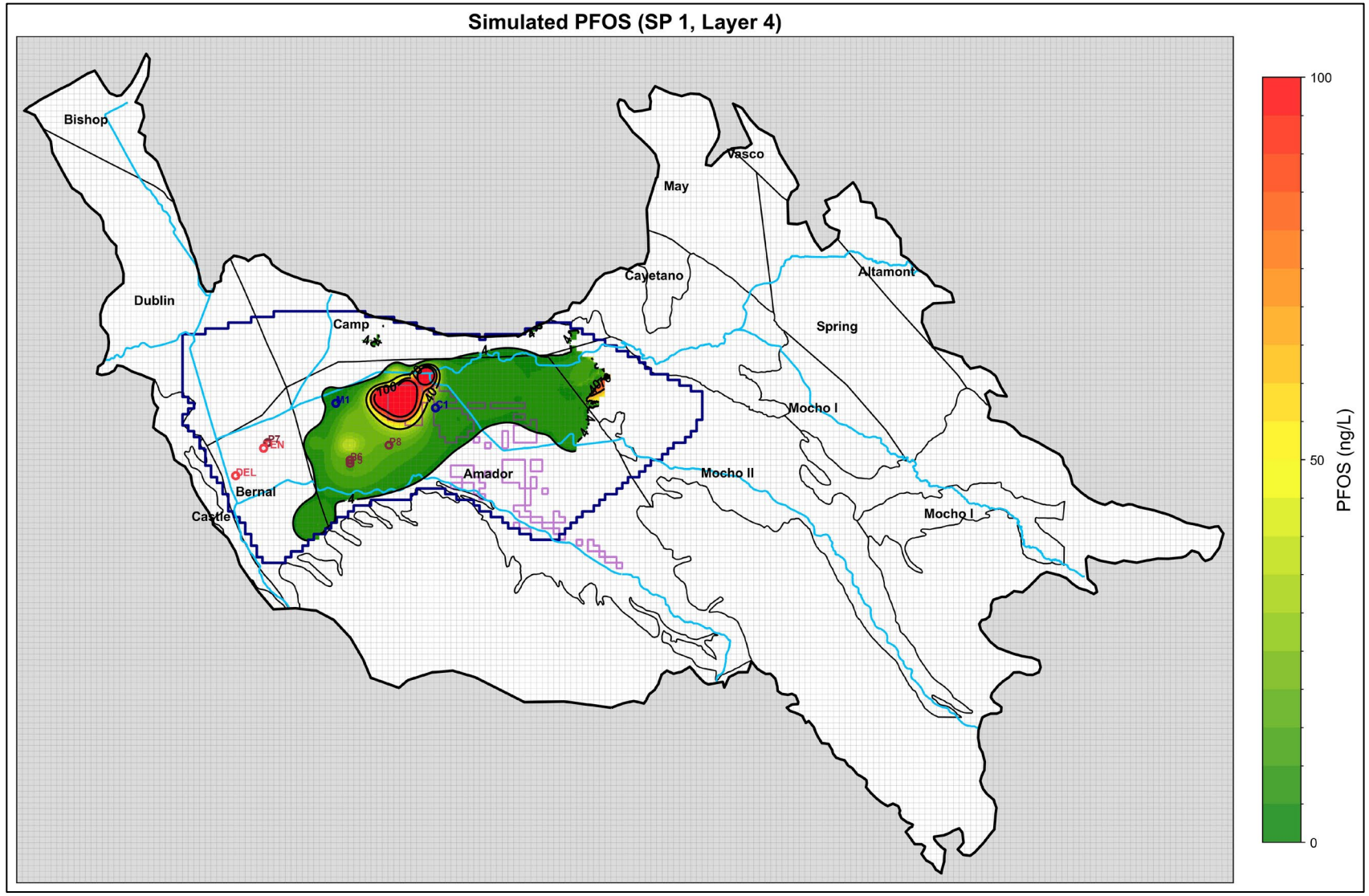
PFOS MOBILIZATION IN MODEL LAYER 2 (UPPER AQUIFER)



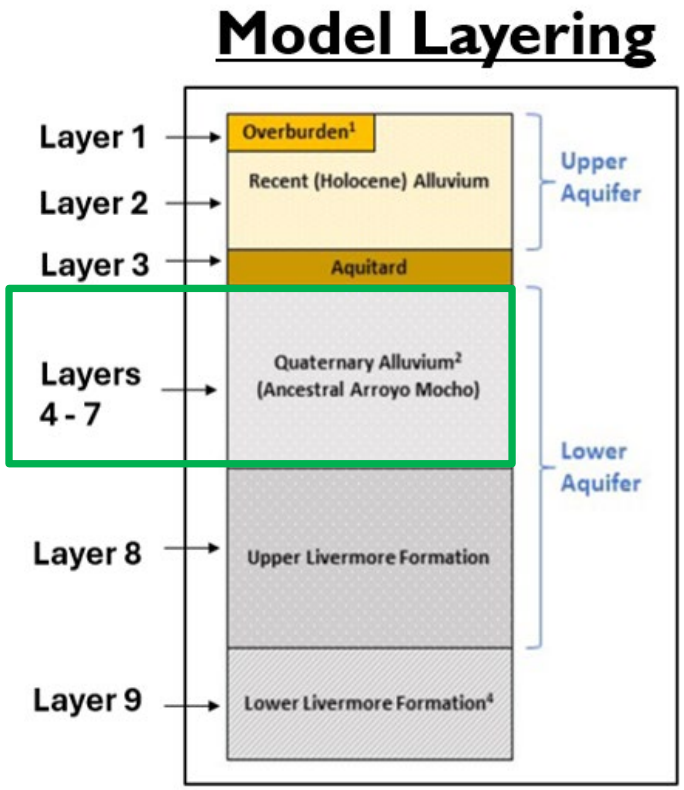


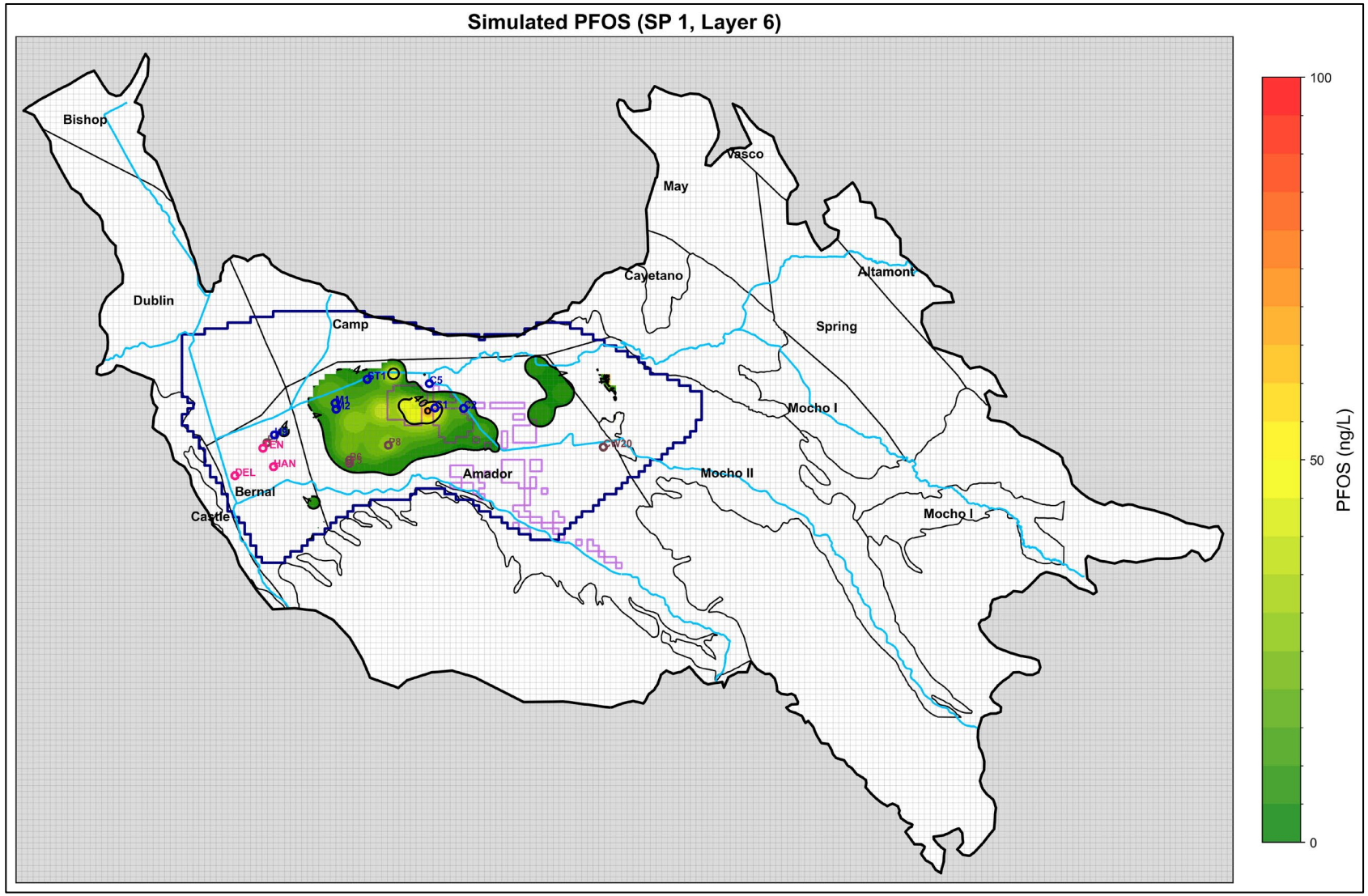
PFOS MOBILIZATION IN MODEL LAYER 4 (LOWER AQUIFER)



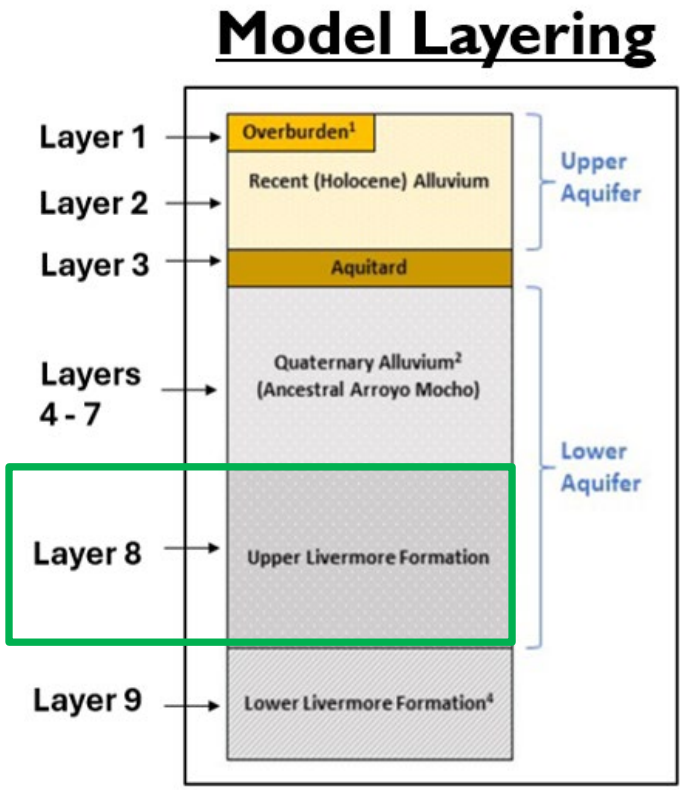


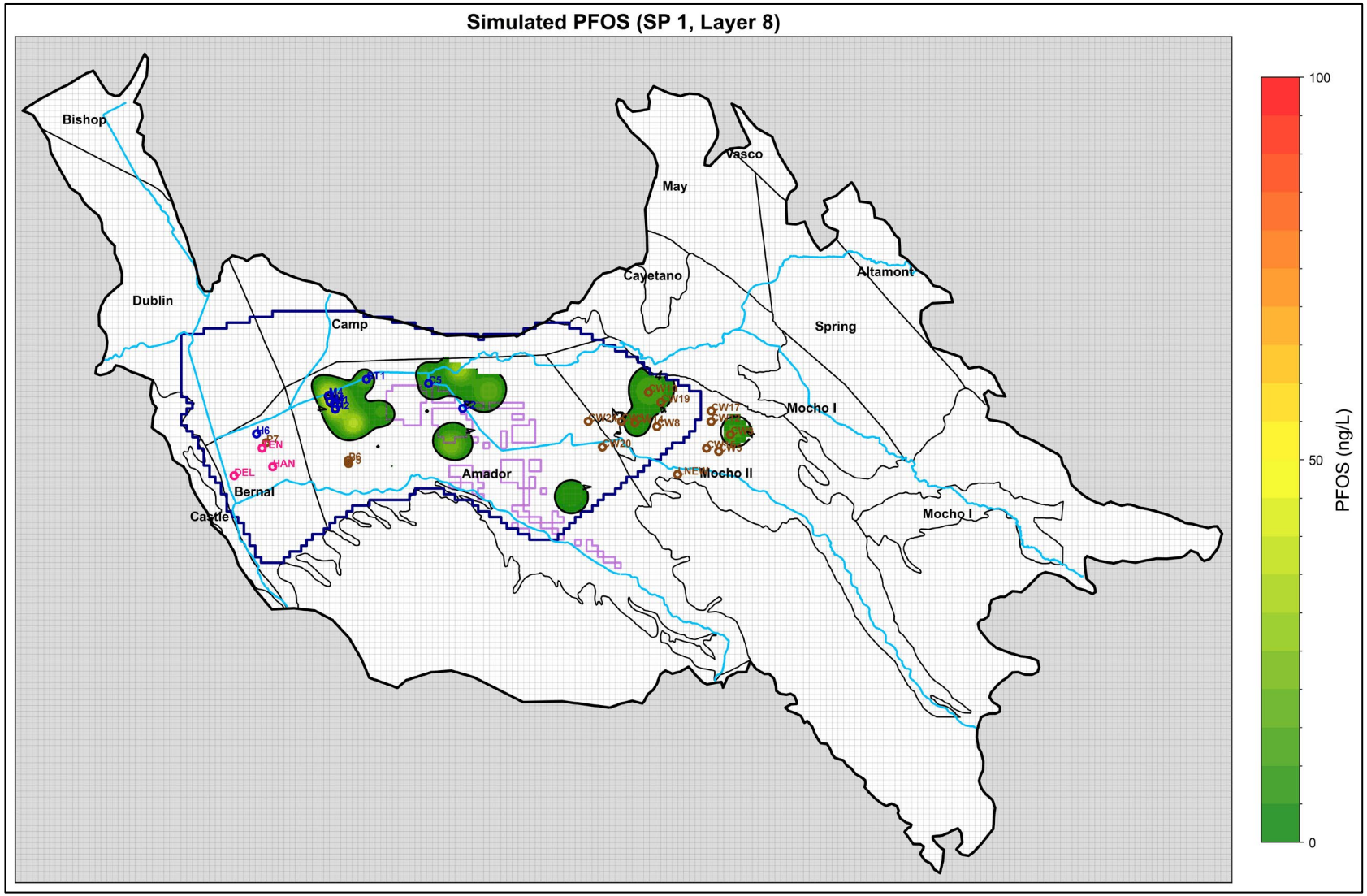
PFOS MOBILIZATION IN MODEL LAYER 6 (LOWER AQUIFER)





PFOS MOBILIZATION IN MODEL LAYER 8 (UPPER LIV FMT.)





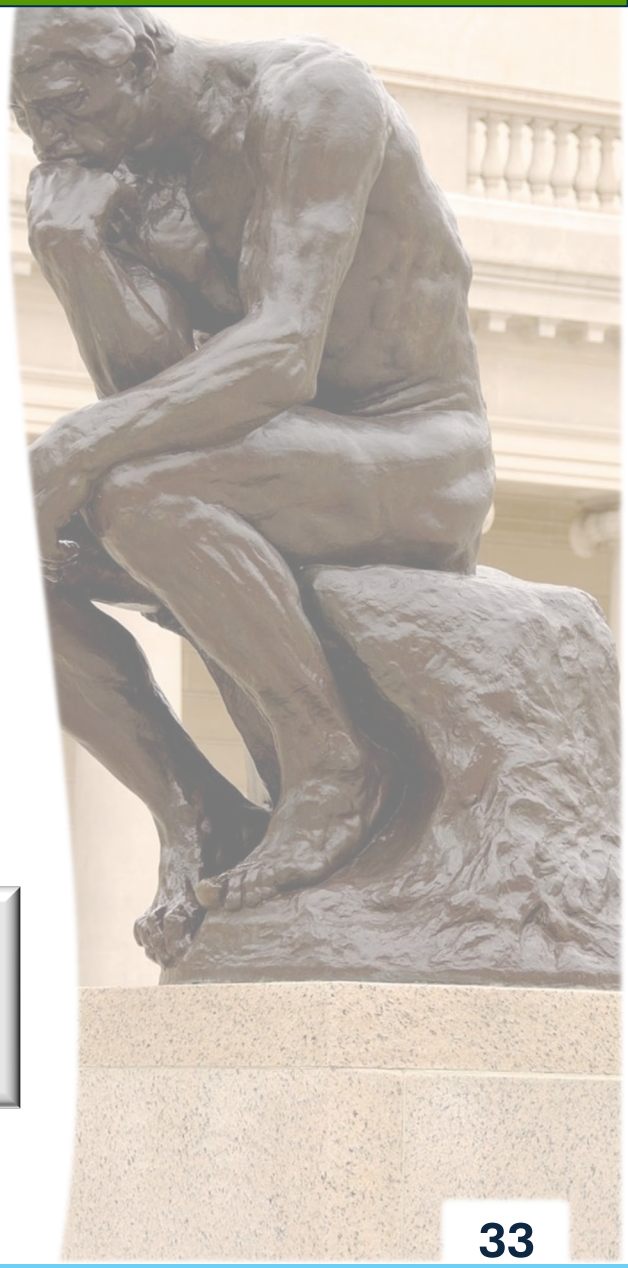
Model Findings

Criteria	Baseline (no wells)	Project Scenario 1 (Tennis, Hansen, Del Prado)	Project Scenario 2 (Tennis and Hansen)	Project Scenario 3 (Tennis and Del Prado)
Groundwater Sustainability	✓	✓	✓	✓
Well Interference	✓	✓	✓	✓
PFAS Mobilization	✓	✓	✓	✓

CONCLUSIONS and NEXT STEPS

- The basin groundwater model was refined and rebuilt using the best available data and methodologies
- The model calibration was completed with a high degree of statistical confidence in the model's performance and utility
- The analysis of the regional project scenarios showed that operating the project wells is sustainable over the 20-year projected timeframe
- The analysis also shows that PFAS mobilization is not a concern for the project wells within the 20-year projected timeframe based on currently known sources and concentrations
- Zone 7's PFAS management strategy is viable and effective

***Next Step**: Complete the feasibility study within the coming months and present it to the Zone 7 Board, along with recommendations, in November.*



ZONE 7 WATER AGENCY


Questions?