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2025 Safe Yield Reevaluation

Chino Valley Model Calibration Workshop #1

May 29, 2024

Meeting Objectives

Develop an understanding of updates to the 2025 Chino Valley Model (2025 CVM), the recalibration/uncertainty analysis, and the proposed process for selecting calibrated realizations to be used in the 2025 Safe Yield Reevaluation (2025 SYR)

Gather feedback on recalibration/uncertainty analysis and process for choosing realizations

Agenda

- Welcome
- Process and Timeline
- Updates to the 2025 CVM
- Manual Calibration
- PESTPP-IES and Uncertainty Analysis
- Next Steps and Schedule

Agenda

- Welcome
- **Process and Timeline**
- Updates to the 2025 CVM
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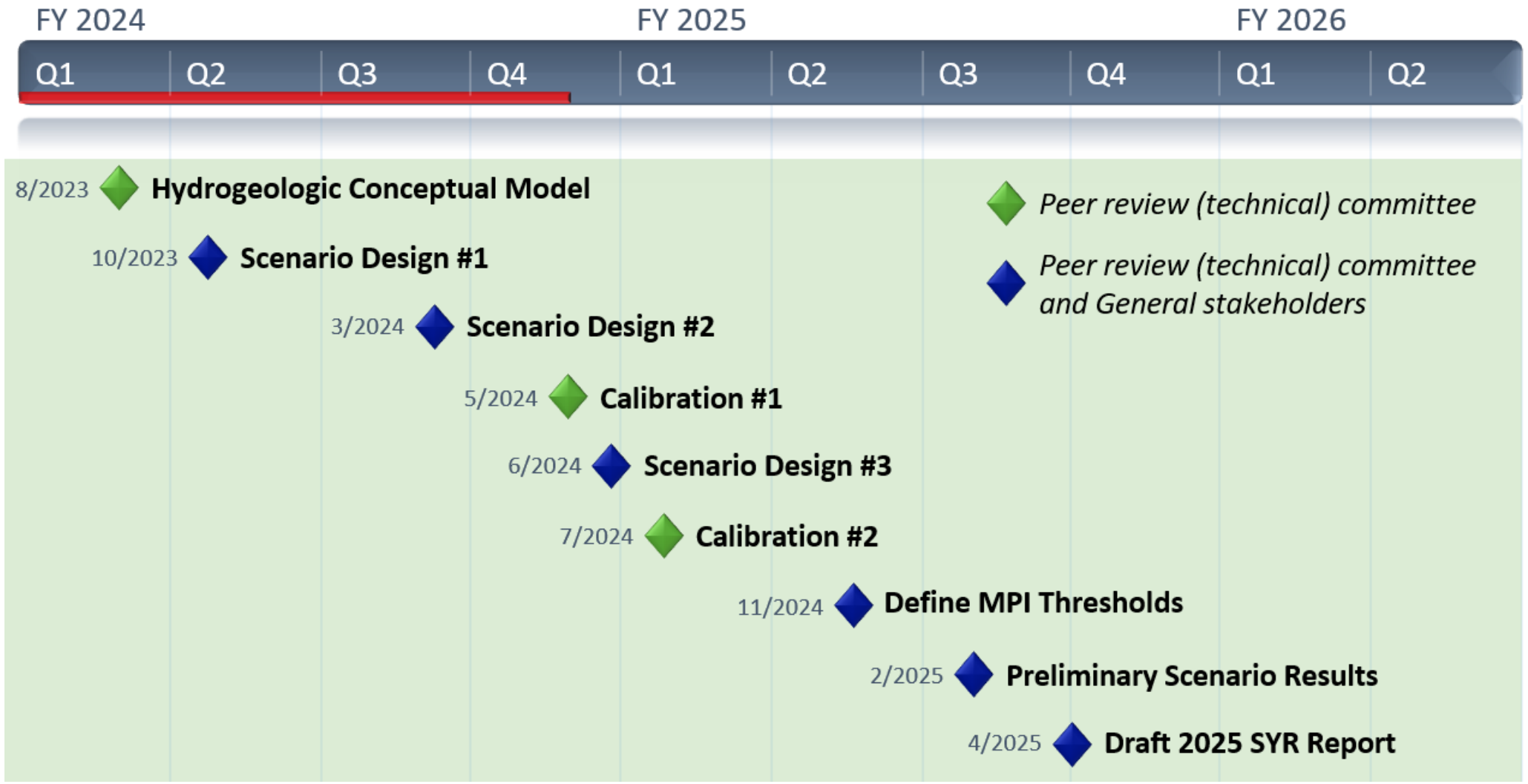
2025 SYR Process

- Update hydrogeologic conceptual model
- Generate calibrated realizations (2025 CVM)
- Develop projection realizations
- Simulate projection realizations
- Evaluate simulation results and calculate Safe Yield
- Develop 2025 SYR report
- Reset Safe Yield (if necessary)

2025 SYR Timeline



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- **Updates to the 2025 CVM**
- Manual Calibration
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Updates to the CVM

- Cross sections, layering, flow barriers
- Santa Ana River/tributary delineation
- Calibration period (FY 1992-2022)
- Lag time calculation
- R4 model update and validation
- Updated calibration targets

Agenda

- Welcome
- Process and Timeline
- Updates to the 2025 CVM
- **Manual Calibration**
- PESTPP-IES and Uncertainty Analysis
- Next Steps and Schedule

Calibration Process

Manual calibration

- Ensure that model runs reasonably and matches expected behaviors/calibration metrics
- Inform prior parameter distributions

PESTPP-IES

- Generate calibrated model realizations and quantify uncertainties in water budget terms

Objective of Calibration

Minimize the differences between the measured and simulated water level

Objective Function (ϕ) = The Sum of Squared Differences

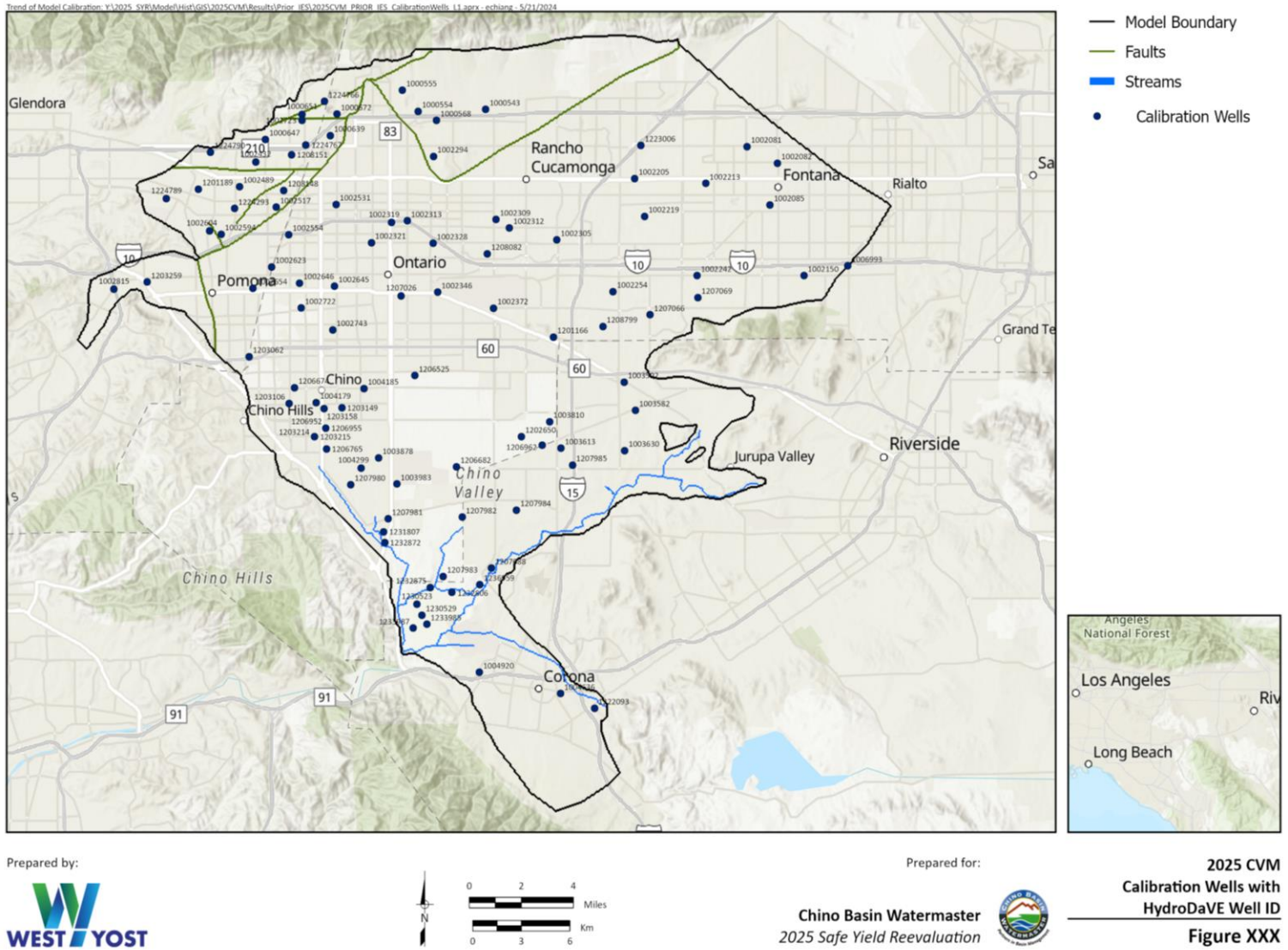
Selection of Calibration Targets

Wells used in calibration are evenly distributed across the model domain

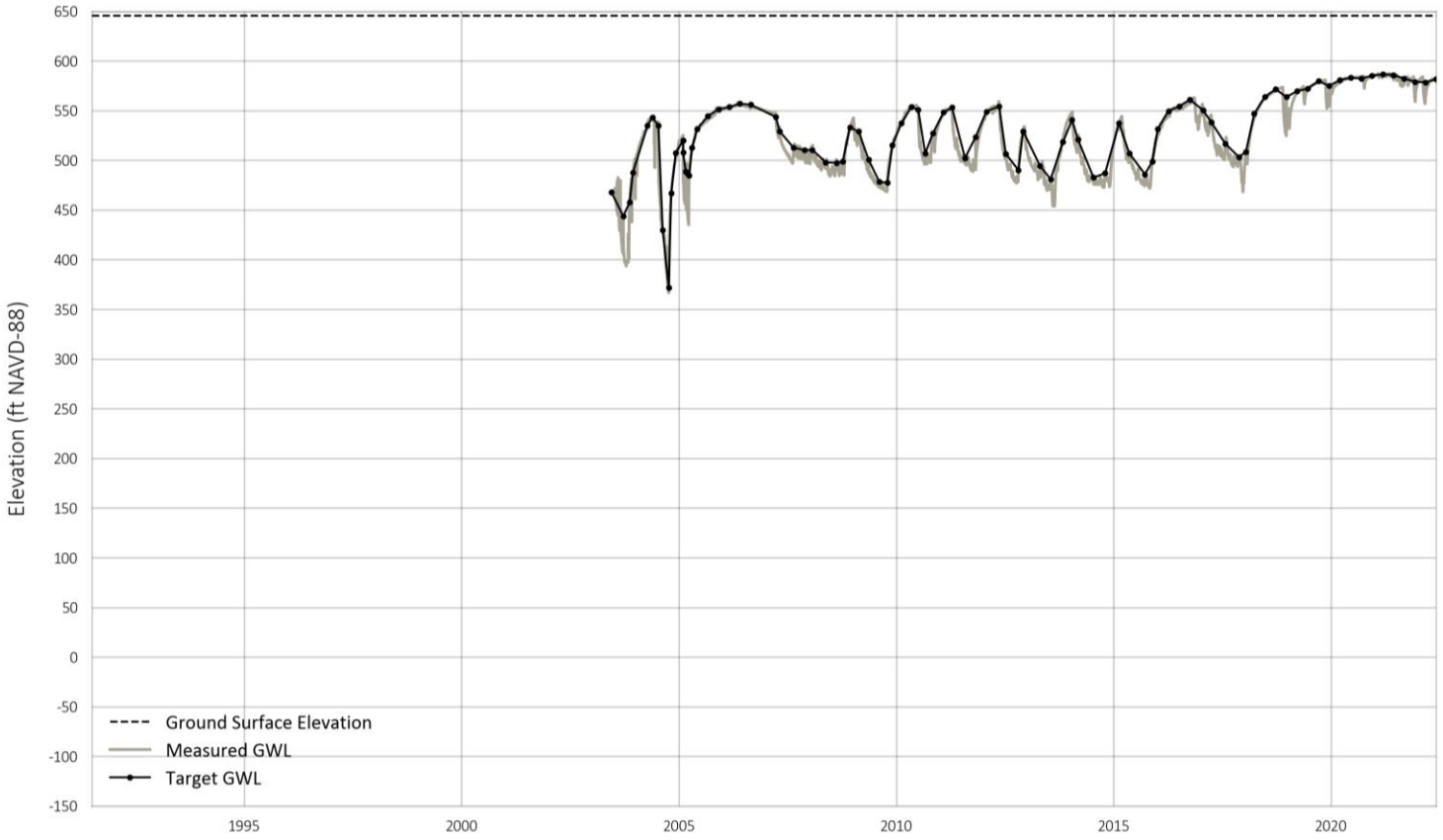
Water level measurements used for calibration are evenly distributed over time

Total number of selected calibration targets = 7,954

Map of Calibration Wells



Calibration Targets



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Well Location

Statistics

Target GWL (ft)
Mean = 526.27
Standard Deviation = 39.66

2025 CVM Realization: PRIOR-IES
Groundwater Level (GWL)
HydroDaVE Well ID: 1206952
Well Name: AP-PA/7
Owner: Chino Basin Watermaster

Figure A-11

Manual Calibration

Aquifer parameters

- Horizontal/vertical hydraulic conductivity (HK, VK)
- Specific Yield (SY)
- Specific Storage (SS)

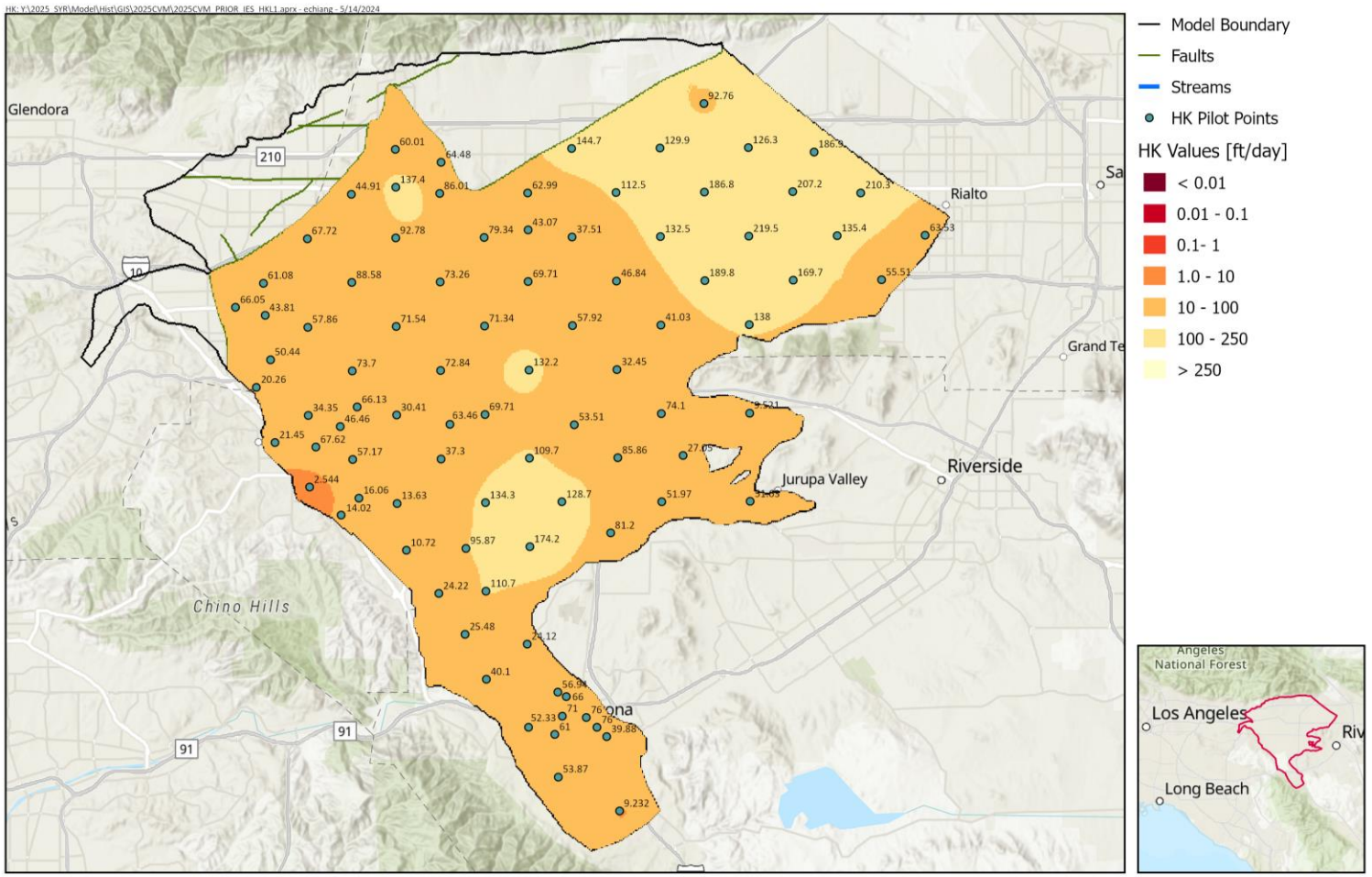
Pilot points were placed across the model domain

Aquifer parameters of 2020 CVM were assigned to Pilot Points

Kriging was applied to interpolate pilot point values to model cells

The aquifer parameters were not adjusted during manual calibration

Aquifer Parameters



Adjusted Parameters

Areal Groundwater Recharge Multiplier

- Annual groundwater recharge for each model cell is initially estimated by R4
- The calibrated multiplier of all annual groundwater recharge is 0.94

Streambed Conductivity

- Santa Ana River and its tributaries were subdivided into eight reaches
- The calibrated streambed conductivity ranges between 0.23 and 10 ft/day

Adjusted Parameters

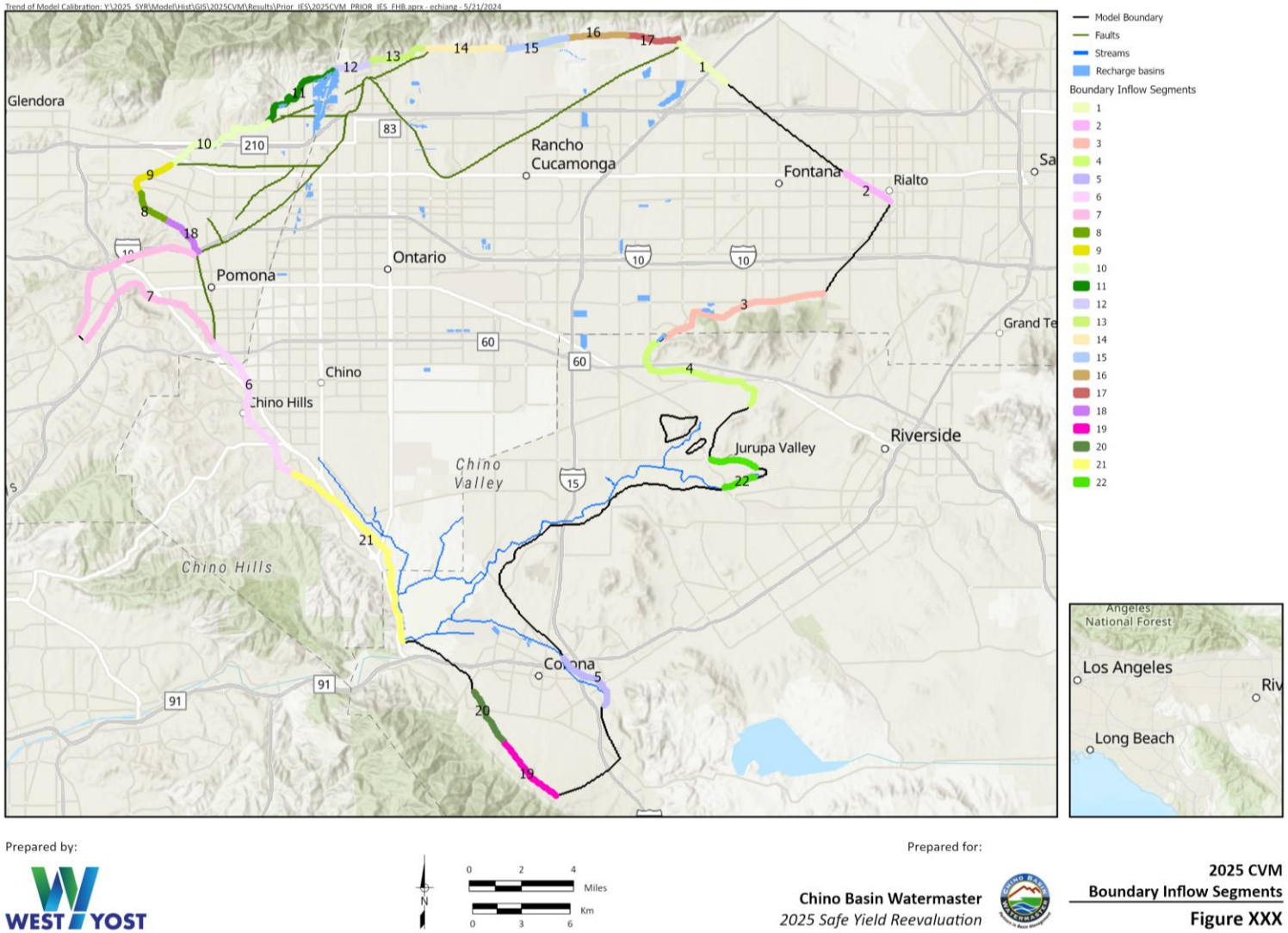
Boundary Inflow Multiplier

- Boundary inflow is simulated with the Flow and Head Boundary (FHB) package
- Boundary is subdivided into 22 segments, each with an initial multiplier of 1
- The calibrated multipliers range from 0.6 to 1.8

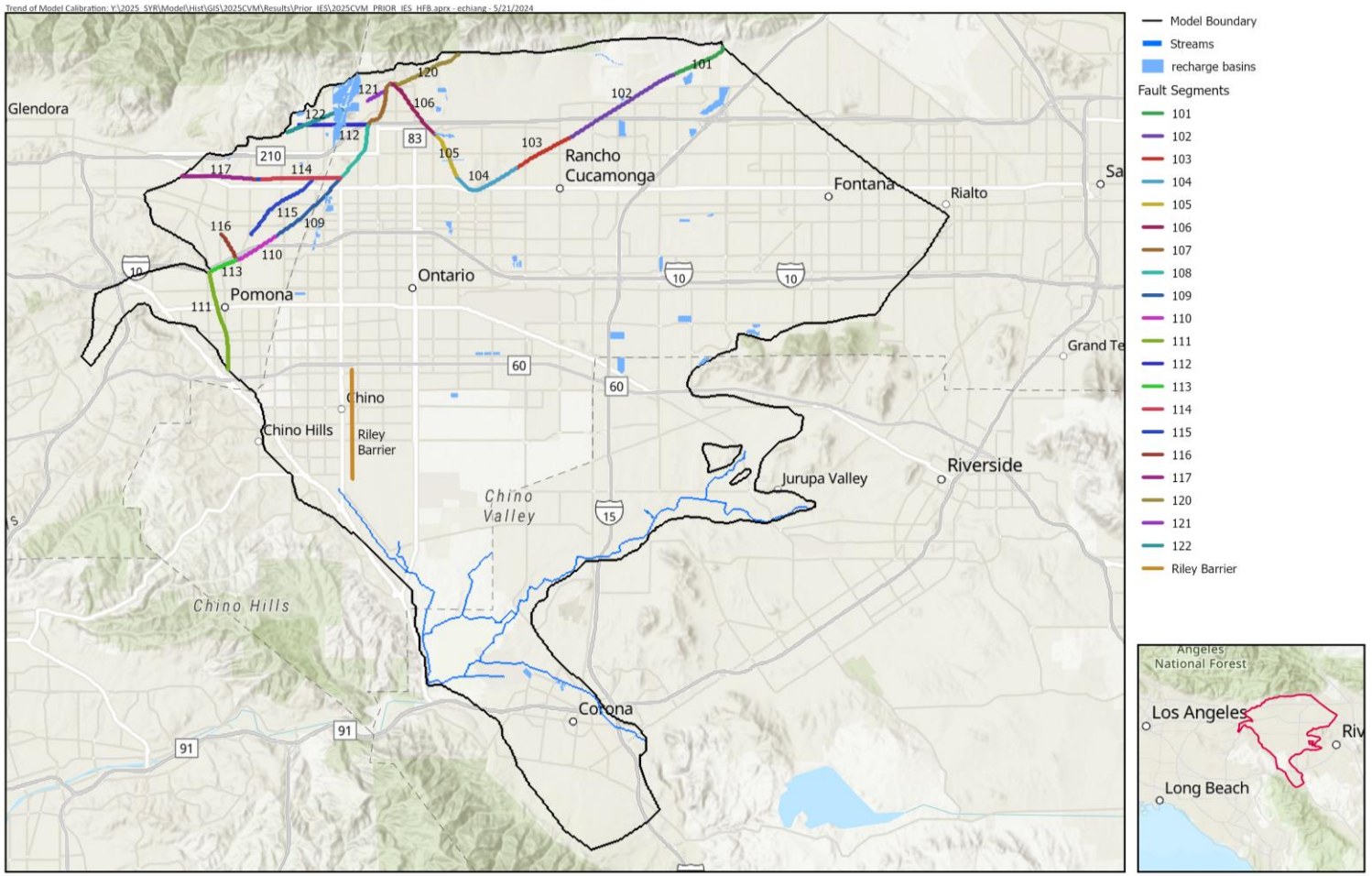
Faults

- 21 faults were simulated through the Horizontal Flow Barrier (HFB) package
- Some fault locations were adjusted based on InSAR images
- Calibrated hydraulic conductivity of faults ranges between 0.0017 and 1E-9 ft/day

Map of Boundary Inflow Segments



Map of Fault Segments



Prepared by:

WEST YOST

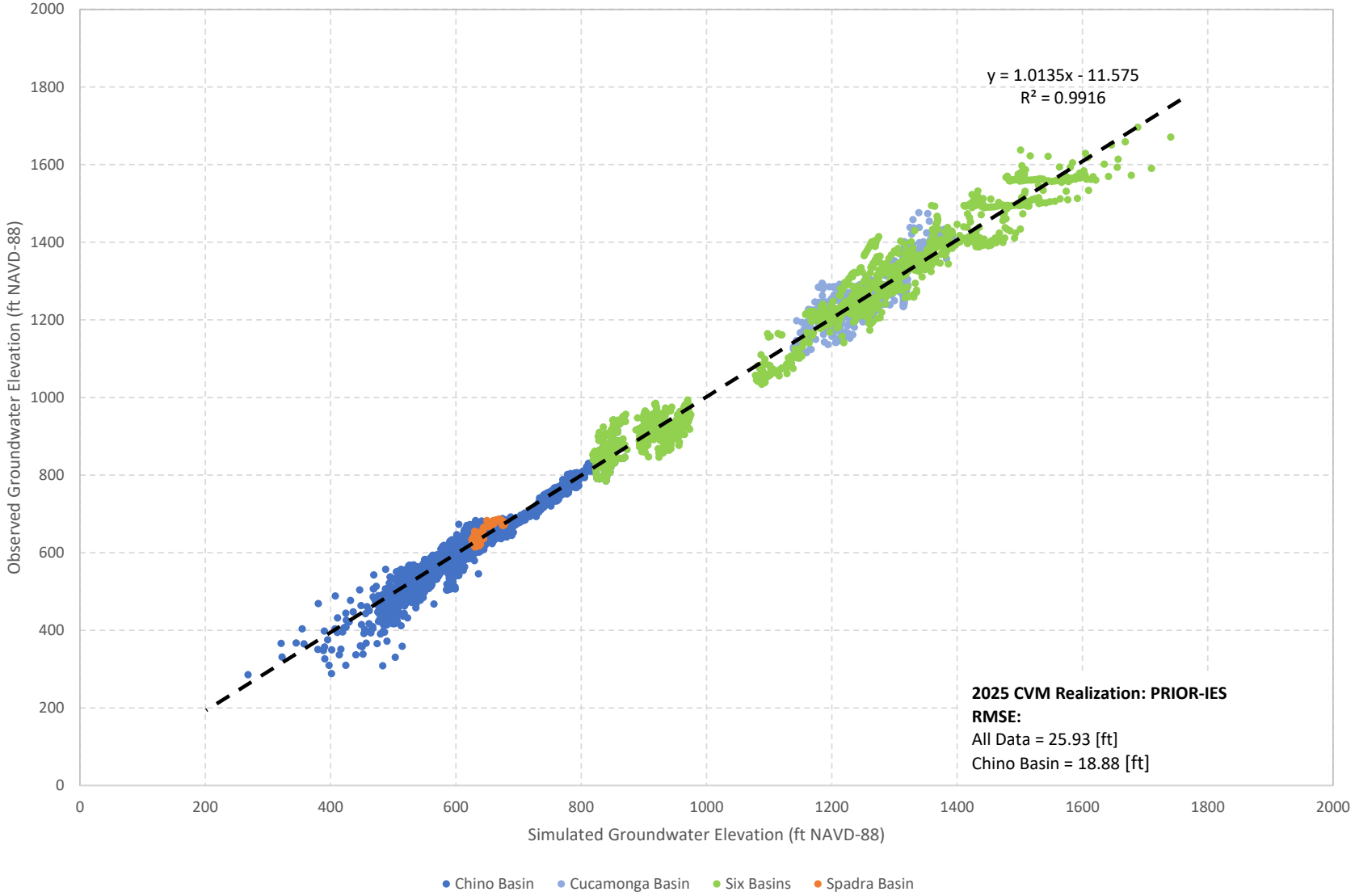
Prepared for:

Chino Basin Watermaster
2025 Safe Yield Reevaluation

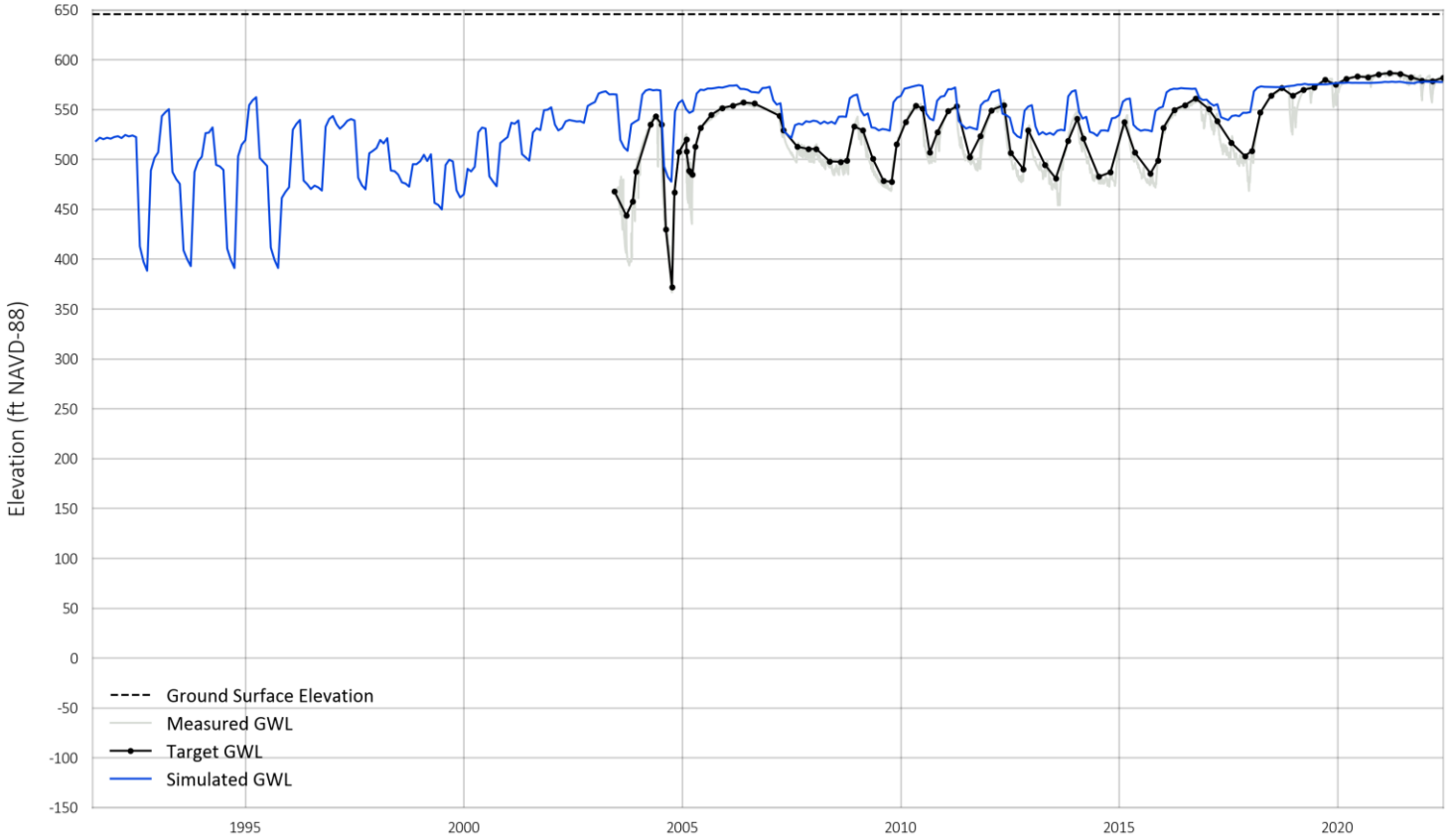
2025 CVM Fault Segments

Figure XXX

Manual Calibration Results



Manual Calibration Results



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Well Location

Statistics

Target GWL (ft)
Mean = 526.27
Standard Deviation = 39.66

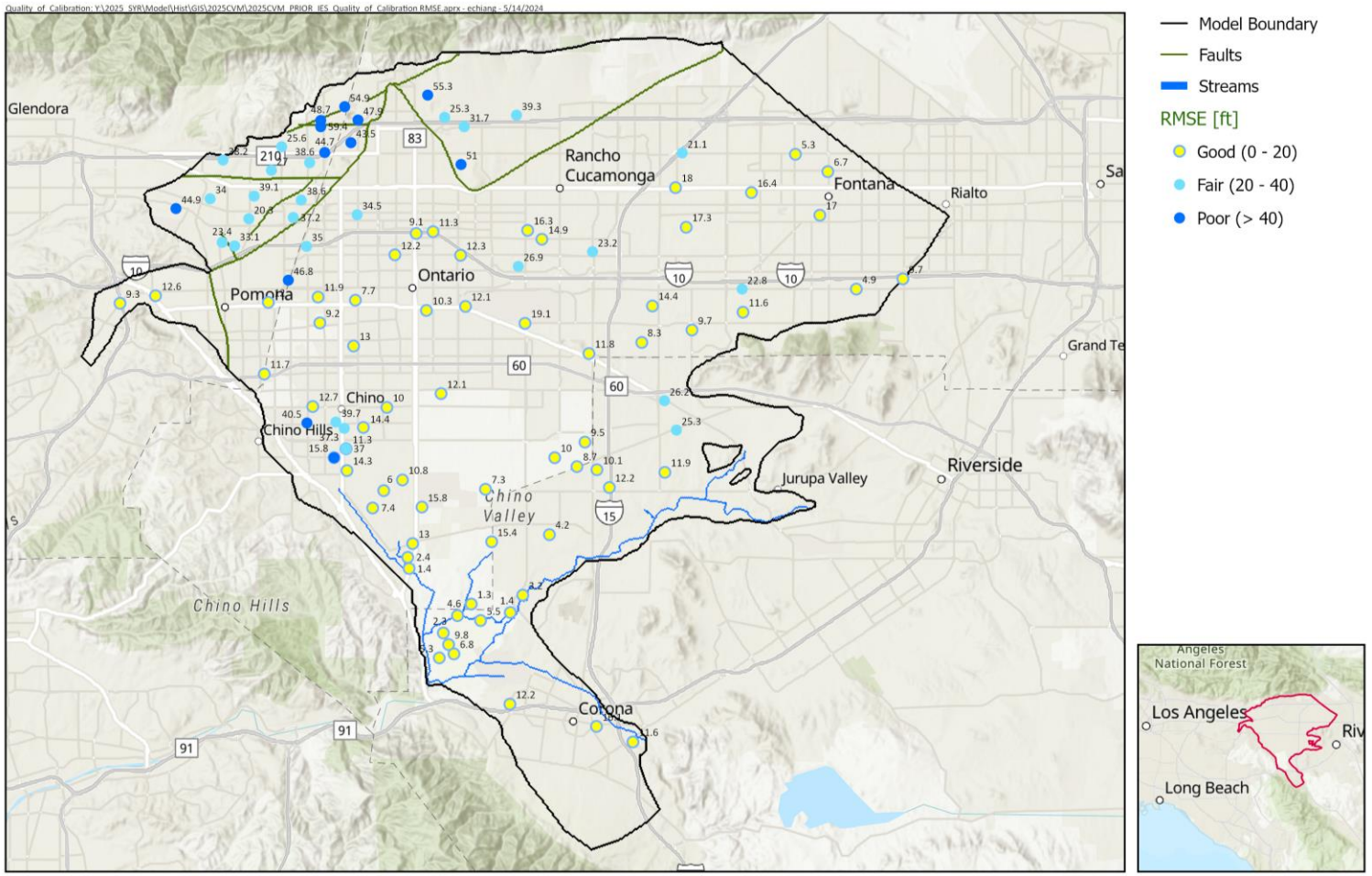
Simulated GWL (ft)
Mean = 554.32
Standard Deviation = 19.48

Mean Residual (ft) = 28.05
RMSE (ft) = 37.03

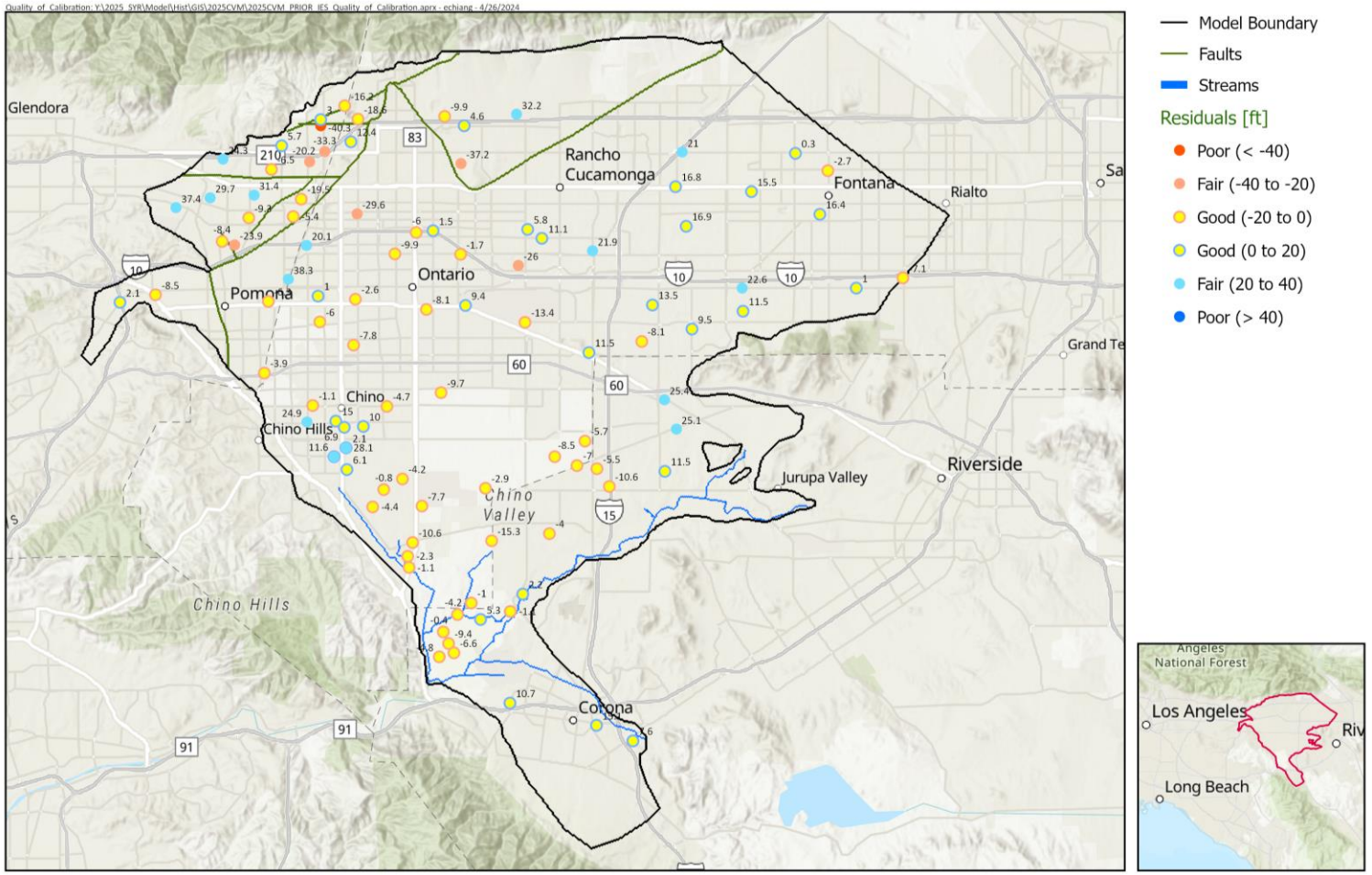
2025 CVM Realization: PRIOR-IES
Groundwater Level (GWL)
HydroDaVE Well ID: 1206952
Well Name: AP-PA/7
Owner: Chino Basin Watermaster

Figure A-11

Manual Calibration Results



Manual Calibration Results



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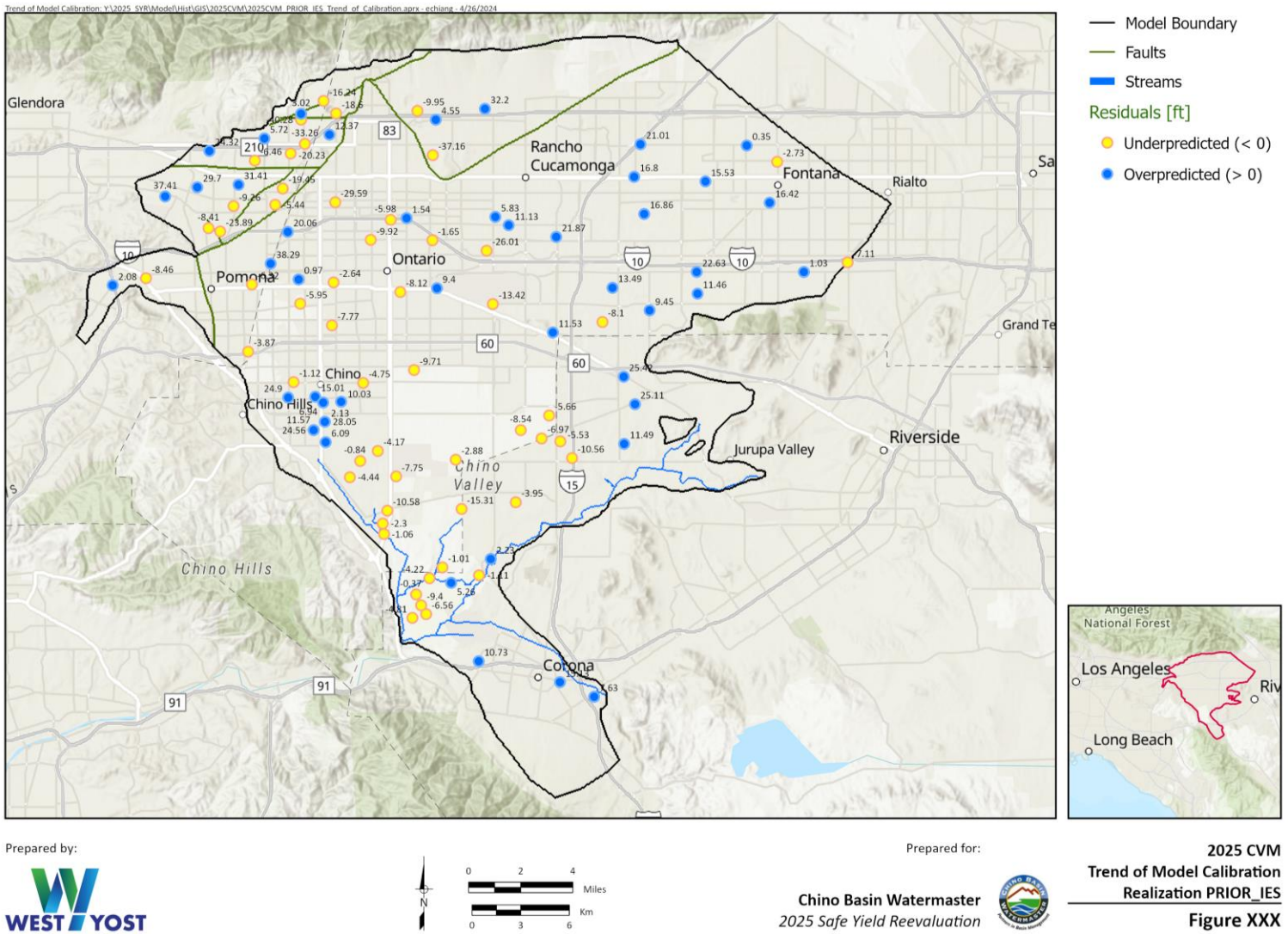
Prepared for:

Chino Basin Watermaster
2025 Safe Yield Reevaluation

2025 CVM Quality of Model Calibration Realization PRIOR-IES

Figure XXX

Manual Calibration Results



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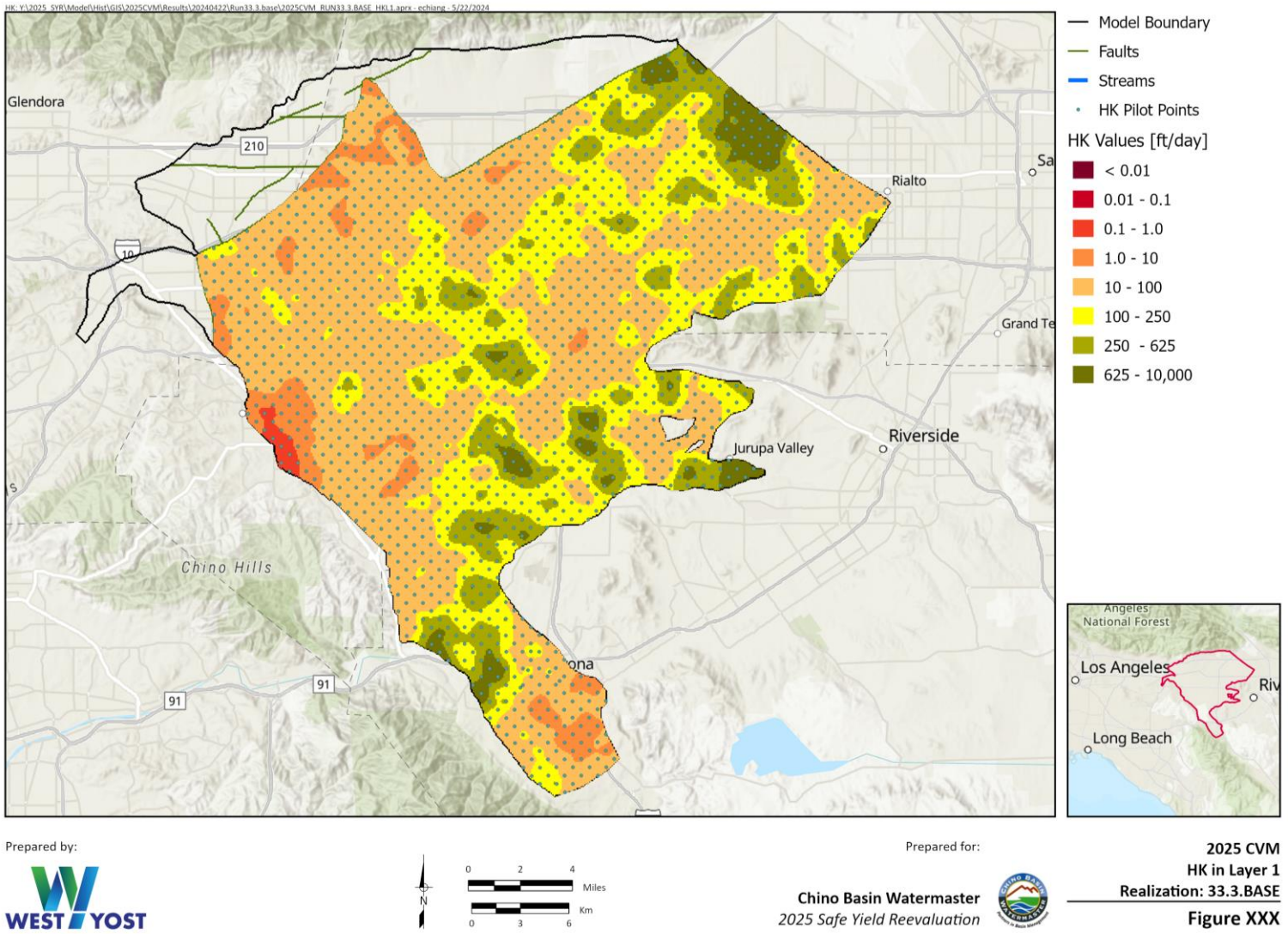
- **PESTPP-IES and Uncertainty Analysis**
- Next Steps and Schedule

PESTPP-IES and Uncertainty Analysis

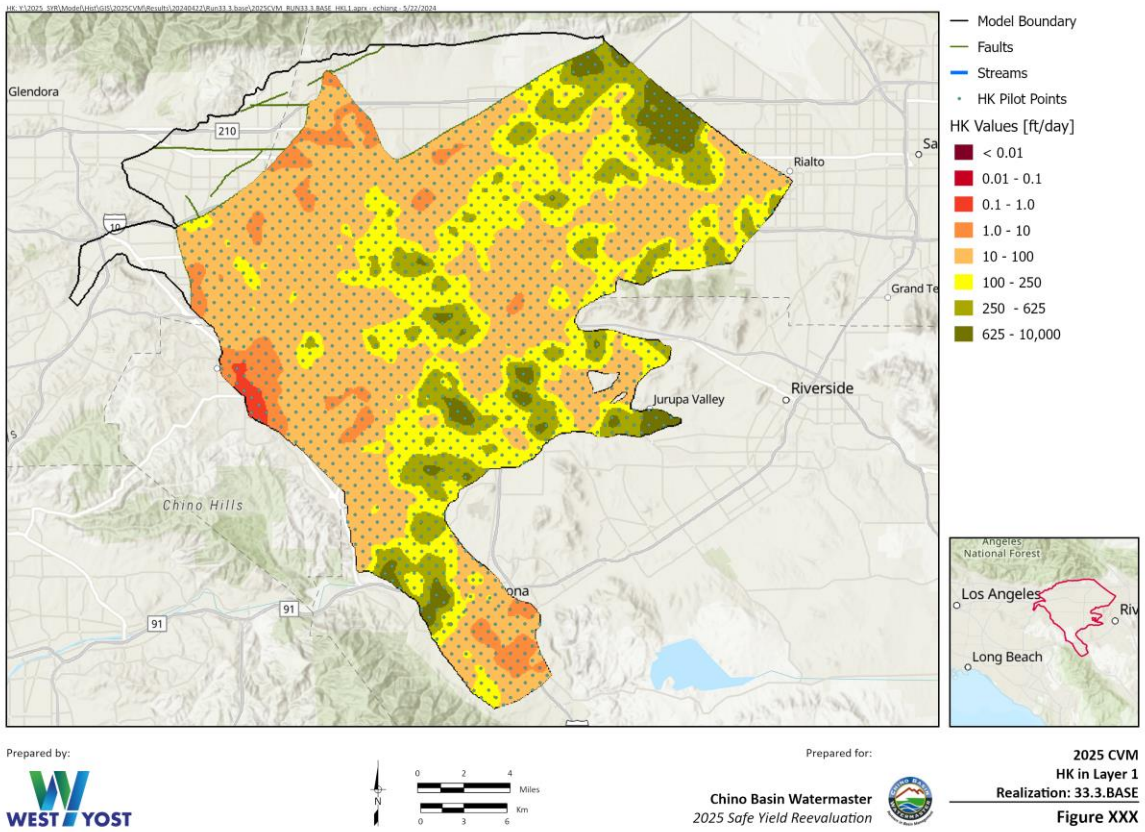
We tested models with various numbers of adjusted parameters

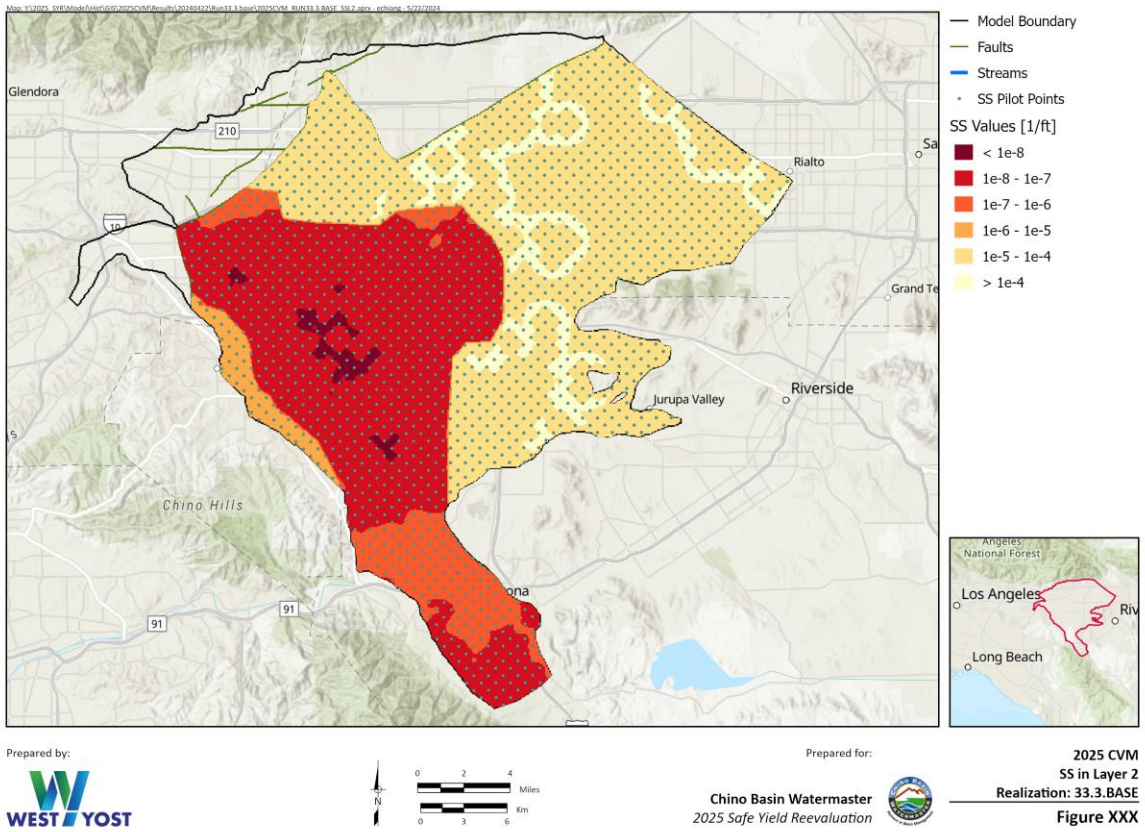
Models with many adjusted parameters tend to produce extreme parameter values and artifacts due to over-fitting

The selected configuration includes **2,701** adjusted parameters (including 2,245 pilot points)

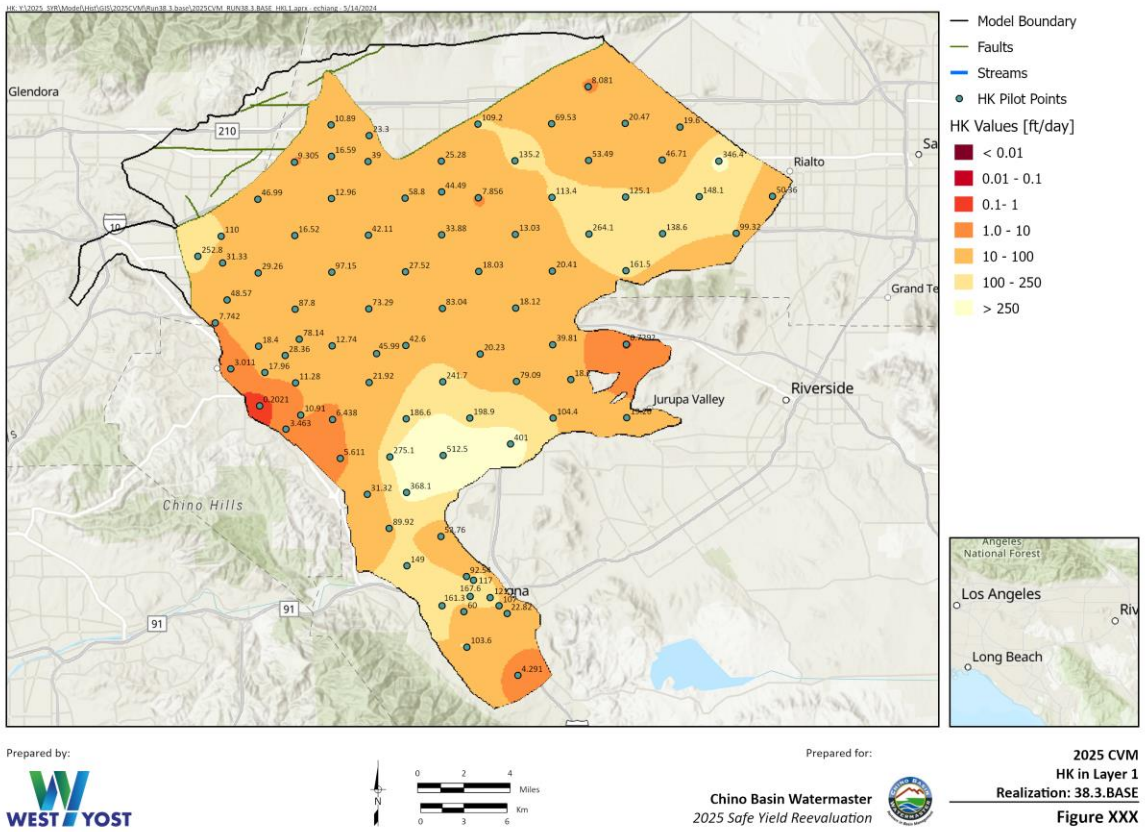


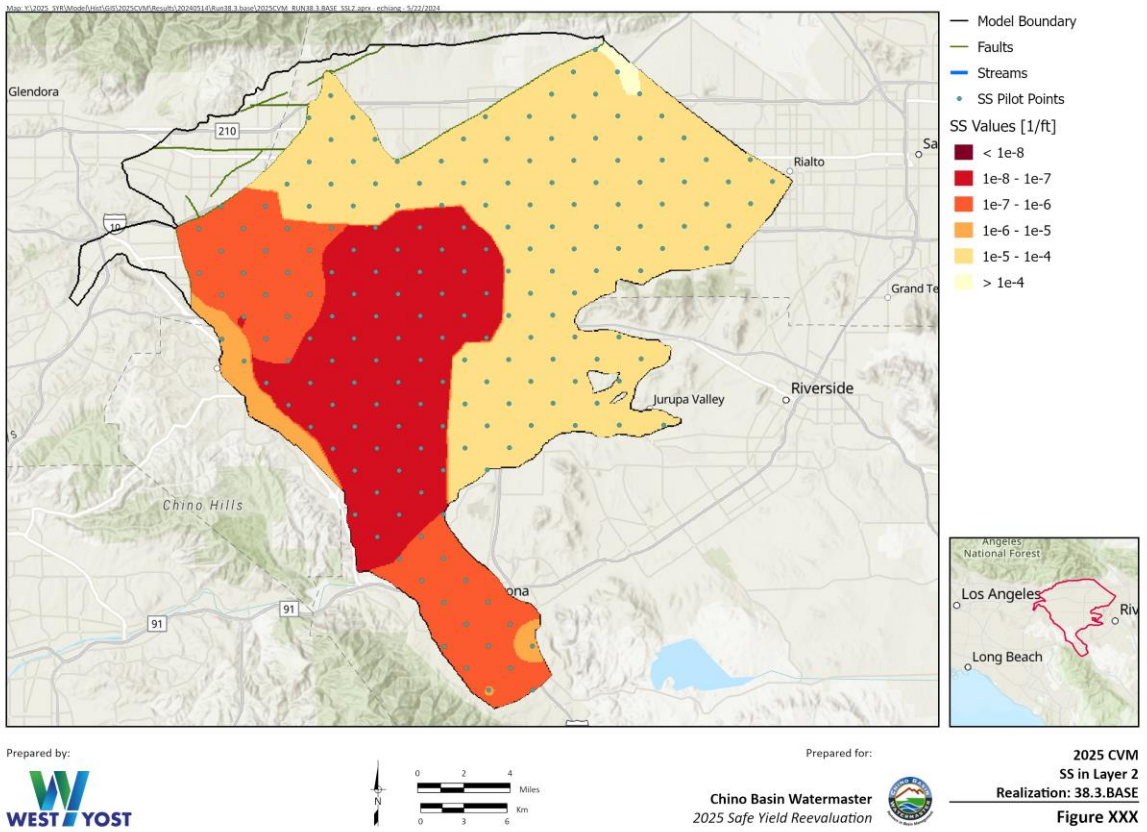
Examples of Parameter Over-fit





Examples of the Selected Configuration



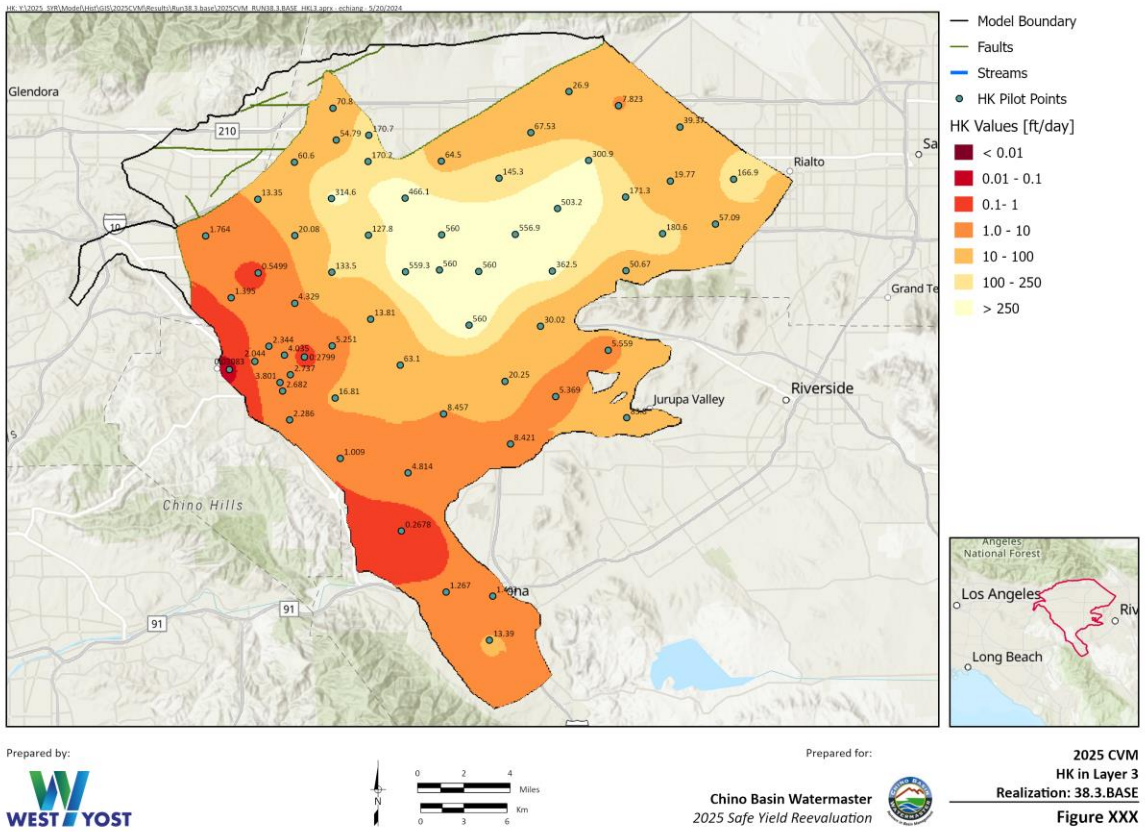


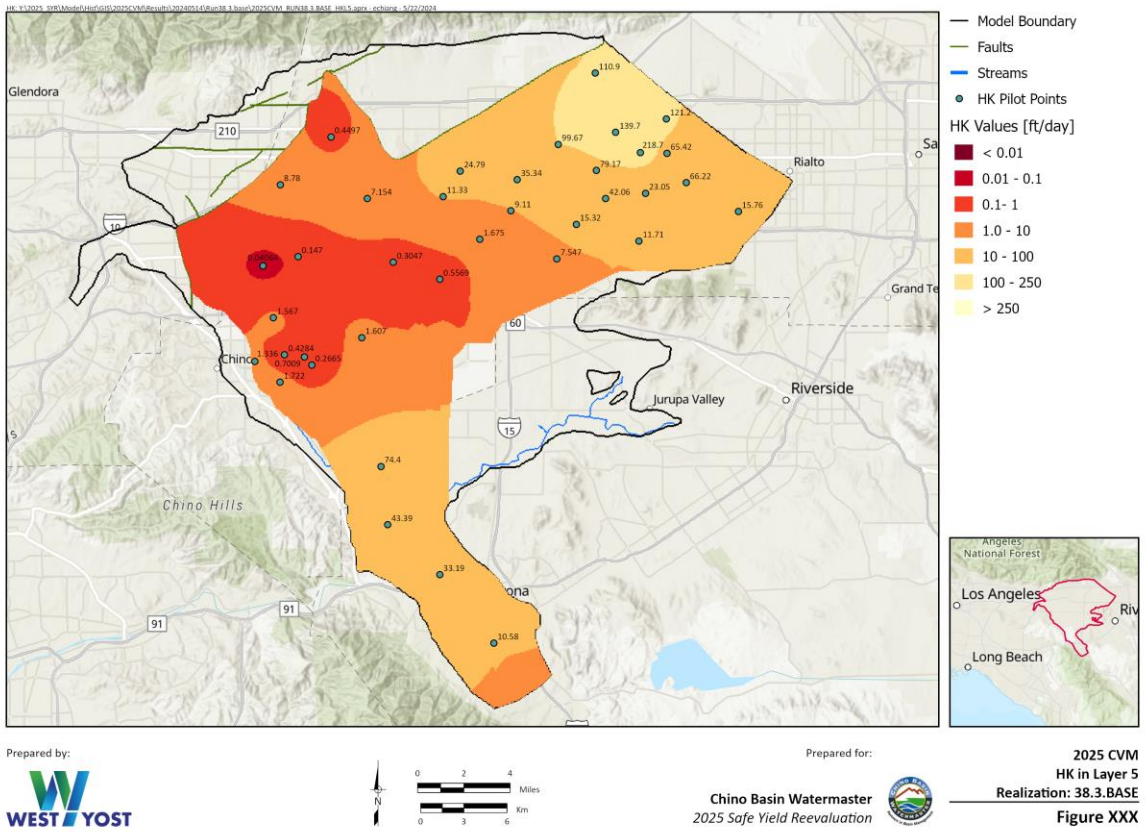
PESTPP-IES and Uncertainty Analysis

2,701 adjusted parameters, including:

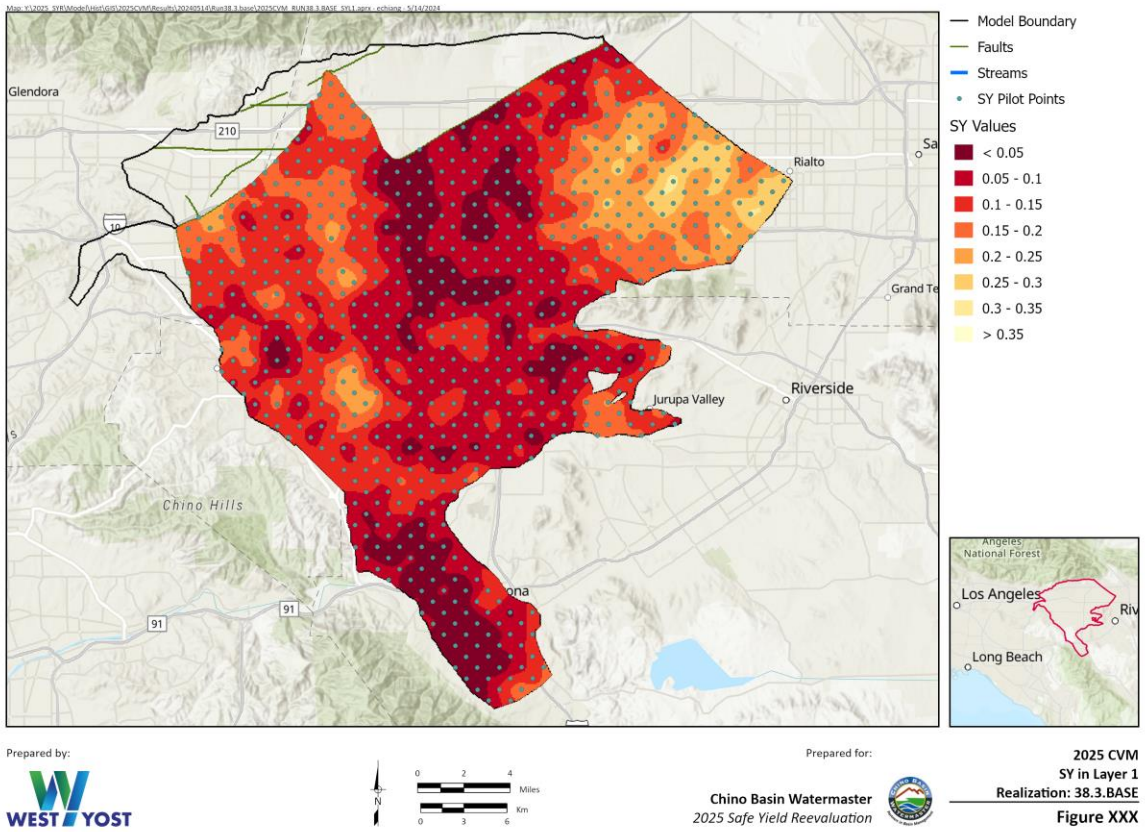
- Areal groundwater recharge multiplier
- Boundary inflow multiplier
- Max ET rate multiplier
- Streambed conductivity
- Hydraulic conductivity of faults
- HK values at pilot points in model layers 1 to 5
- VK values at pilot points in model layers 1 to 5. Most VK values are linked to HK values with the same ratio of their initial values.
- SY values at pilot points in model layer 1
- SS values at pilot points in model layers 2 to 5

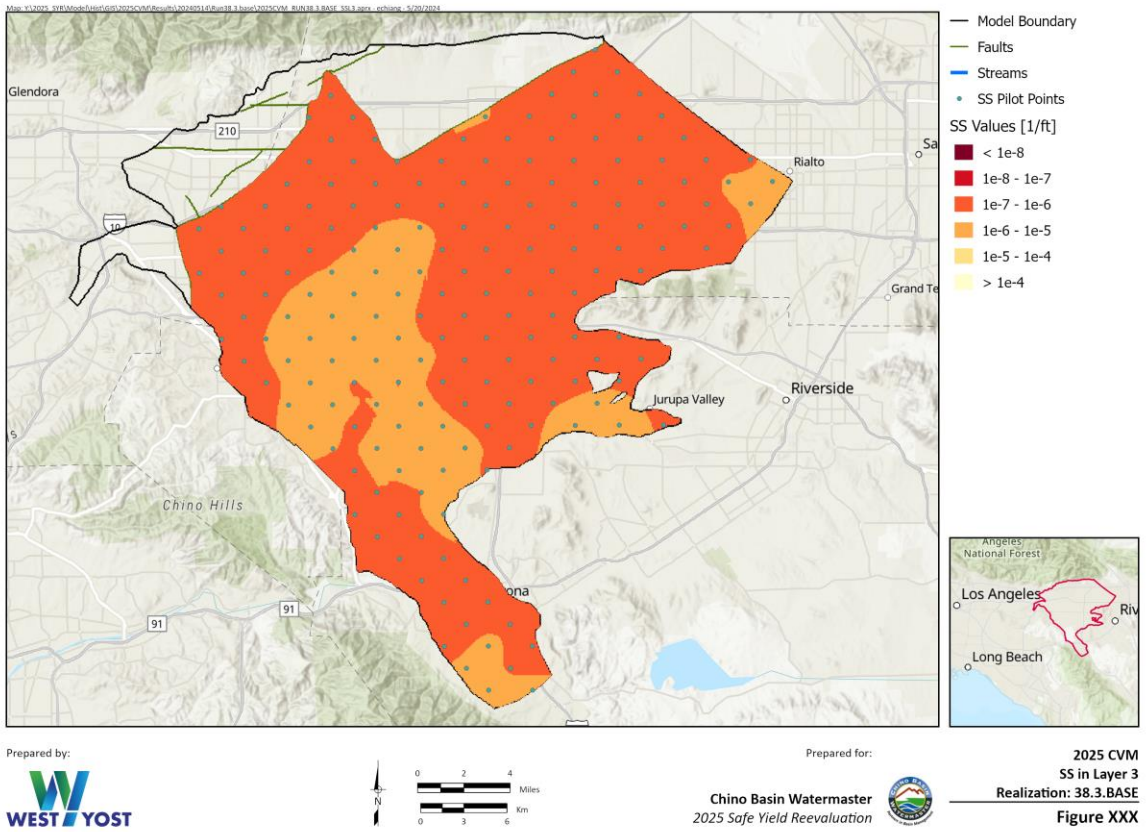
Examples of Adjusted Parameters



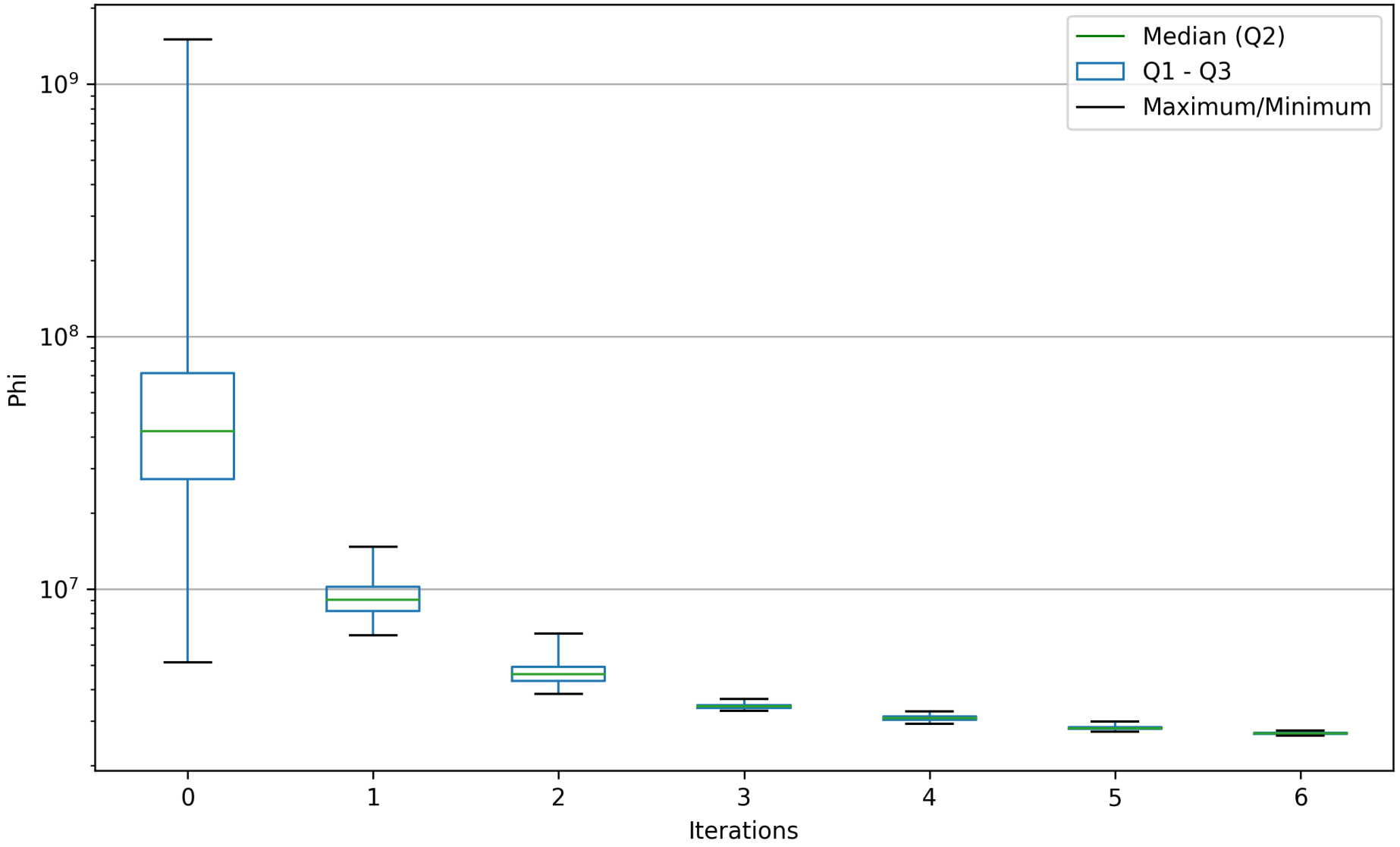


Examples of Adjusted Parameters

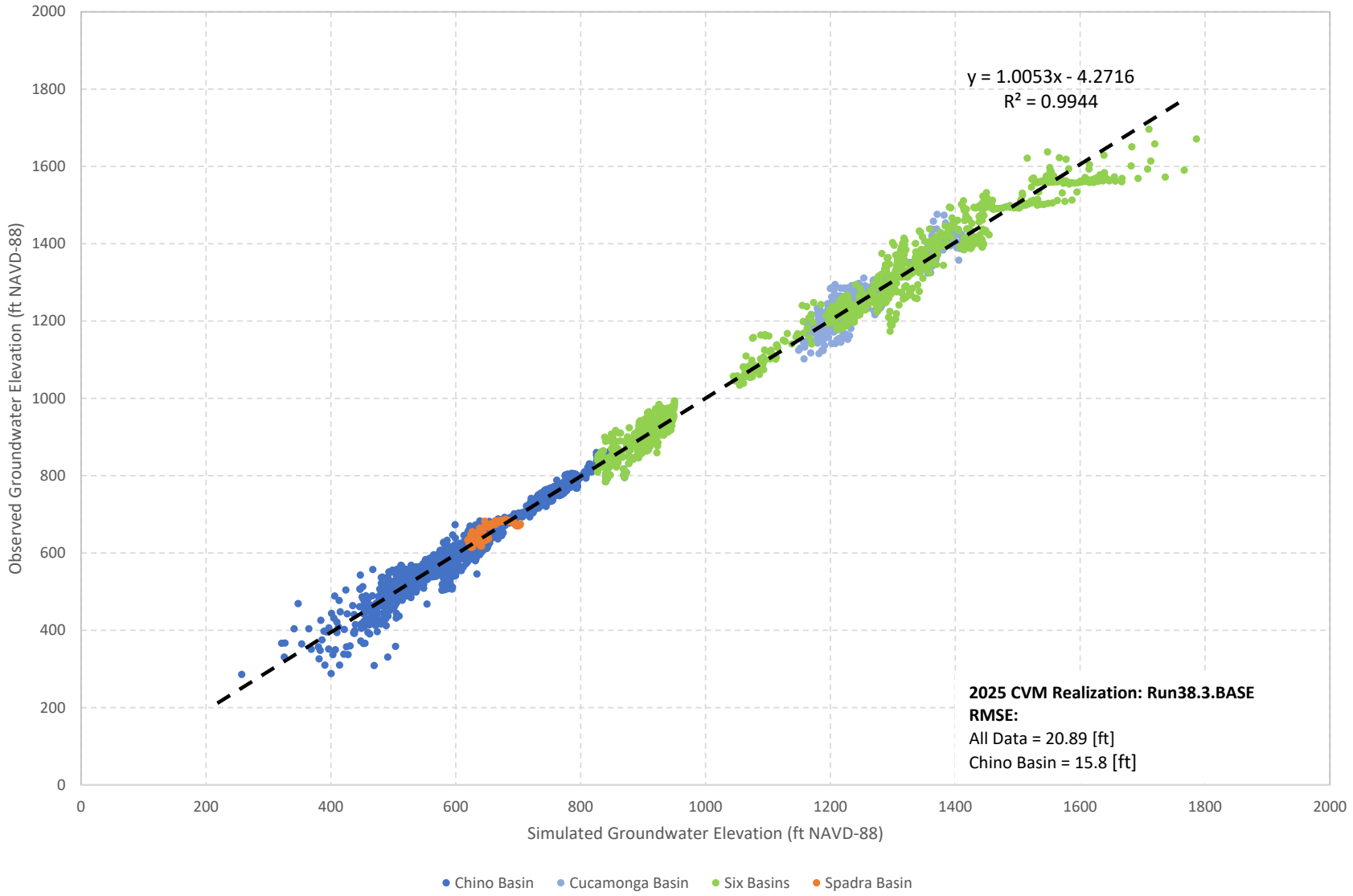




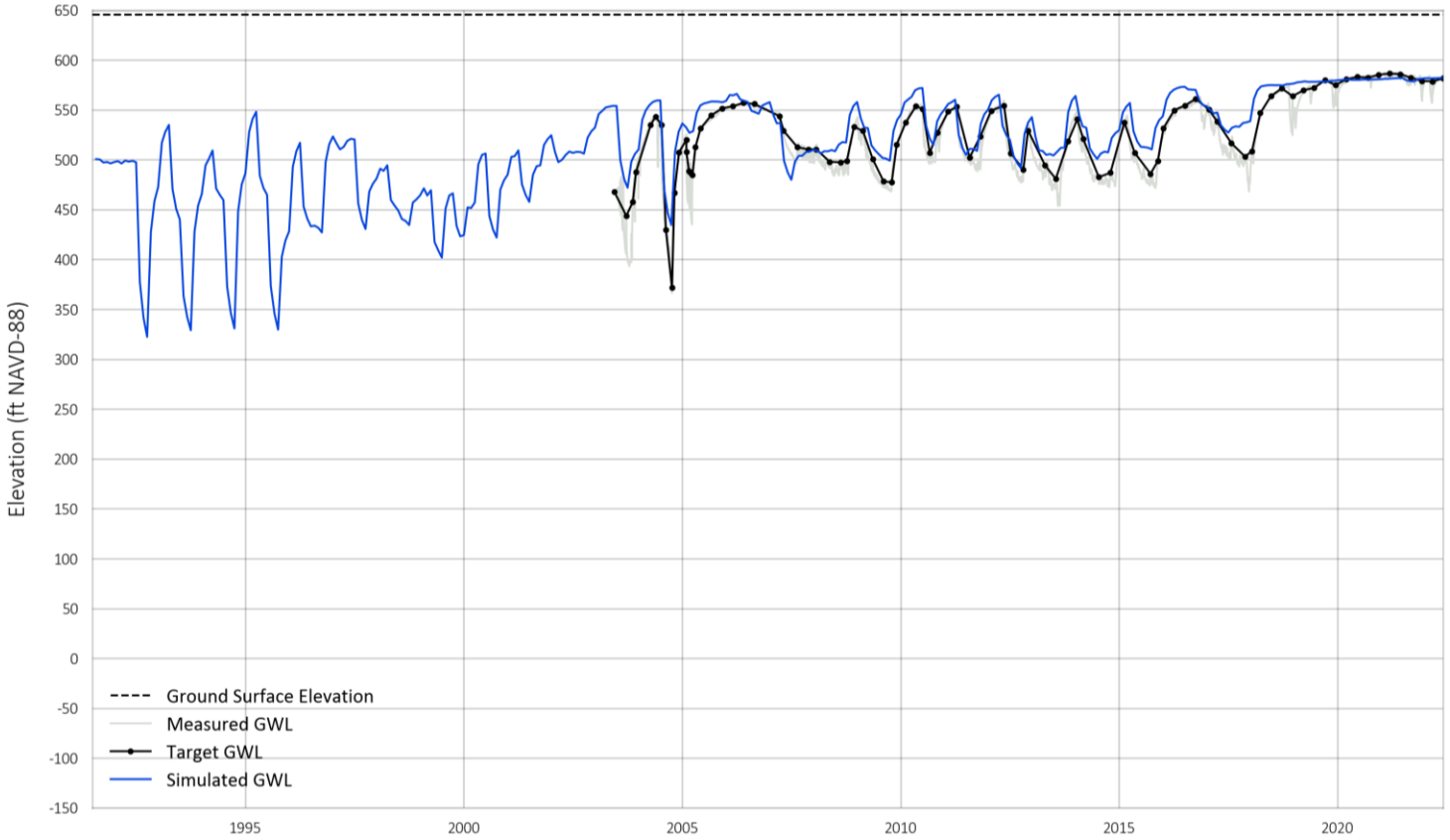
PESTPP-IES Results



PESTPP-IES Results



PESTPP-IES Results



Prepared by:

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Well Location

Statistics

Target GWL (ft)
Mean = 526.27
Standard Deviation = 39.66

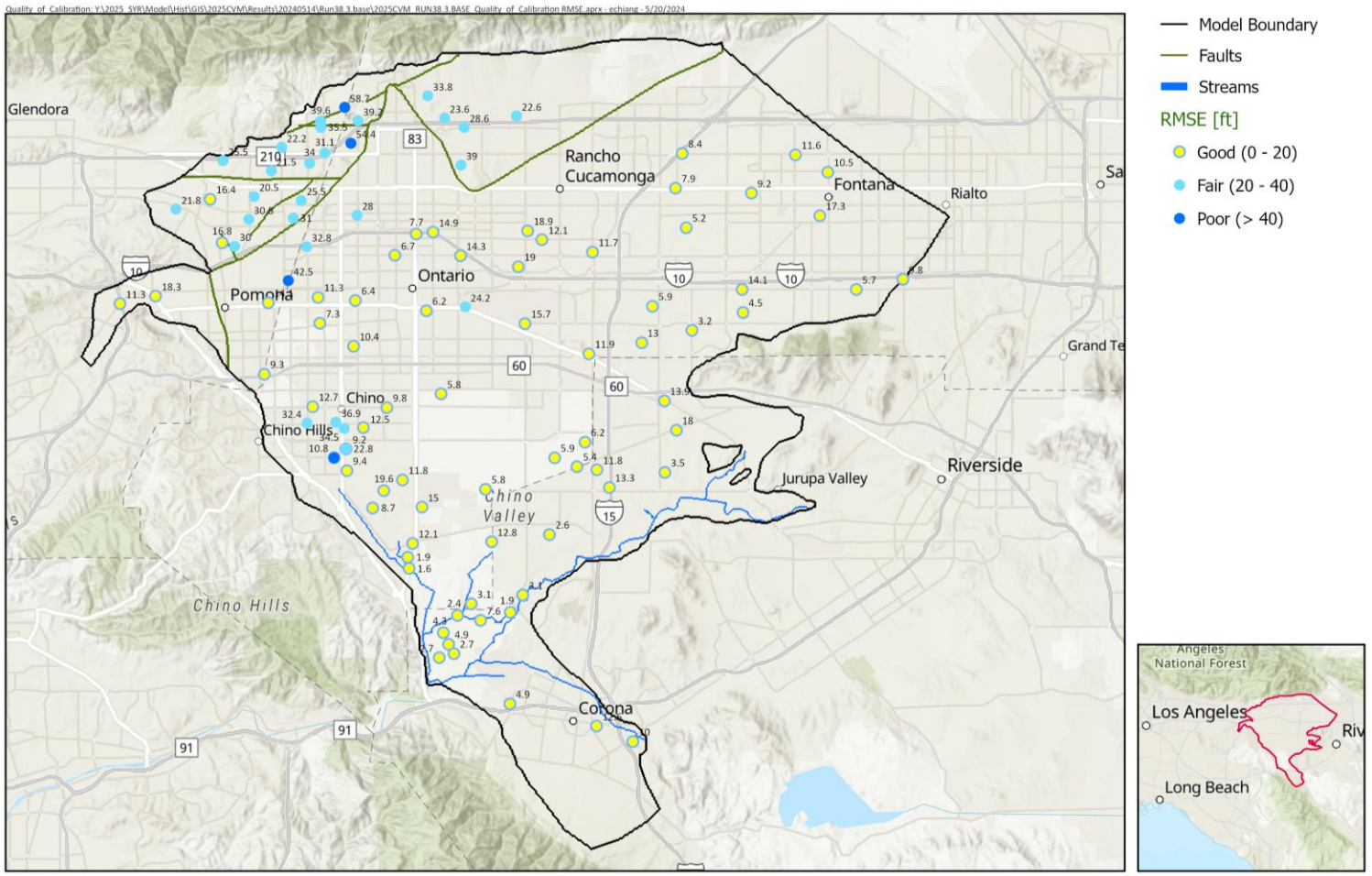
Simulated GWL (ft)
Mean = 541.07
Standard Deviation = 29.83

Mean Residual (ft) = 14.80
RMSE (ft) = 22.77

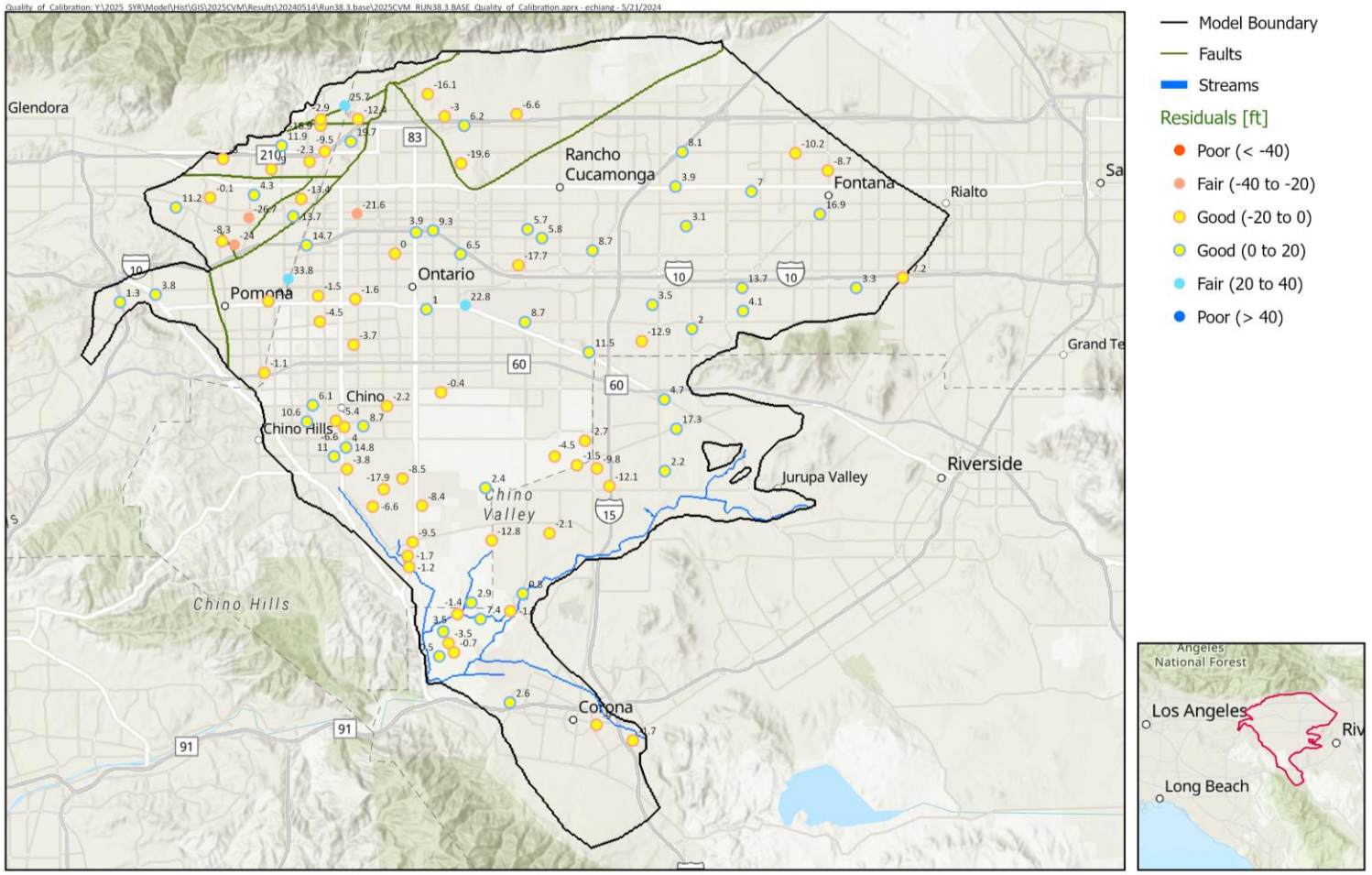
2025 CVM Realization: Run38.3.base
Groundwater Level (GWL)
HydroDaVE Well ID: 1206952
Well Name: AP-PA/7
Owner: Chino Basin Watermaster

Figure A-11

PESTPP-IES Results



PESTPP-IES Results



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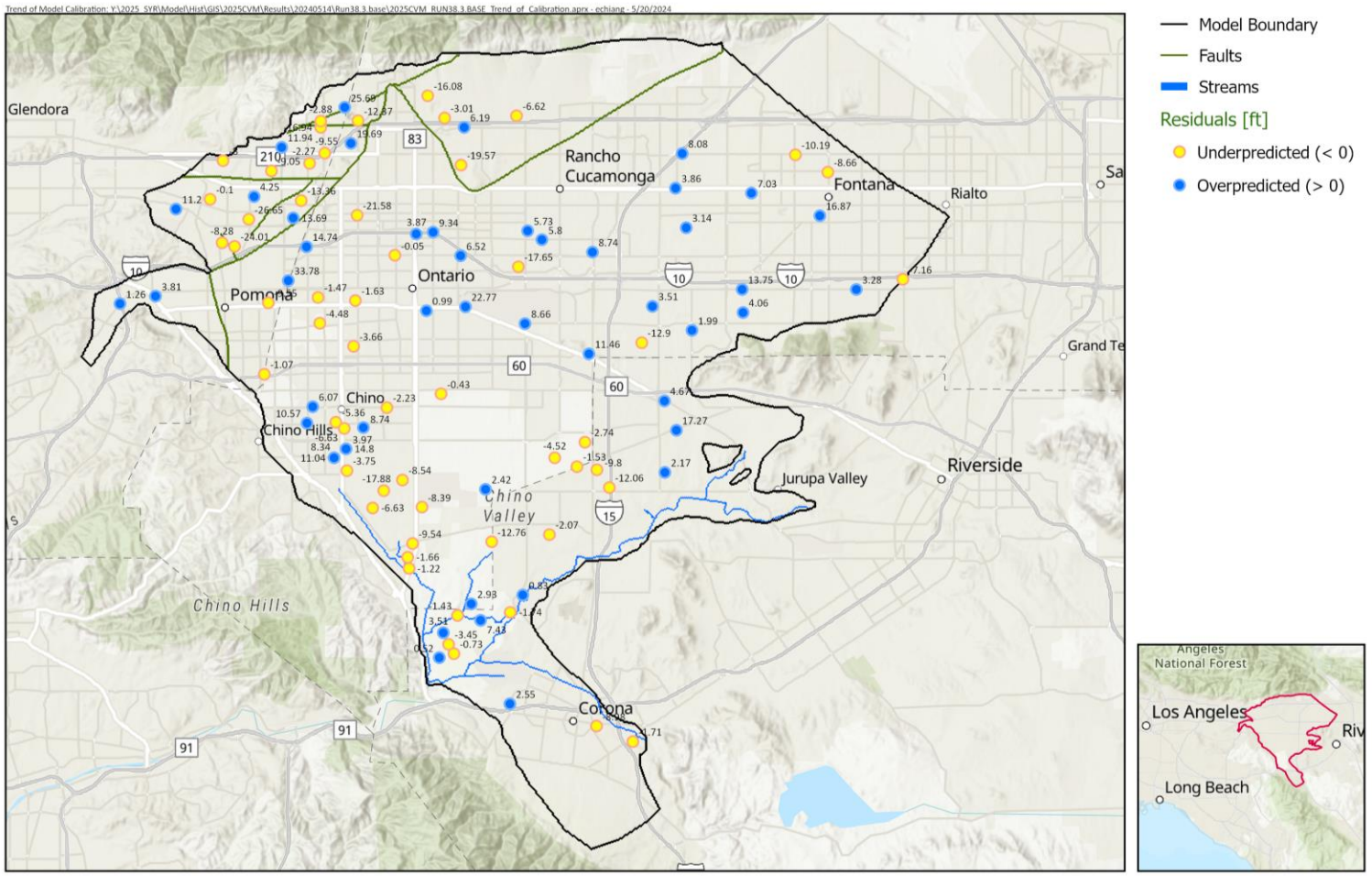
WEST YOST

Prepared for:

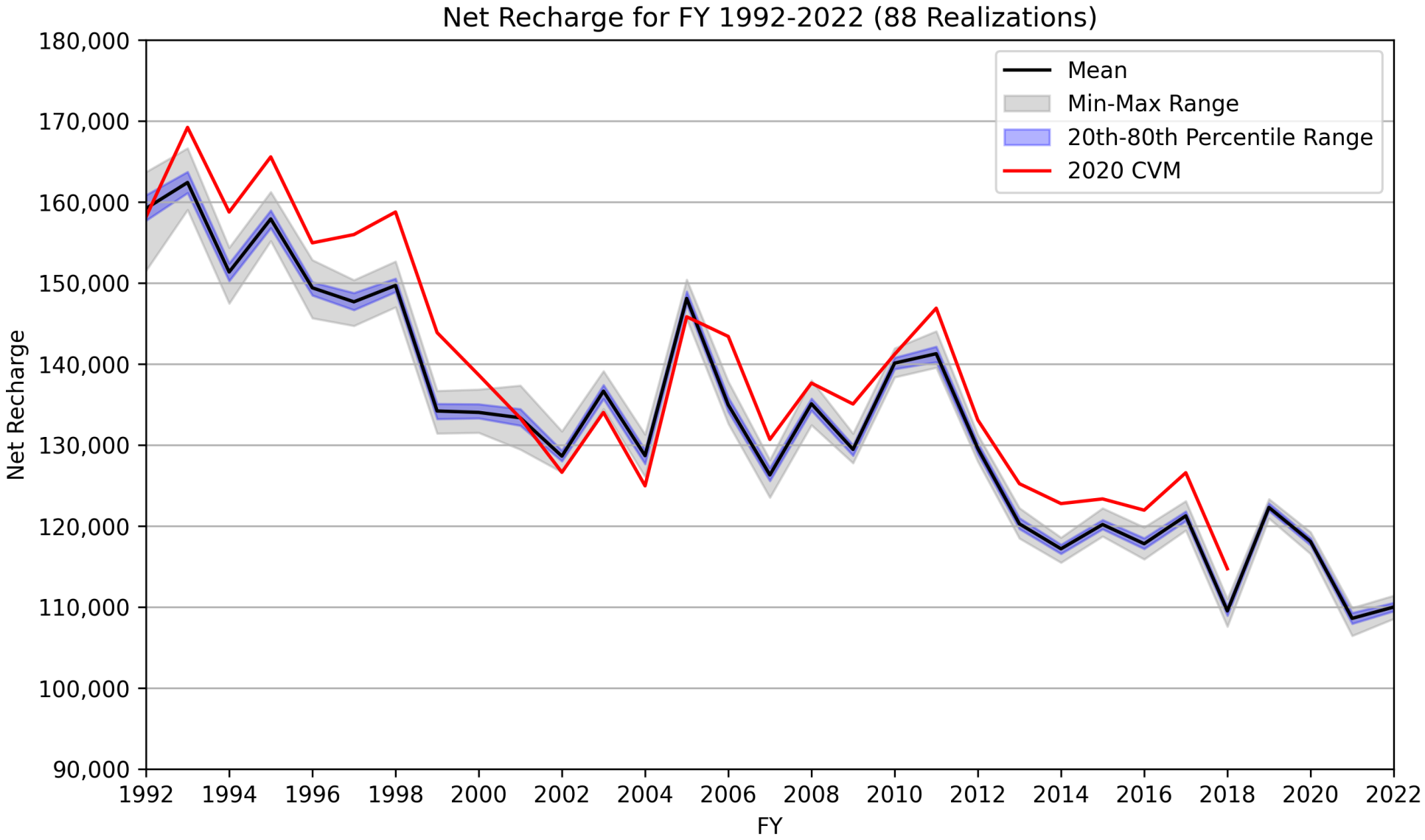
Chino Basin Watermaster
2025 Safe Yield Reevaluation

2025 CVM
Quality of Model Calibration
Realization 38.3.BASE
Figure XXX

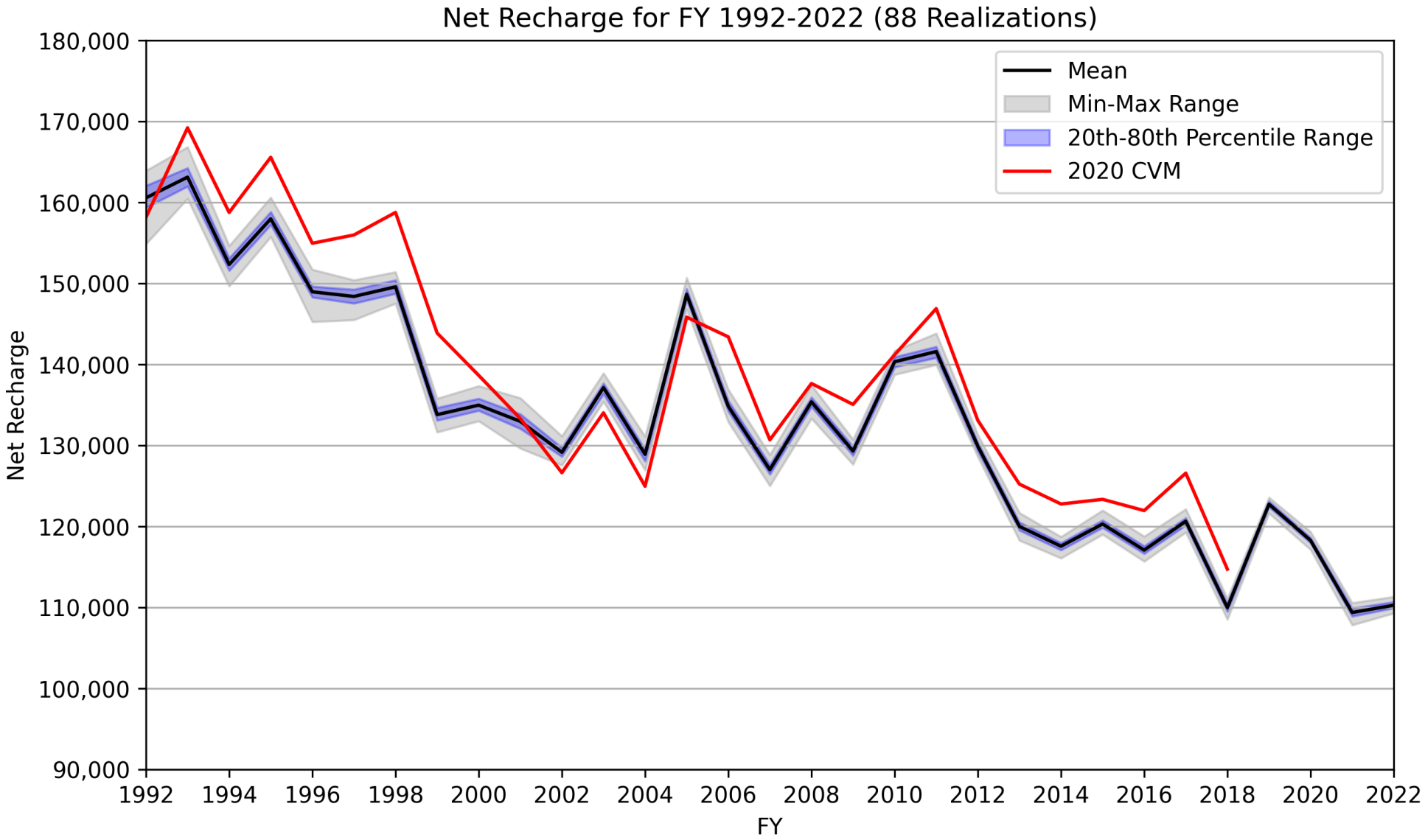
PESTPP-IES Results



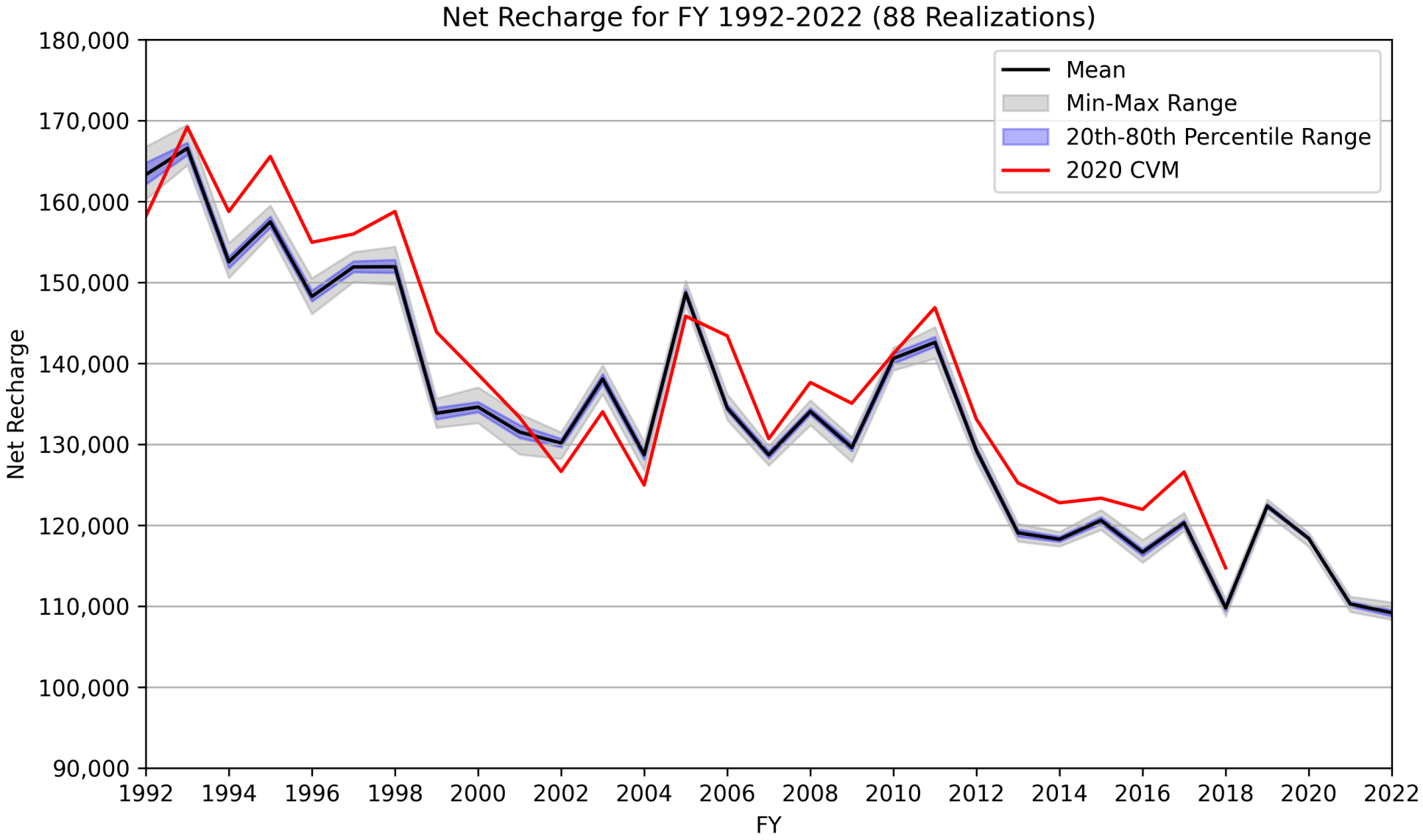
PESTPP-IES Results – 2nd Iteration



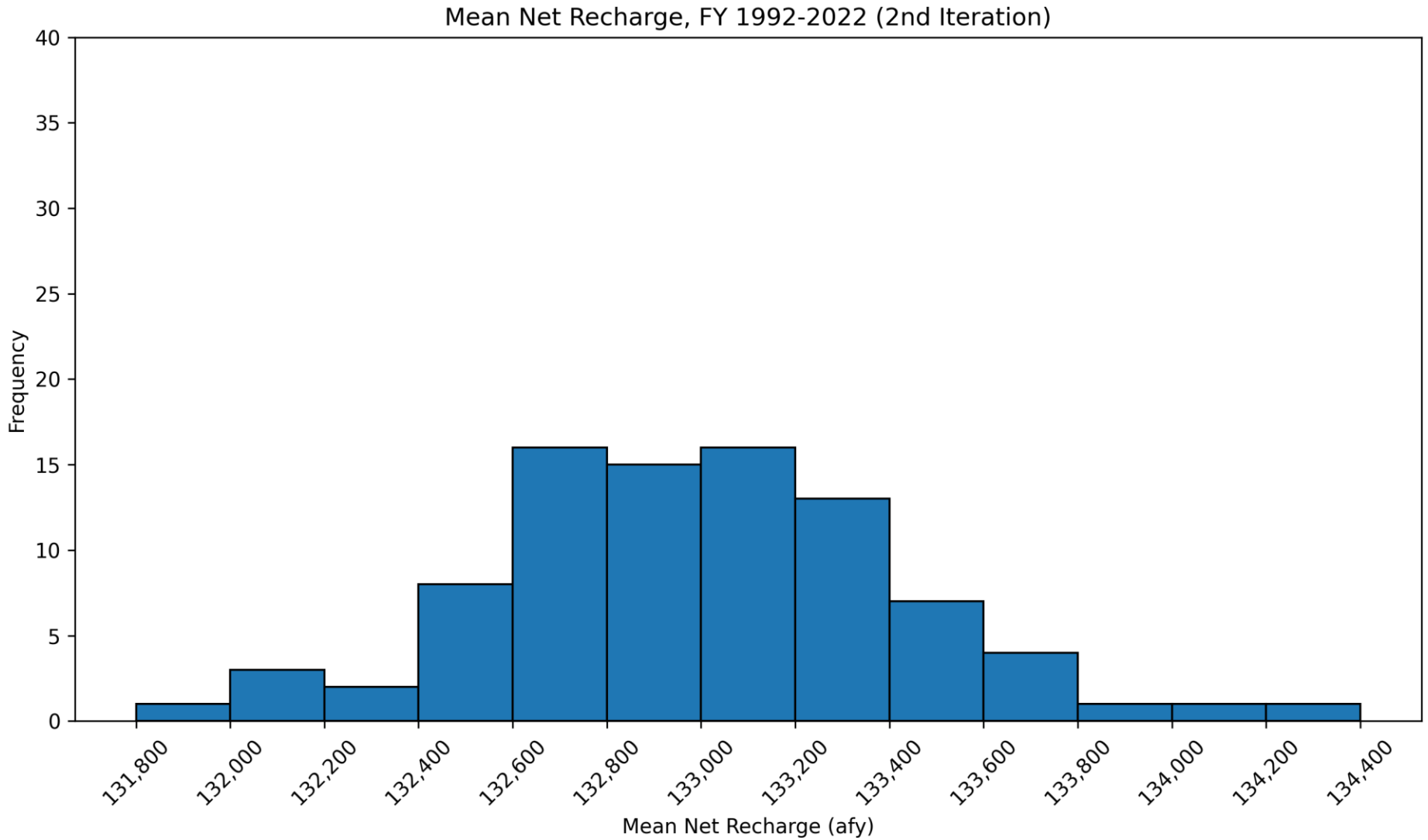
PESTPP-IES Results – 3rd Iteration



PESTPP-IES Results – 4th Iteration



PESTPP-IES Results – Mean Net Recharge



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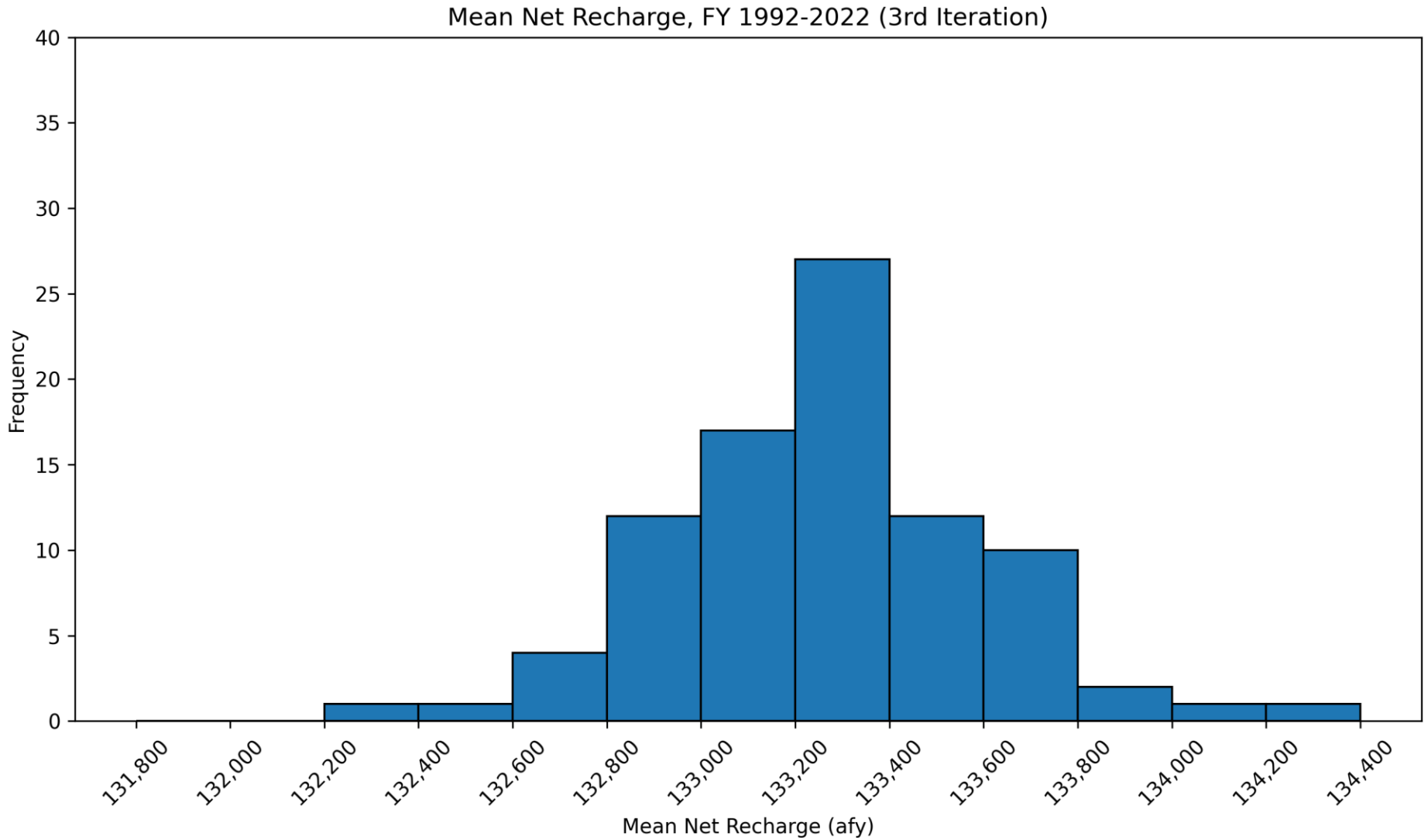
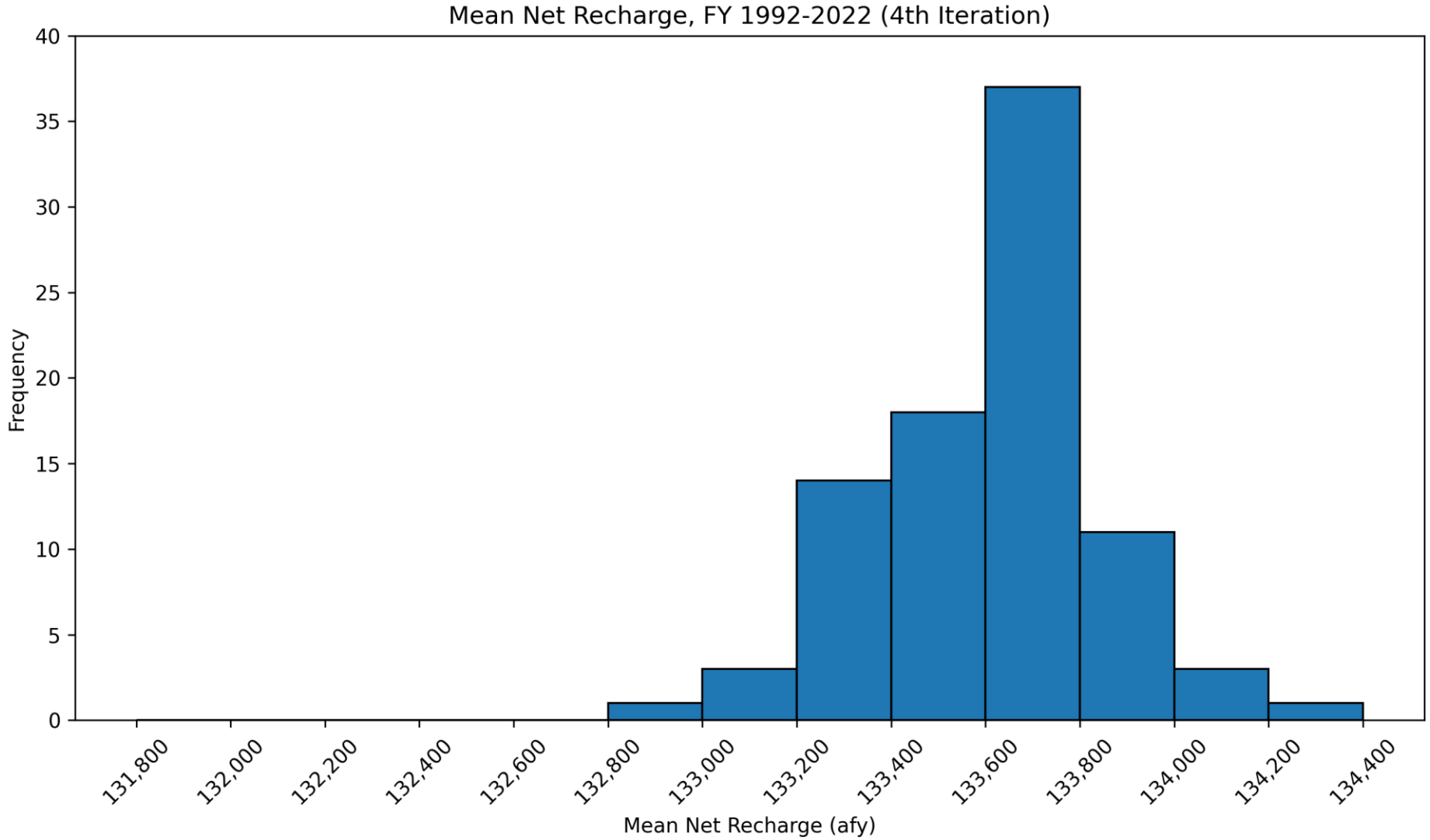


PESTPP-IES Results – Mean Net Recharge



Selection of Realizations for 2025 SYR

Choose earliest iteration that produces normal distribution of net recharge

Choose realizations that represent mean and +/- 1, 2 SD from mean

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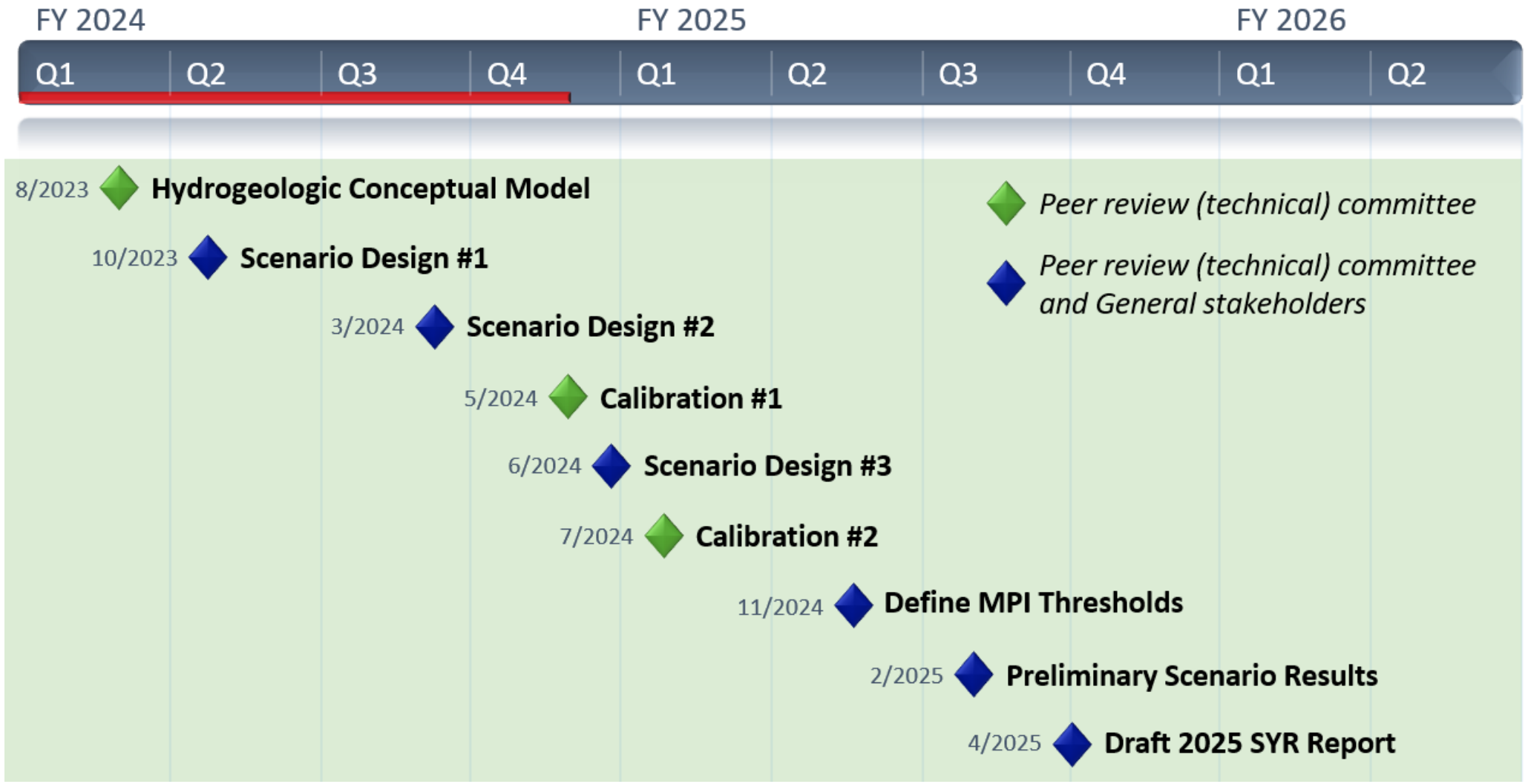
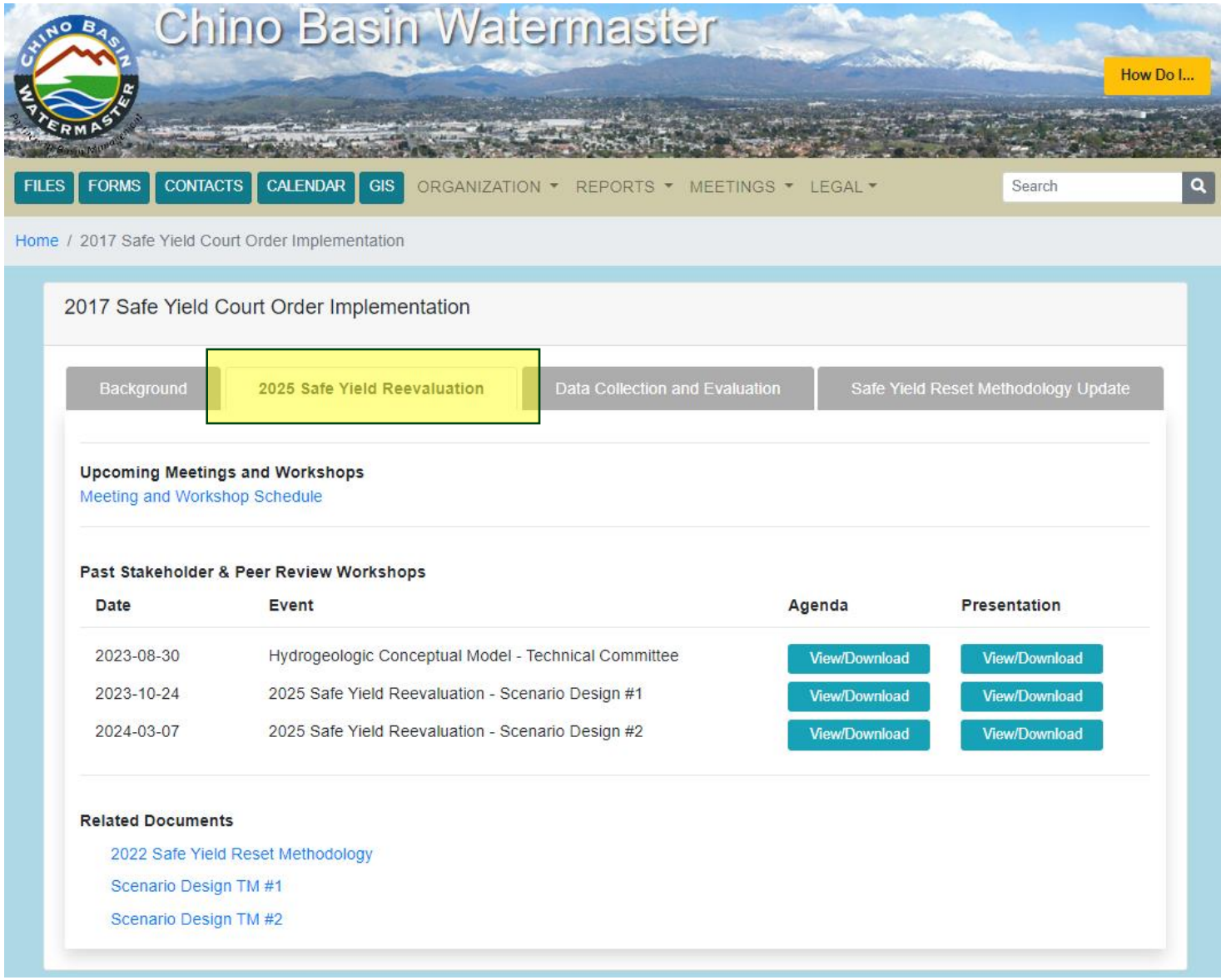
Next Steps

- Generate and analyze more realizations to ensure that uncertainty is captured
- Compile feedback from peer reviewers on recalibration/uncertainty analysis and proposed process for choosing realizations
- Complete calibration/uncertainty analysis, finalize calibrated realizations, develop projection realizations
- Upcoming workshops:
  - **June 25, 2024:** Scenario design workshop #3 (peer reviewers/stakeholders)
  - **July 2024:** Calibration workshop #2 (peer reviewers)

2025 SYR Timeline



https://www.cbwm.org/pages/syrm/



THANK YOU