Groundwater Flow Model Preliminary Results

August 15, 2018

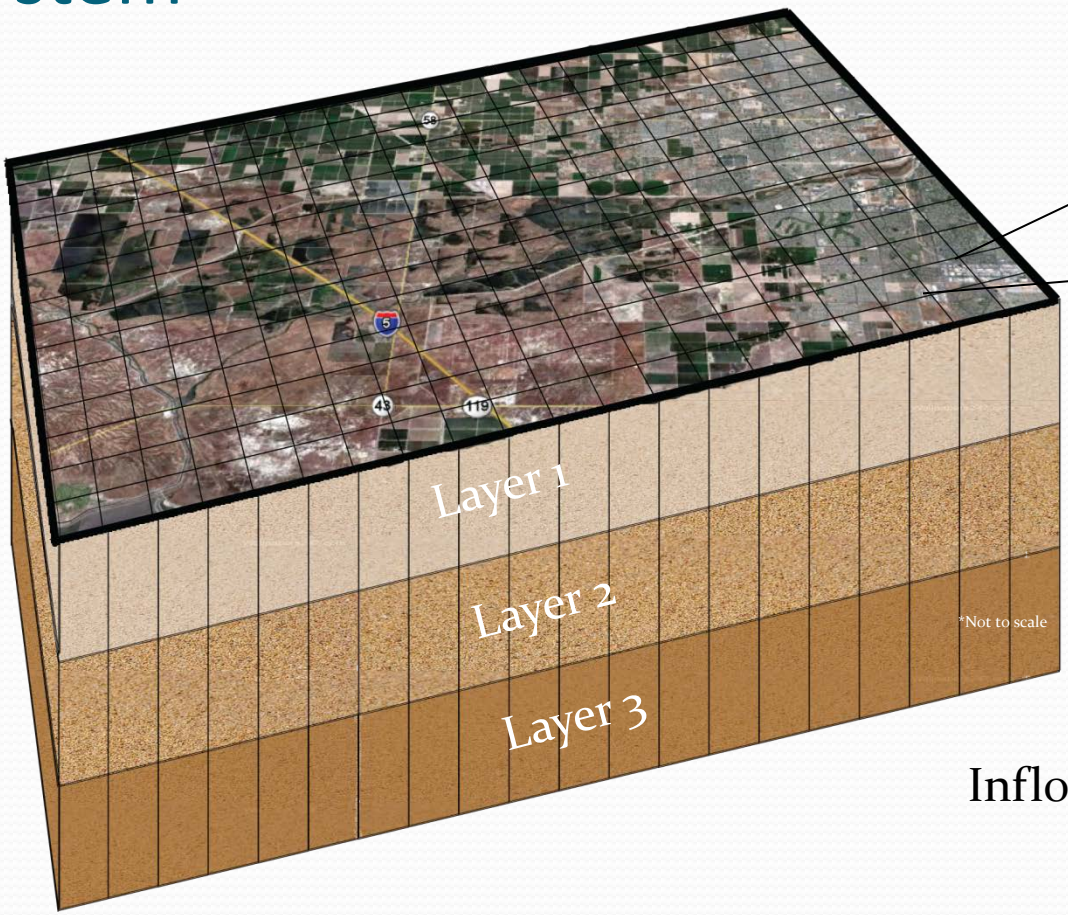
Prepared for:
Tule Subbasin MOU Group

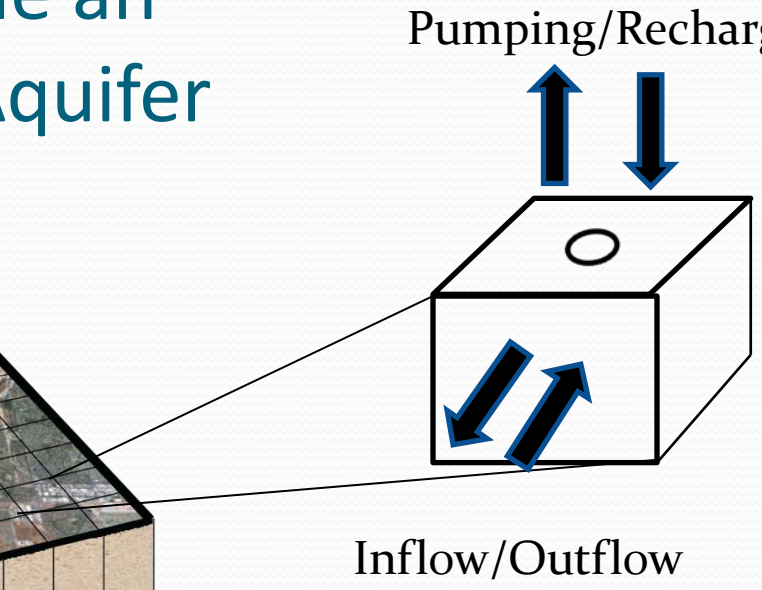
Thomas Harder & Co.
Groundwater Consulting

Presentation Overview

- Model Overview
- Model Calibration
- Model Results
  - Sustainable Yield
  - Projections of Land Subsidence
  - Projections of Groundwater Levels by GSA
- Monitoring Plan

Groundwater Models Provide an Approximation of the Real Aquifer System





Inflow – Outflow = +/-ΔStorage

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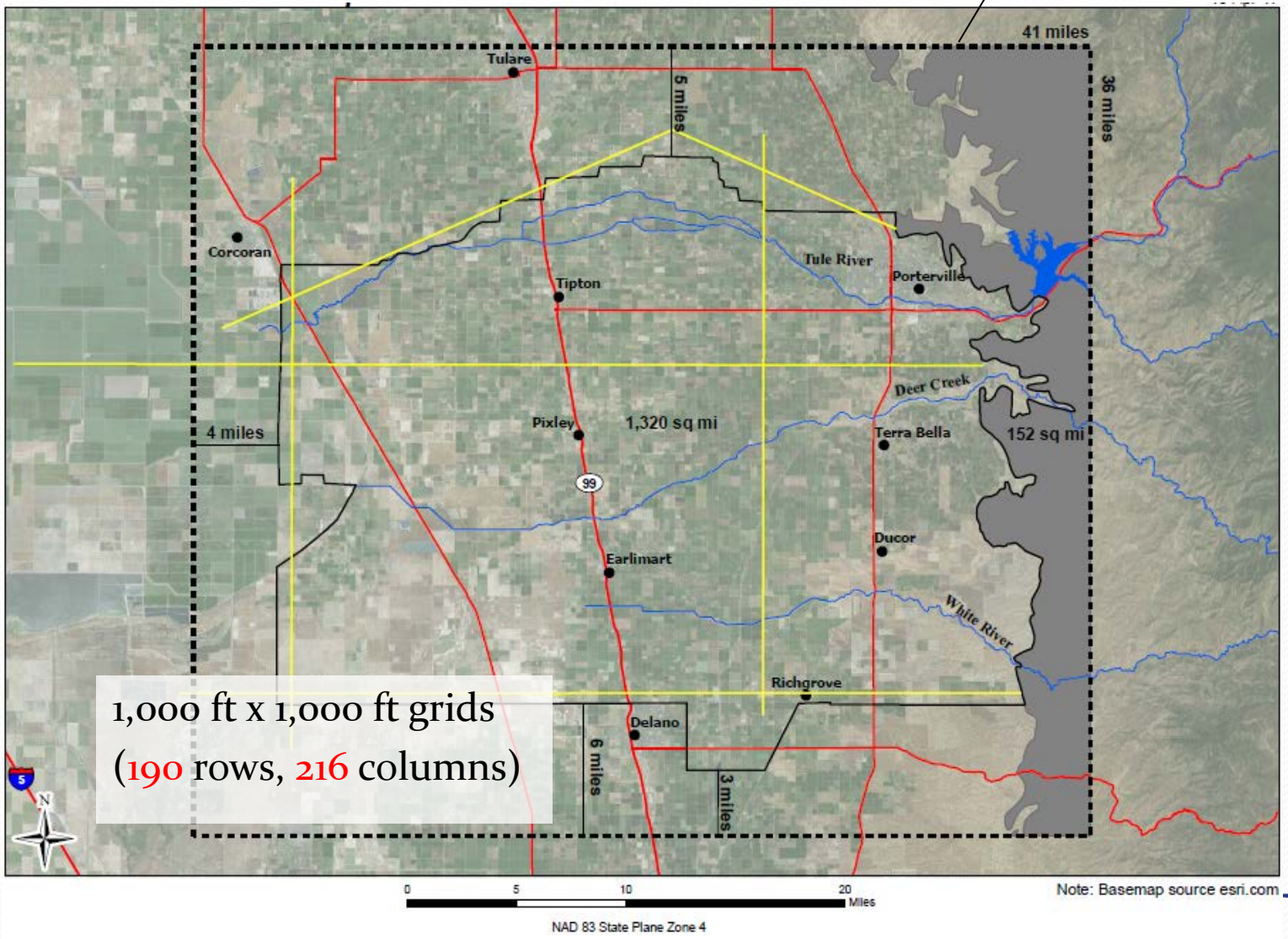
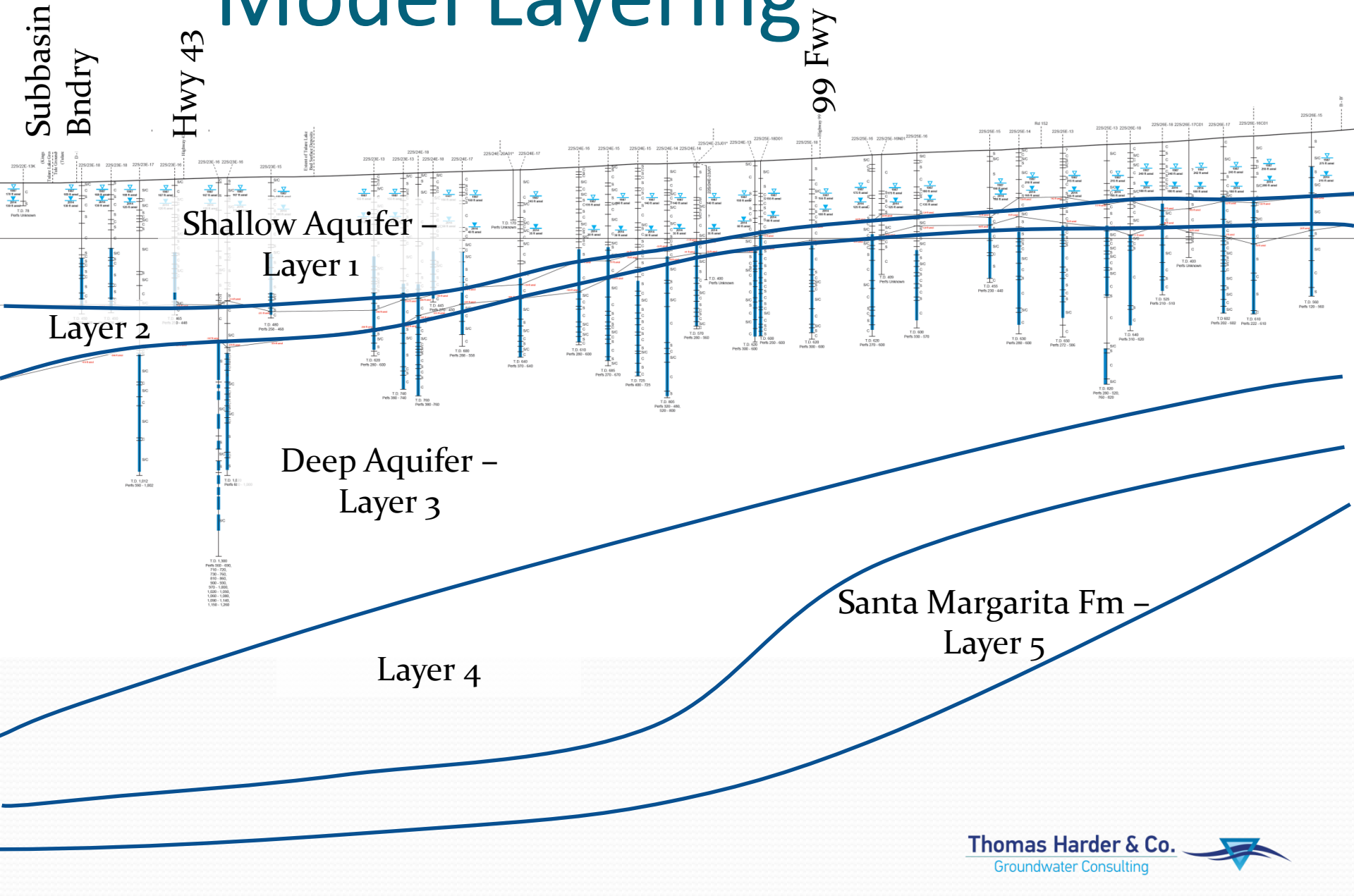
Model Domain

Approximately 1,475 sq miles



Model Layering



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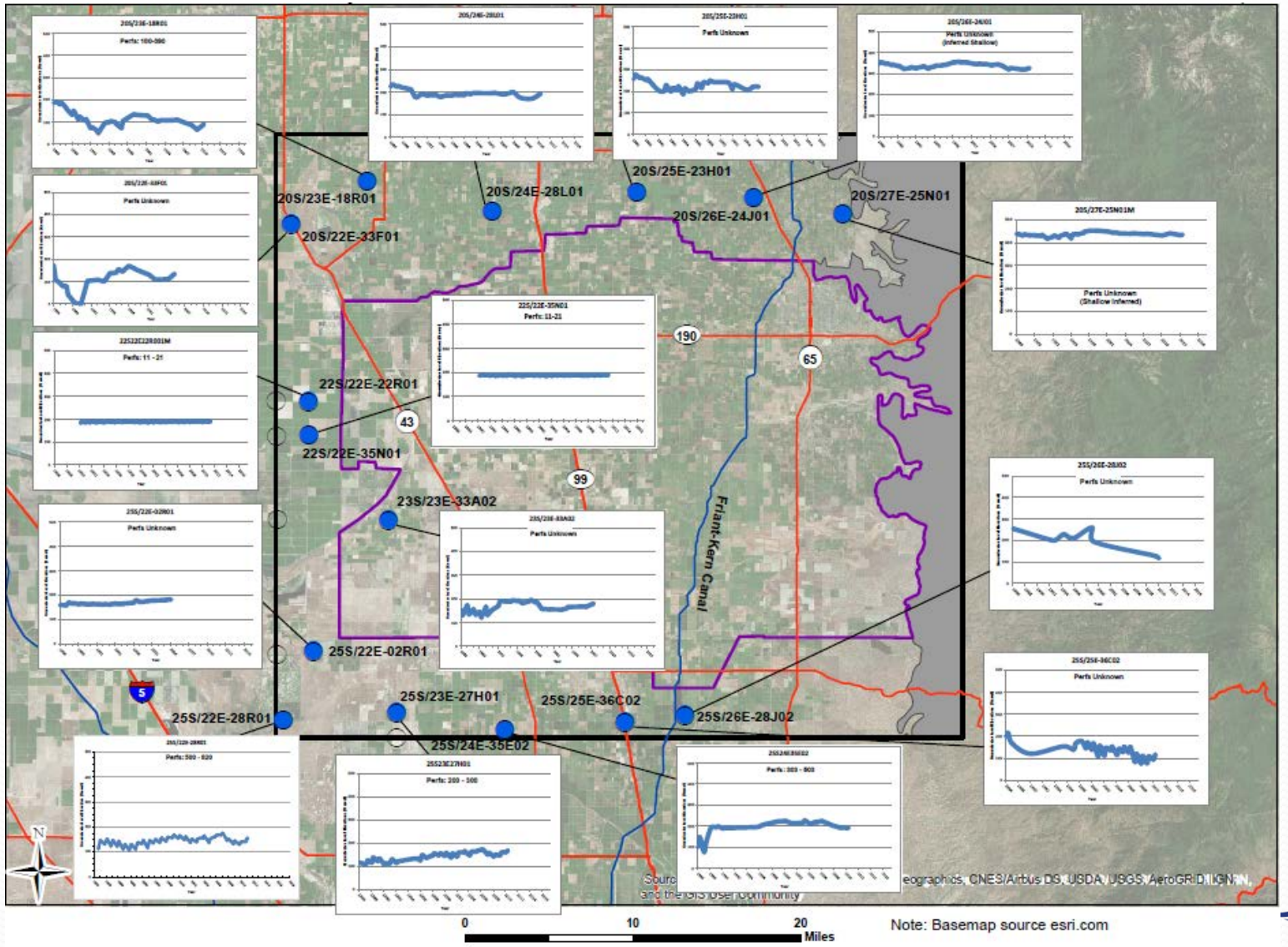
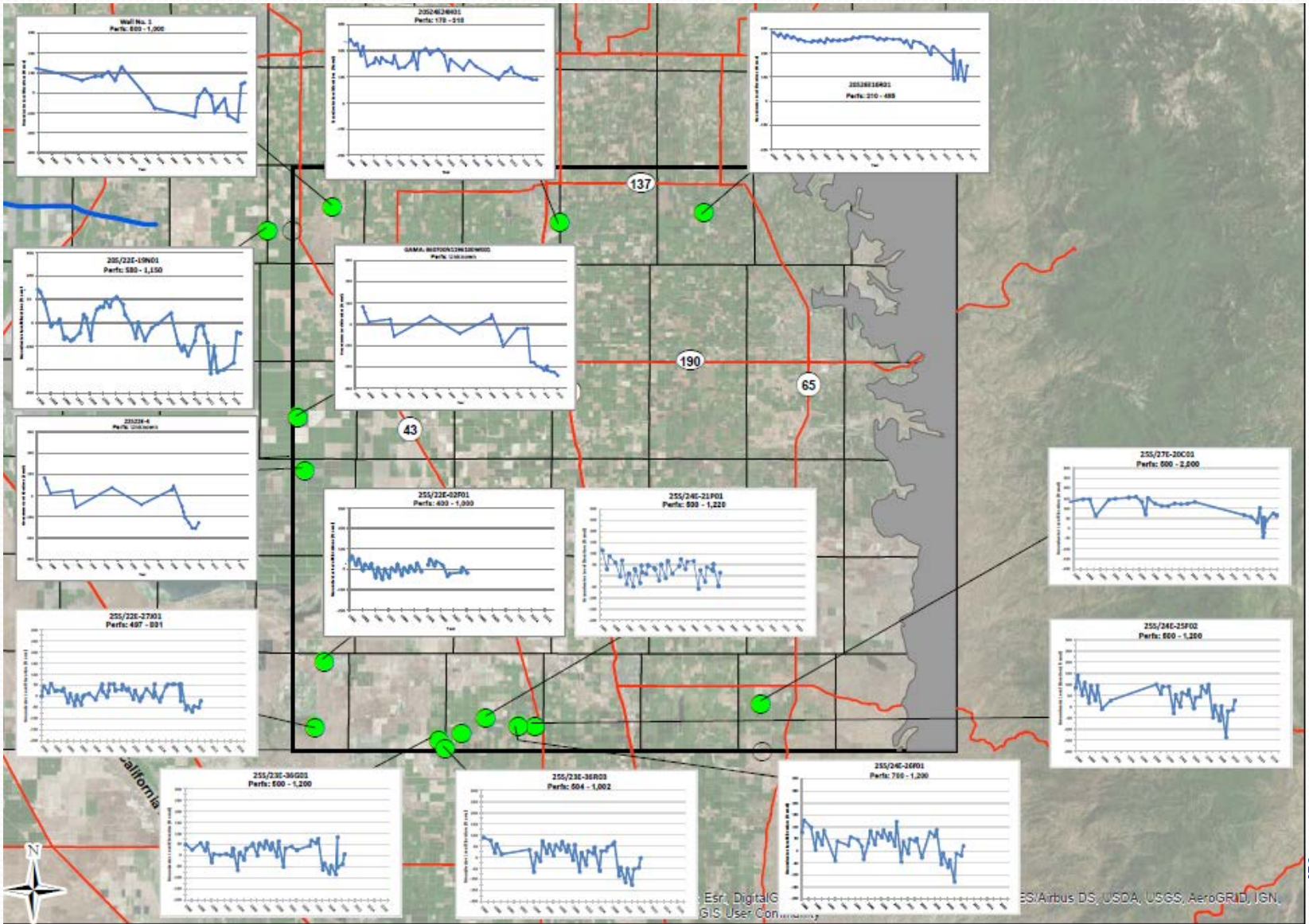
Model Boundary Conditions – Shallow Aquifer



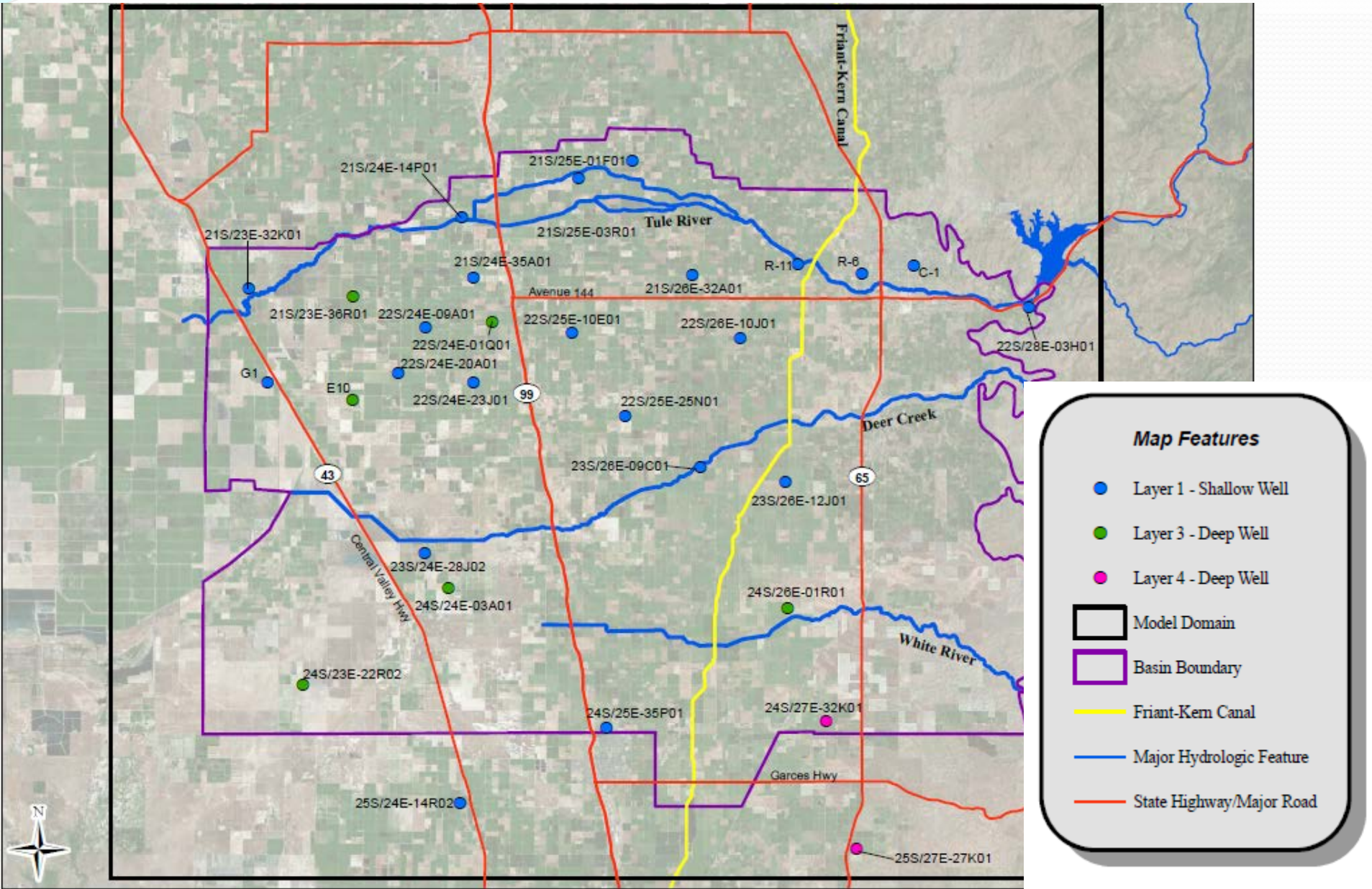
Model Boundary Conditions – Deep Aquifer



Model Calibration Process

- Assign Initial Spatially Distributed Aquifer Parameters
- Auto-Adjust Parameters on a Layer-Wide and then Zone Specific Basis
- Manually Adjust Parameters in Local Zones to Improve Calibration

Model Calibration – Groundwater Levels



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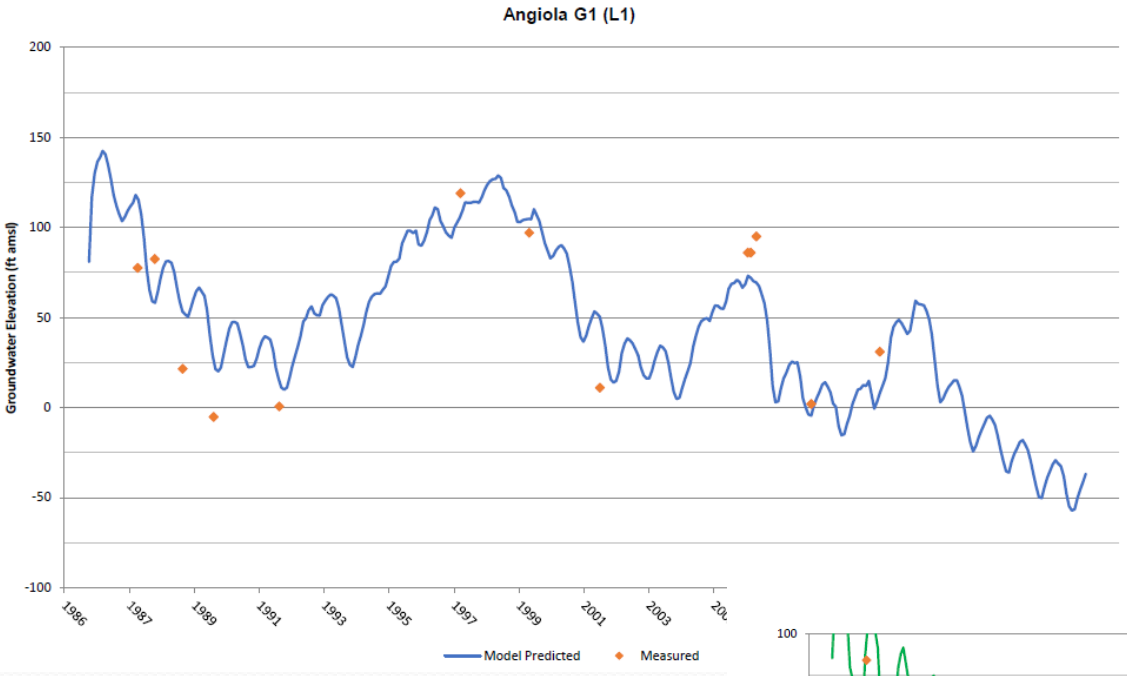

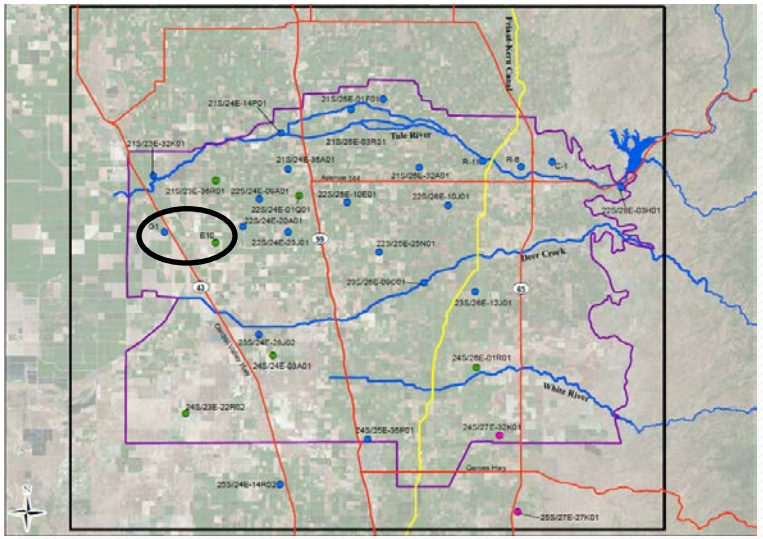

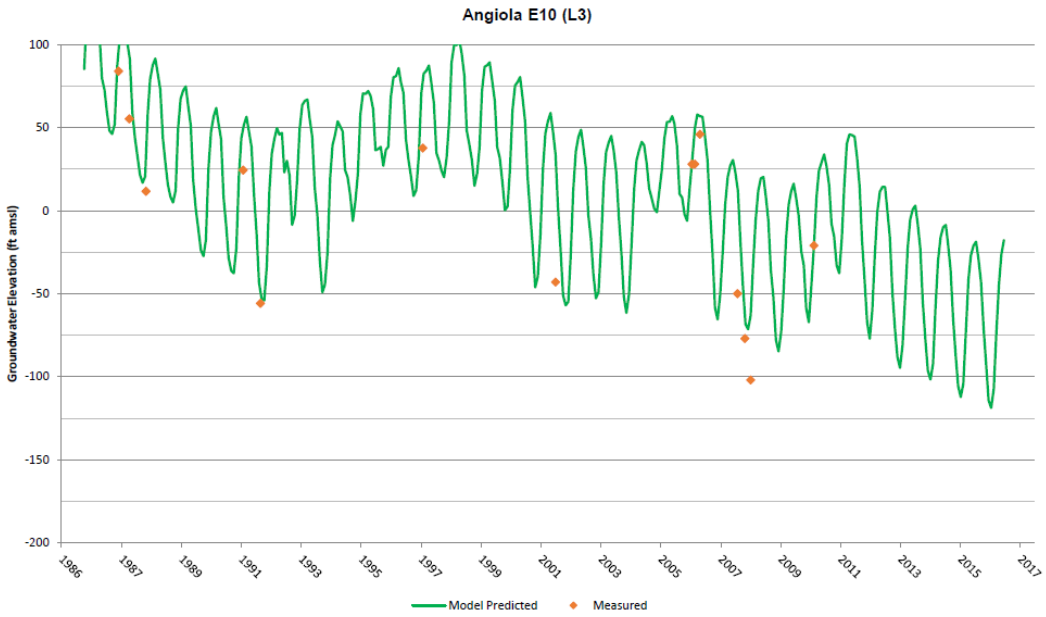

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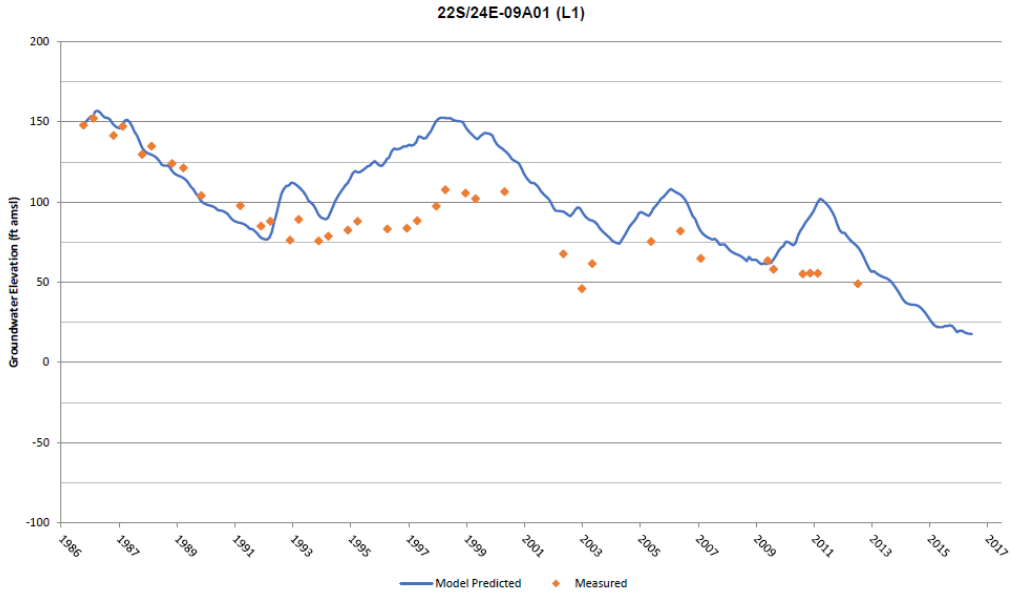

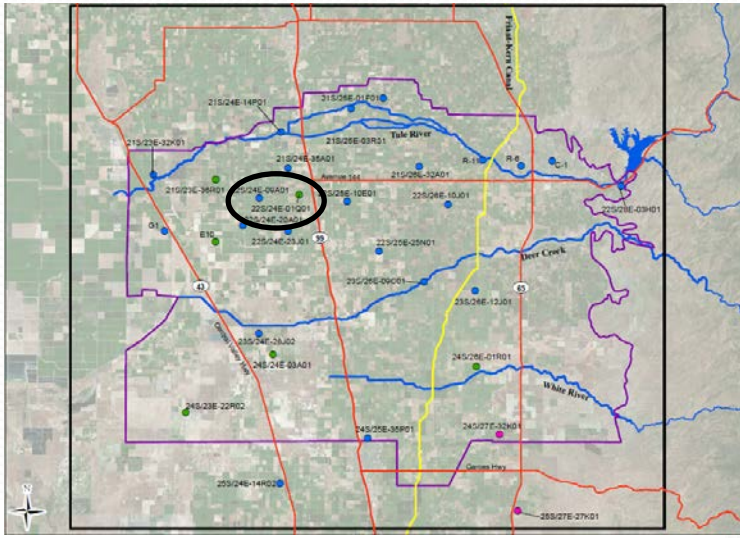

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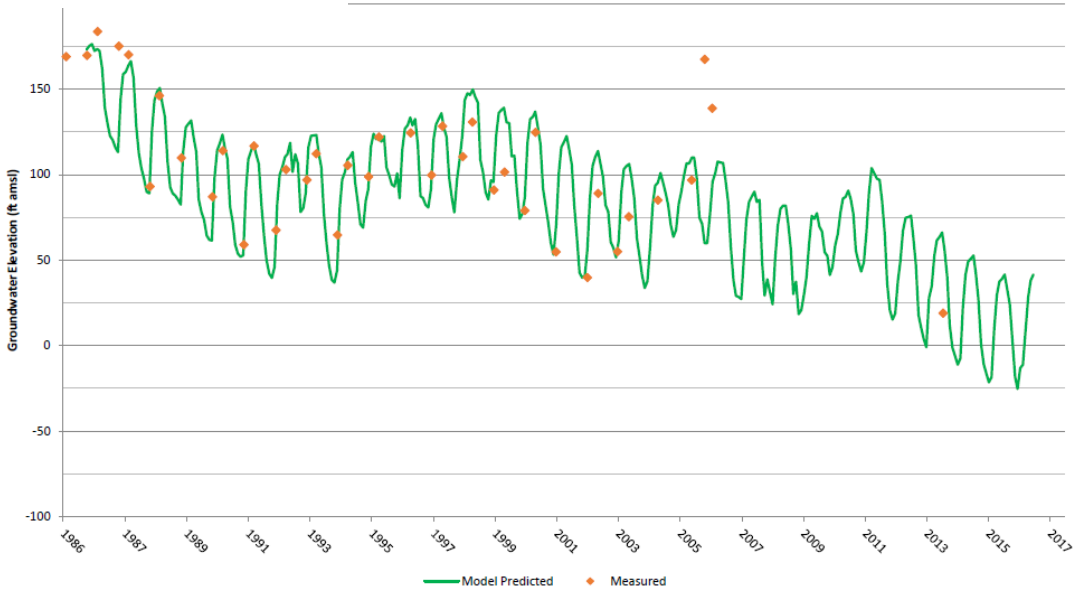

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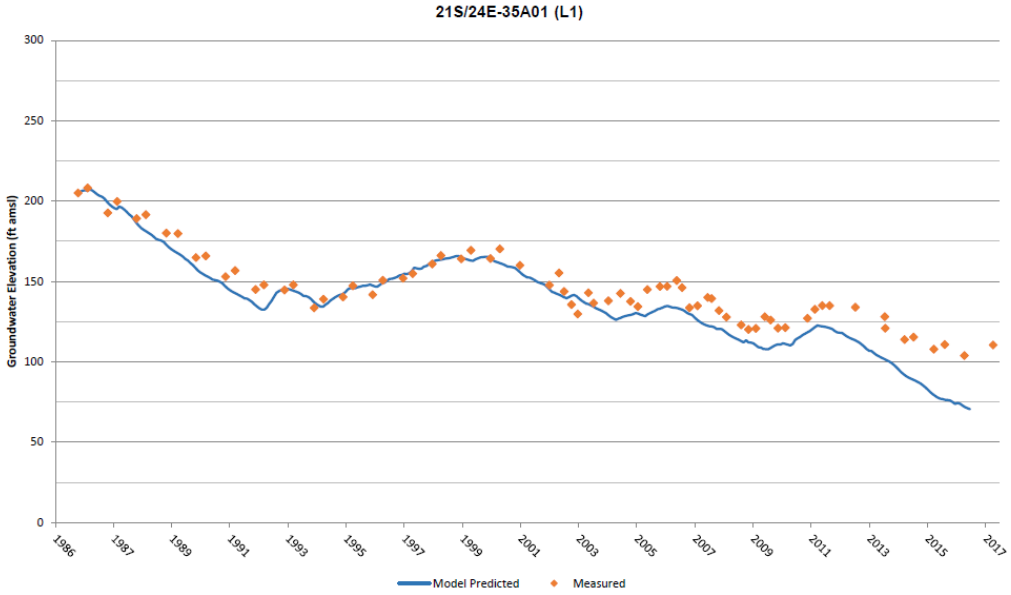

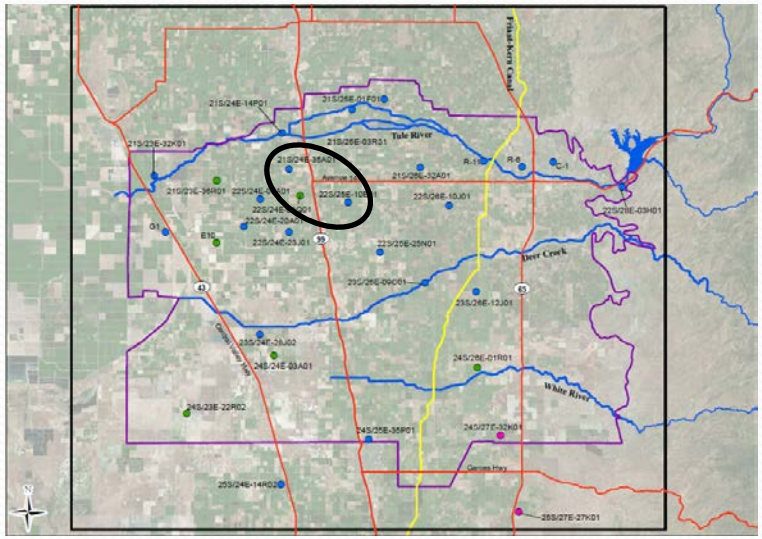

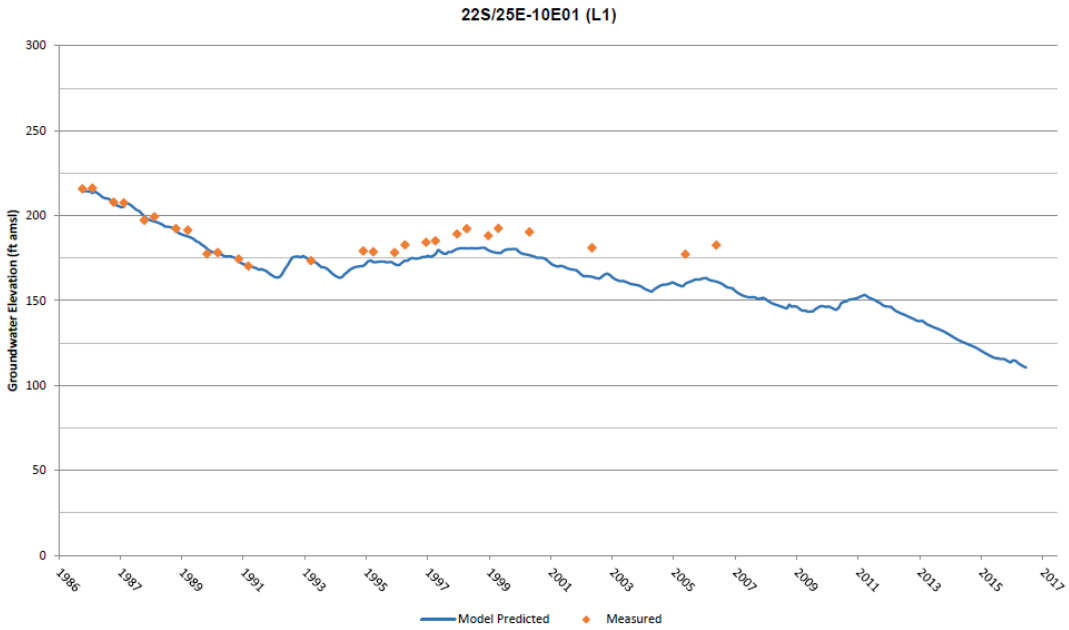

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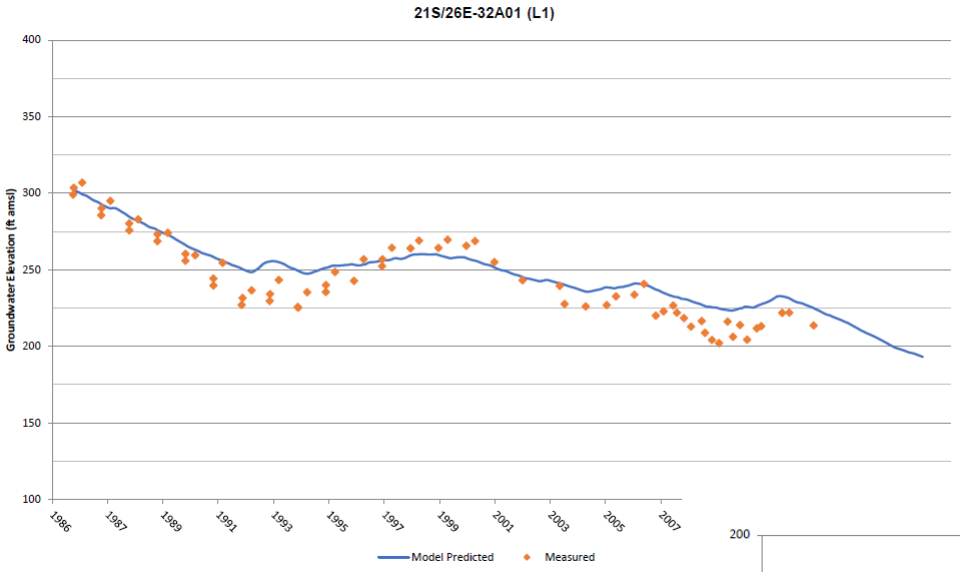

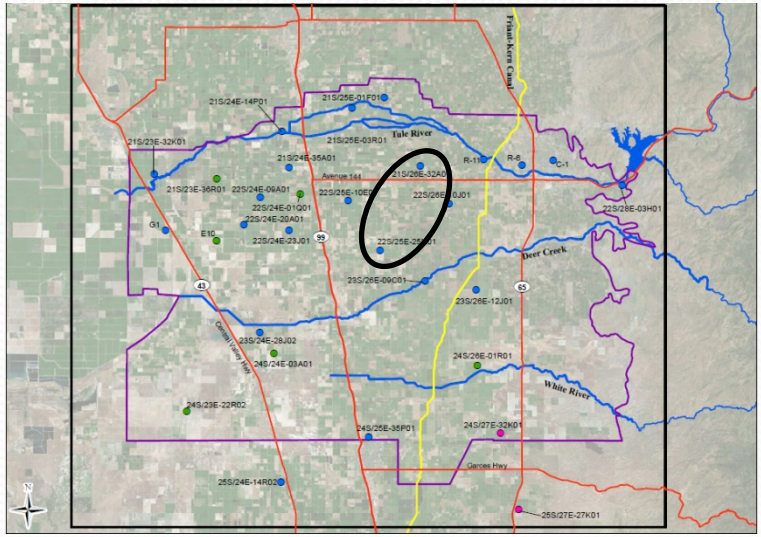

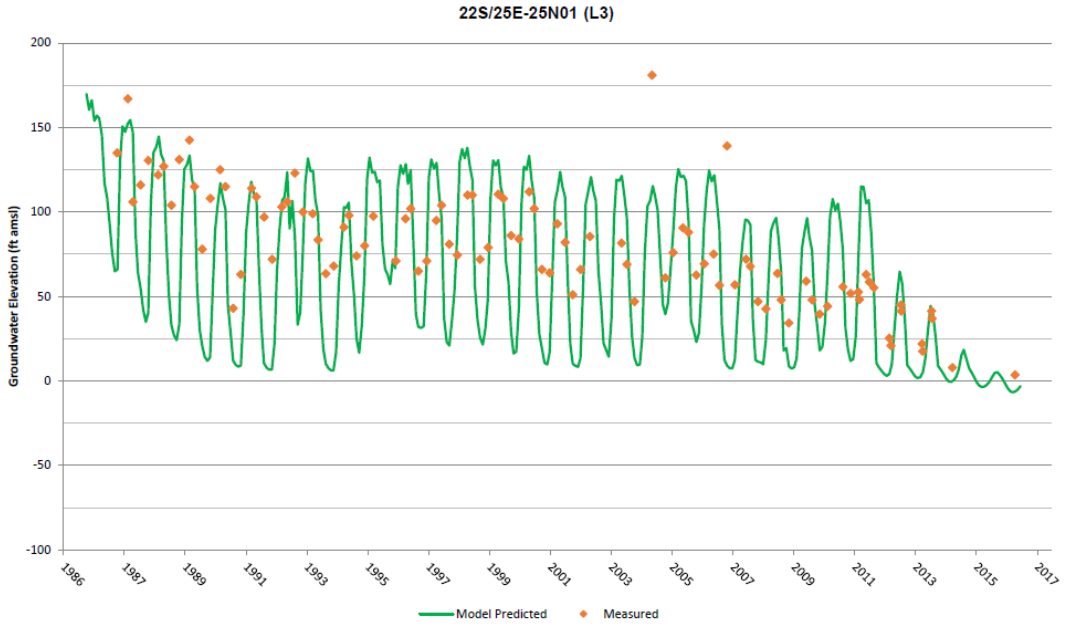

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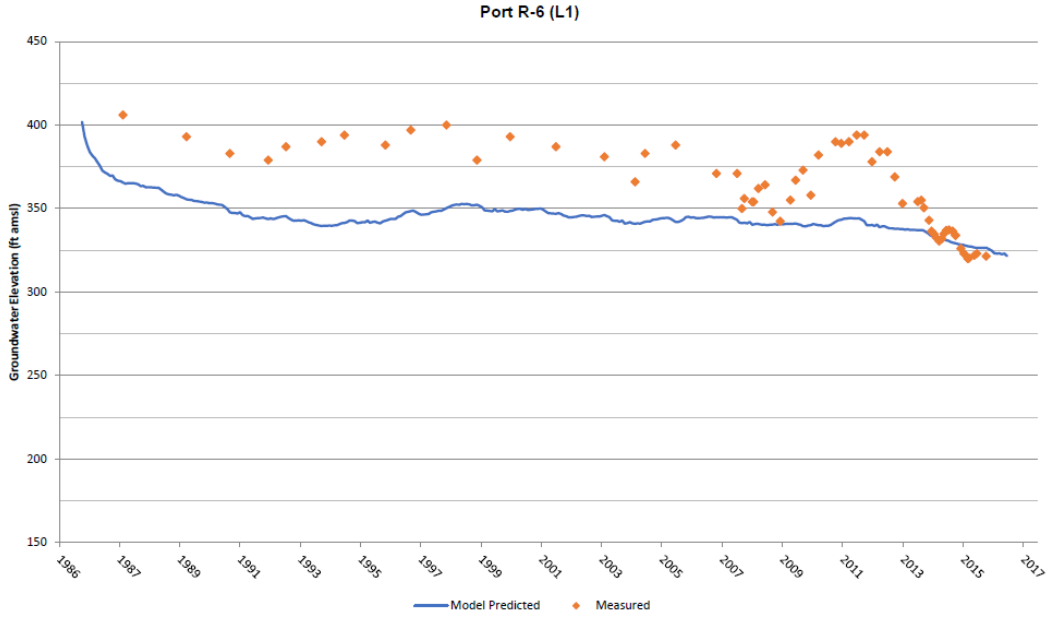

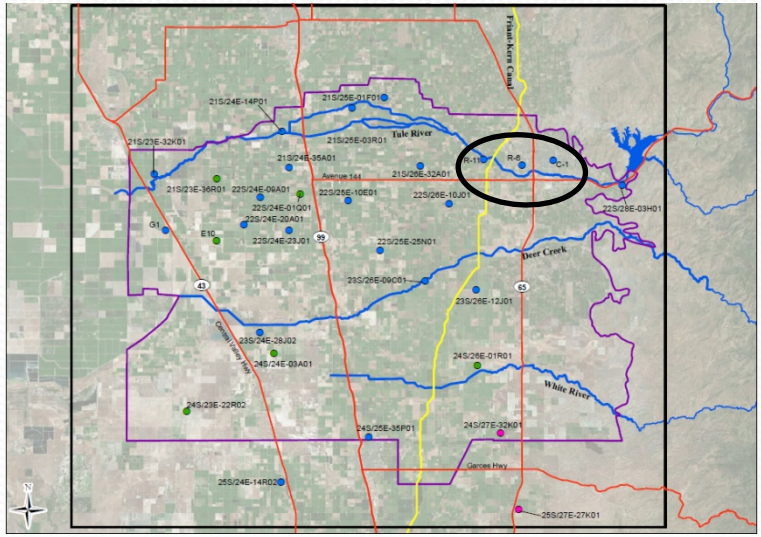

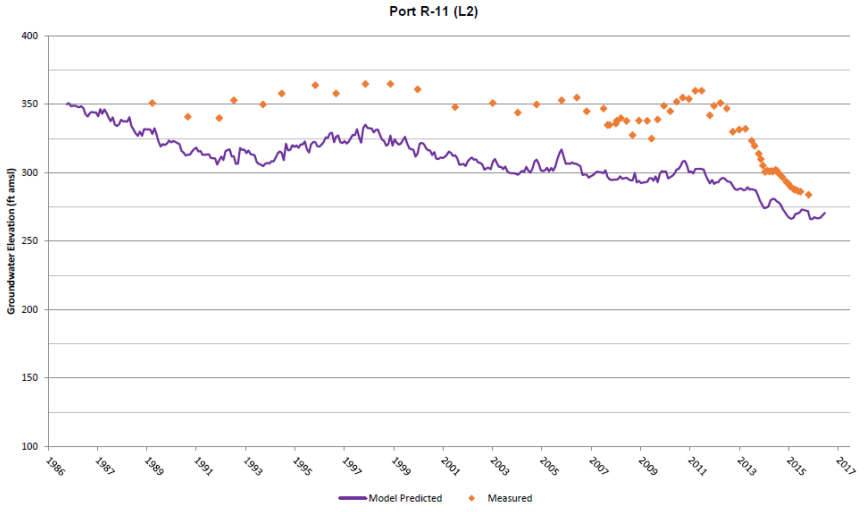

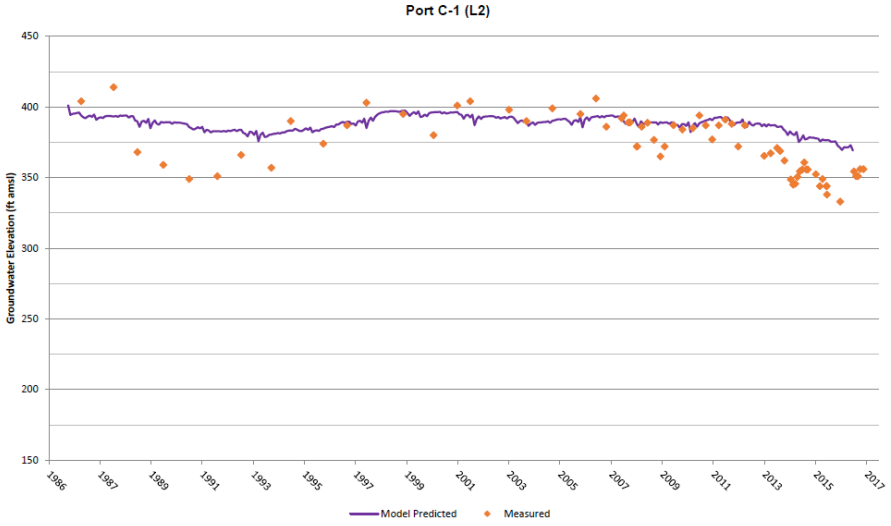

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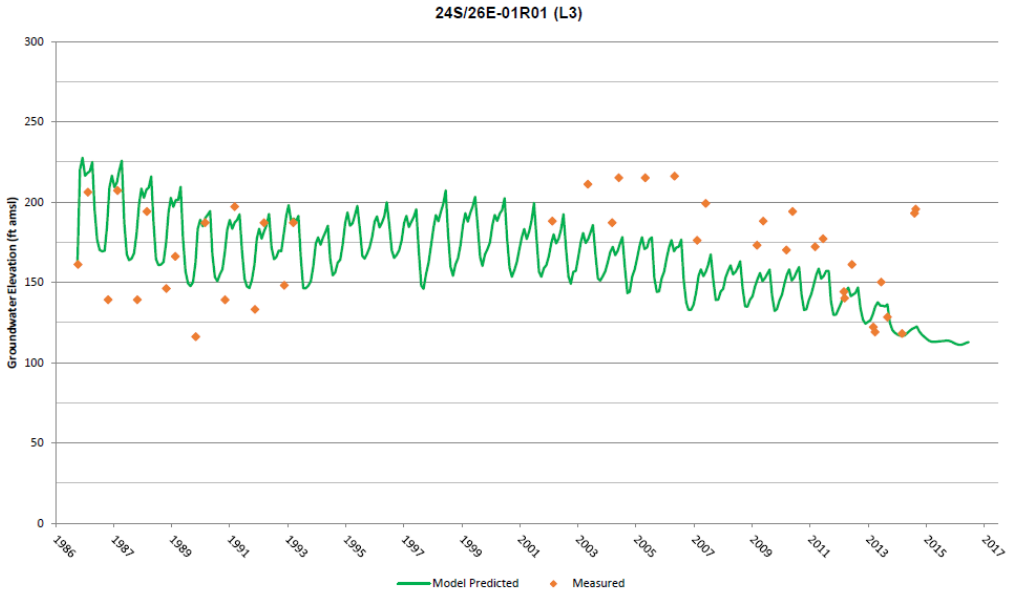

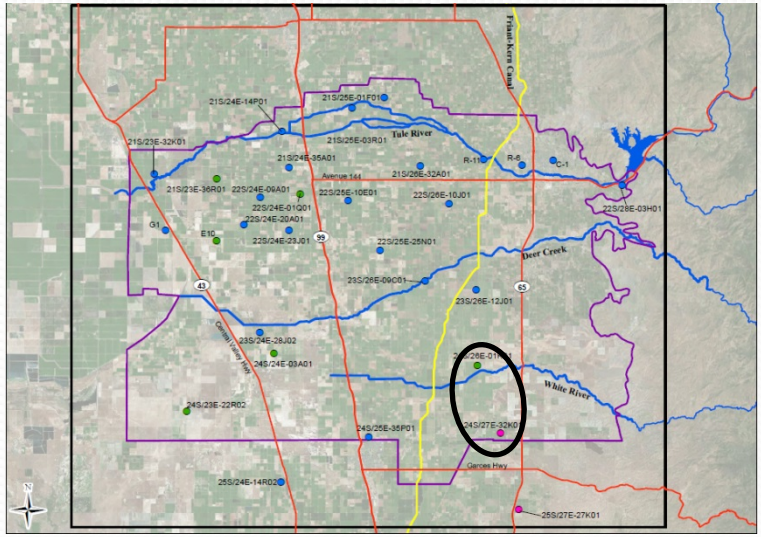

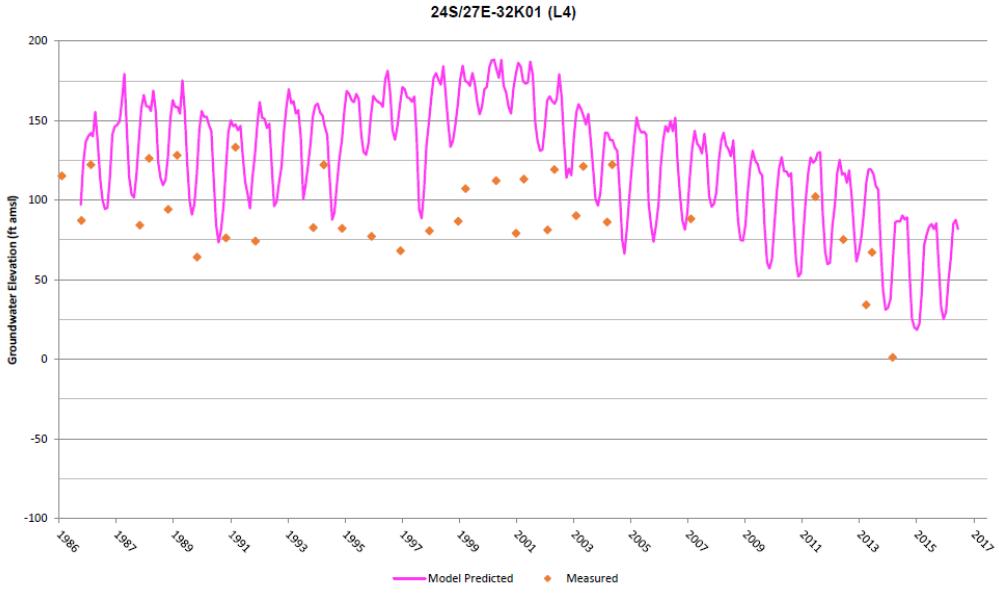

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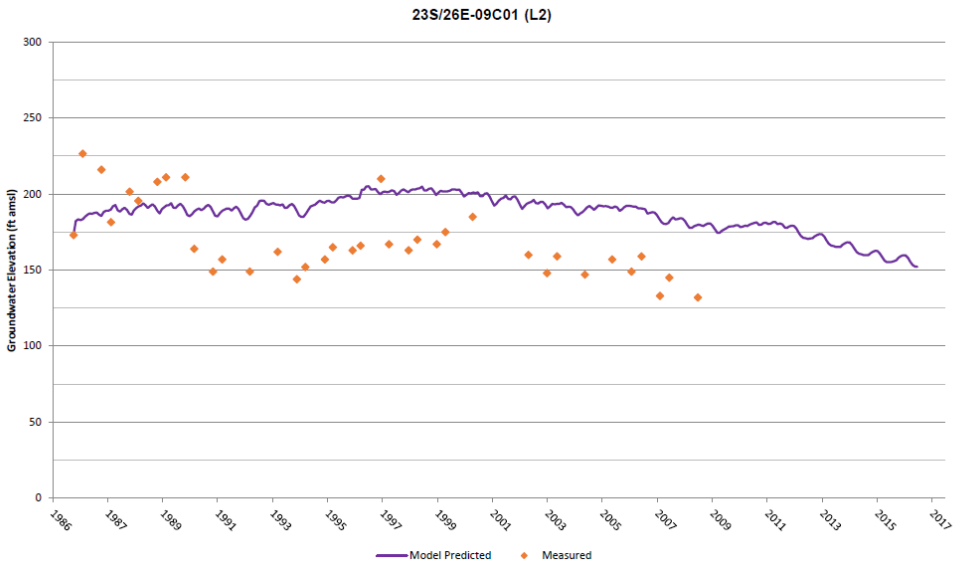

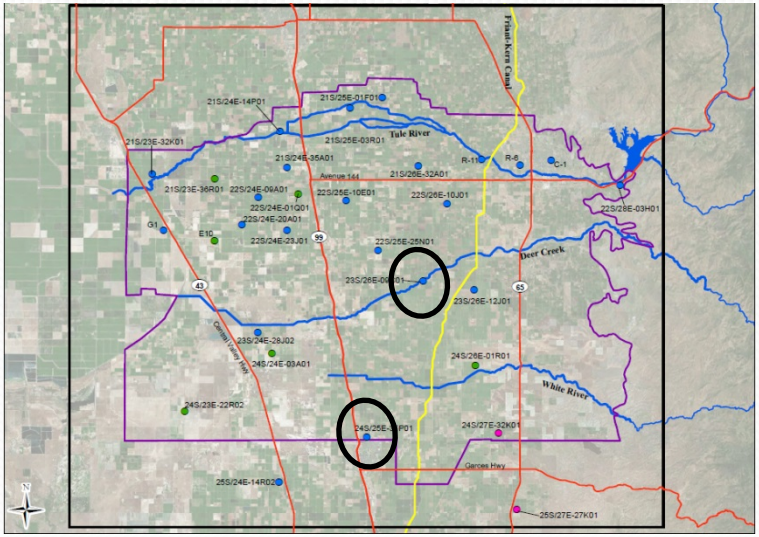

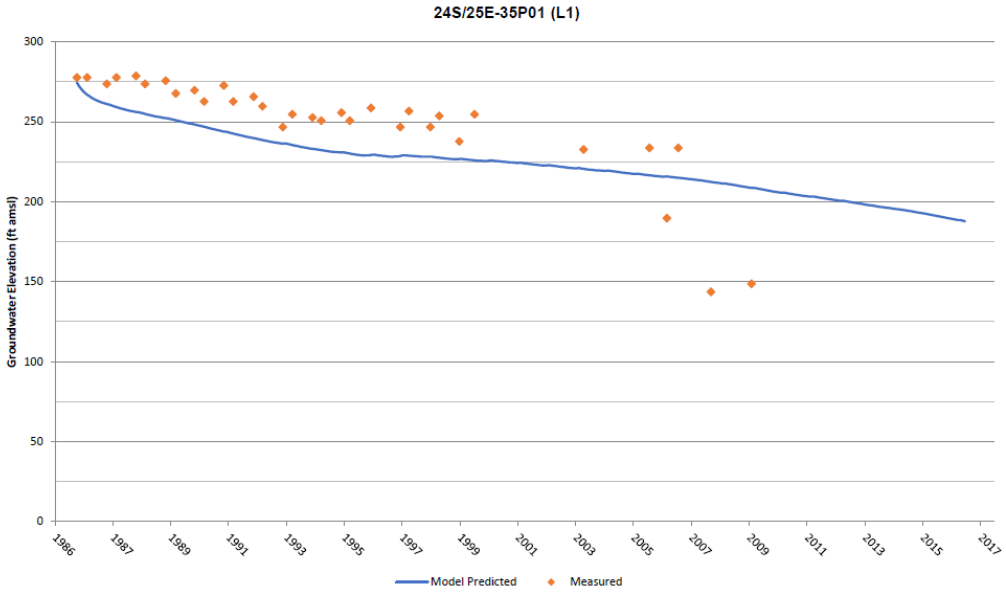

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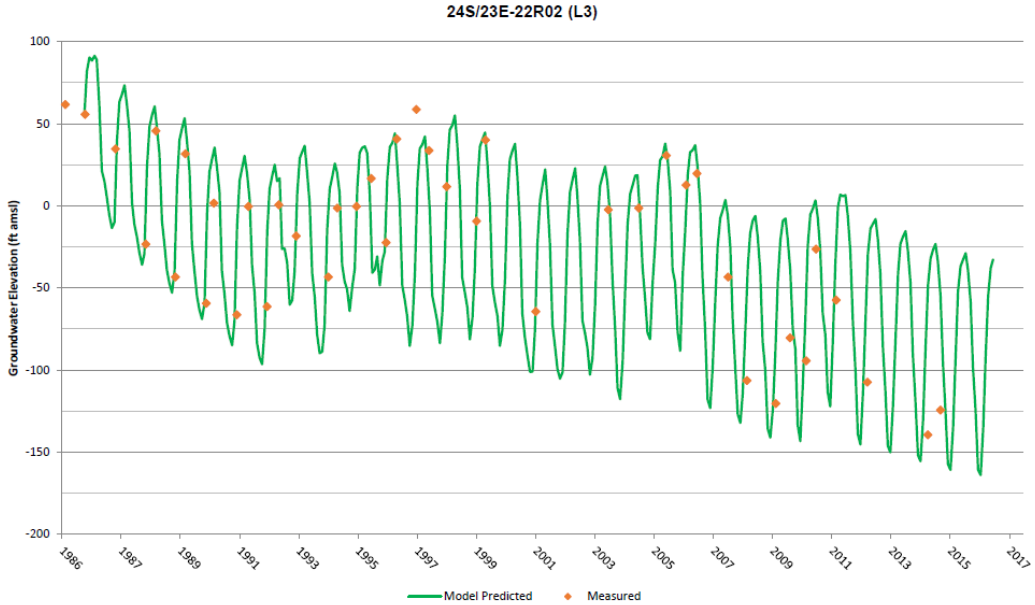
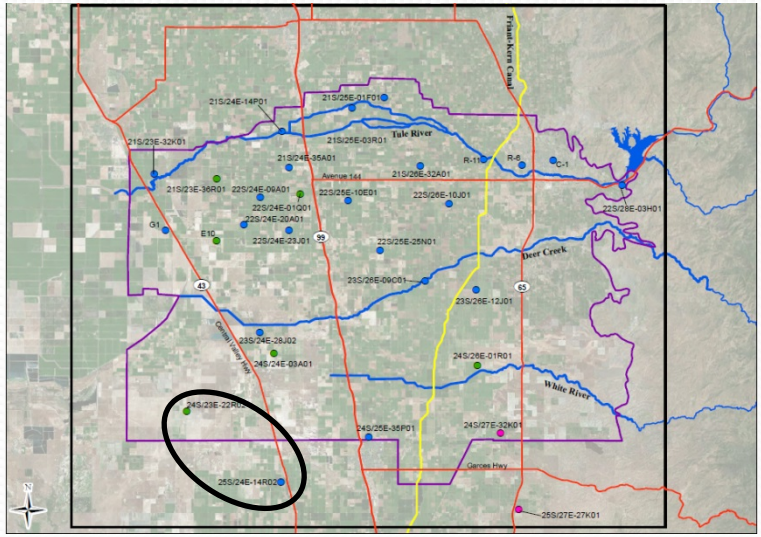
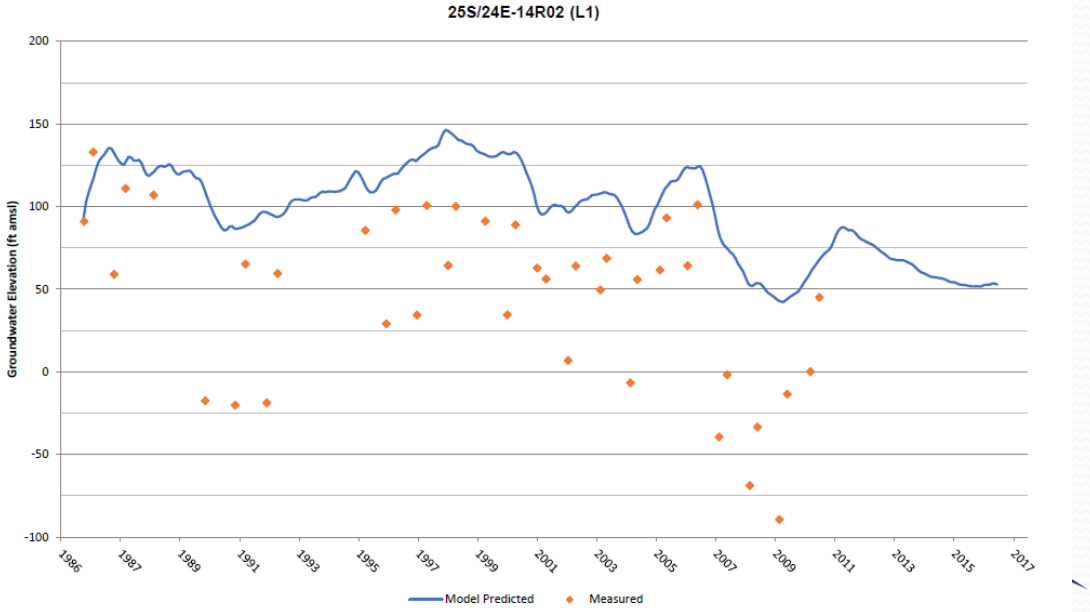
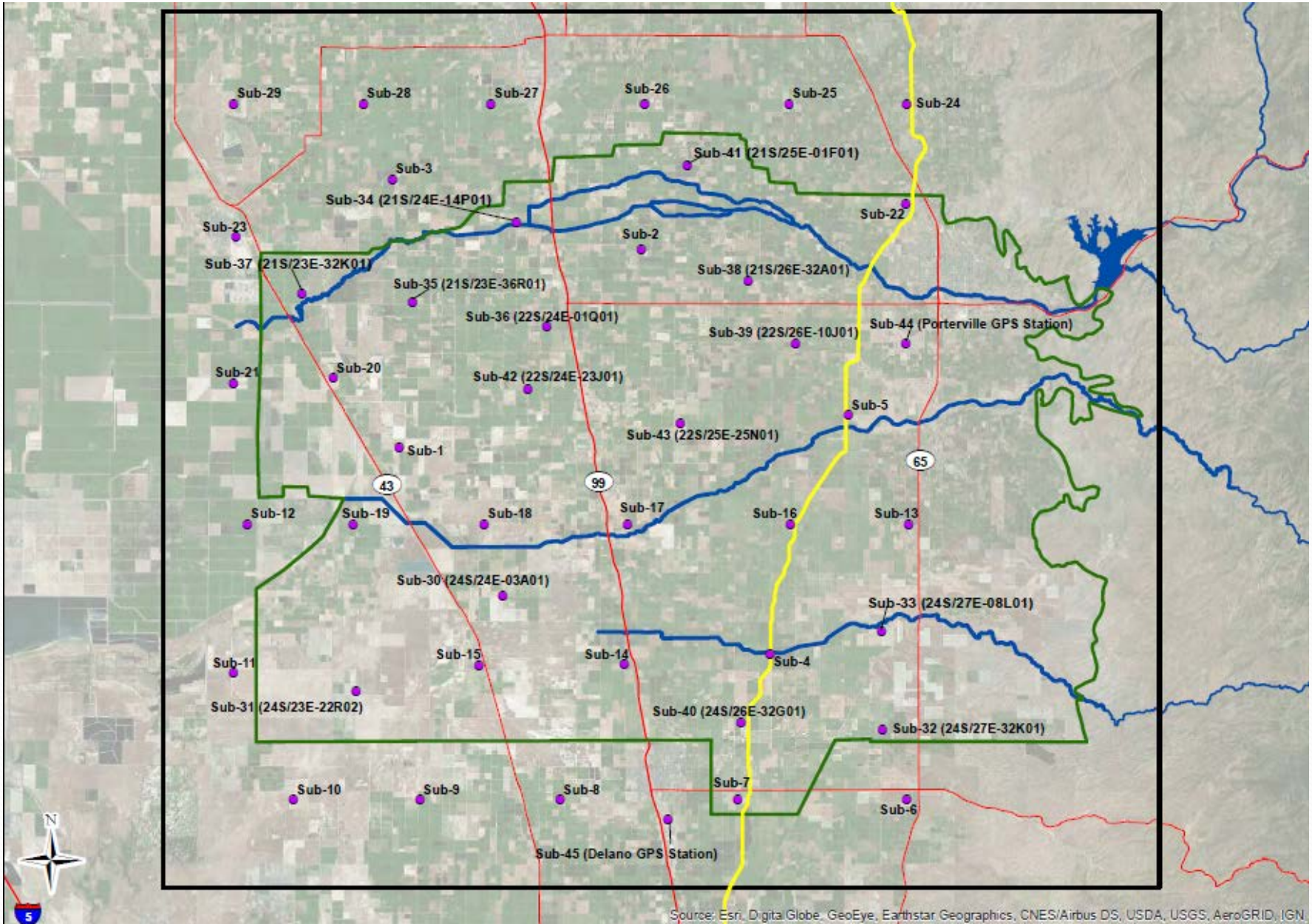






Model Calibration – Land Subsidence



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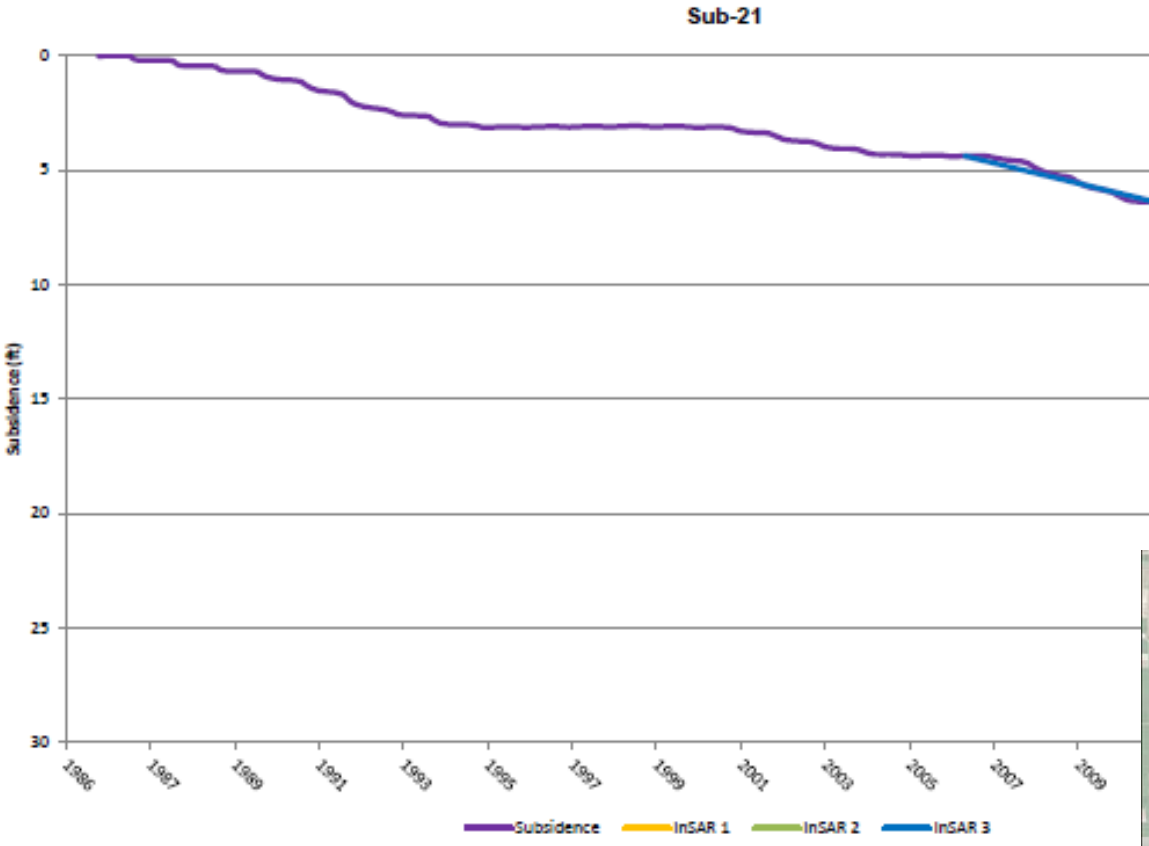

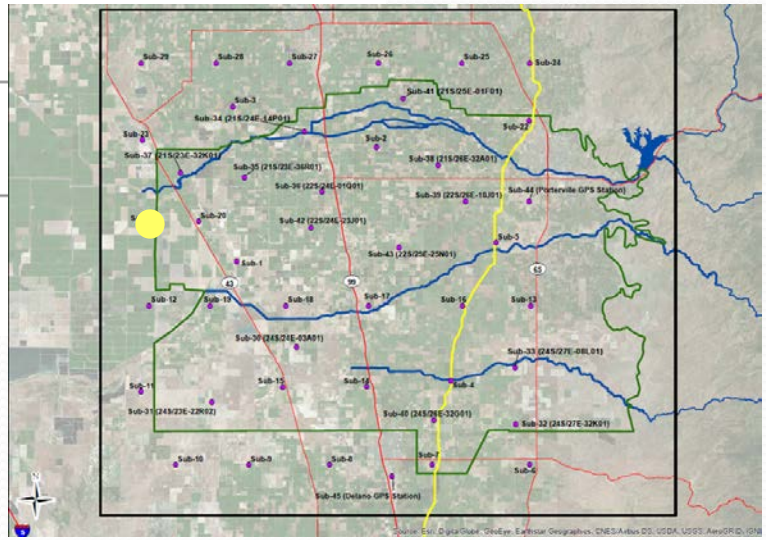

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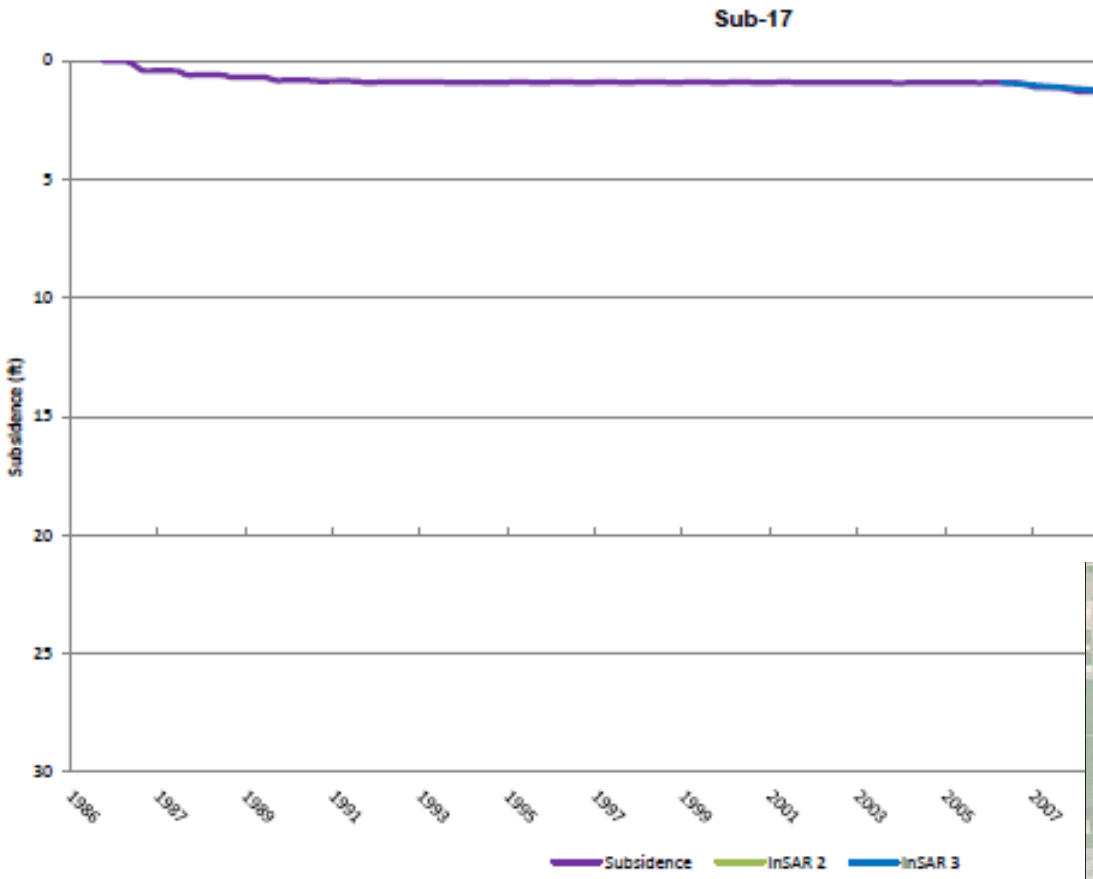
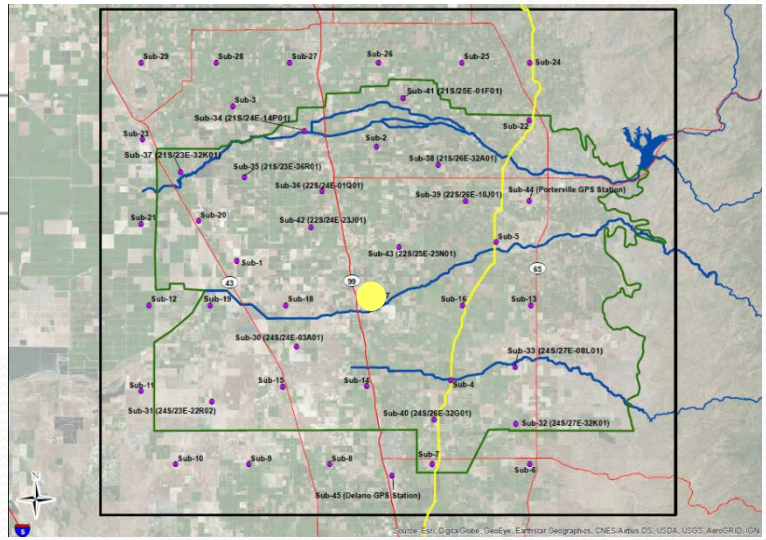
Model Calibration – Land Subsidence





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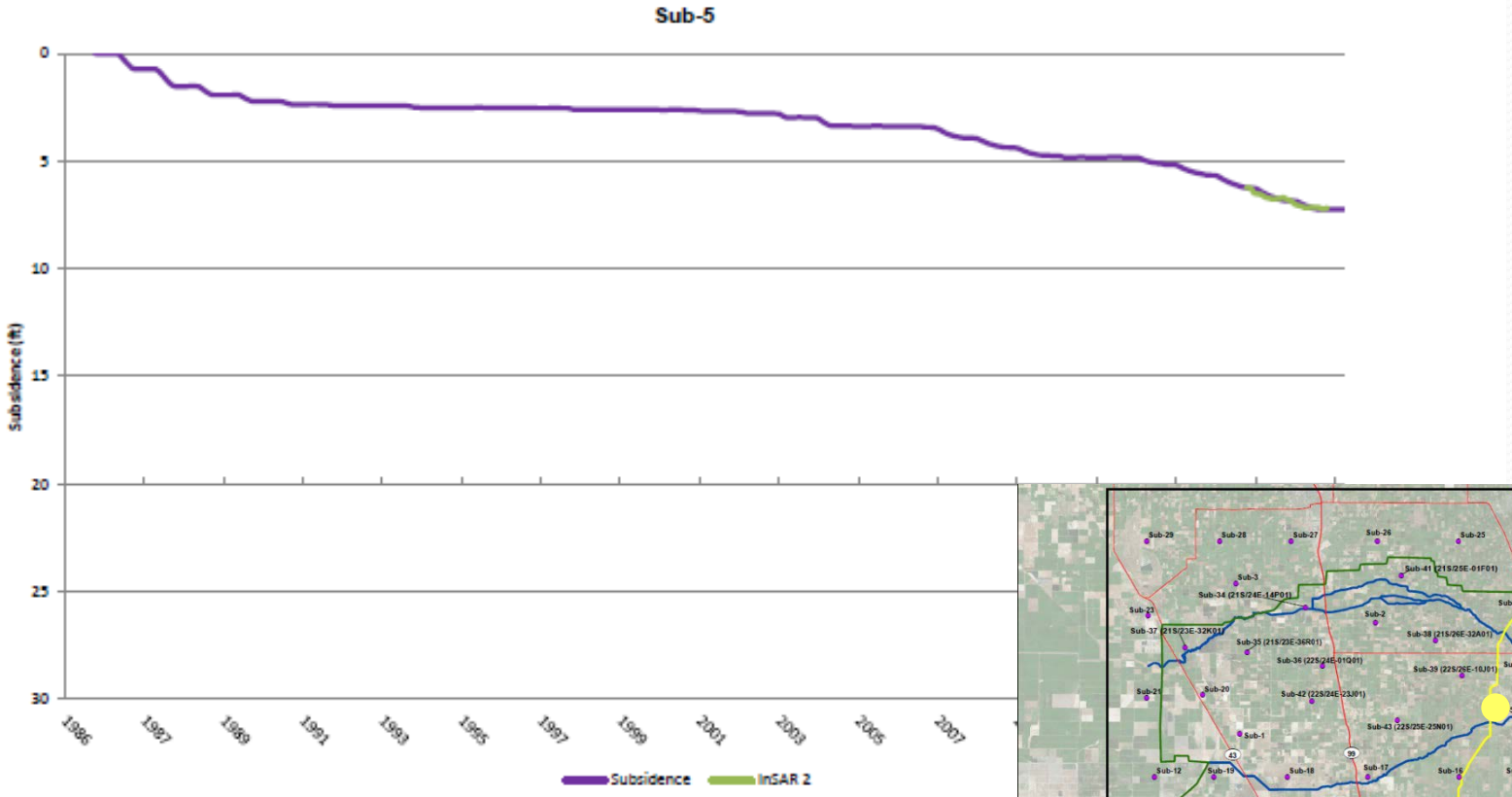

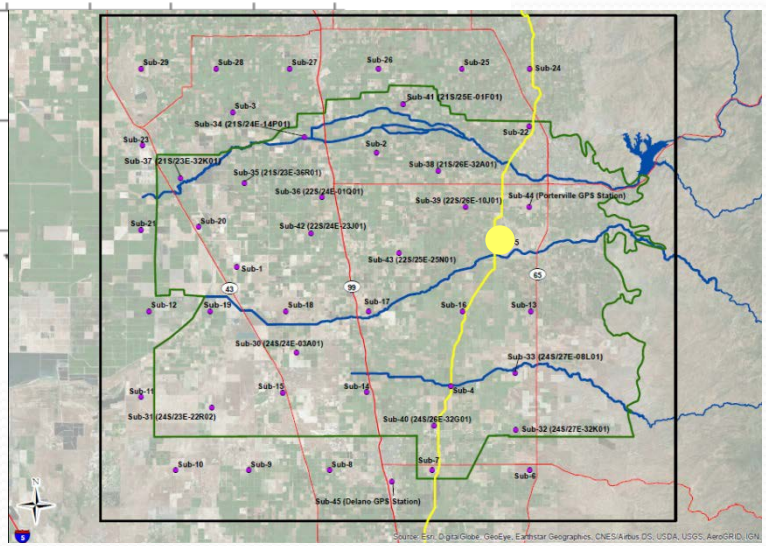

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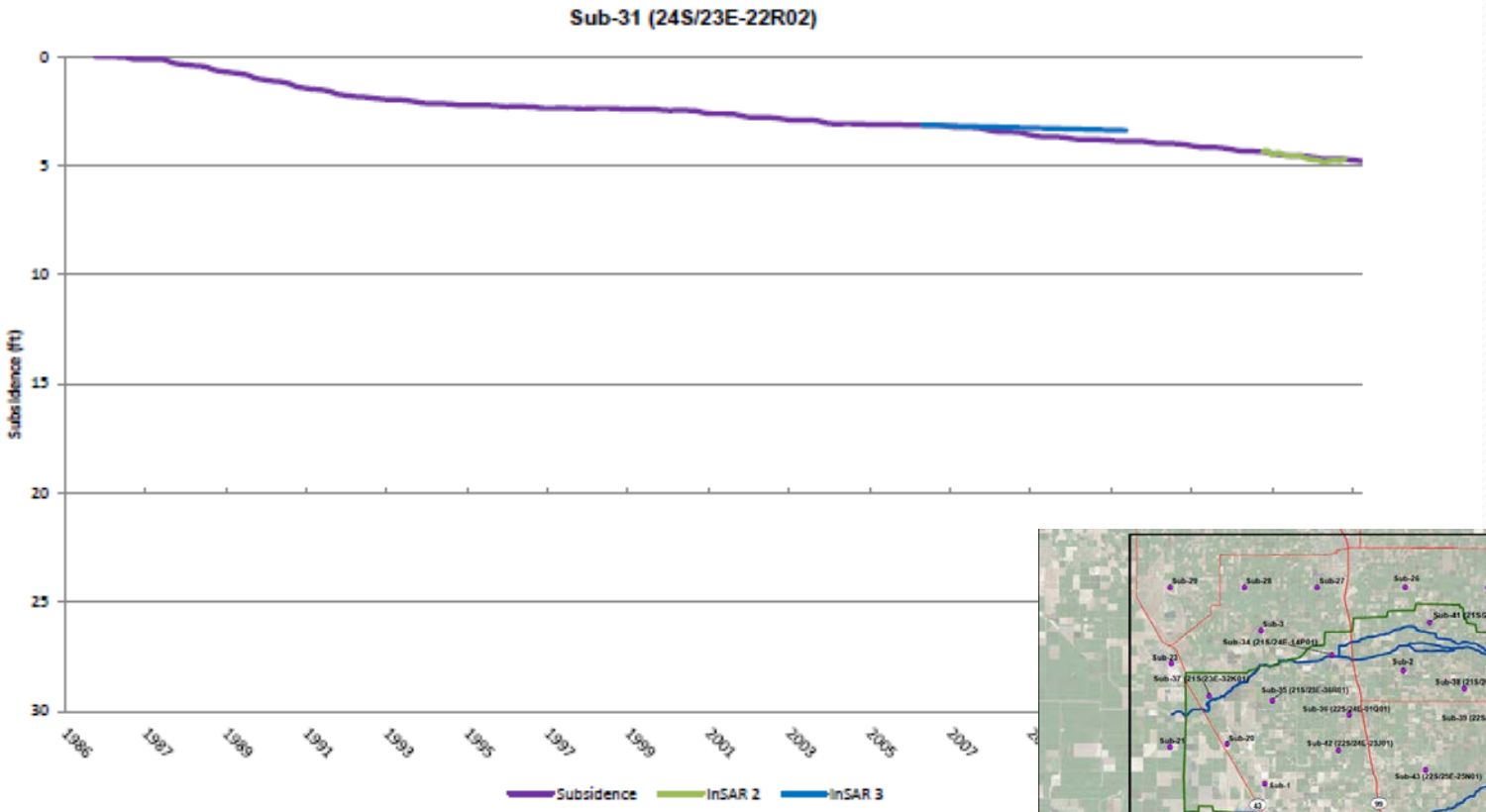

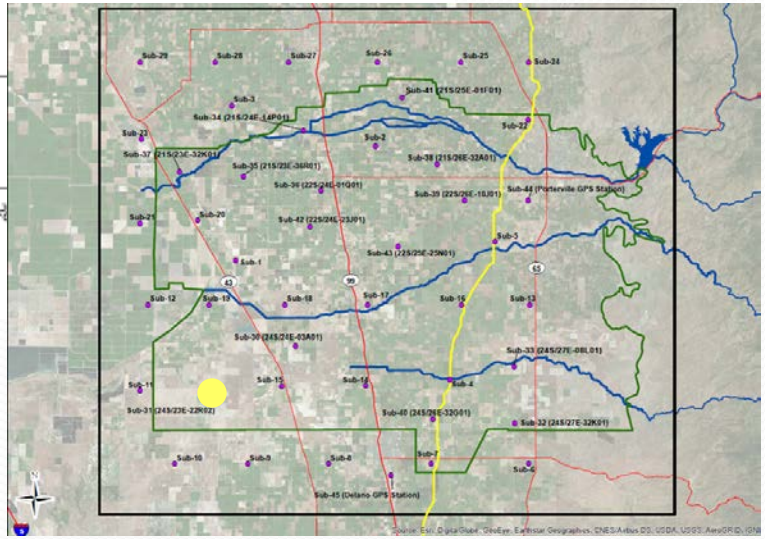

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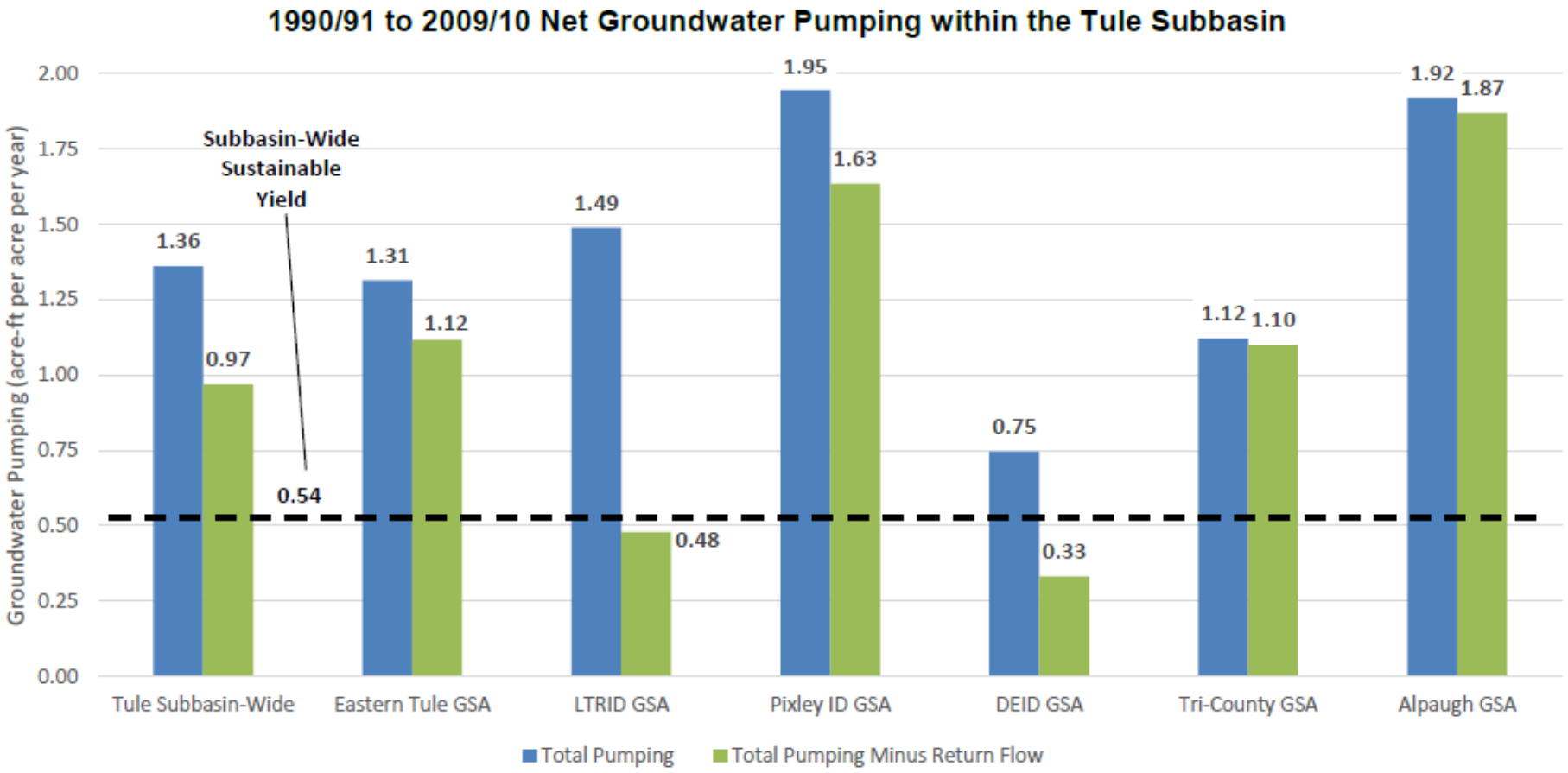
Model Projections of Future Pumping and Recharge Were Used to Evaluate the Sustainable Yield

- Assume Net Groundwater Pumping for Agricultural Land Use is Maintained at 0.54 acre-ft/acre
- Assume Average Hydrological Conditions for Water Deliveries (Average of 1986 – 2017)
- Assume Municipal Groundwater Production (Including Porterville) Remains Constant at 2017 Rates
- Assume Average Hydrological Conditions for Recharge (Mountain Block Recharge, Stream Bed Infiltration)
- Maintained Constant Groundwater Elevation at the Boundaries

Net Groundwater Pumping By GSA



Notes:

Total pumping includes agricultural pumping, municipal pumping, and groundwater exports.

Return flow includes return flow, canal loss, and recharge in basins from diverted or applied Tule River, Deer Creek, Imported Water, and recycled water.

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Future Scenarios Analyzed with the Model

- Scenario 1
  - 5-Yr Ramp Down (2020 – 2025) in Agricultural Groundwater Production From Current Levels to 0.54 acre-ft/acre (Using Assumed Irrigation Efficiencies)
  - Average Hydrological Conditions (1986 – 2017)
    - Canal Deliveries
    - River Diversions Based
    - Mountain Block and Precipitation Recharge
    - Managed Recharge

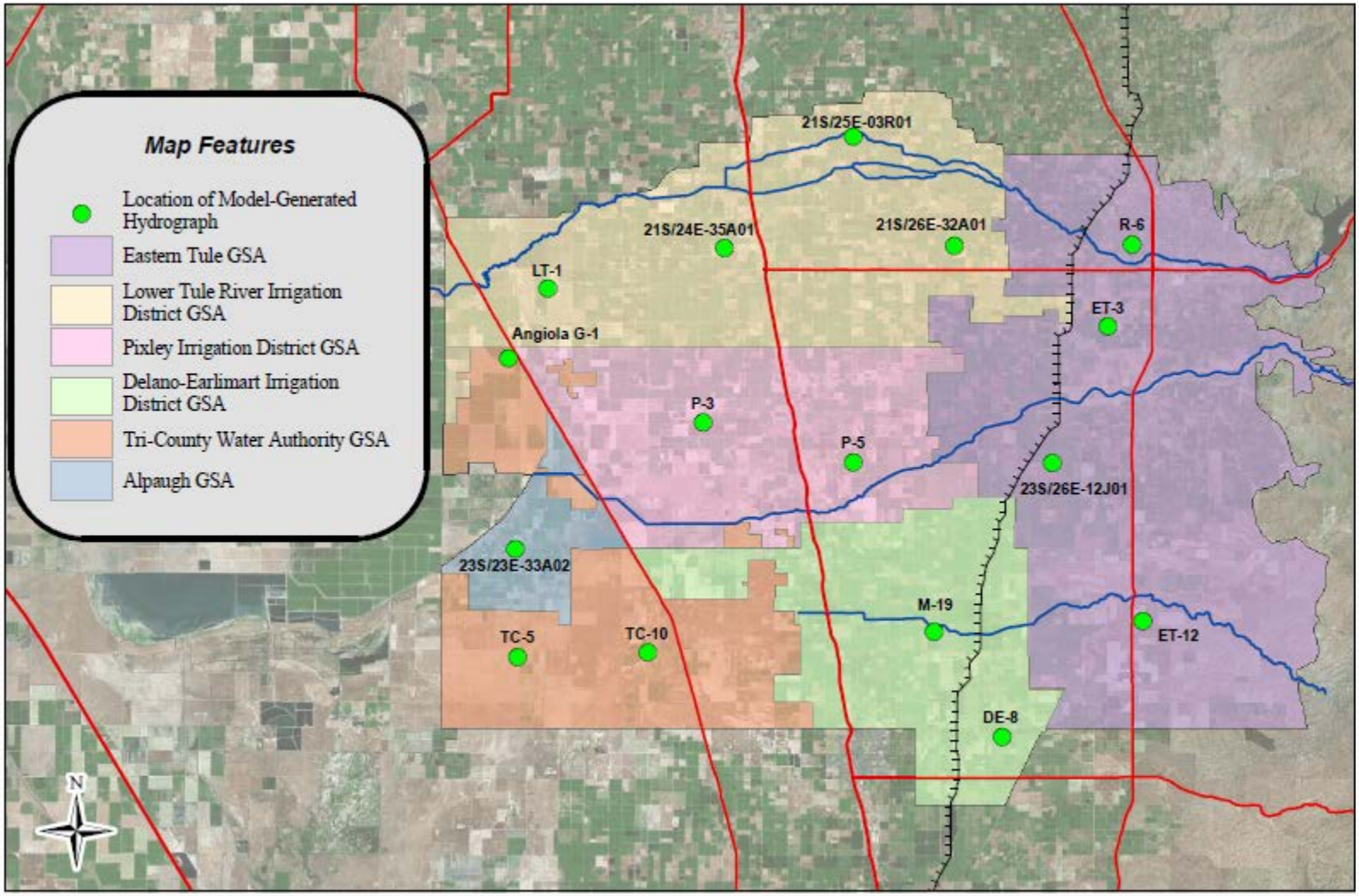
Future Scenarios Analyzed with the Model

- Scenario 2
  - 20-Yr Ramp Down (2020 – 2040) in Agricultural Groundwater Production From Current Levels to 0.54 acre-ft/acre (Using Assumed Irrigation Efficiencies)
  - Average Hydrological Conditions (1986 – 2017)
    - Canal Deliveries
    - River Diversions Based
    - Mountain Block and Precipitation Recharge
    - Managed Recharge

Future Scenarios Analyzed with the Model

- Scenario 3
  - Continue Current Levels of Agricultural Groundwater Production for 10 Yrs (2020 – 2030)
  - 10-Yr Ramp Down (2030 – 2040) in Agricultural Groundwater Production From Current Levels to 0.54 acre-ft/acre (Using Assumed Irrigation Efficiencies)
  - Below Normal Hydrological Conditions for the Initial 10 Yr Period (2020 – 2030)
    - Based on Historical Period from 2004 to 2017)
  - Above Normal Hydrological Conditions for the 10-yr Period from 2030 – 2040
    - Based on Historical Period from 1993 - 1998

Model-Projected Groundwater Elevations



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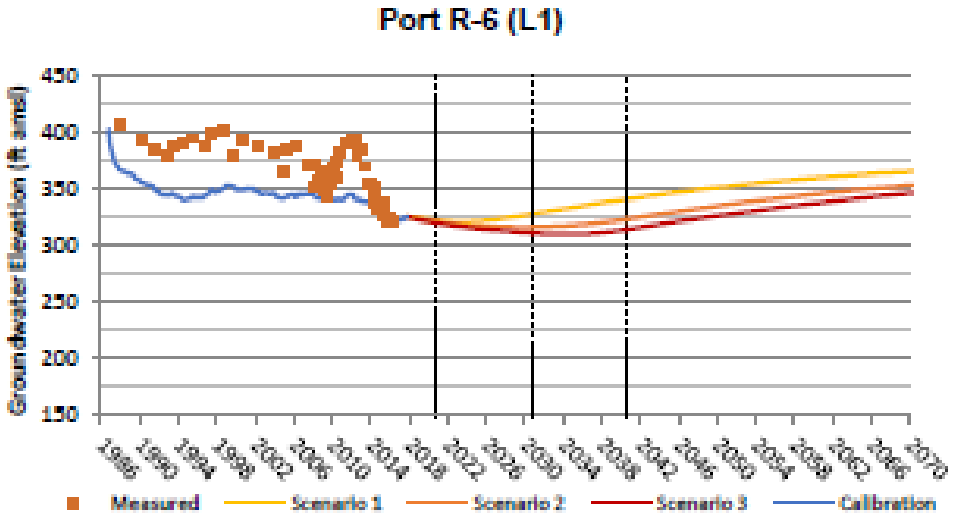

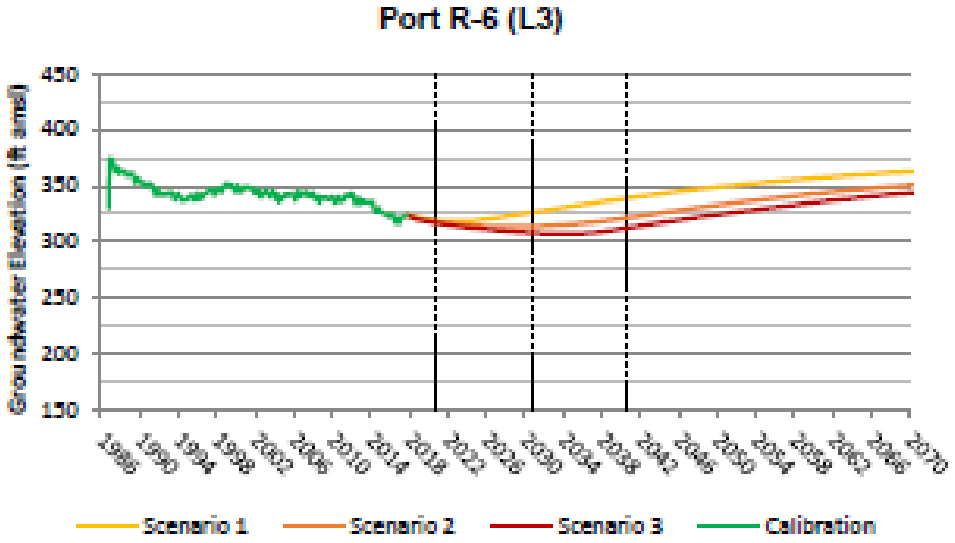

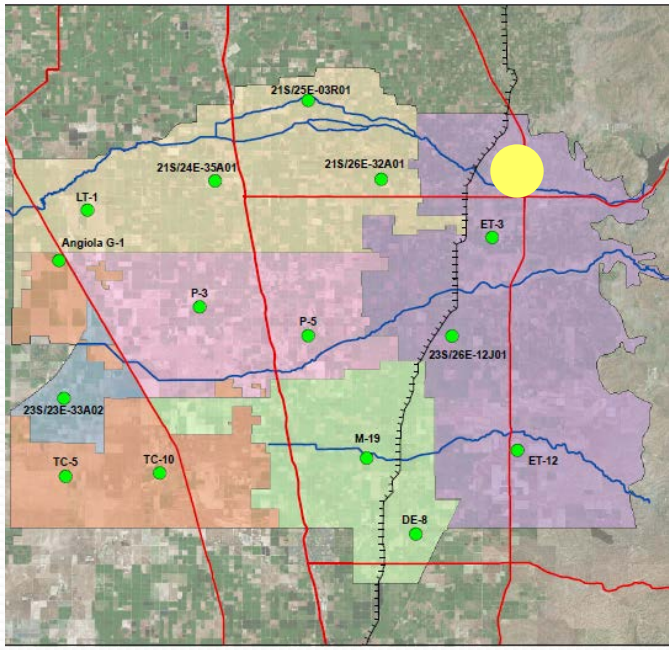

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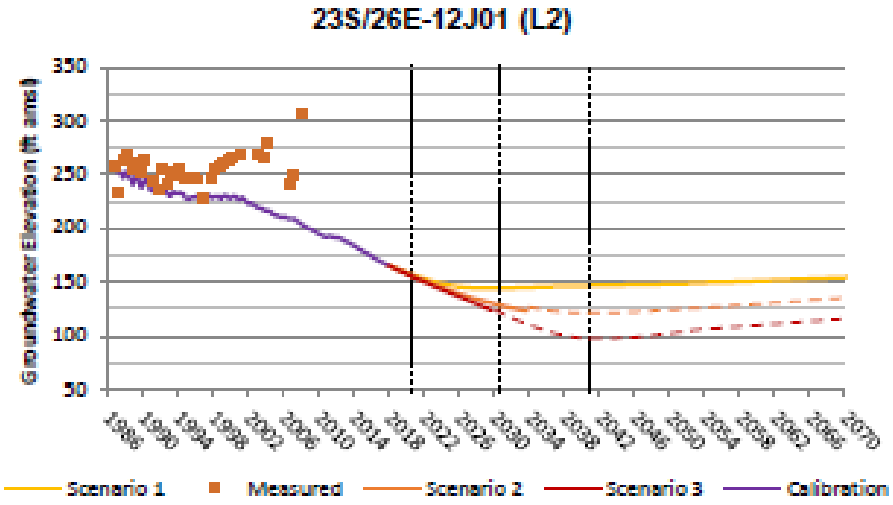

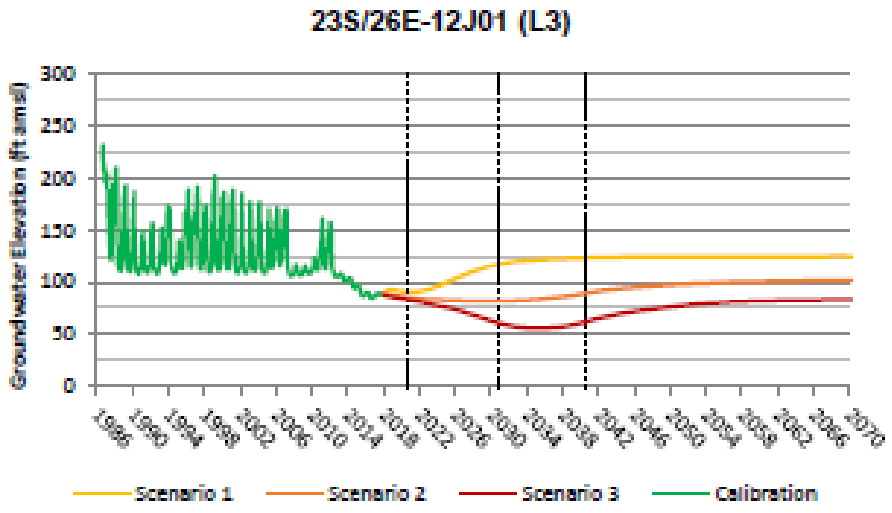

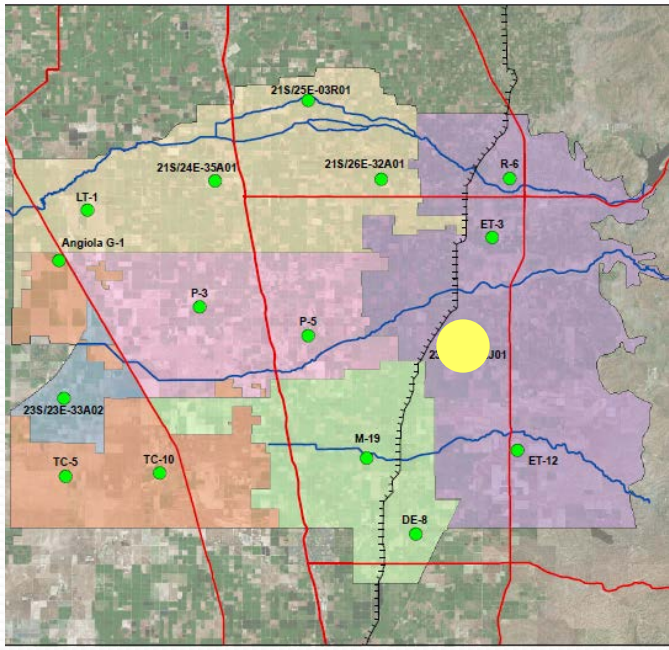

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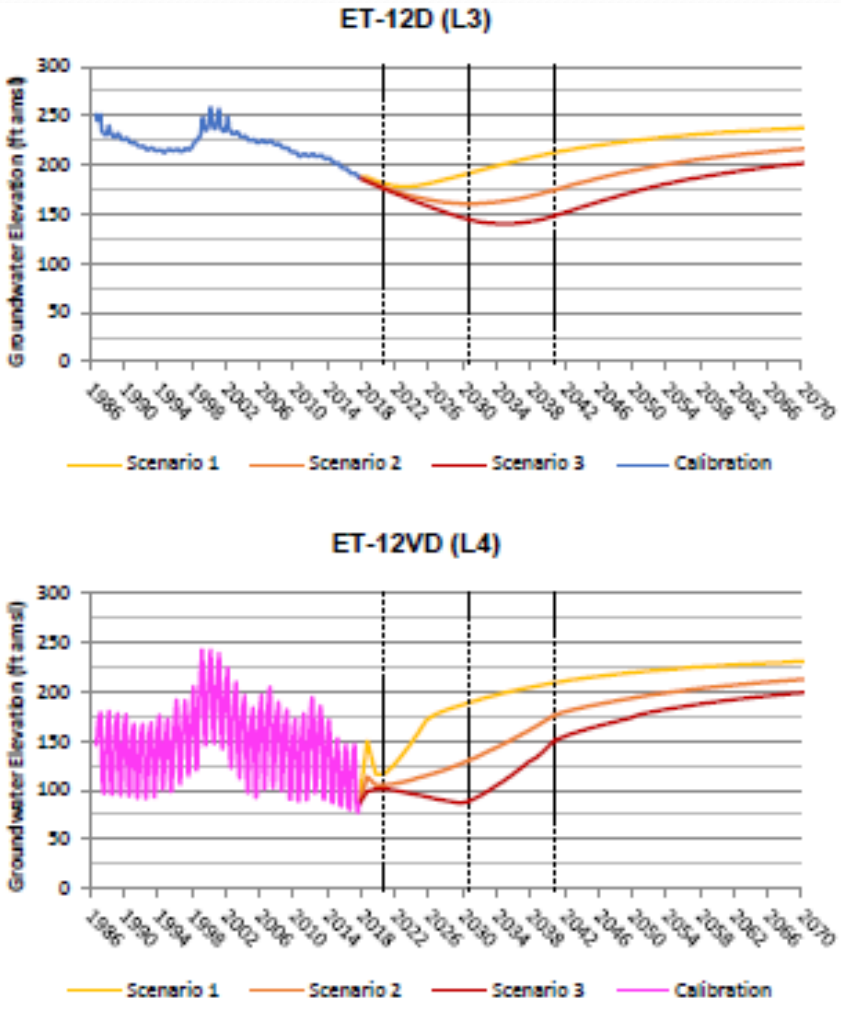
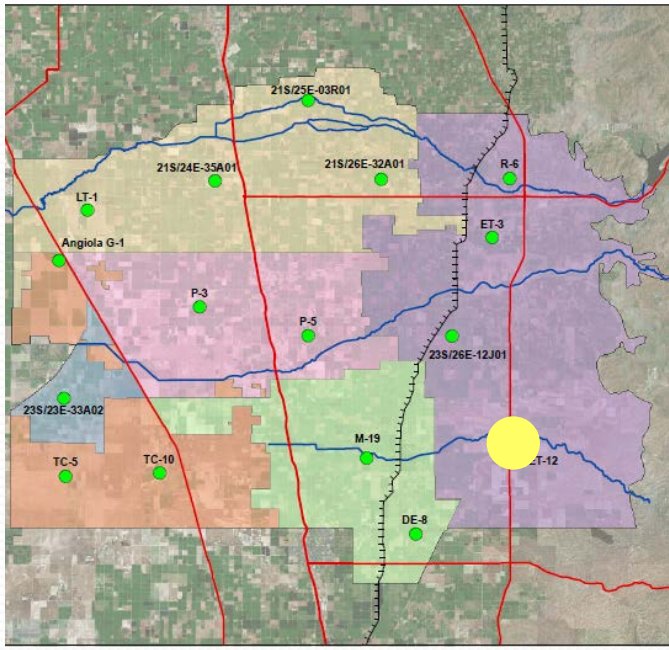
Model-Projected Groundwater Elevations





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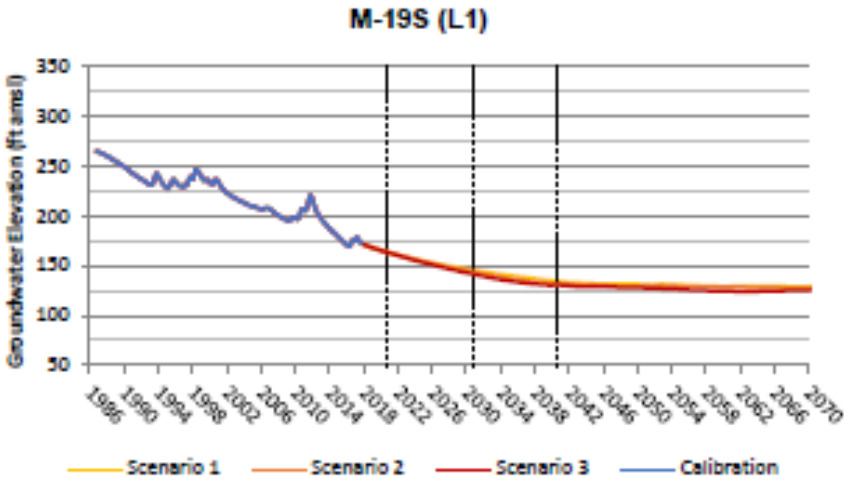

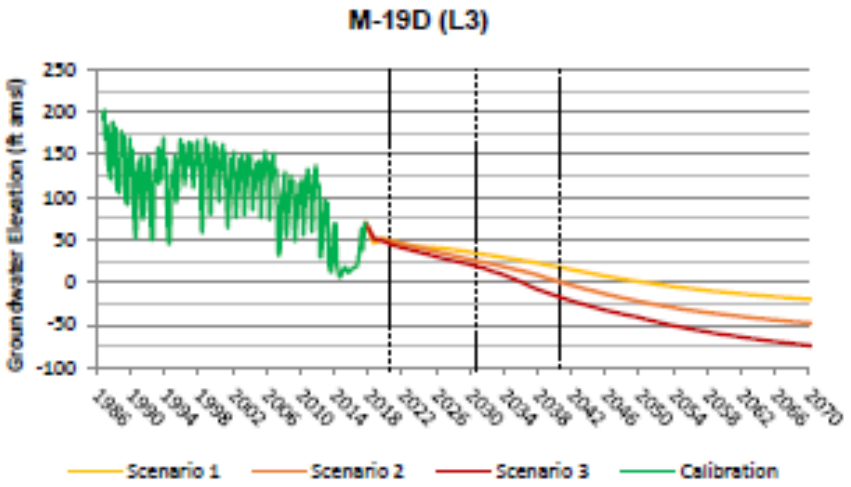

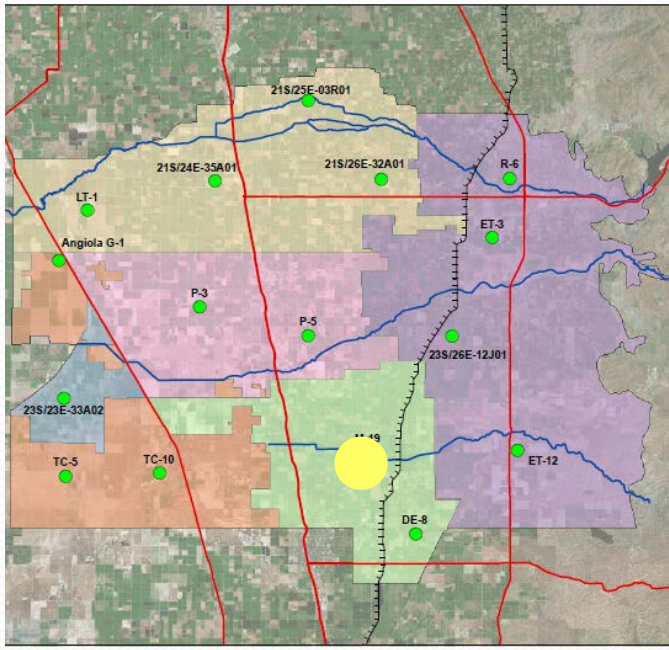

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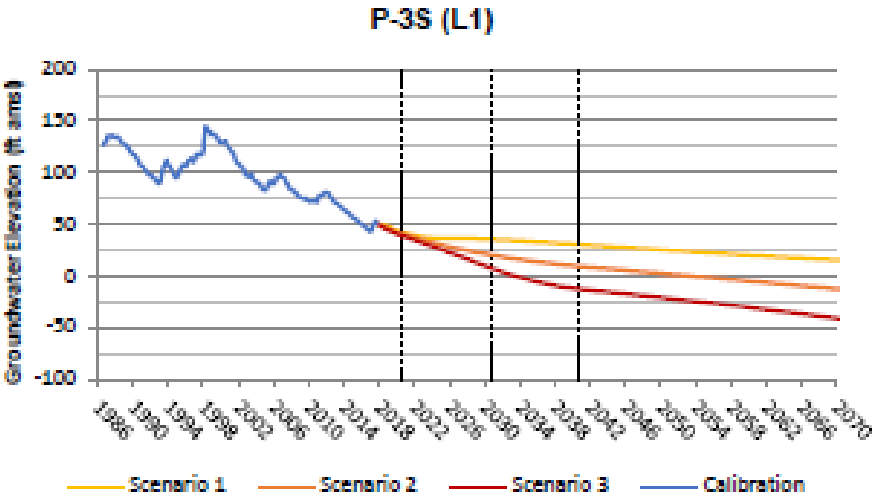

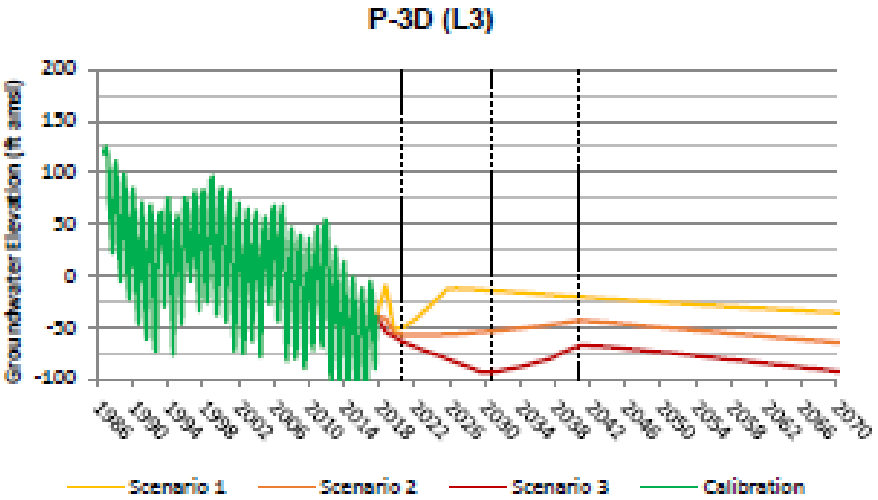

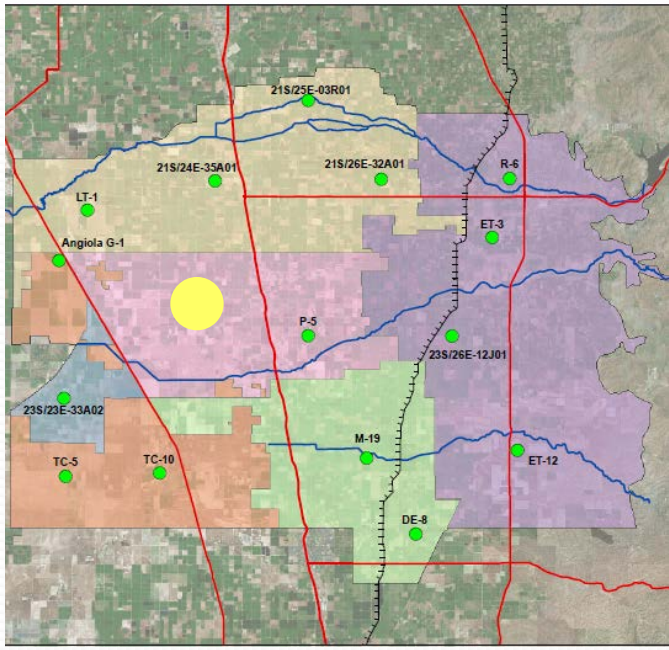

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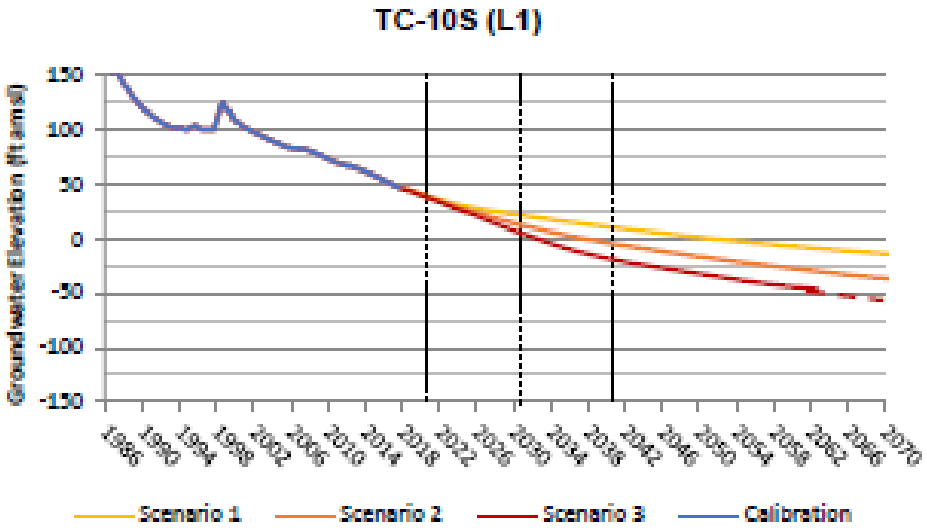
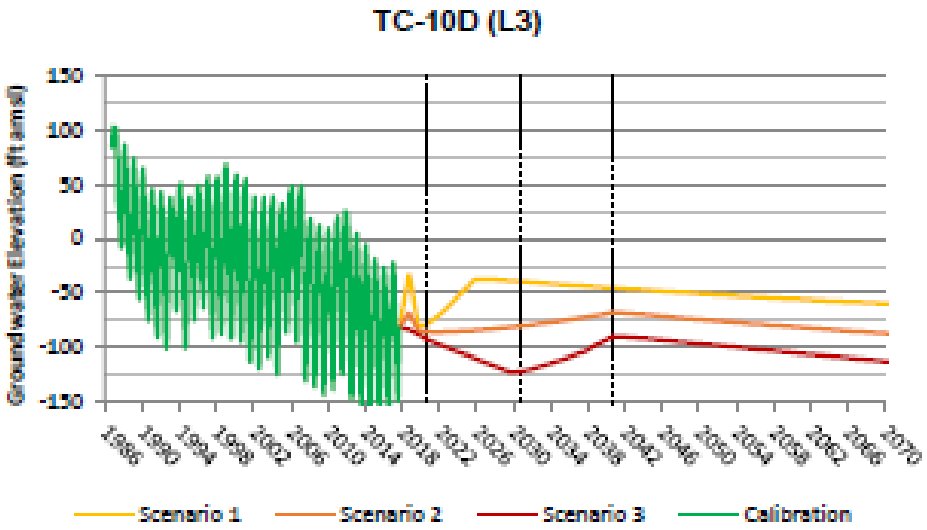
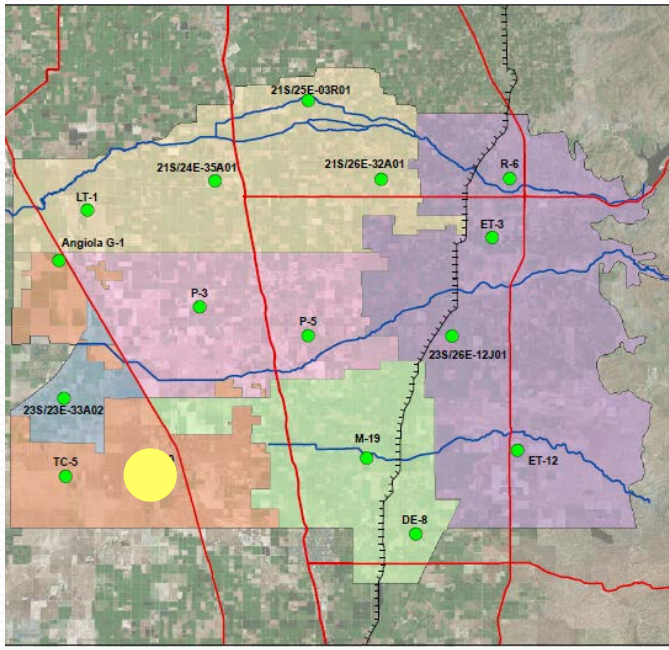
Model-Projected Groundwater Elevations







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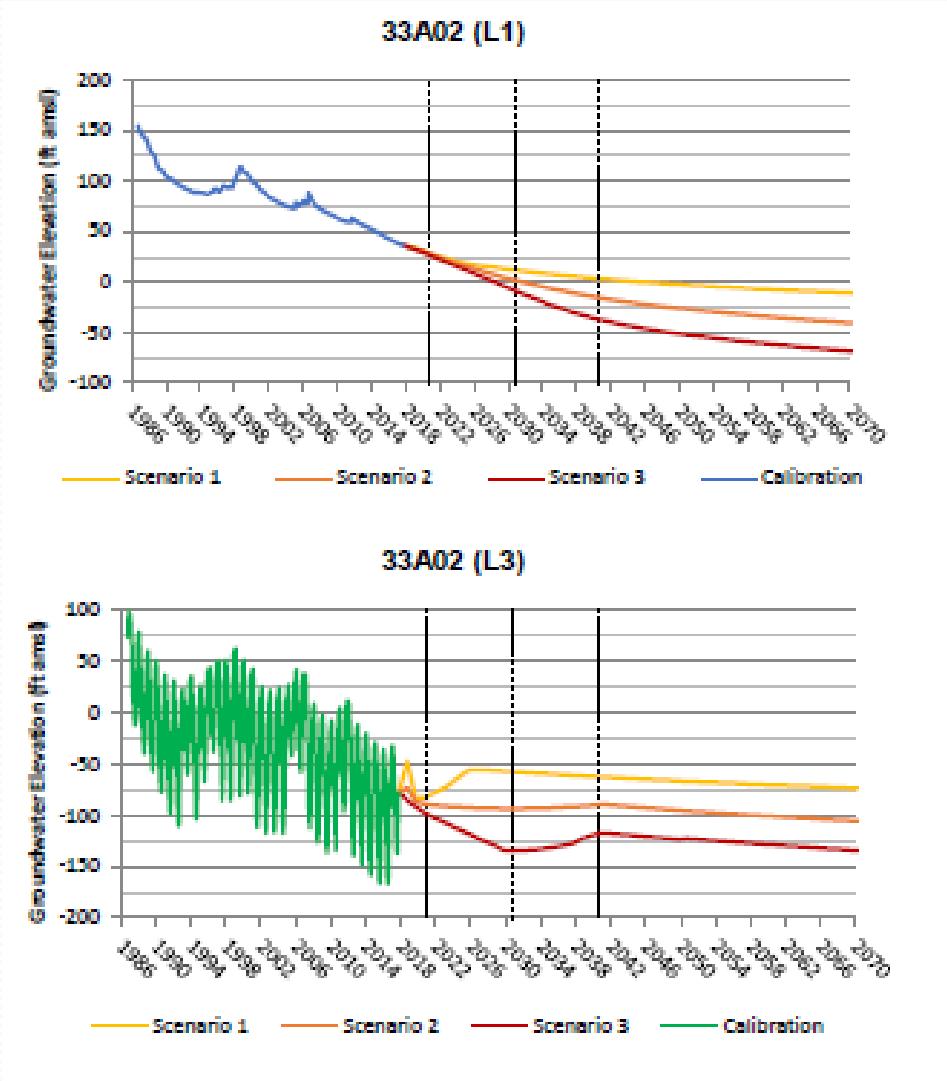
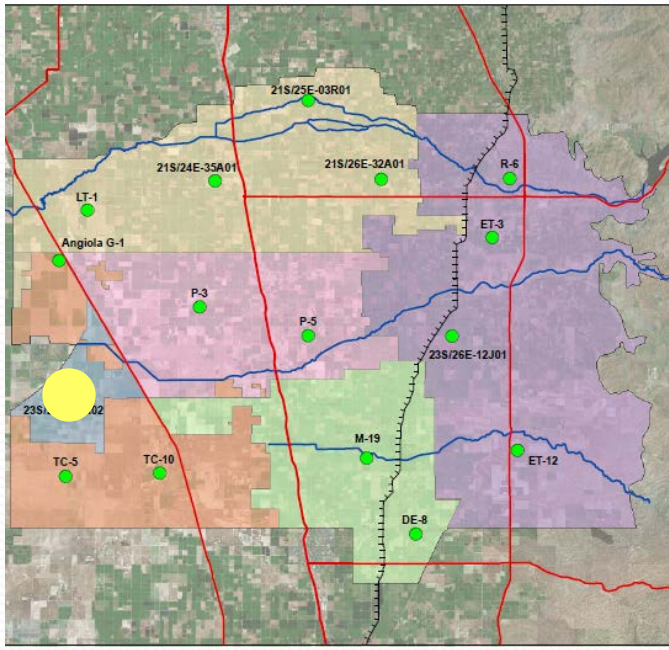
Model-Projected Groundwater Elevations





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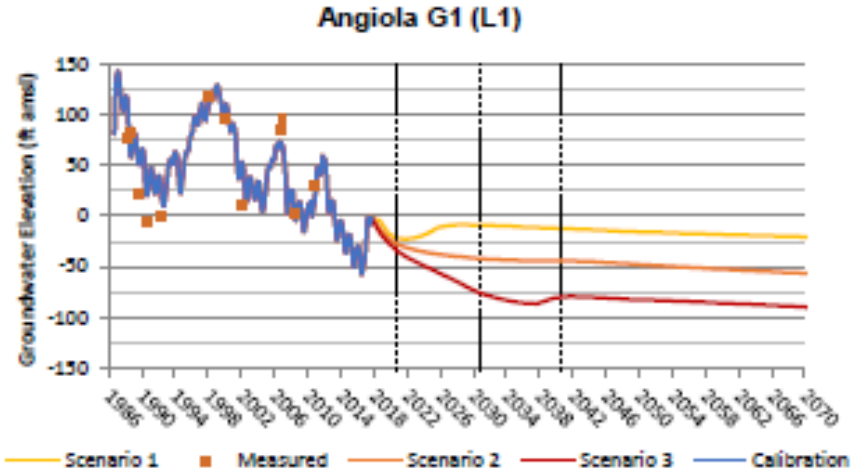

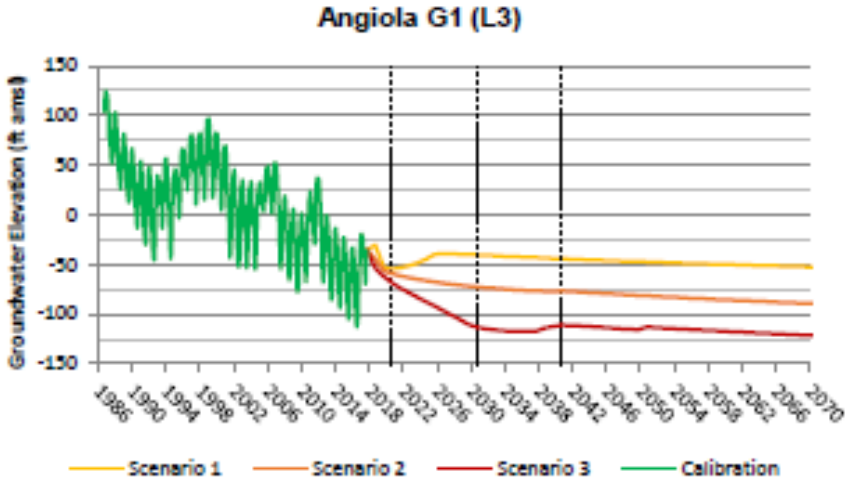

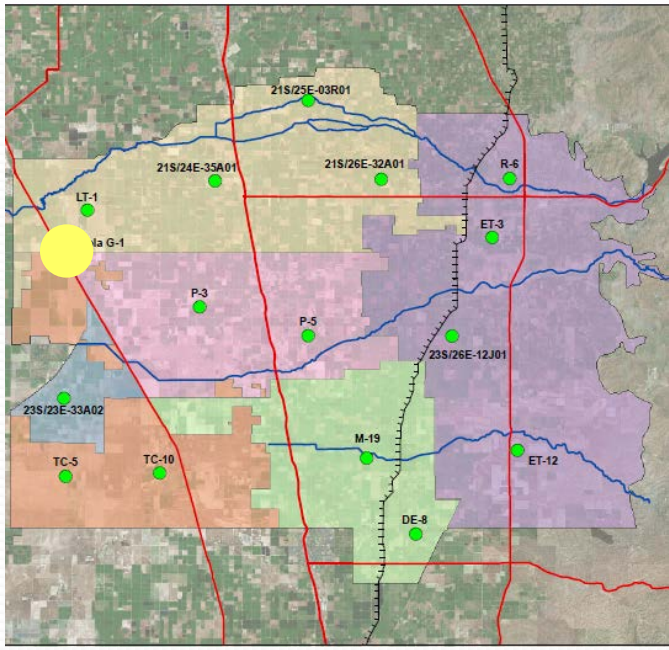

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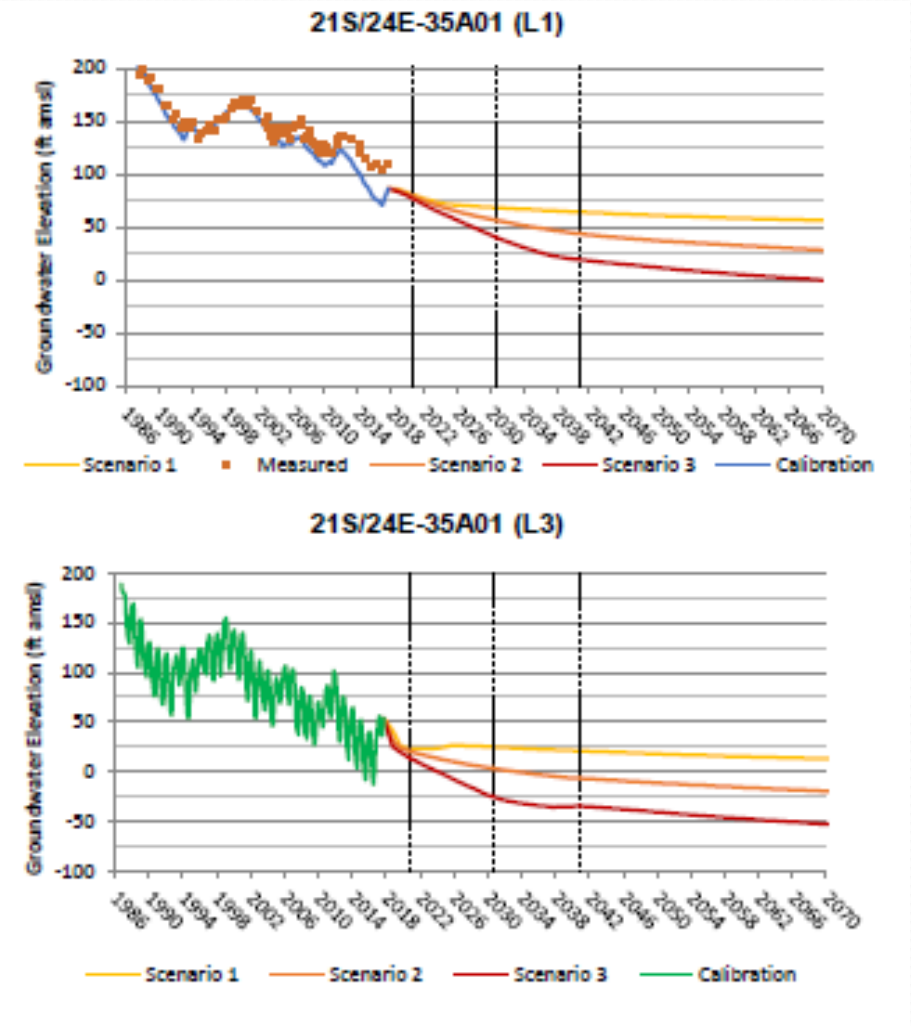

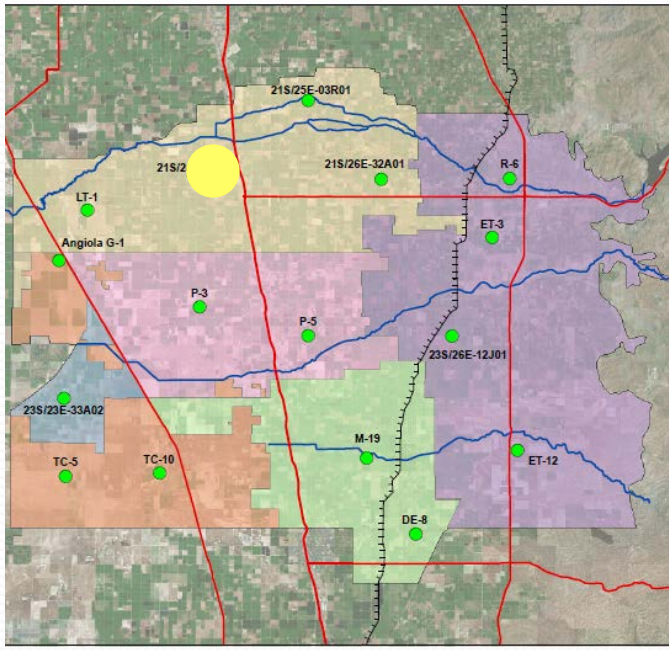

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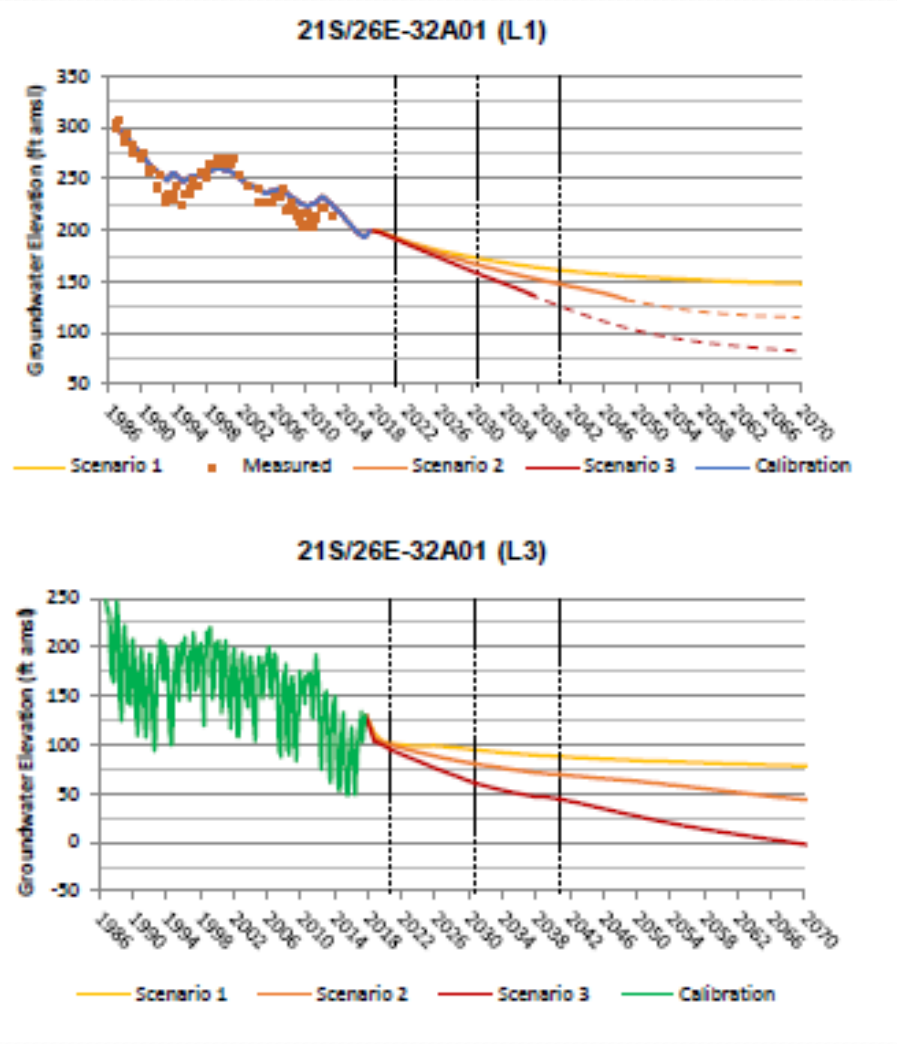

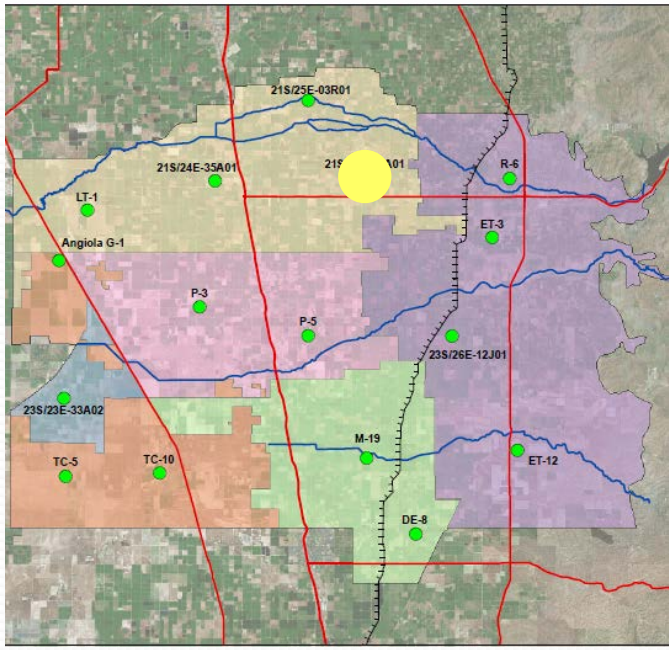

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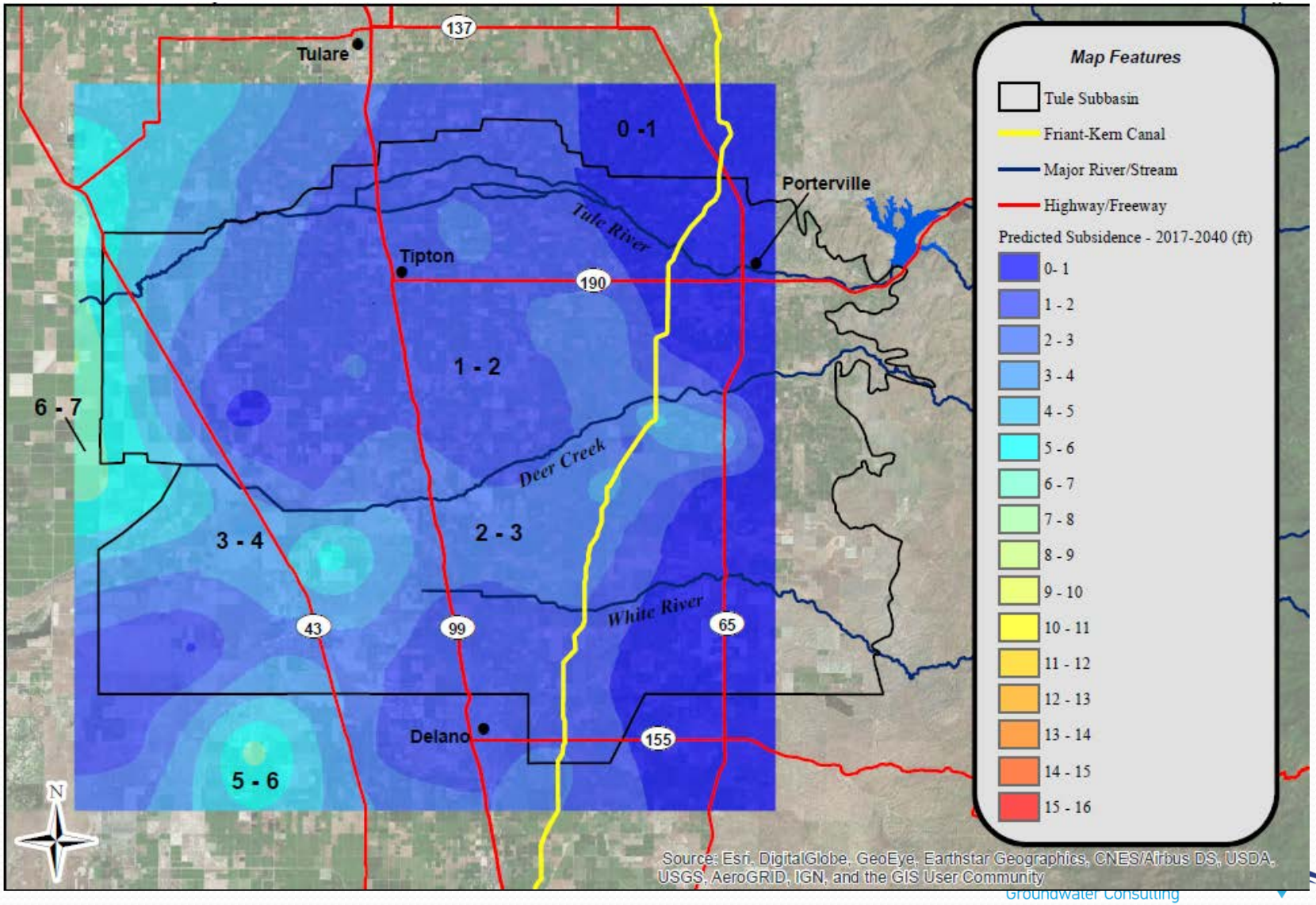
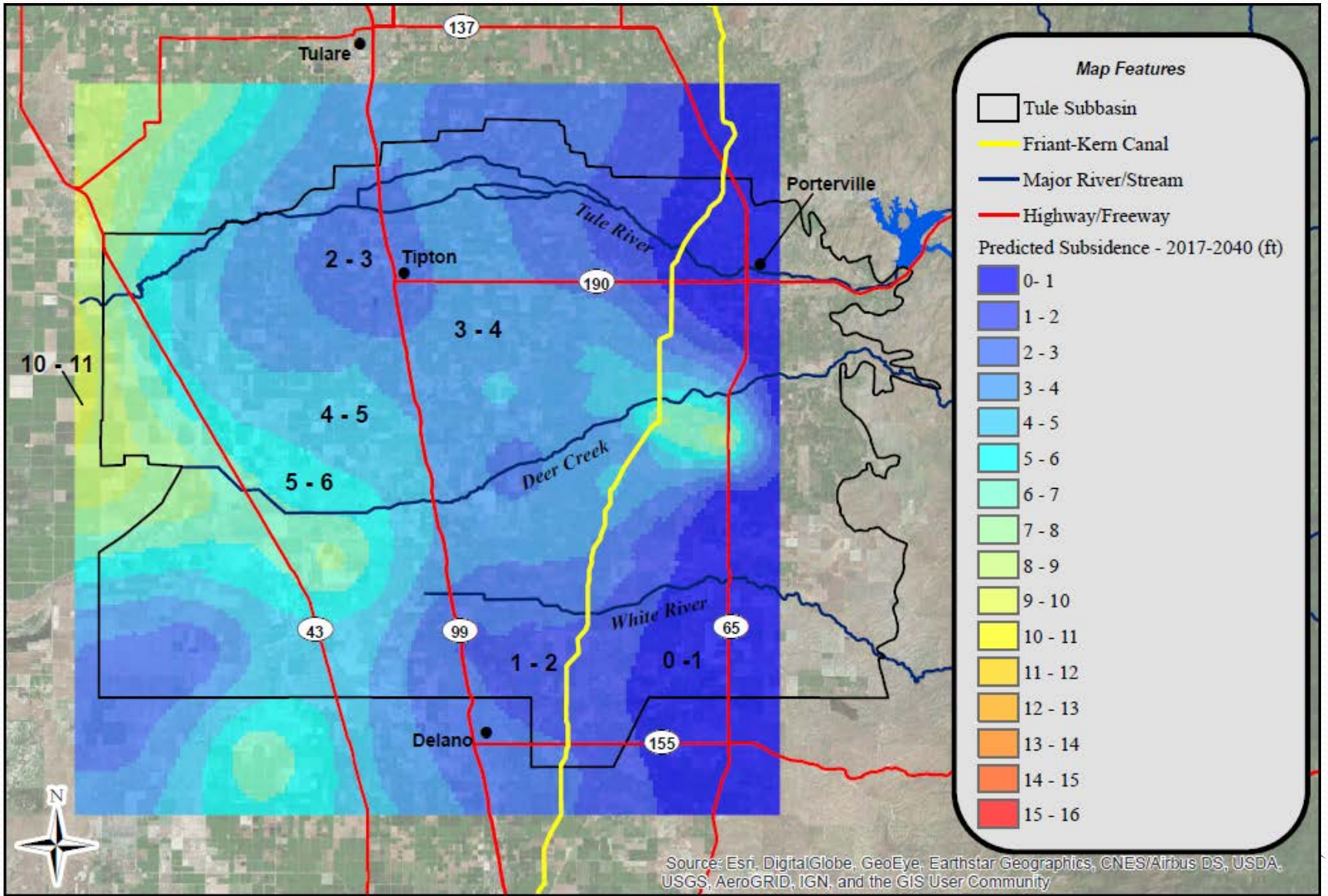
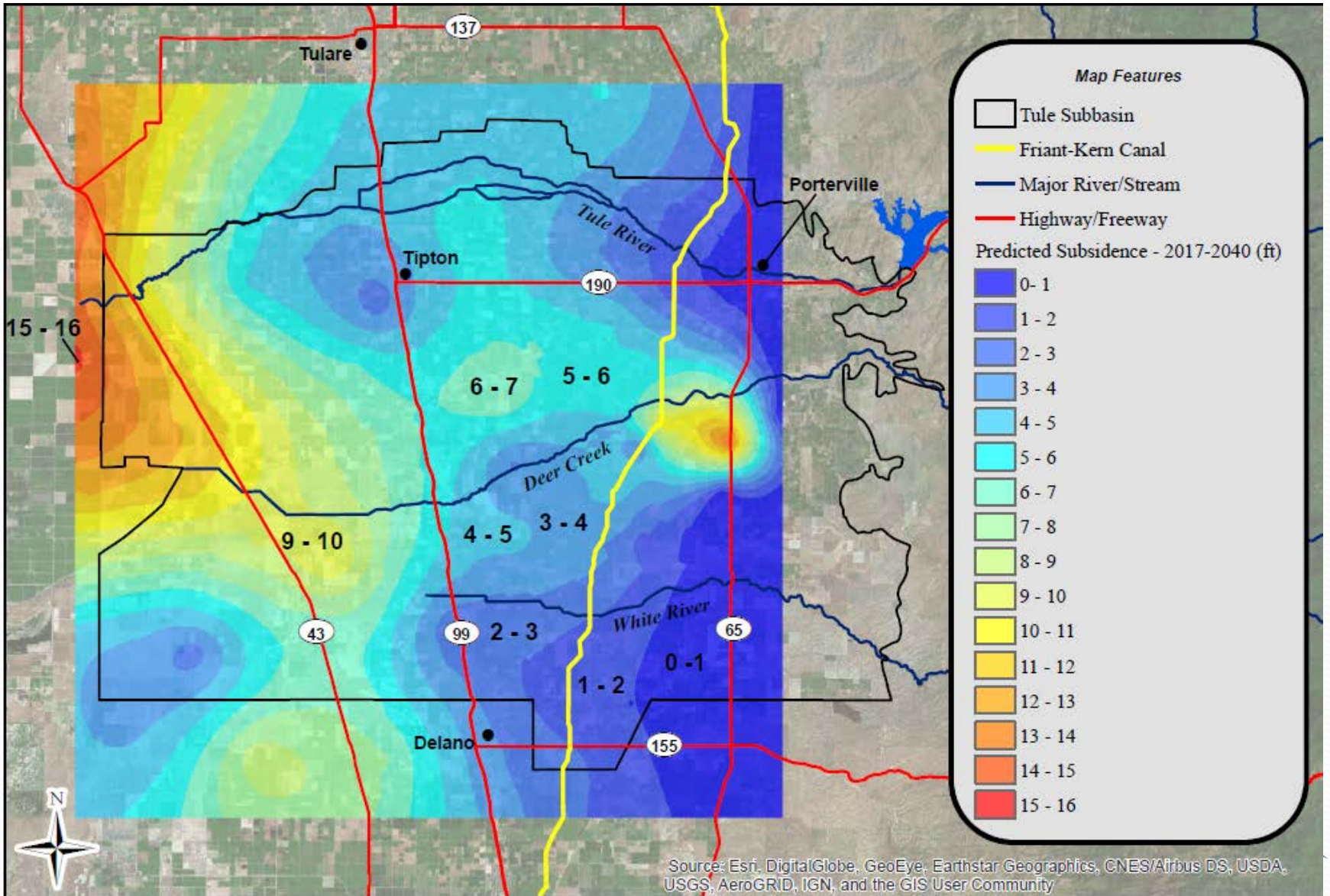
Model-Projected Land Subsidence Scenario 1



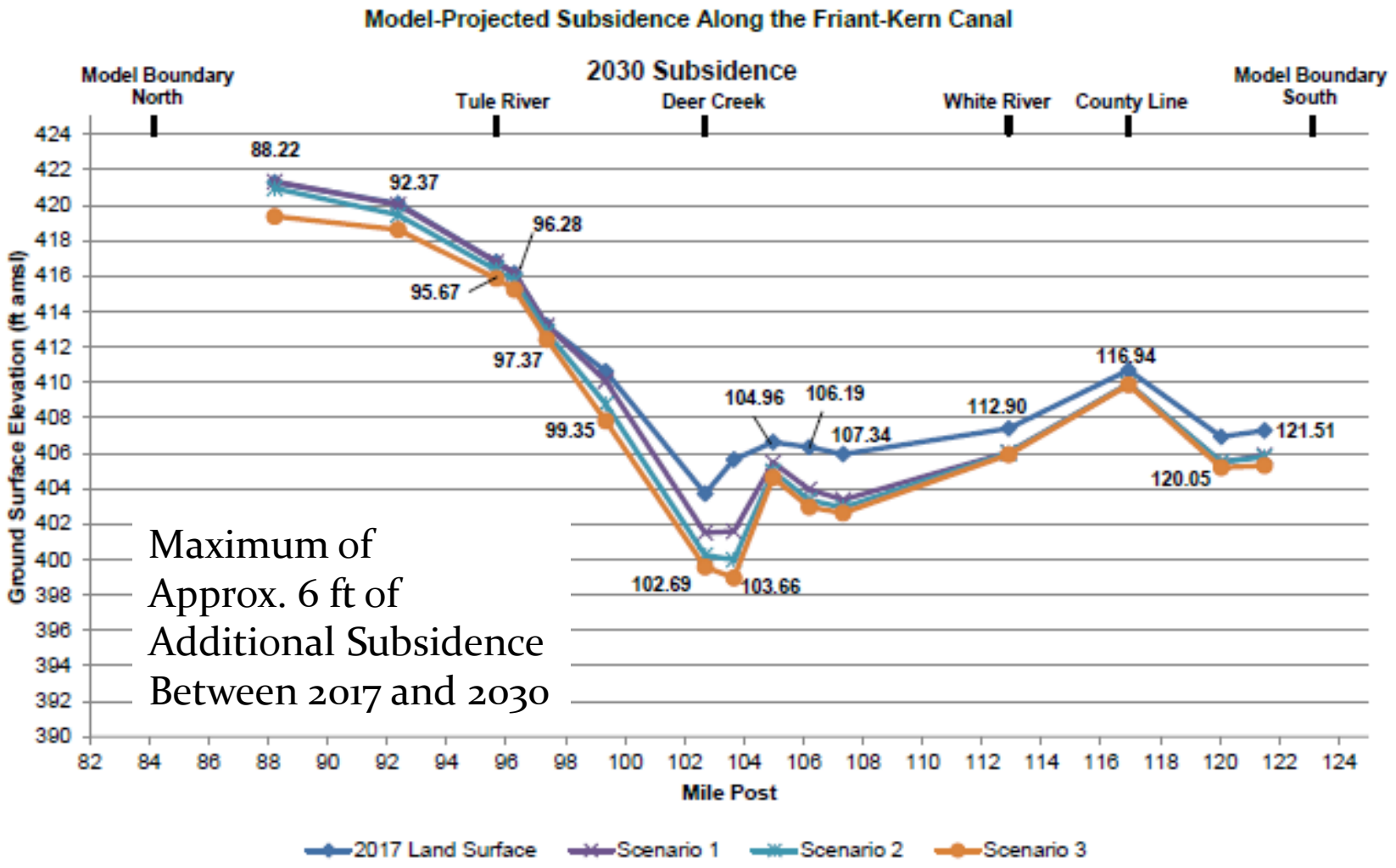
Model-Projected Land Subsidence Scenario 2



Model-Projected Land Subsidence Scenario 3



Model-Projected Land Subsidence Beneath Friant-Kern Canal



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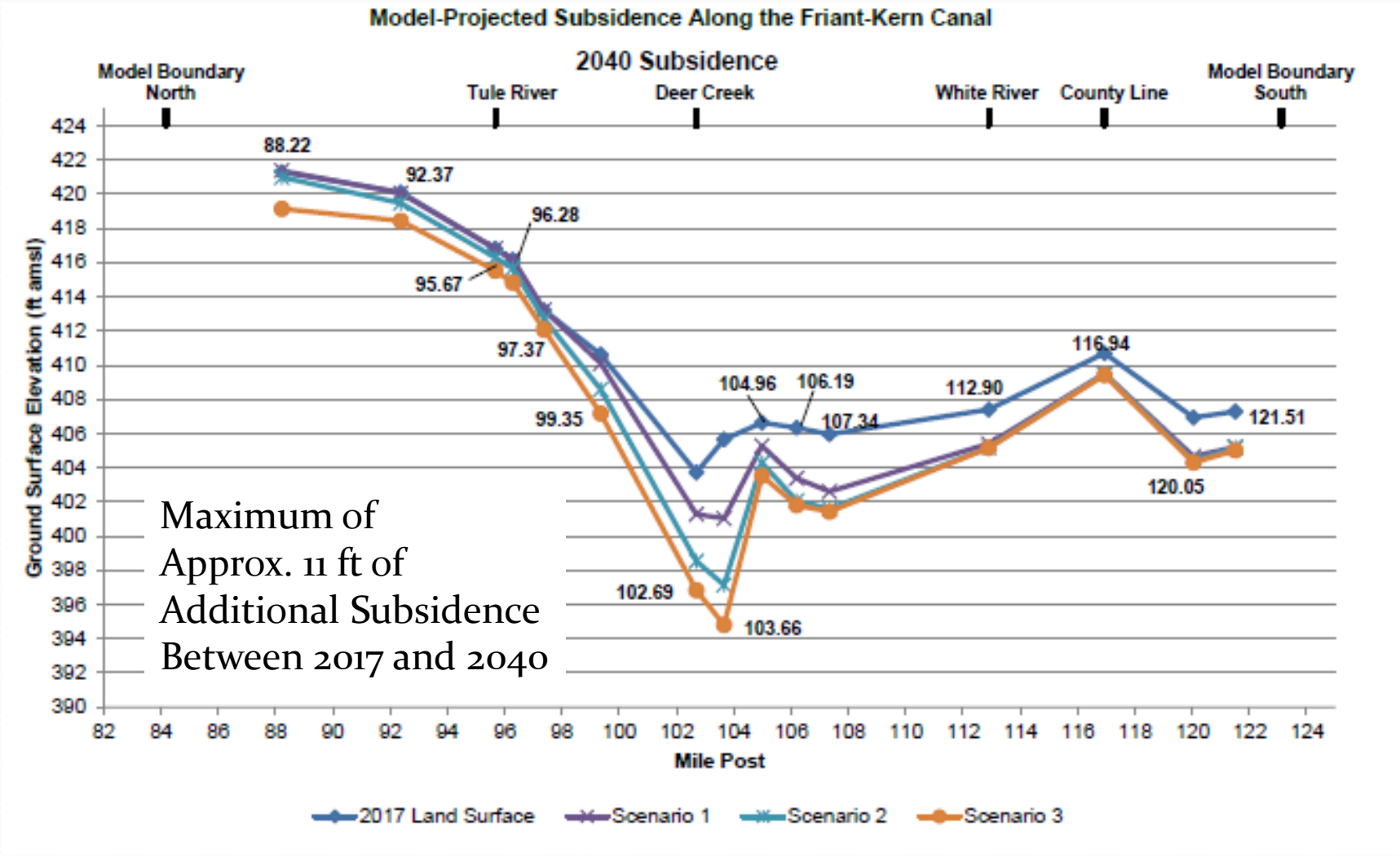
Model-Projected Land Subsidence Beneath Friant-Kern Canal



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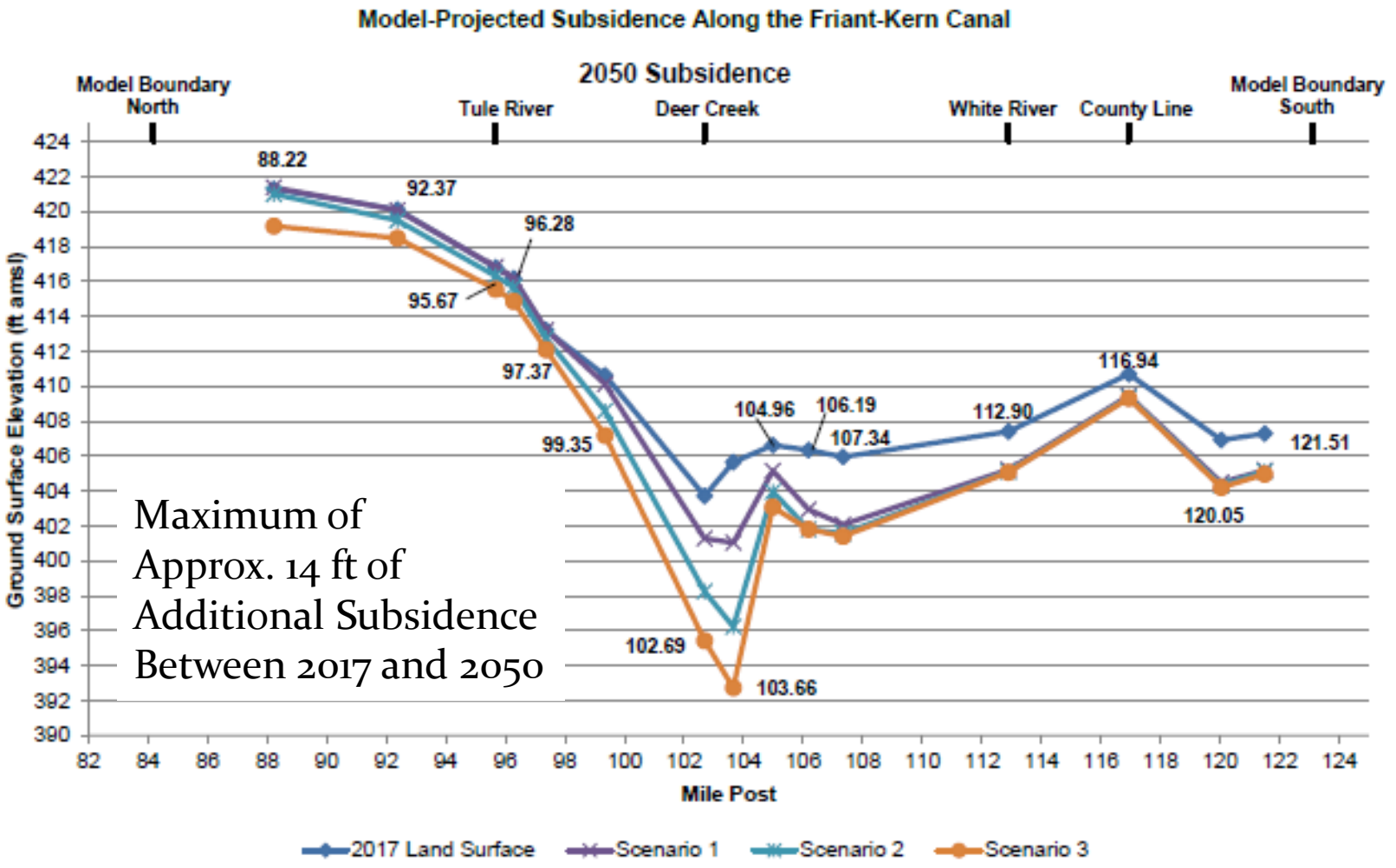

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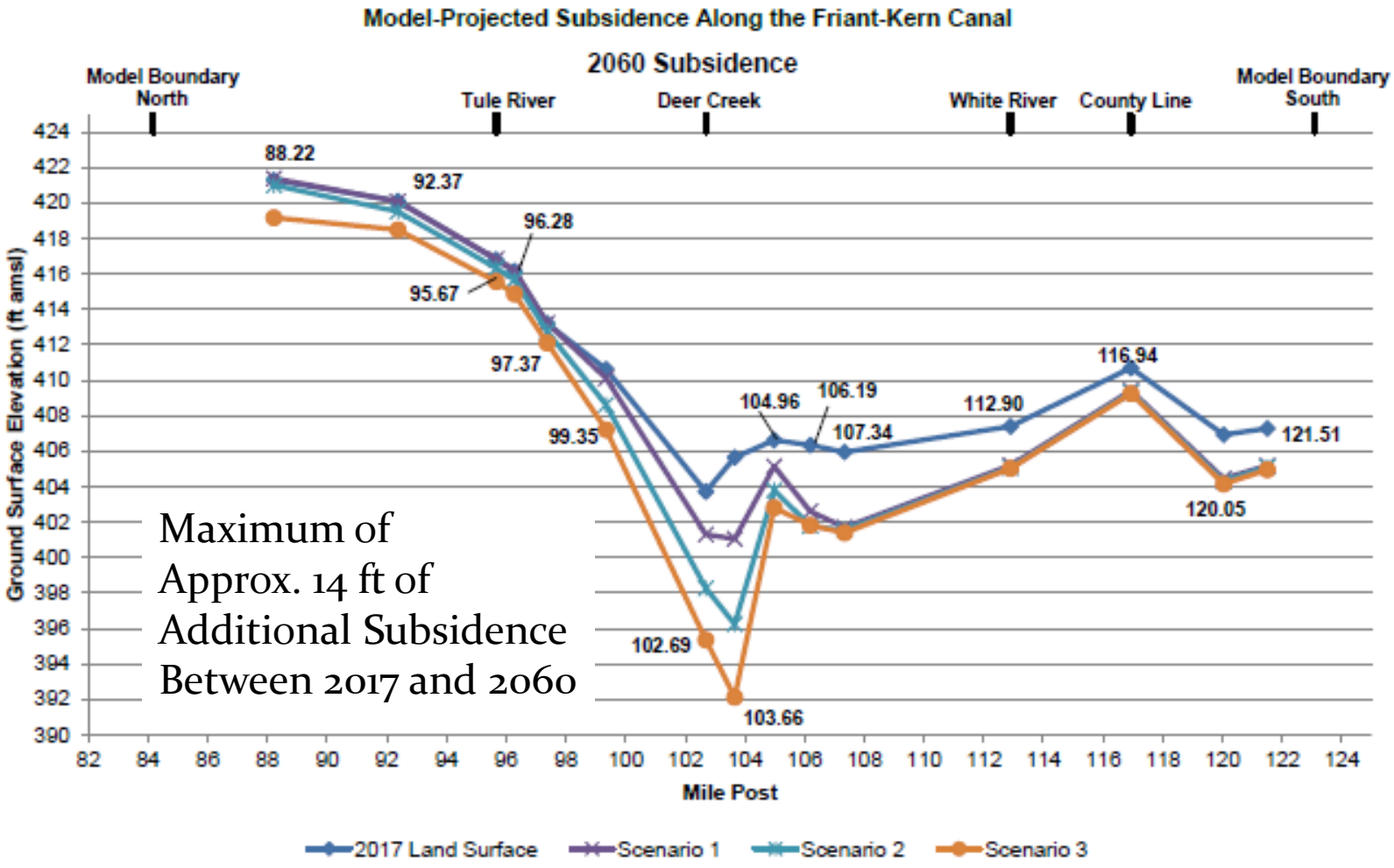

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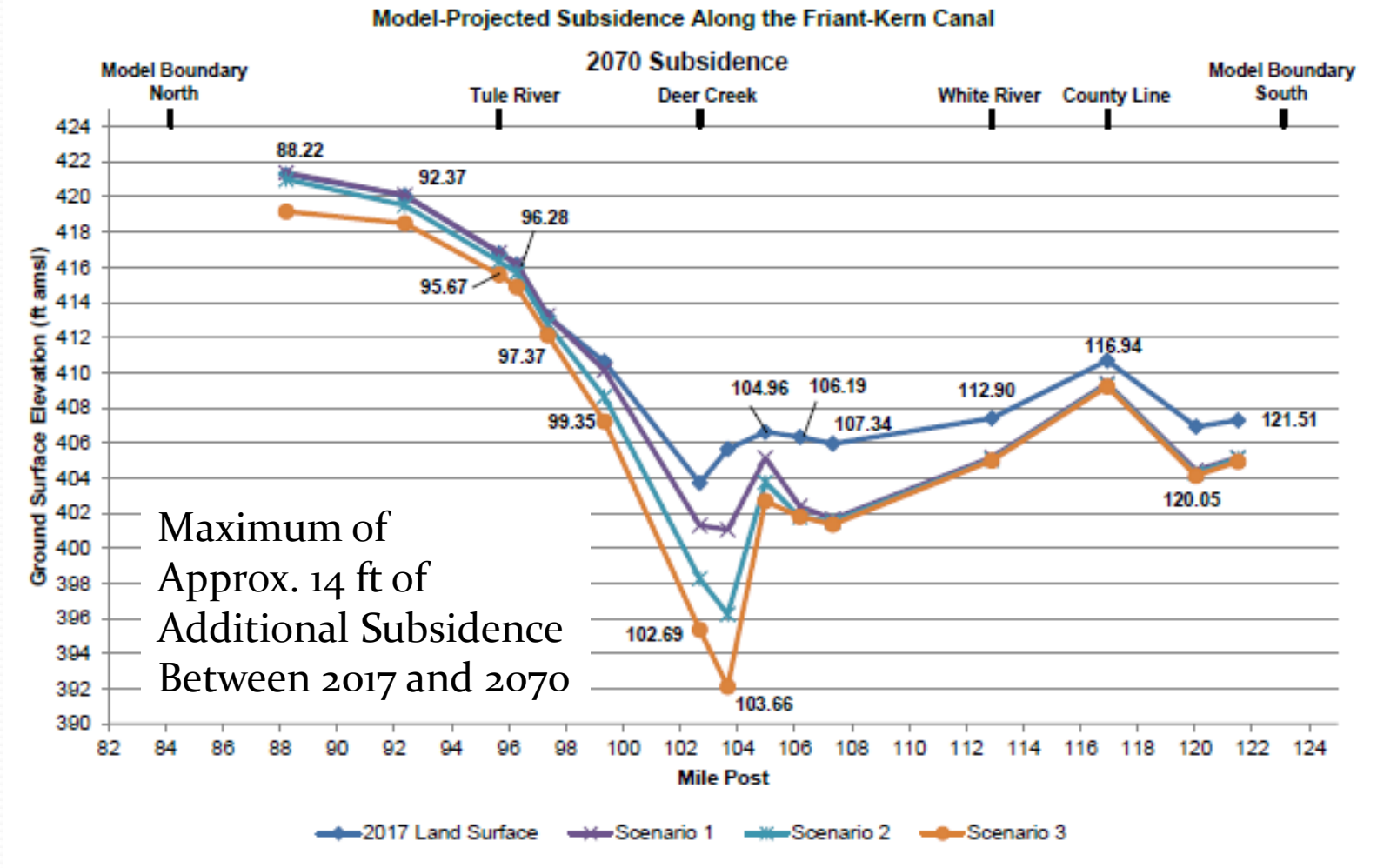

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GSP Next Steps

- Evaluate Potential Minimum Thresholds
- Identify Potential Measureable Objectives
- As Needed, Identify Alternate Key Wells at Which to Evaluate Minimum Thresholds and Measureable Objectives
- As Needed, Identify Alternative Scenarios to Analyze with the Model

SUSTAINABILITY CRITERIA

1. SUSTAINABILITY GOAL: Basin-Wide Goal to achieve Sustainability (absence of undesirable results) within 20 years.

2. UNDESIRABLE RESULTS: Significant and Unreasonable affects caused by groundwater depletion for: GW levels, reduction of GW storage, Seawater intrusion, Degraded Water Quality, Land Subsidence, Surface Water Depletion

3. MINIMUM THRESHOLDS: Quantitative Value, when exceeded, may cause undesirable result.

4. MEASURABLE OBJECTIVES: Series of 5-year milestones until 20 year deadline.

GSA TO DEVELOP PROJECTS AND POLICY TO ADDRESS THE SUSTAINABILITY CRITERIA, EVALUATE USING GW FLOW MODEL, REFINE IN GSP, AND SUBMIT TO TULE SUBBASIN COORDINATION GROUP FOR FINAL ACCEPTANCE.

Monitoring Plan

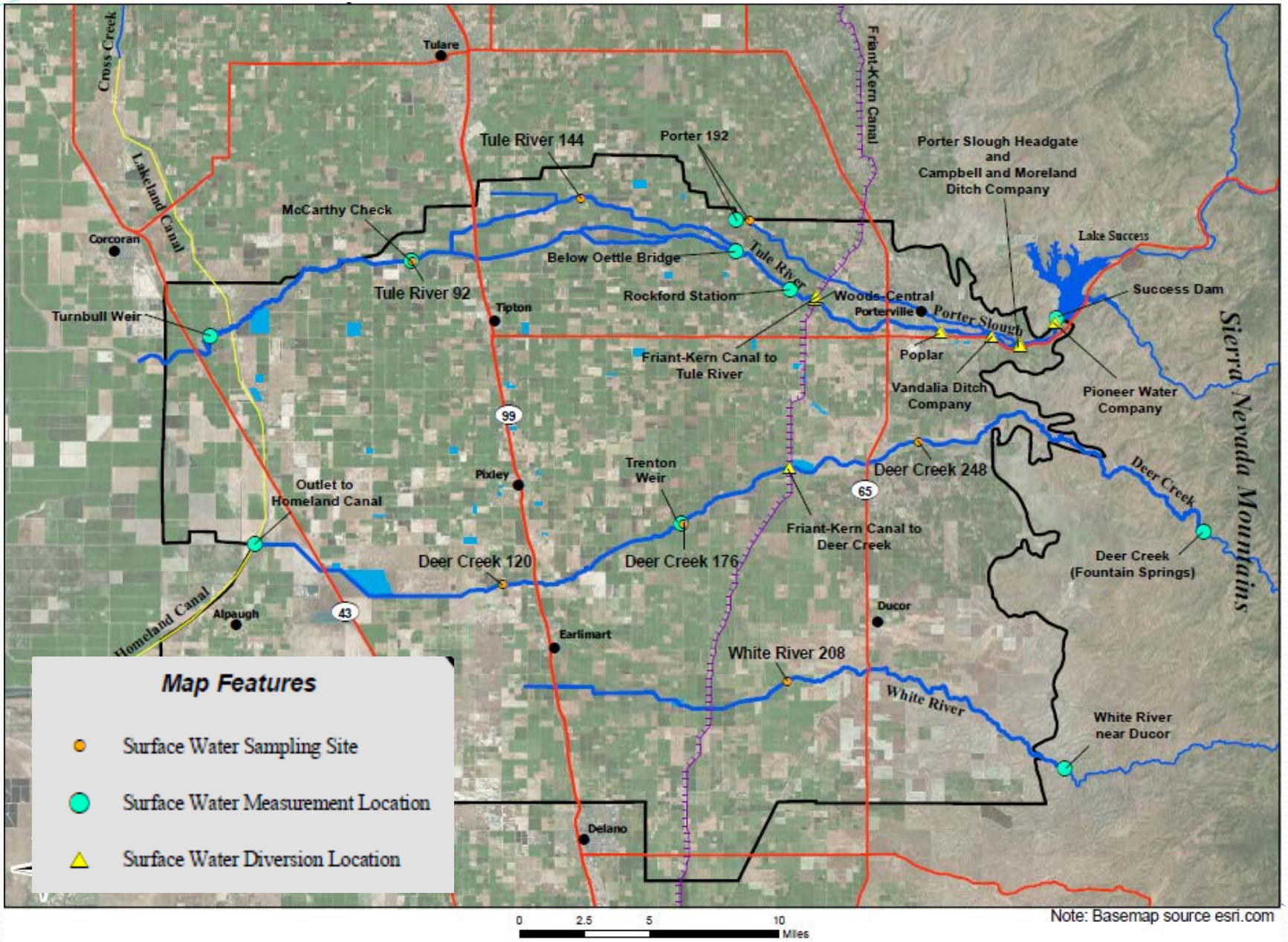
Monitoring Plan Elements

- Background and Objectives
- The Plan Addresses:
  - Surface Water Monitoring
  - Groundwater Monitoring
  - Land Surface Elevation and Subsidence Monitoring

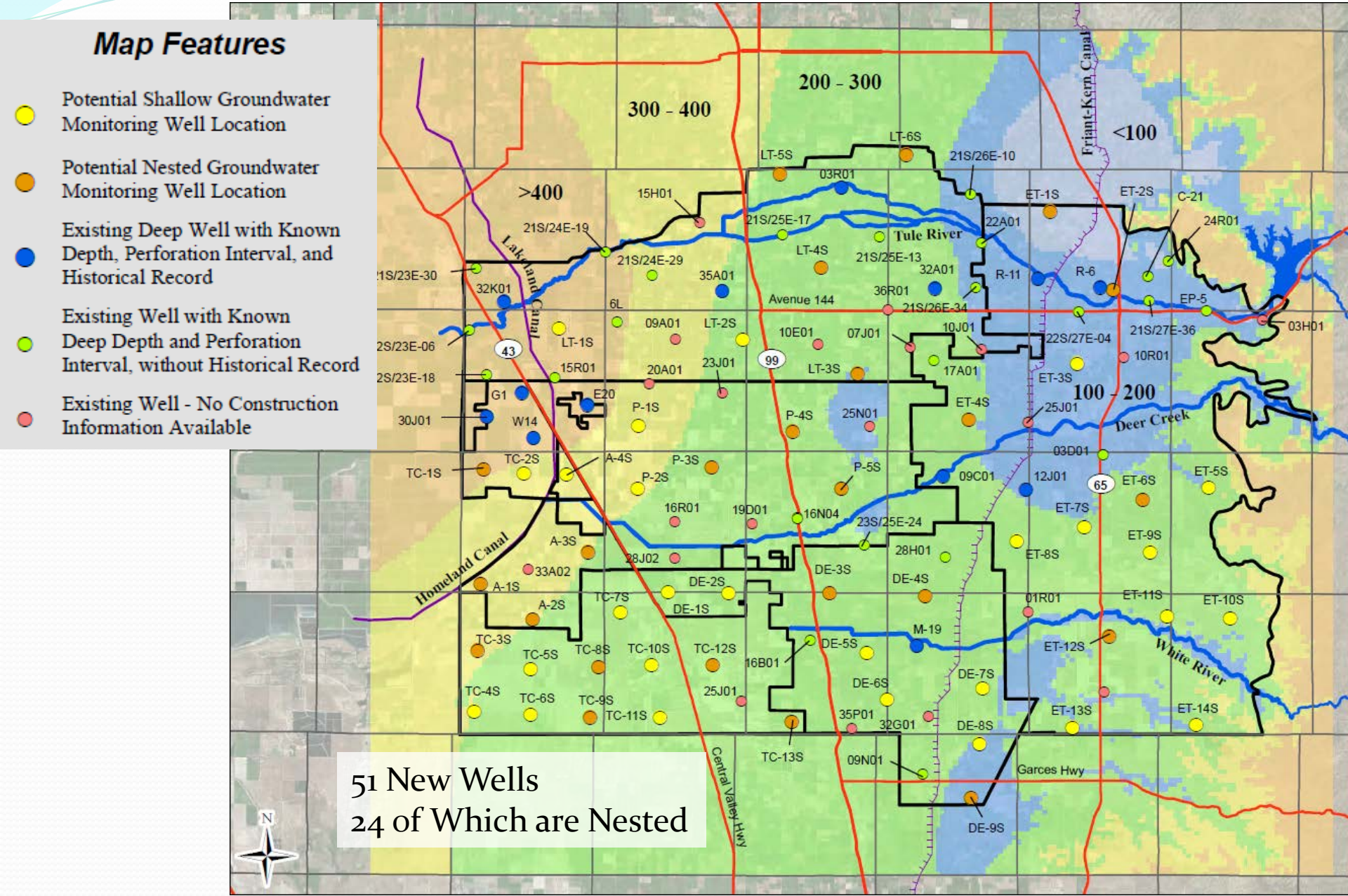
Monitoring Plan Elements

- Each Monitoring Area Includes Sections to Address:
  - Monitoring Features
  - Monitoring Procedure
  - Frequency of Measurement
  - Data Gaps
  - Recommended Monitoring Features/Testing to Address Data Gaps
- Data Management Plan

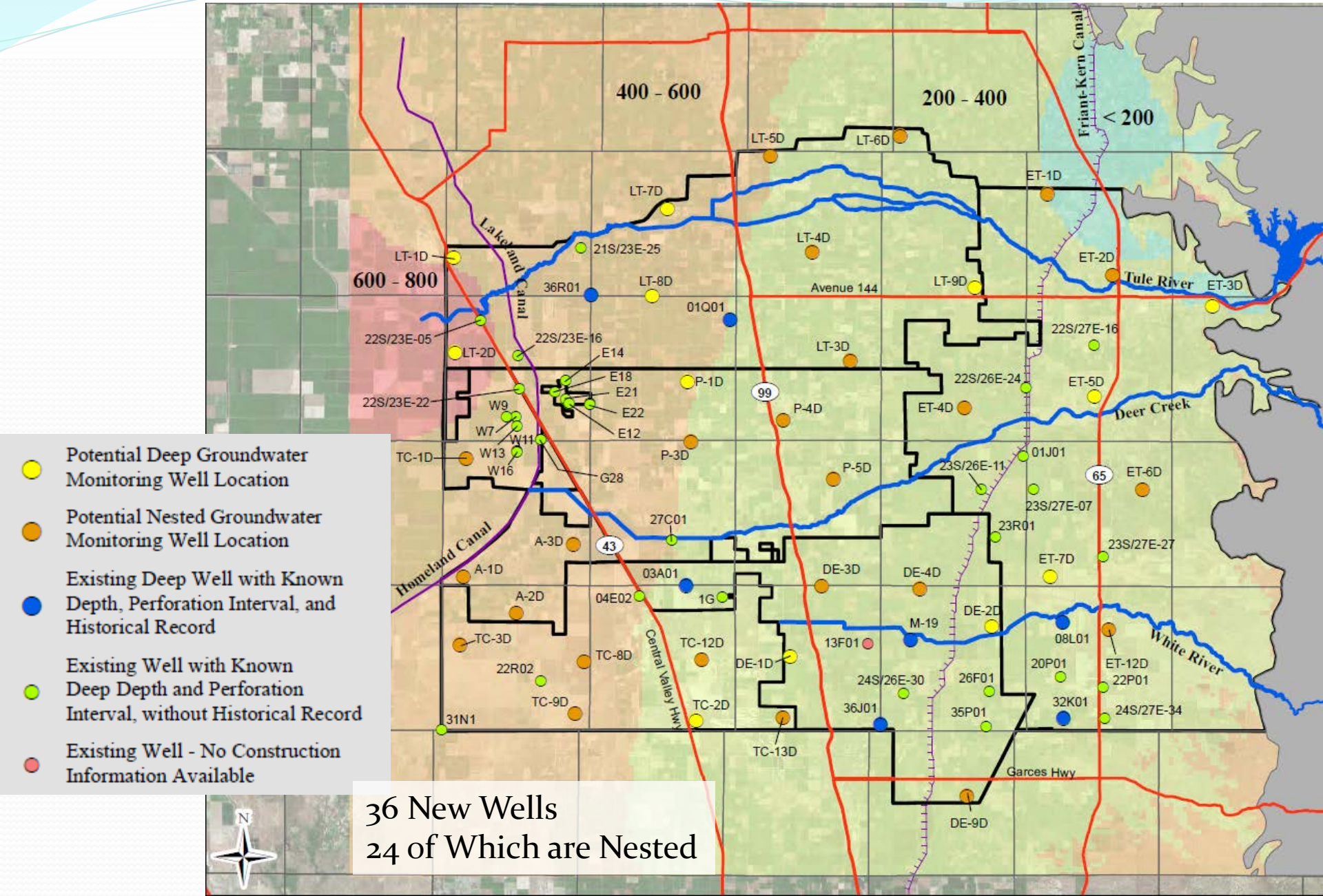
Surface Water Monitoring Features



Shallow Aquifer Groundwater Monitoring Features



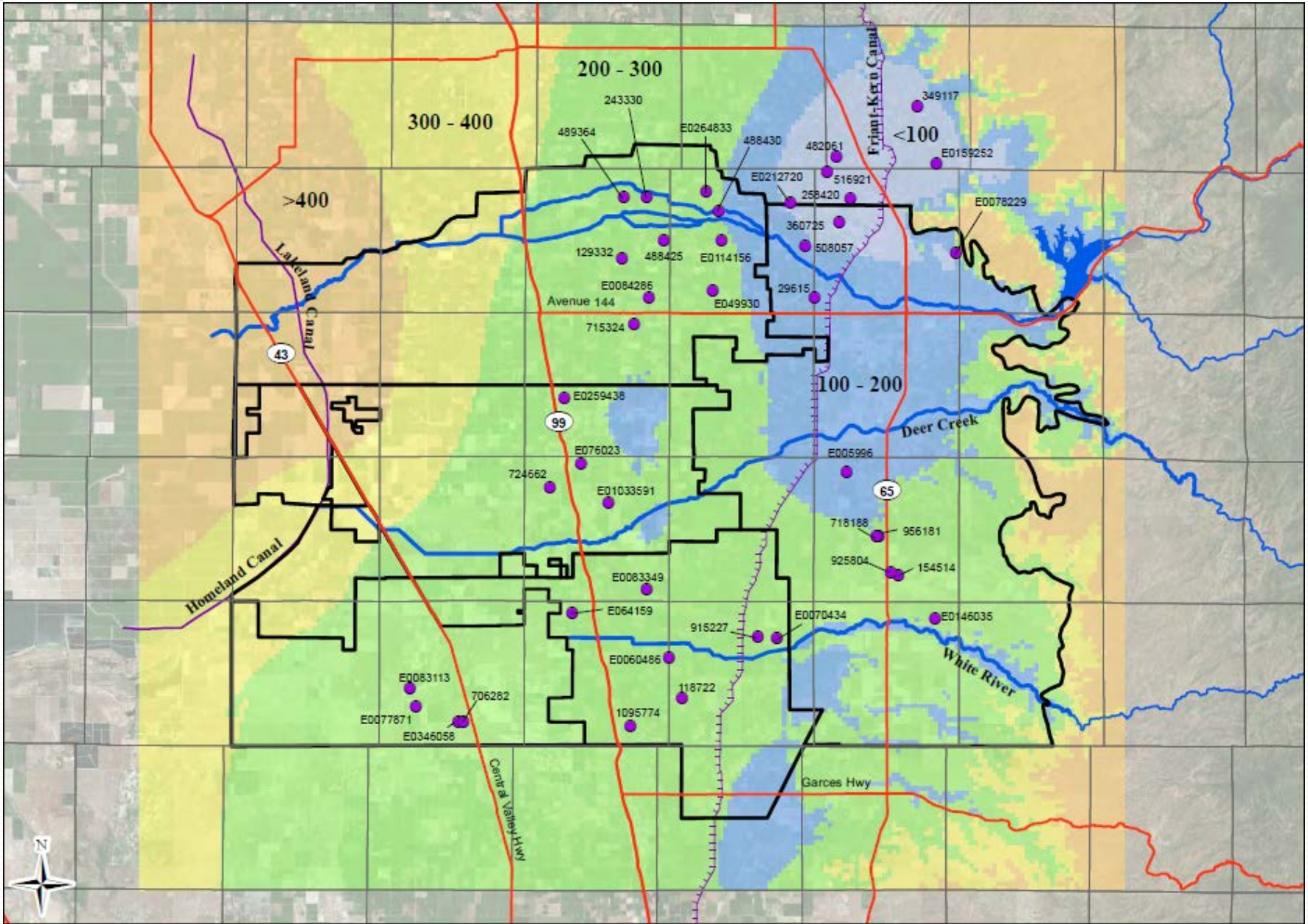
Deep Aquifer Groundwater Monitoring Features



- Potential Deep Groundwater Monitoring Well Location
- Potential Nested Groundwater Monitoring Well Location
- Existing Deep Well with Known Depth, Perforation Interval, and Historical Record
- Existing Well with Known Deep Depth and Perforation Interval, without Historical Record
- Existing Well - No Construction Information Available

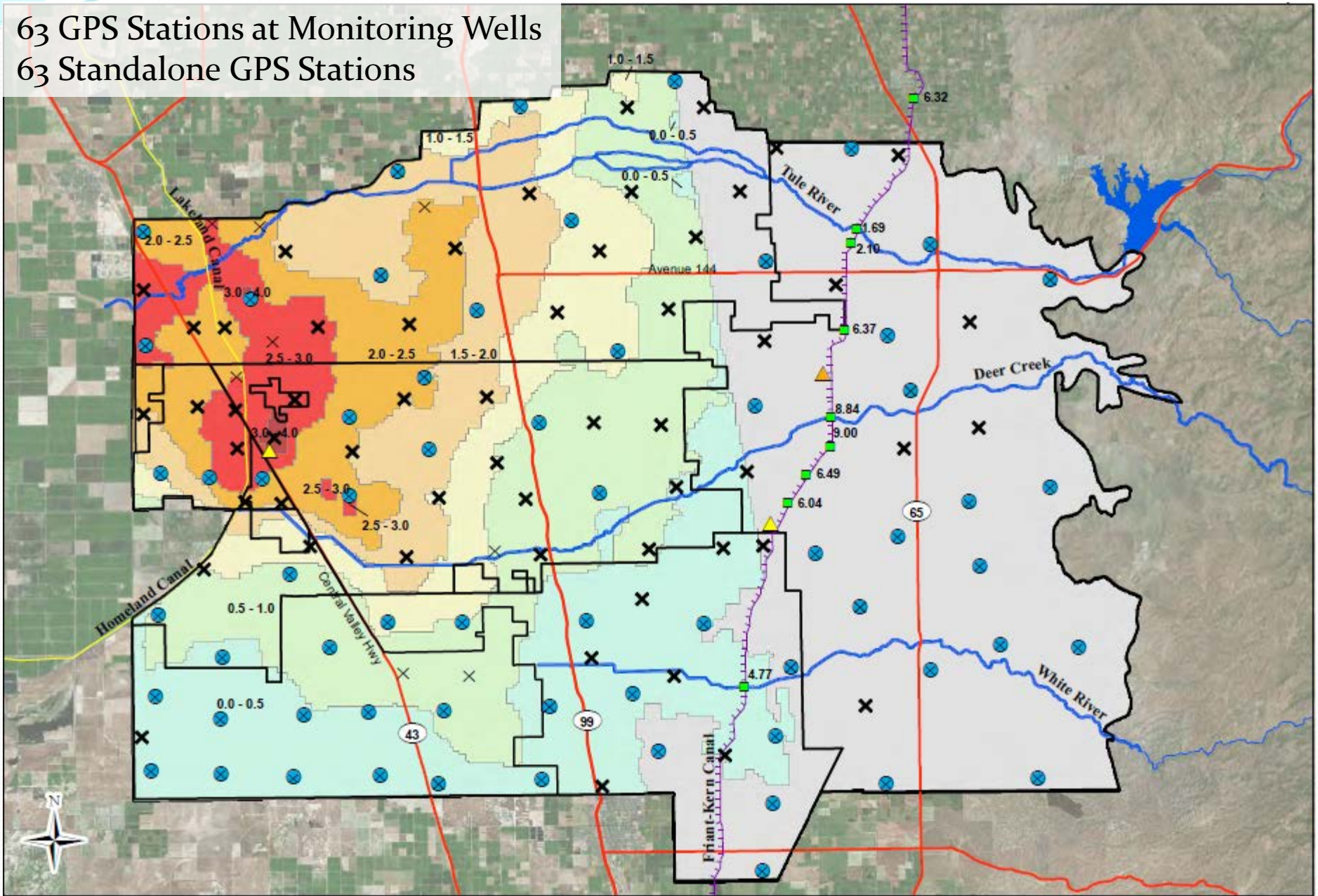
36 New Wells
24 of Which are Nested

Groundwater Quality Monitoring Features



Groundwater Quality Monitoring Features

63 GPS Stations at Monitoring Wells
63 Standalone GPS Stations



Questions