UC WATER
Security and Sustainability Research Initiative

UC DAVIS
CENTER FOR WATERSHED SCIENCES

DROUGHT STRESS TESTS FOR WATER SUPPLY: RESIDENTIAL WELL IMPACTS AND ECONOMIC EXTERNALITIES

Robert M. Gailey, P.G., C.HG.

26th Annual Meeting
Groundwater Resources Association of California
Sacramento, California
October 3 and 4, 2017

DISCALIMER

This presentation addresses a groundwater management issue that has gained some notoriety

- Intent is to be balanced and neutral
- Focus is on known conditions and phenomena
- Exceptions to the characterizations presented likely exist
- Discussing the premises of this talk is welcome!

Outline

- Motivation for study
- Background
- Overview of technical approach
- Some details of the analysis
- Takeaway points

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  - Identify issues
  - Include stakeholder groups
  - Balance interests
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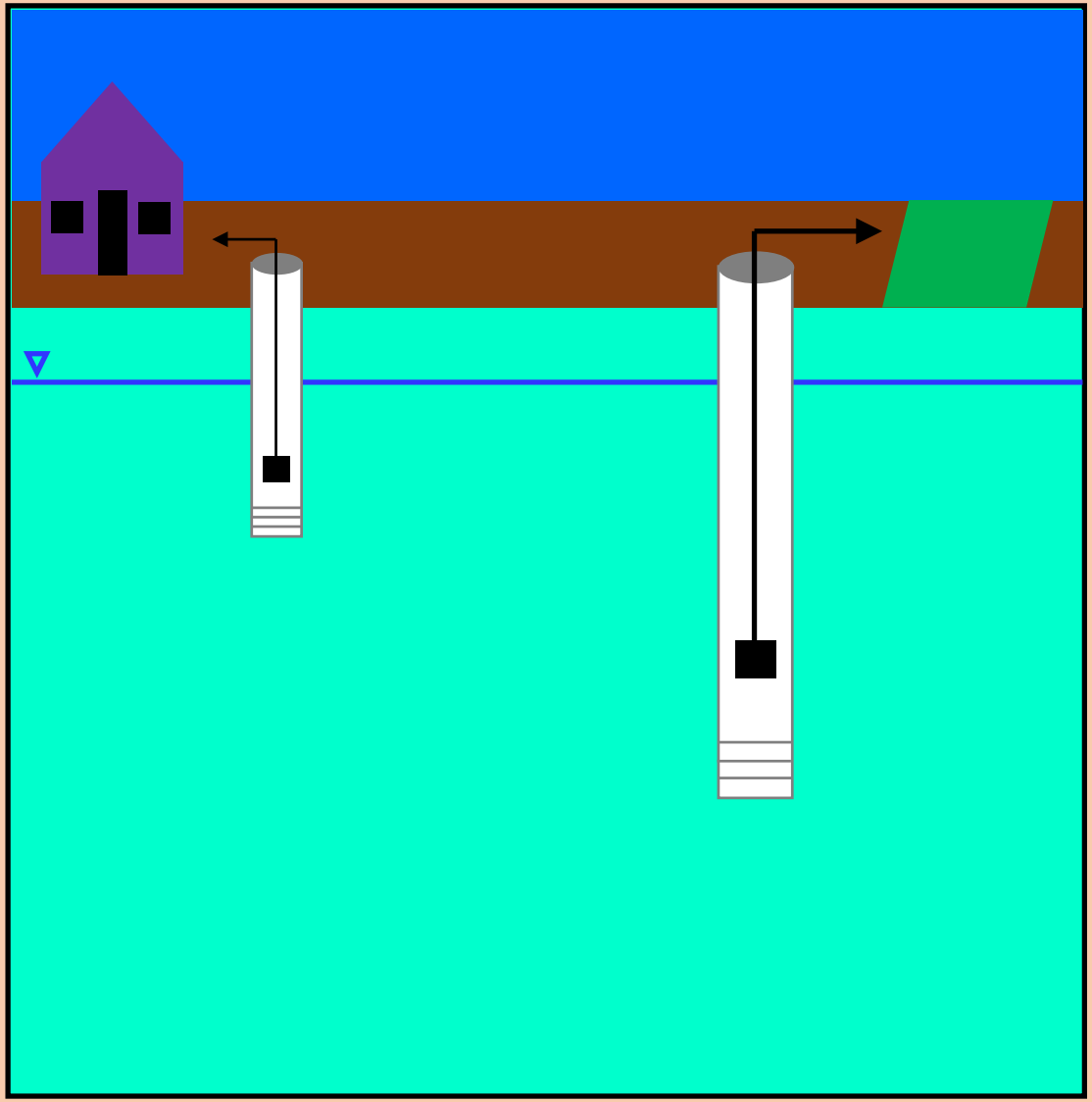
- Example: Increasing pumping during drought (surface water shortfalls)
- Stakeholders
  - Residential well owners
  - Agricultural operations (farmers and corporations)

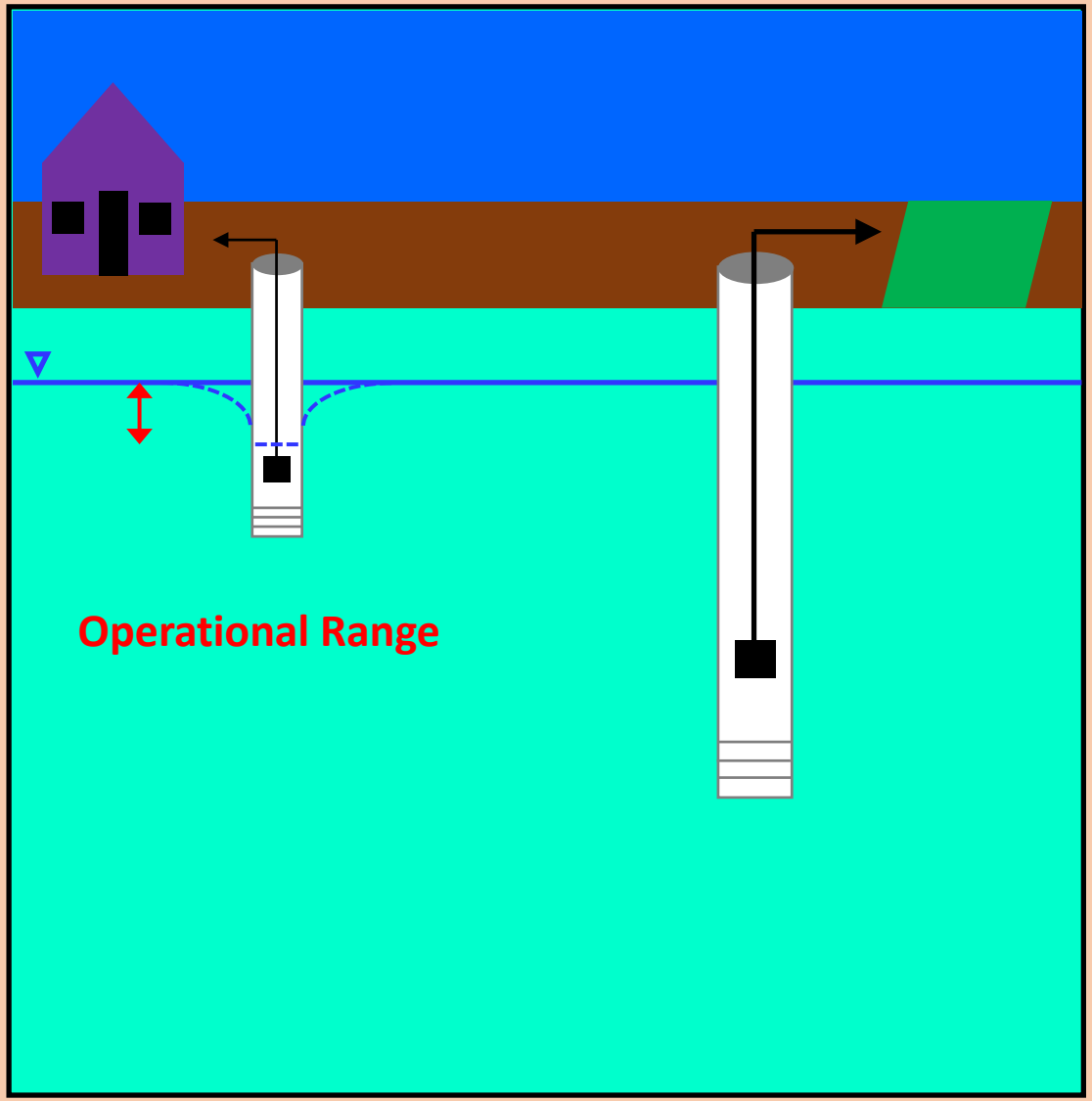
Motivation

- Potential differences in interests



Motivation

- Potential differences in interests
  - Residential well owners
    - Wells often sole source of supply
    - Fairly shallow pumps and screens
    - Water level declines reduce supply
    - Low financial ability to remediate



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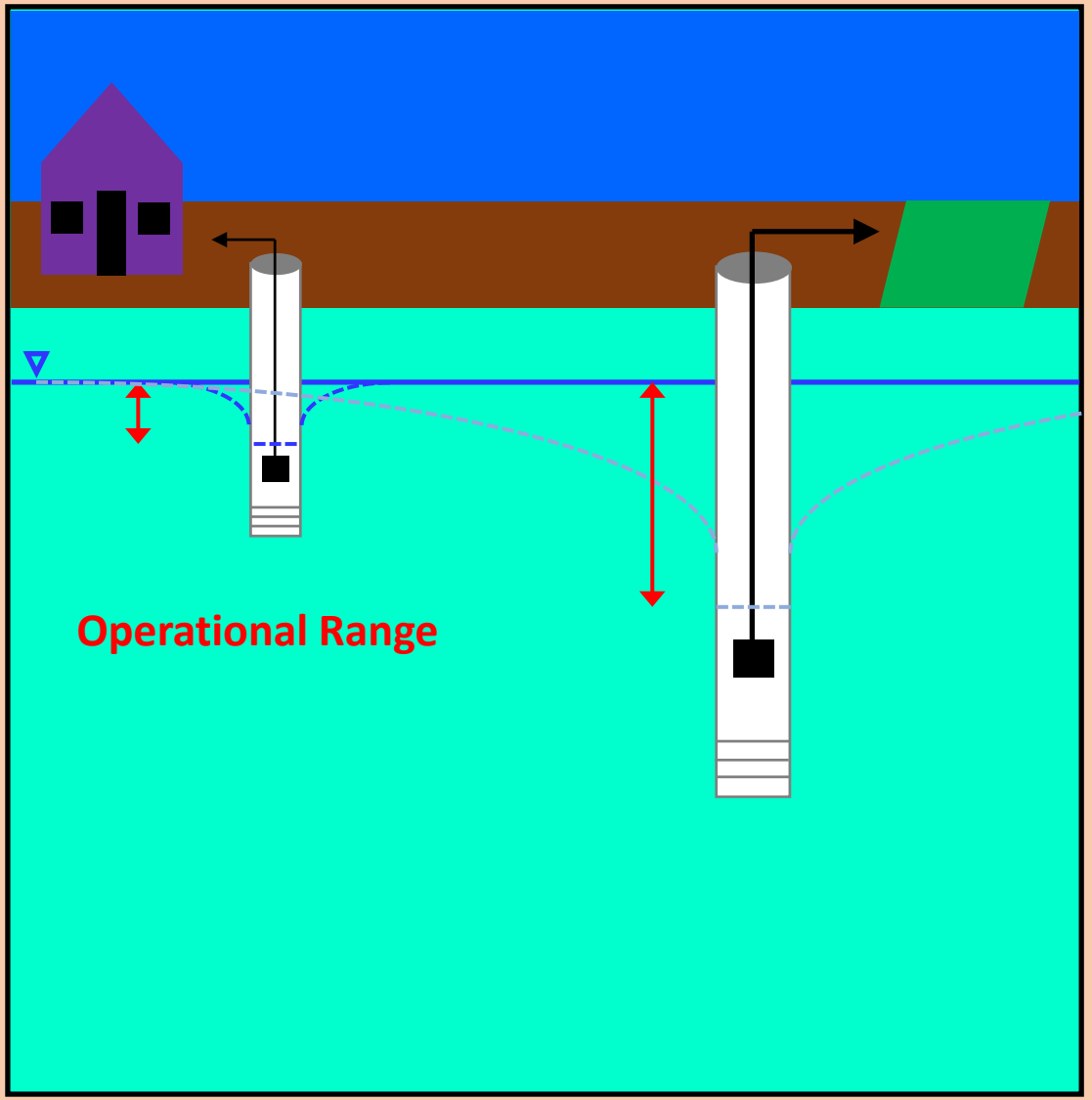
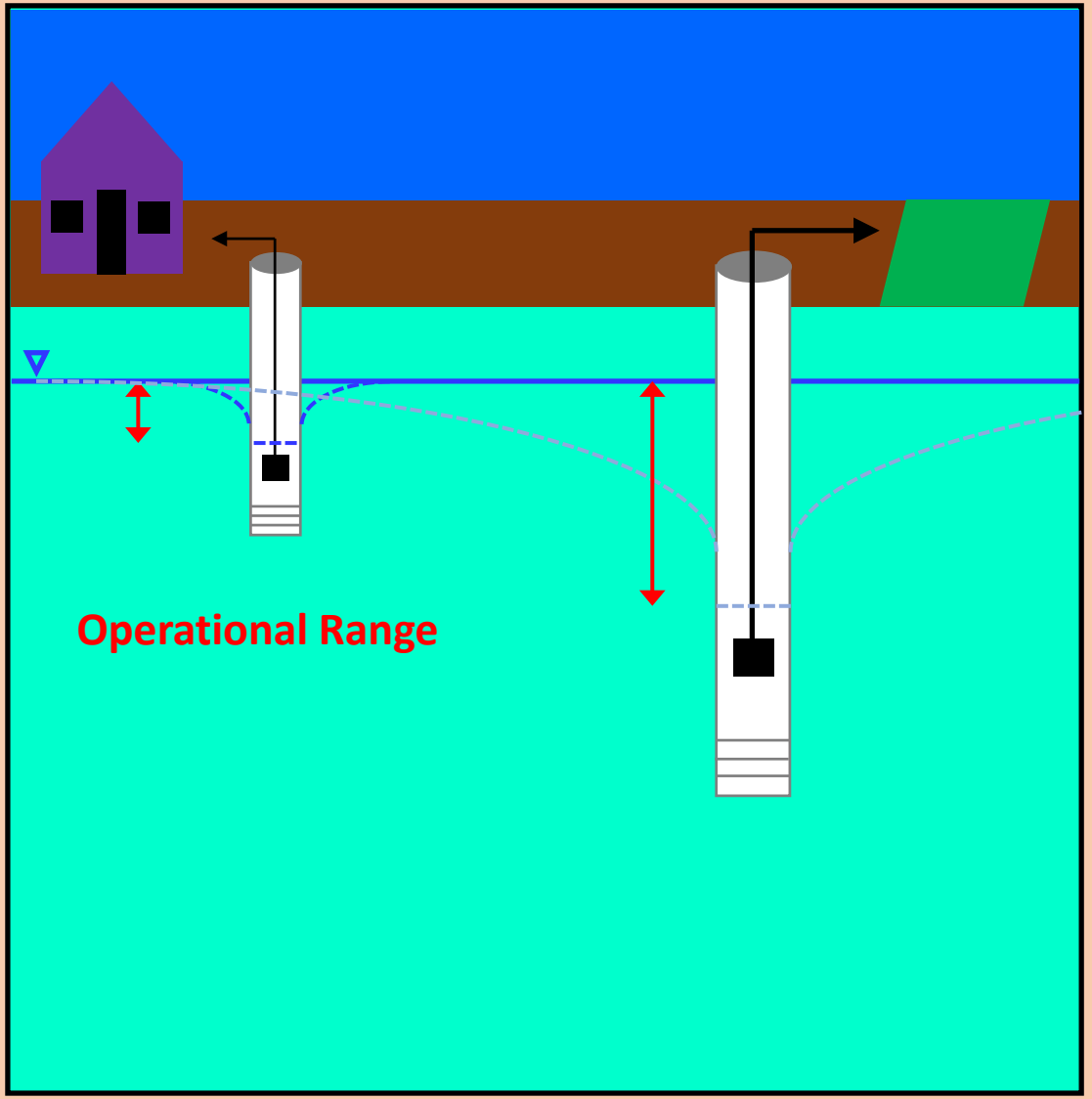
  - Residential well owners
    - Wells often sole source of supply
    - Fairly shallow pumps and screens
    - Water level declines reduce supply
    - Low financial ability to remediate
  - Agricultural operations
    - Wells often backstop SW supplies
    - Usually deeper pumps and screens
    - Less sensitive to water level declines
    - Often higher financial ability to remediate
    - Potential impact to residential supplies



Motivation

- Possible approach for path forward



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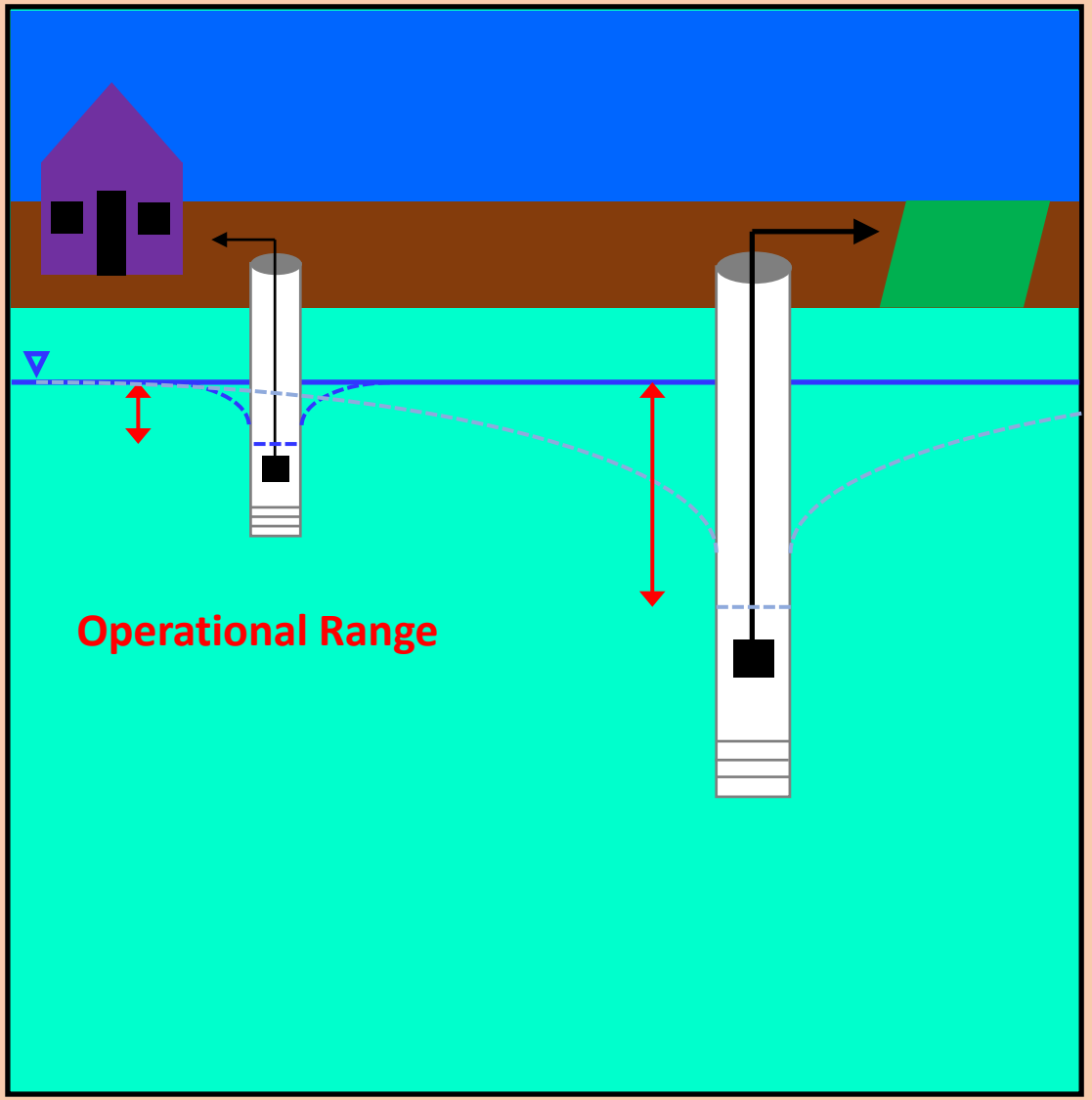
- Possible approach for path forward
  - Evaluate likely effect of management policy options on groundwater levels and supplies (simulated stress test)



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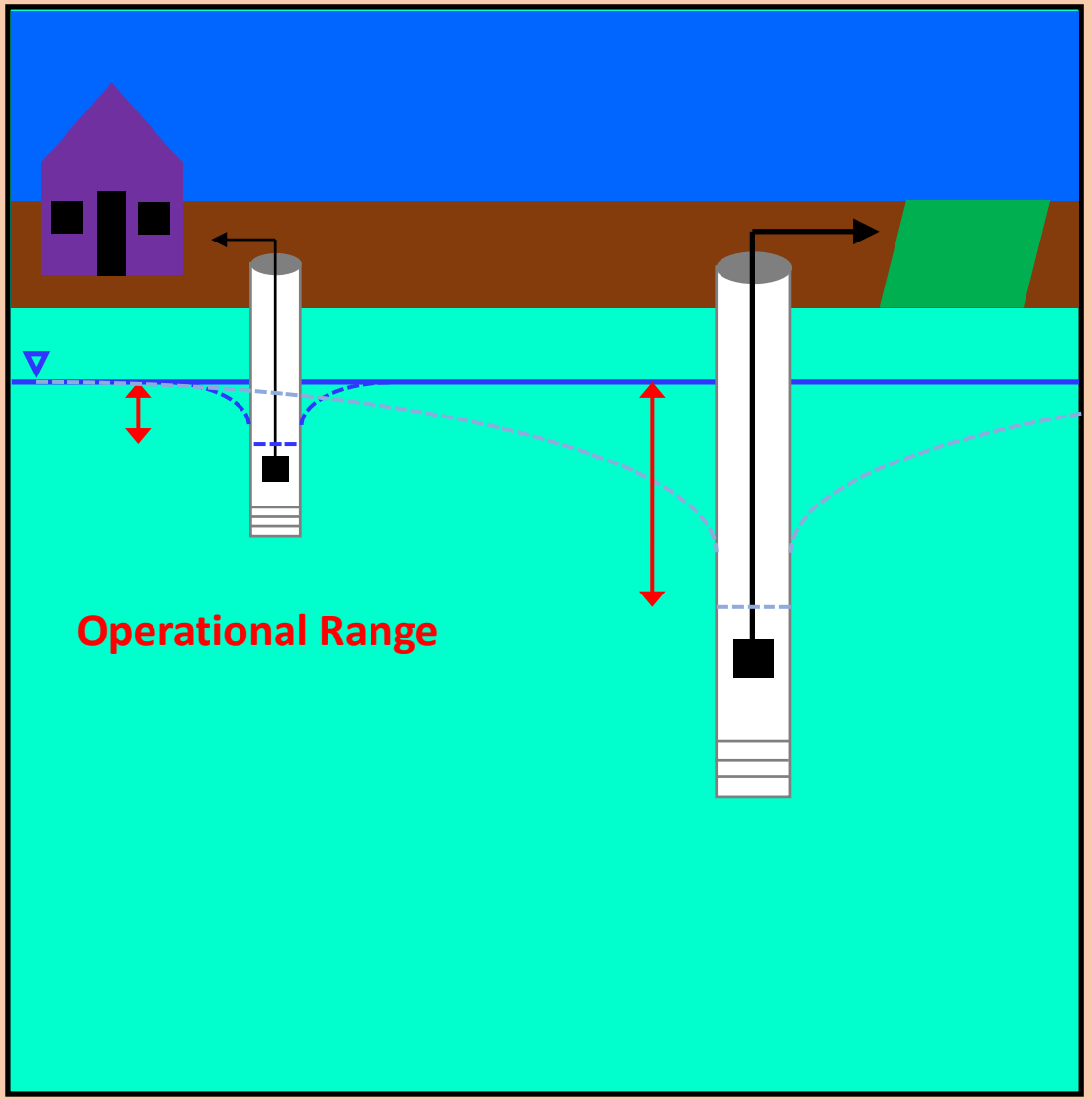

Motivation

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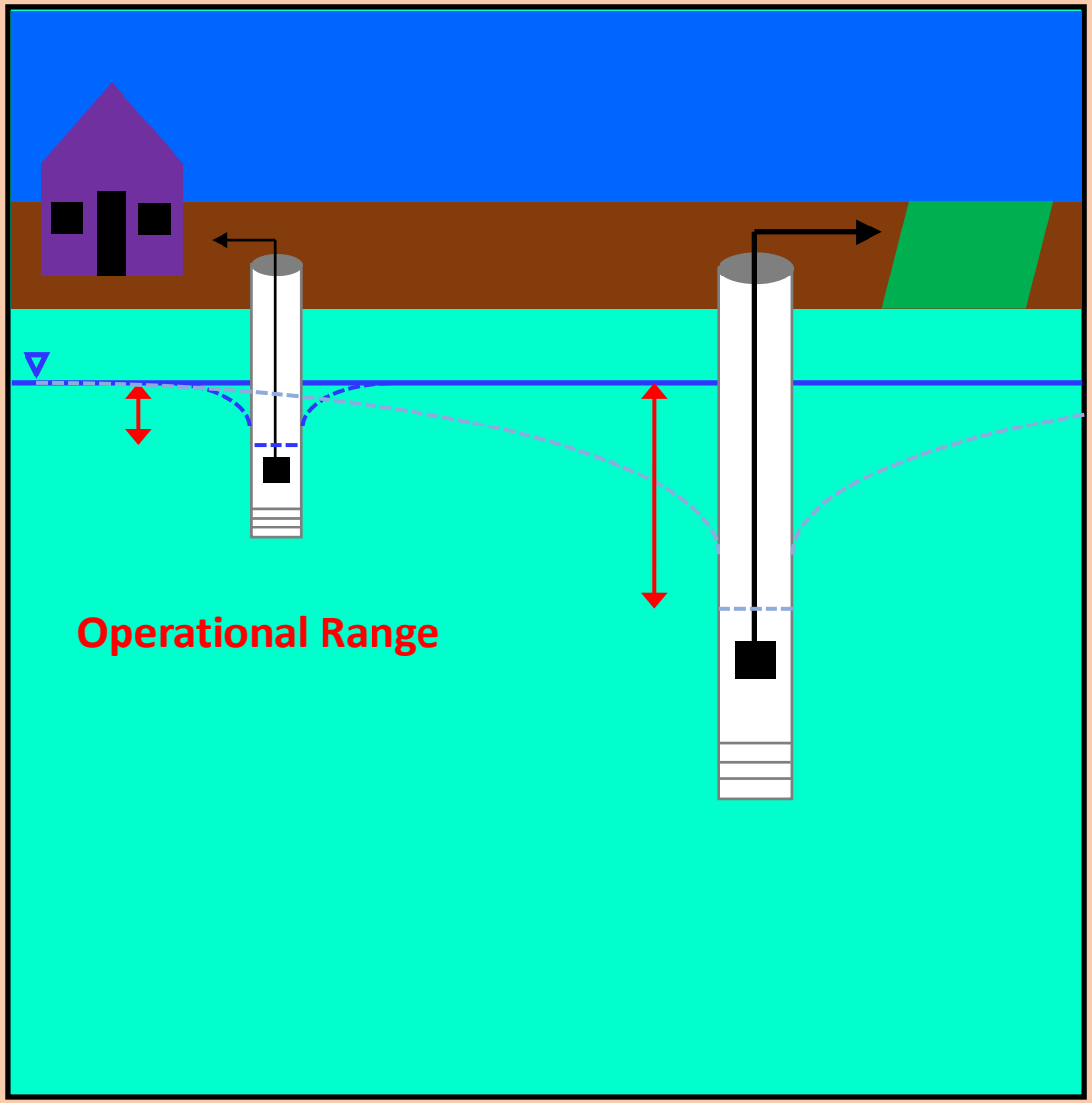
  - Evaluate likely effect of management policy options on groundwater levels and supplies (simulated stress test)
  - Estimate remediation cost to residential well owners
  - Create means to address economic externality borne by residential well owners



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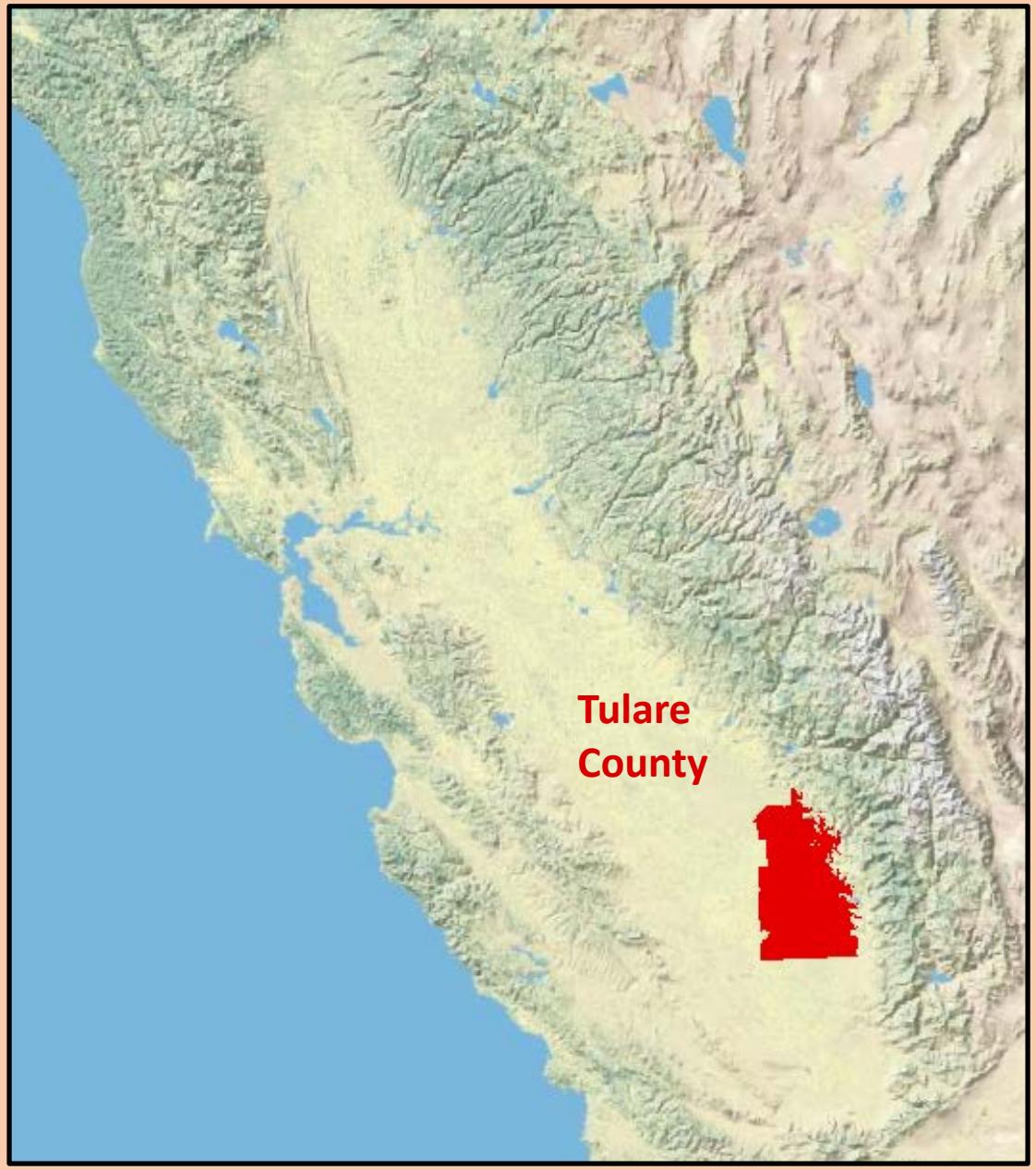
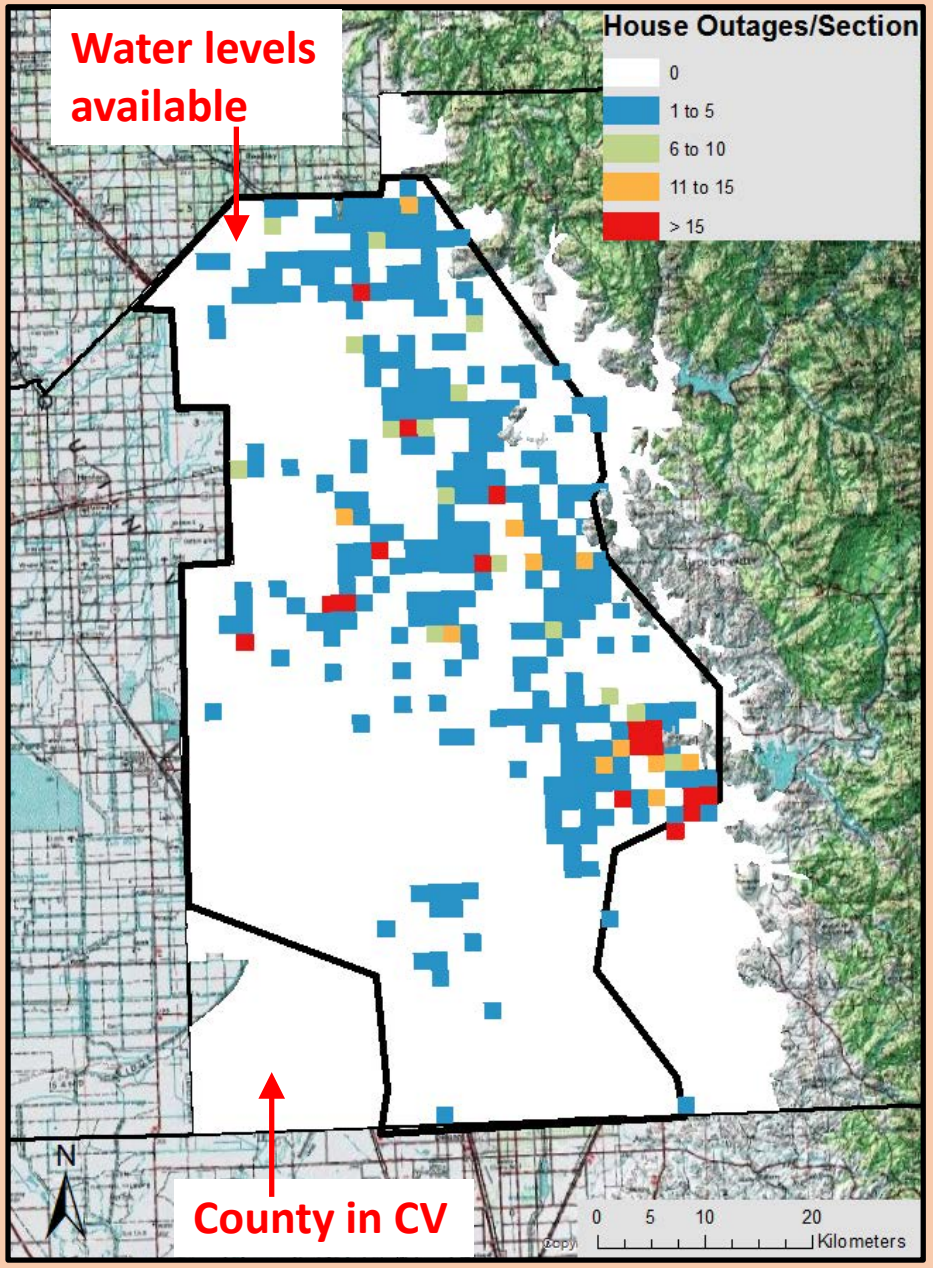
  - Many disadvantaged communities
  - Also prevalence of poor water quality (nitrate and arsenic)
- Tulare County has best data on occurrence in the Central Valley



Background

- Cumulative residential groundwater services outages during drought



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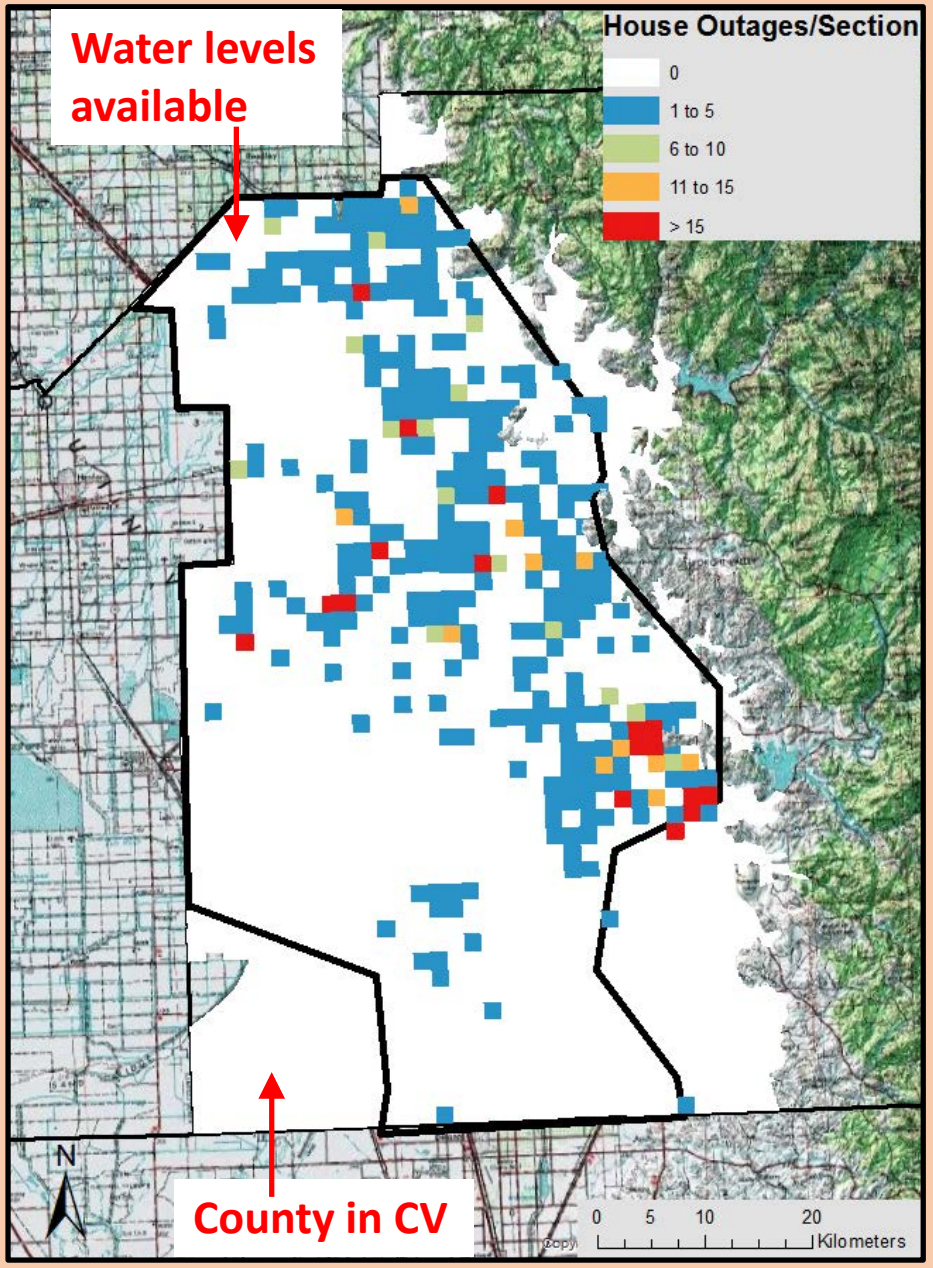

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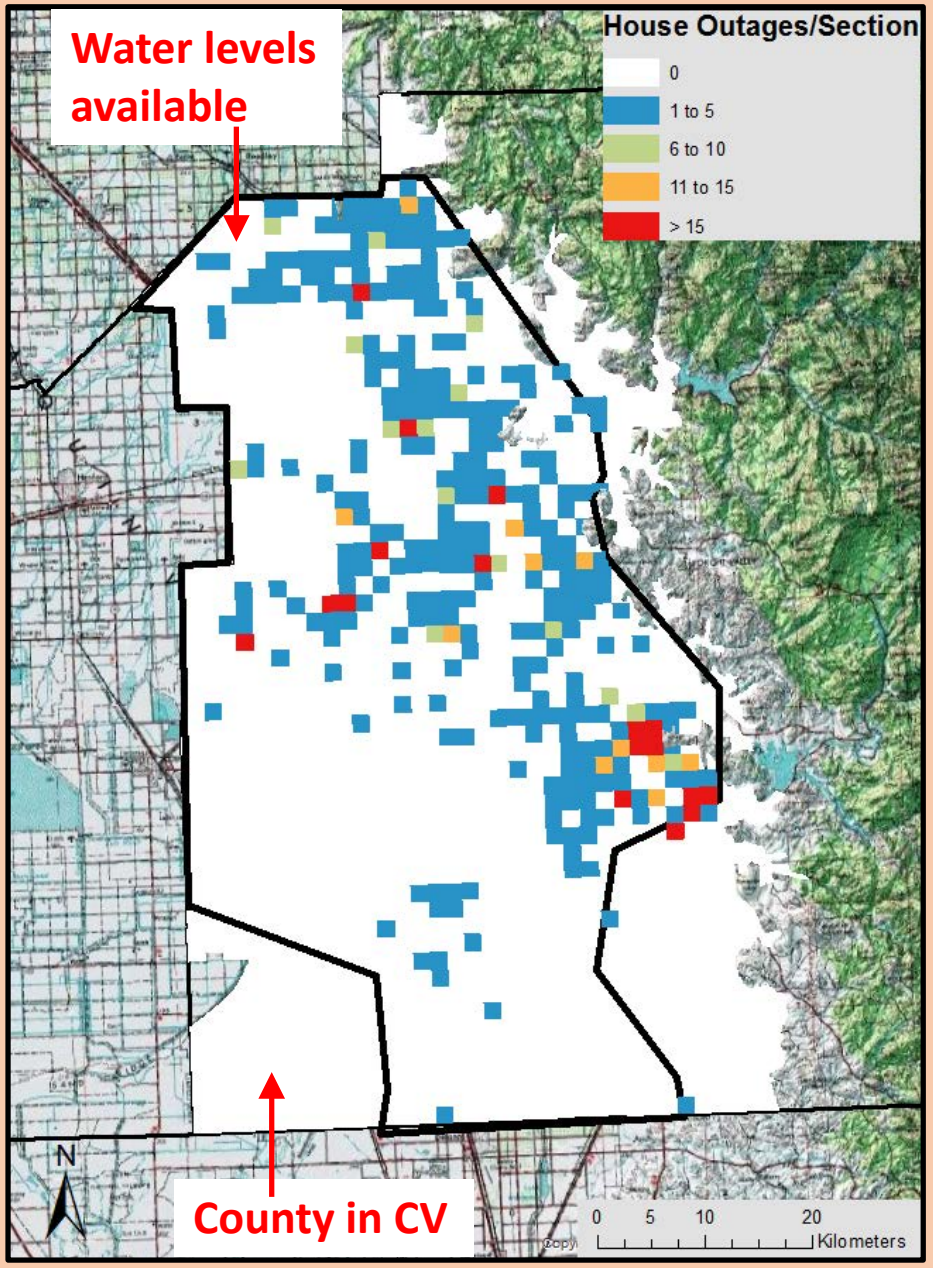

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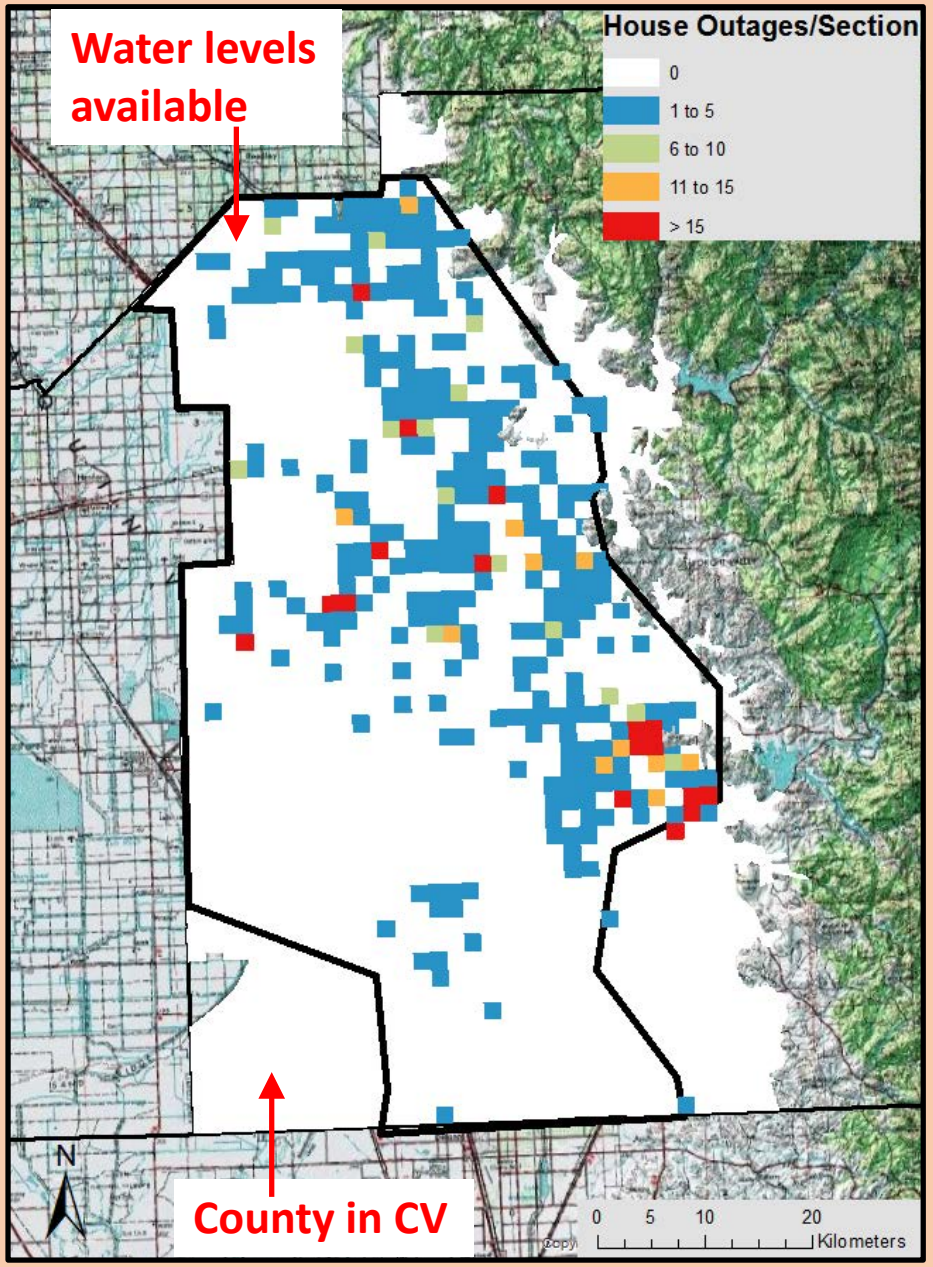
- Under-reporting of outages expected stemming from undocumented immigrant considerations



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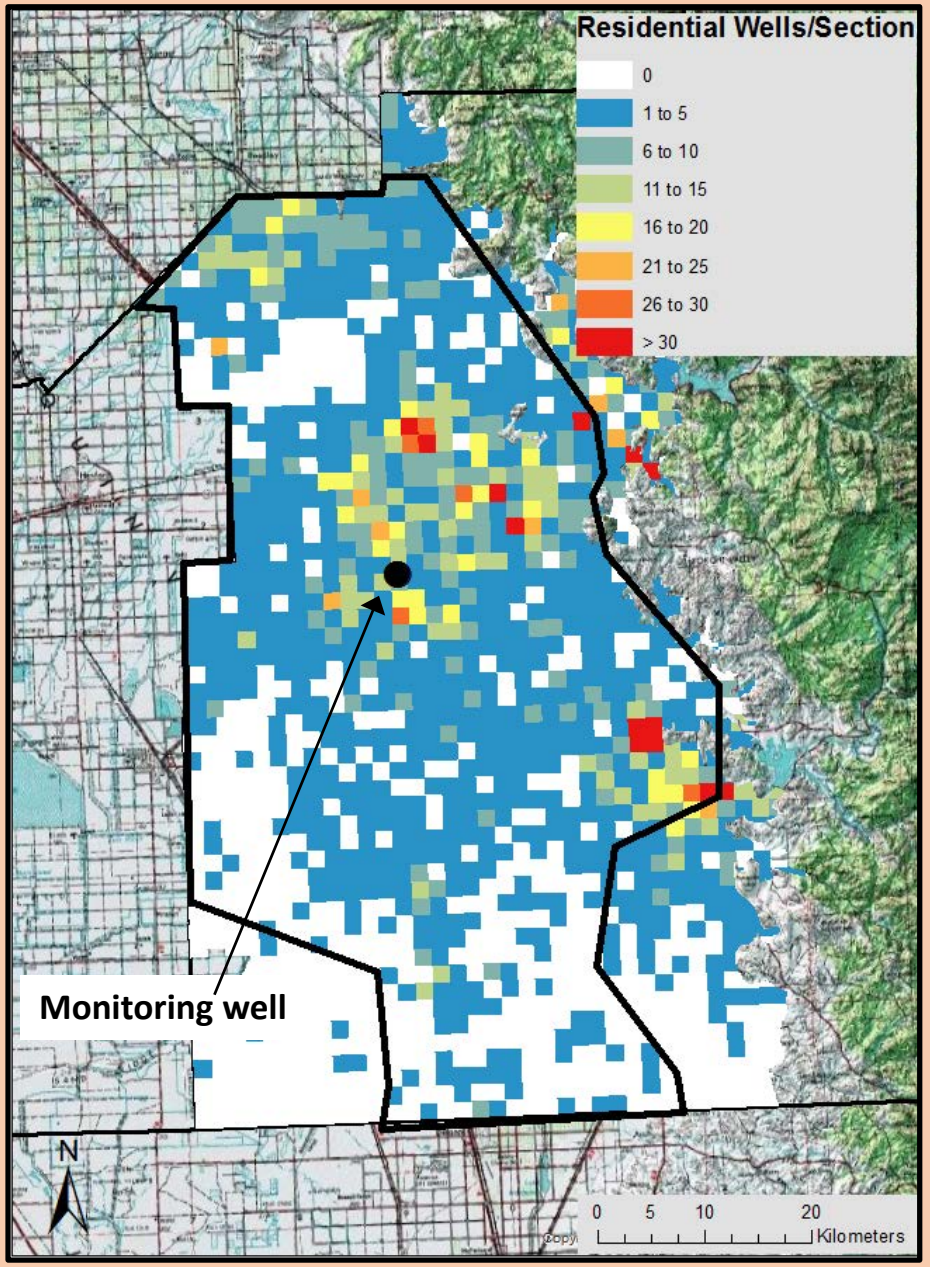
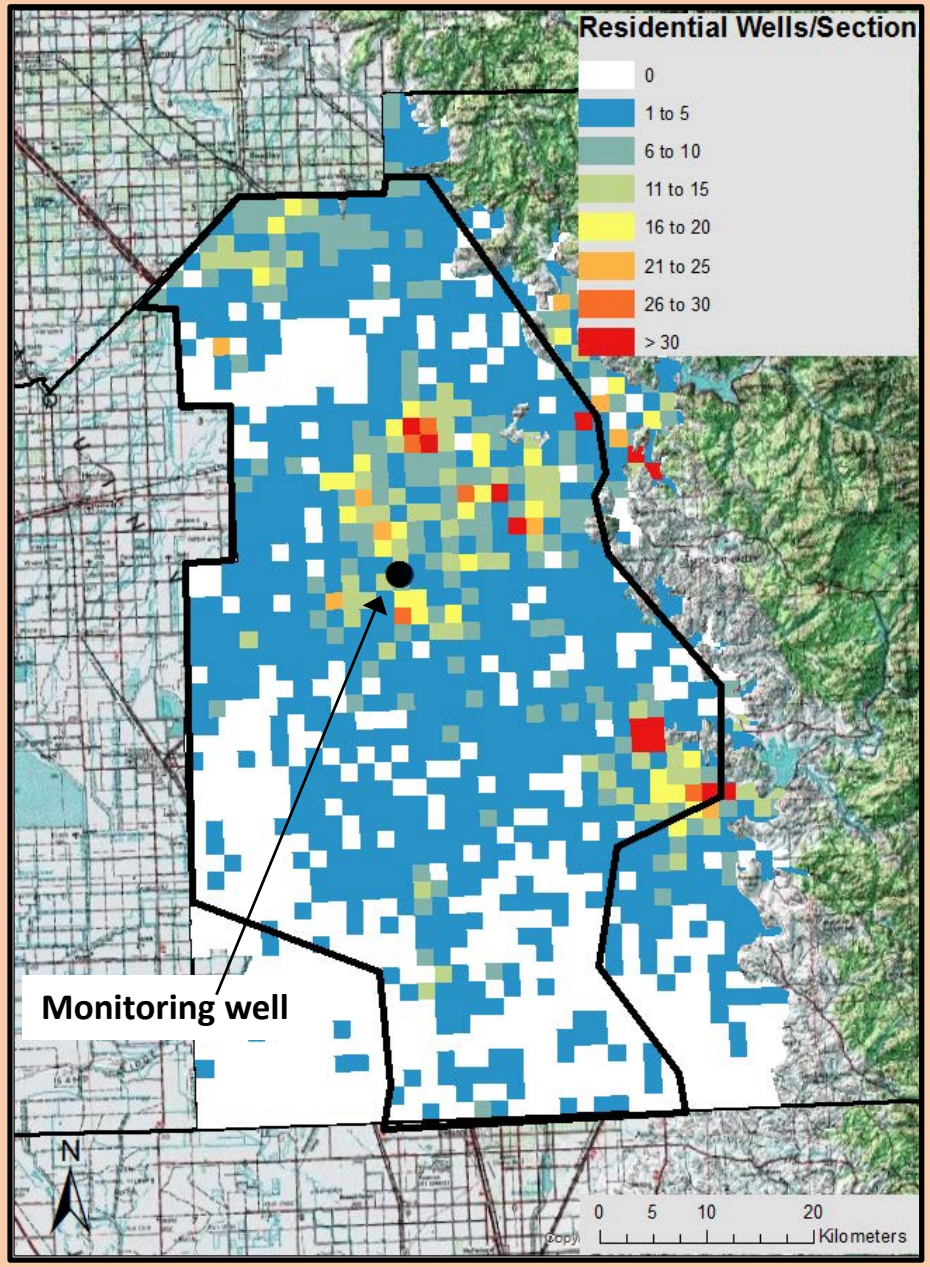
Technical Approach

- Well counts by Public Land Survey System section (1 mi^2)



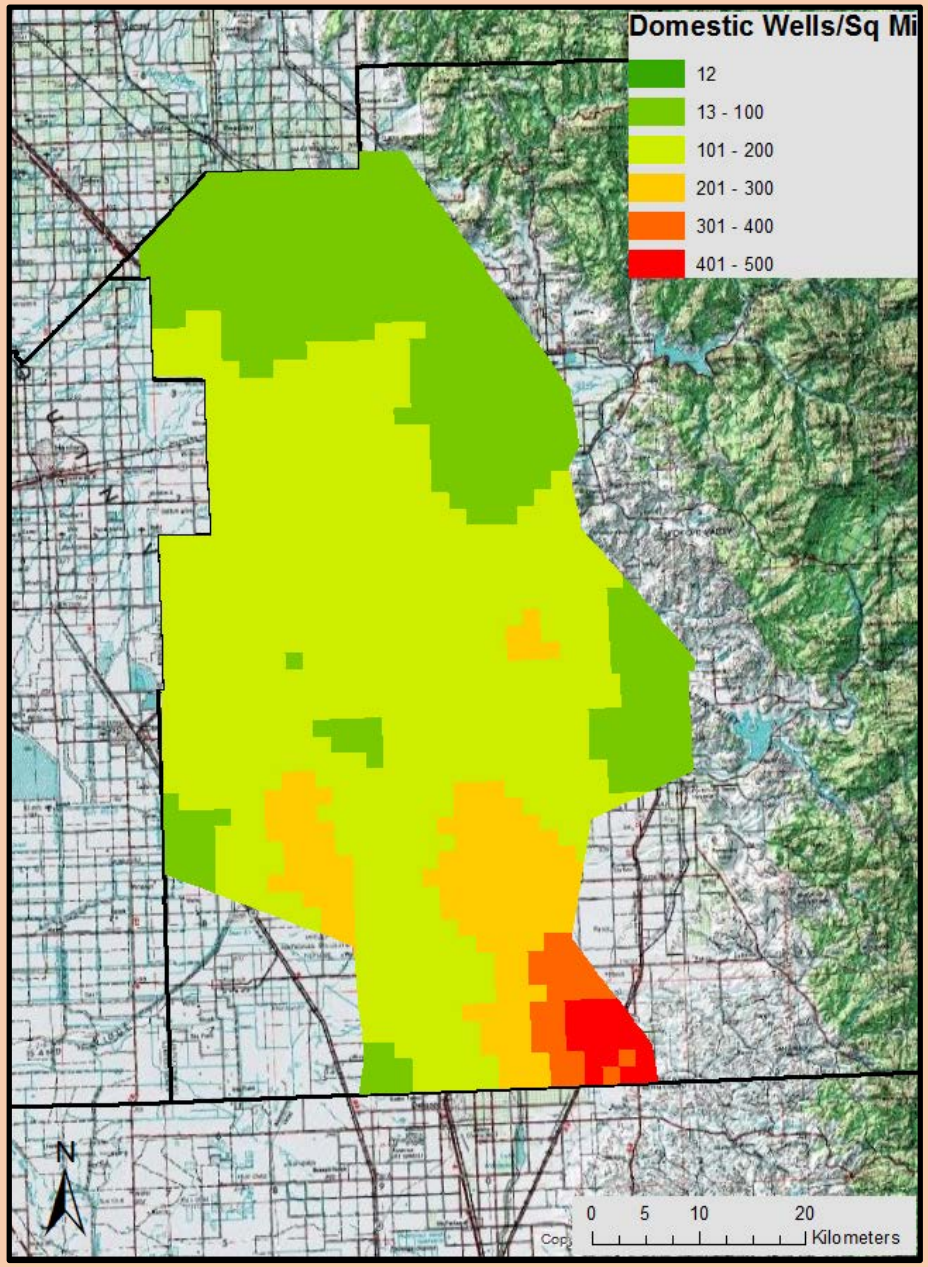
Technical Approach

- Well counts by Public Land Survey System section (1 mi^2)
- Individual construction details by PLSS section include
  - Well depth
  - Screened interval



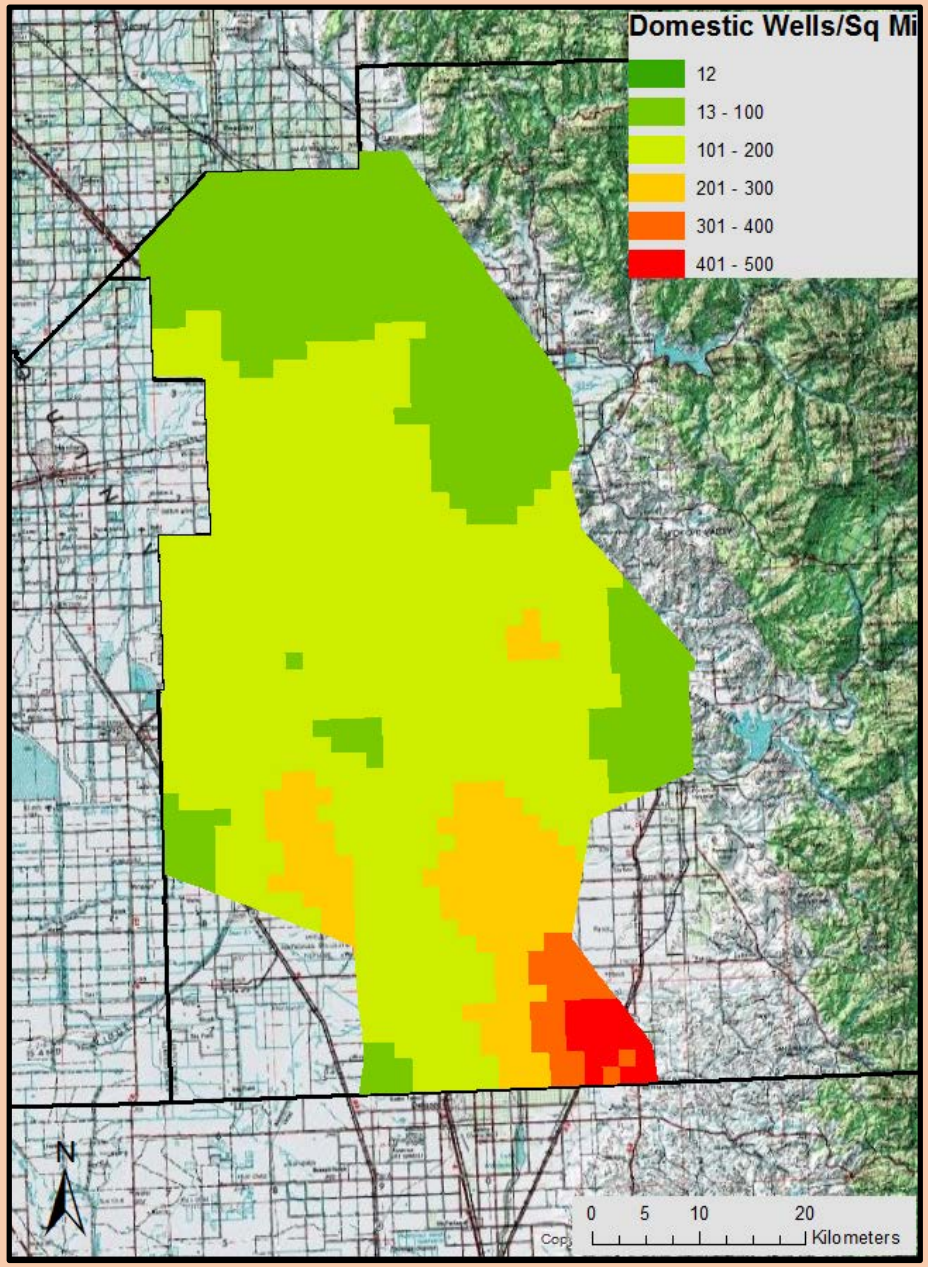
Technical Approach

- Depth to groundwater
  - Derived from DWR contours
  - Seasonal data over drought period
  - Individual values derived for each PLSS section



Technical Approach

- Depth to groundwater
  - Derived from DWR contours
  - Seasonal data over drought period
  - Individual values derived for each PLSS section
- Evaluate effects of water level decline (Fall 2011 to Fall 2016)
  - Pump cavitation
  - Well screen clogging
  - Well going dry
  - Remediation costs



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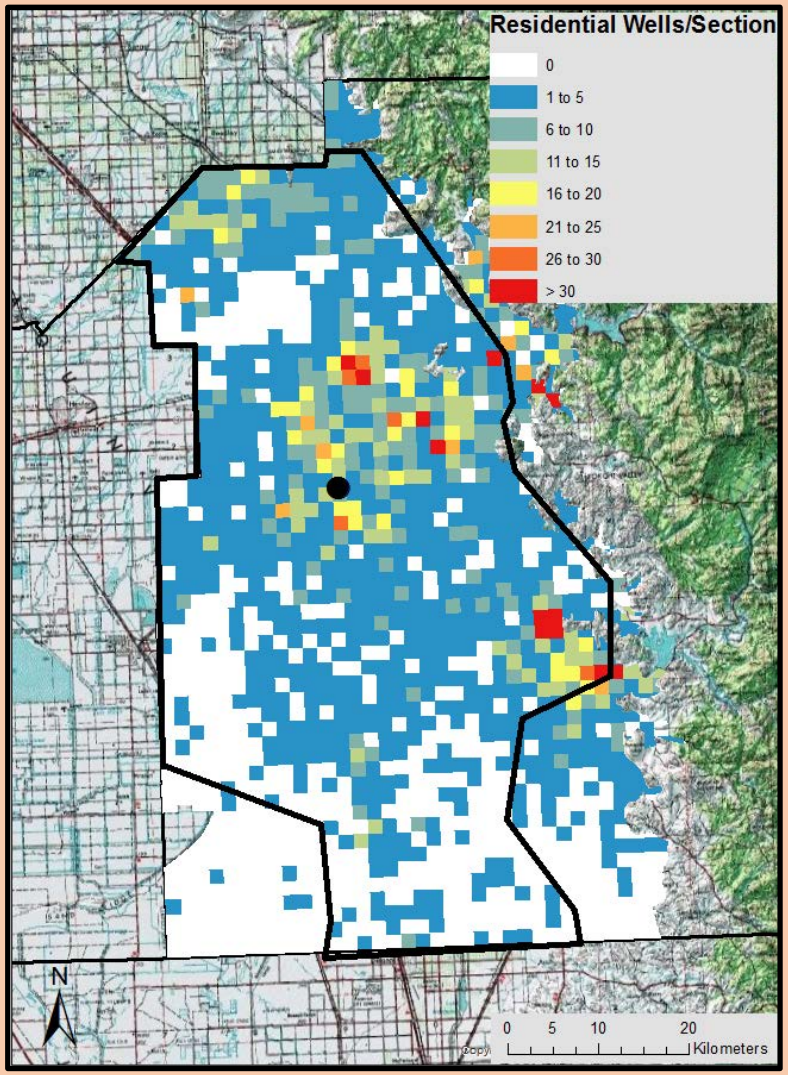

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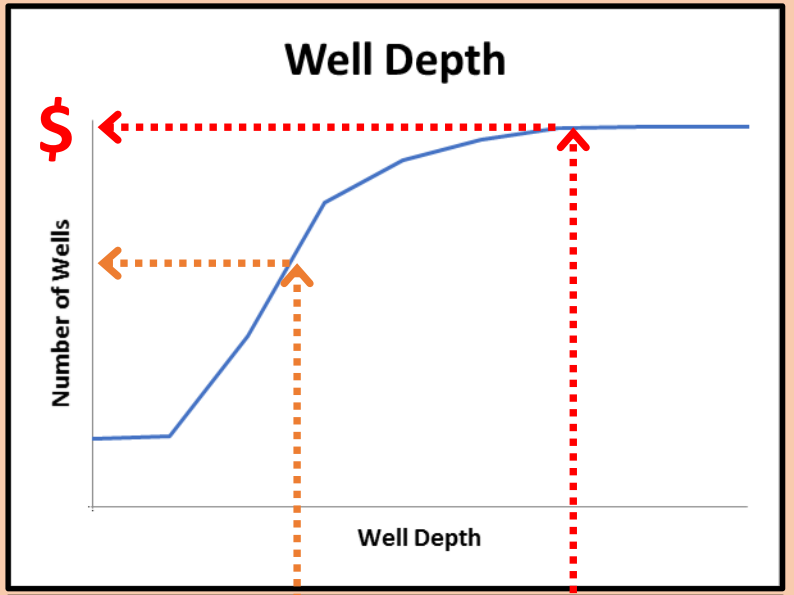

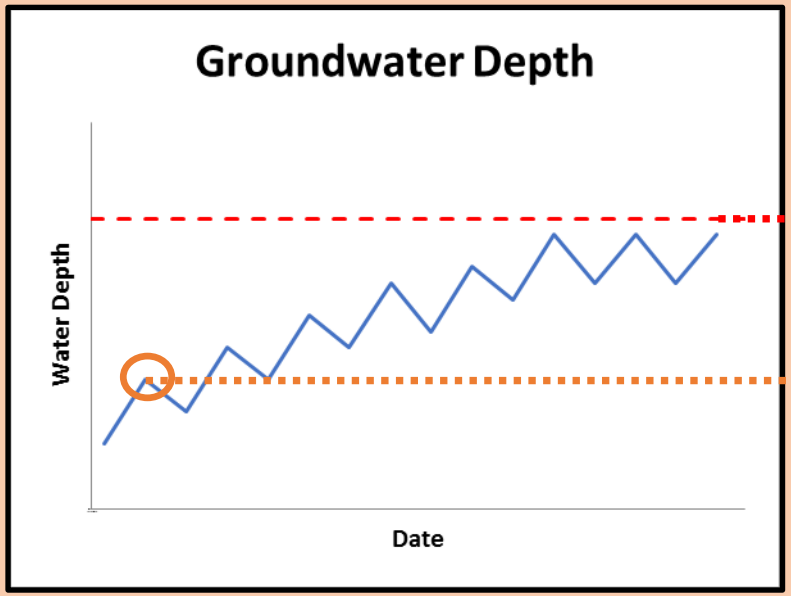

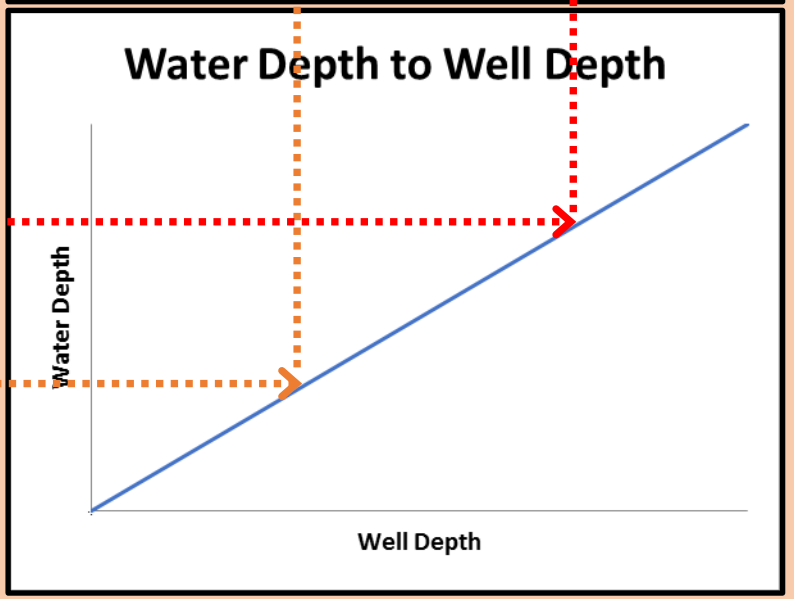

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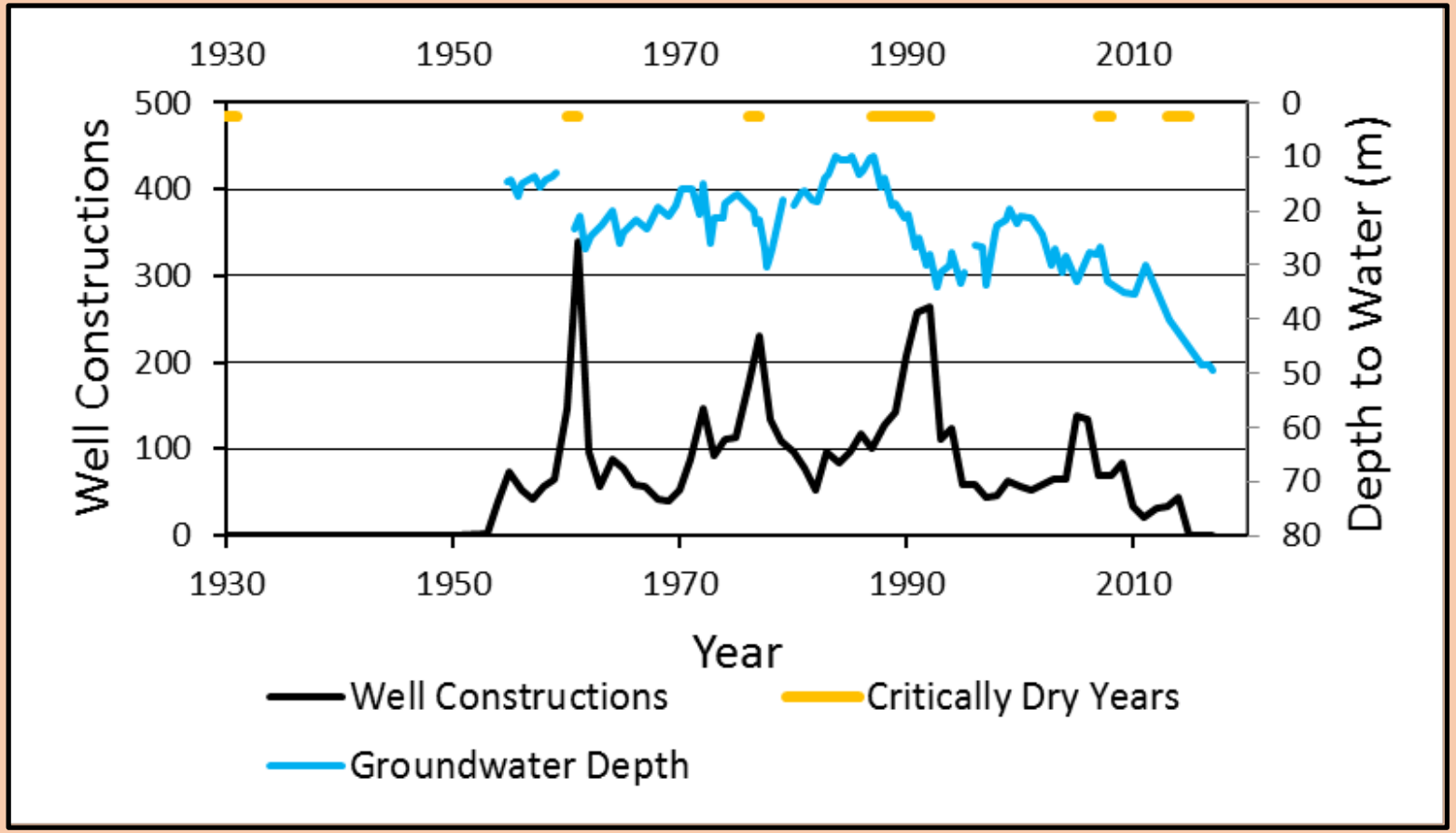
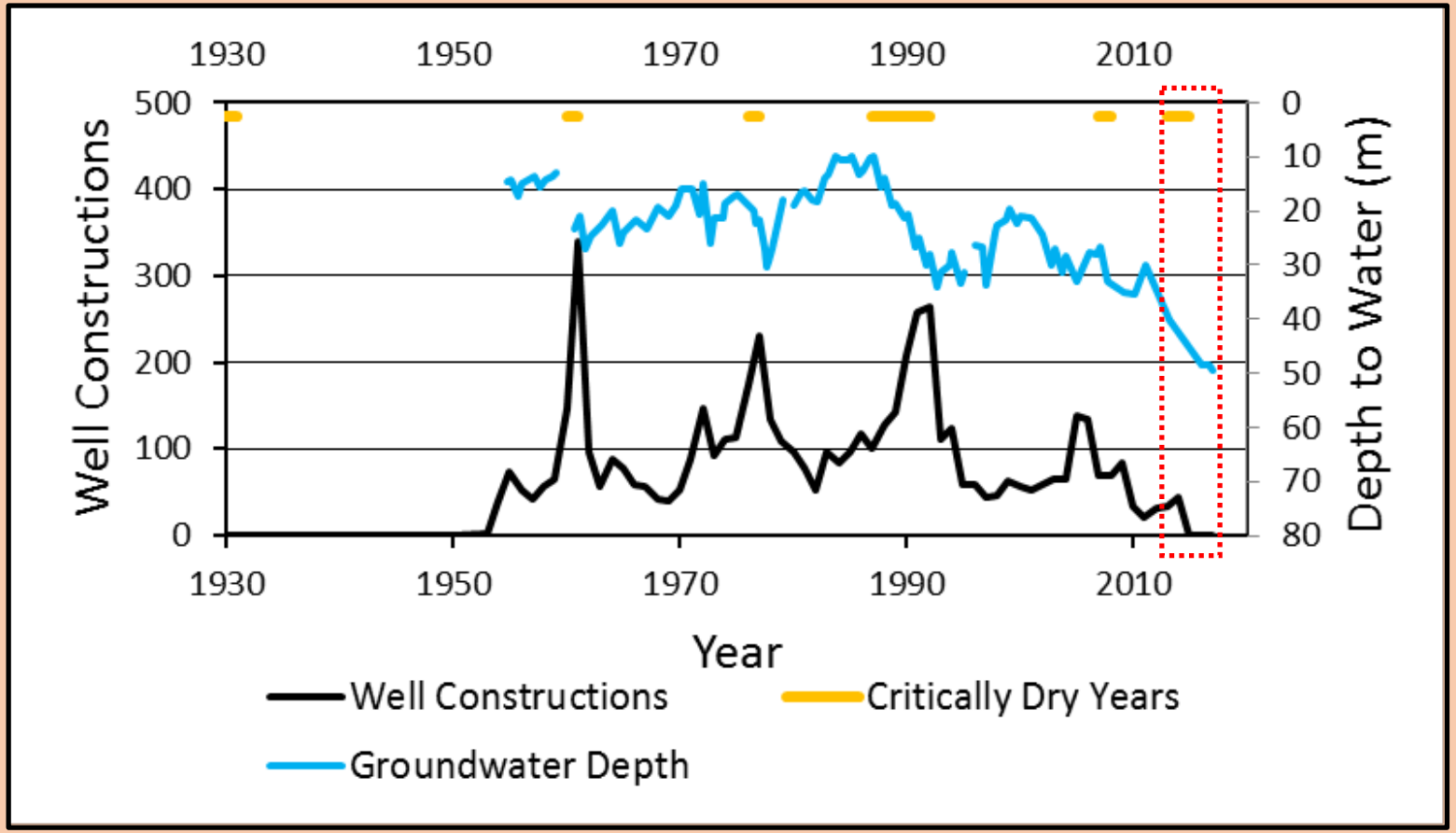


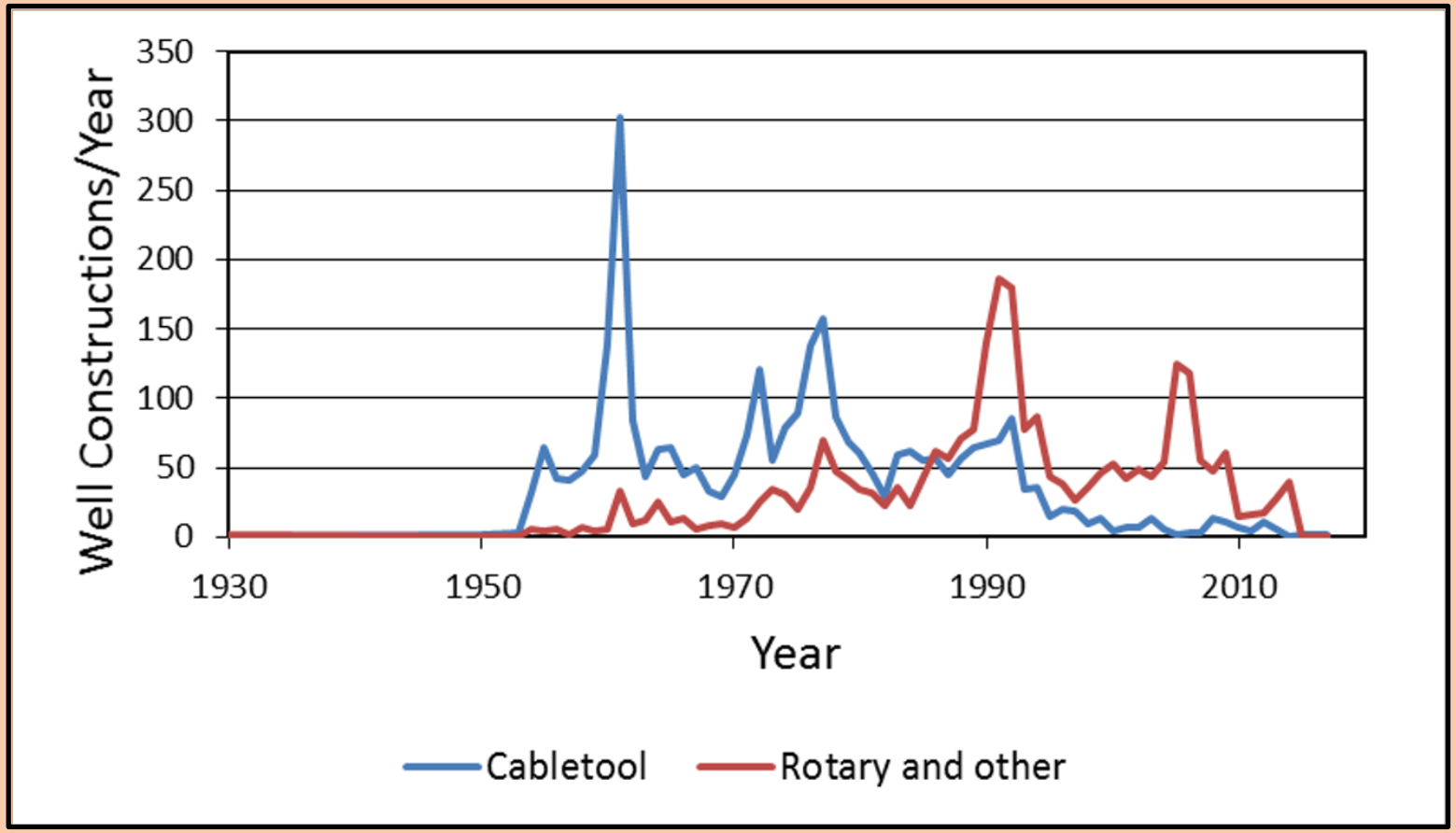
Some Details

- Well construction activity has generally correlated with drought
- Exception is recent drought
  - Related to agricultural demand for new wells?
  - Implications for forward planning?



Some Details

- Well construction technology changes as expected
- Provides some confidence in the data



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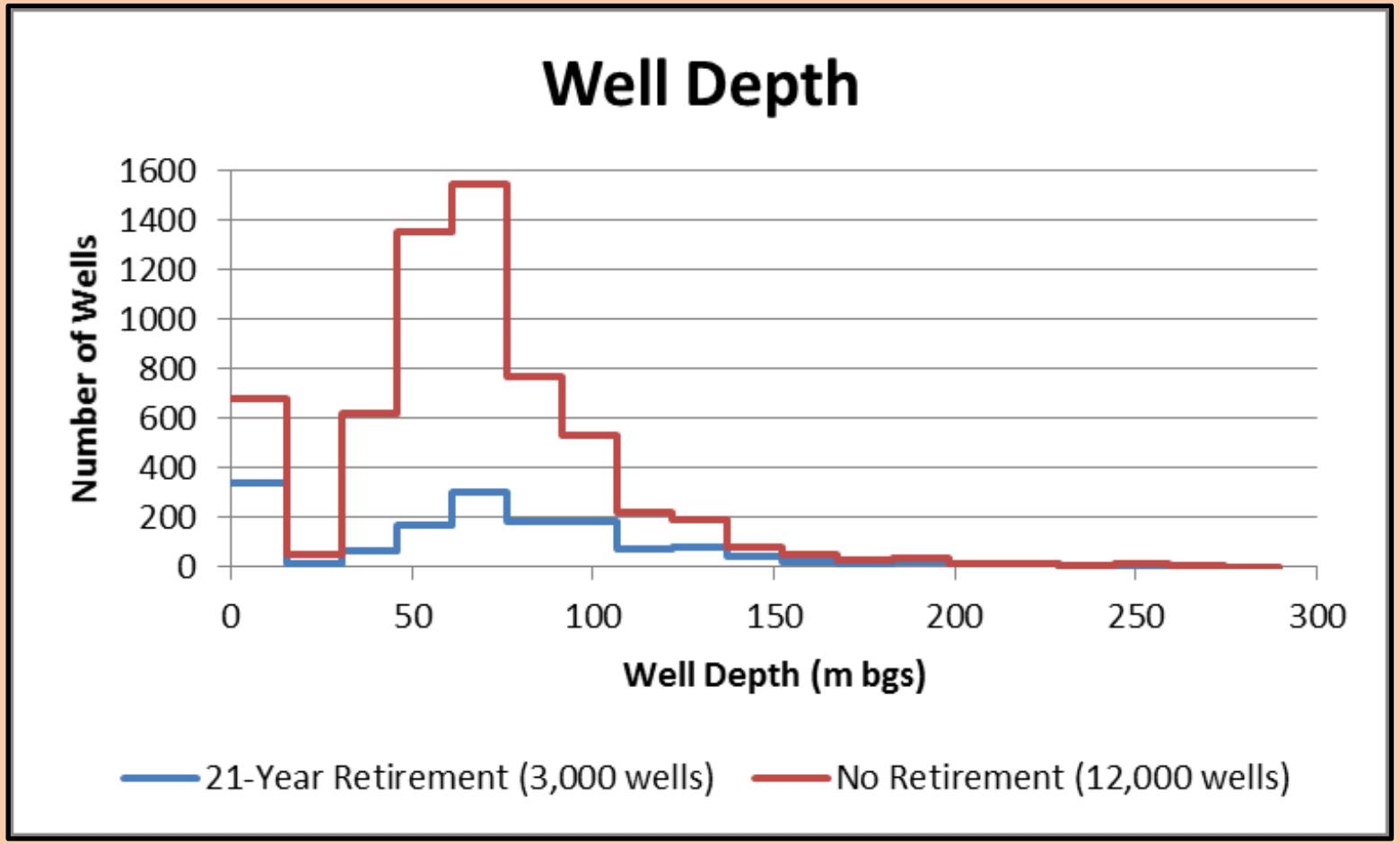

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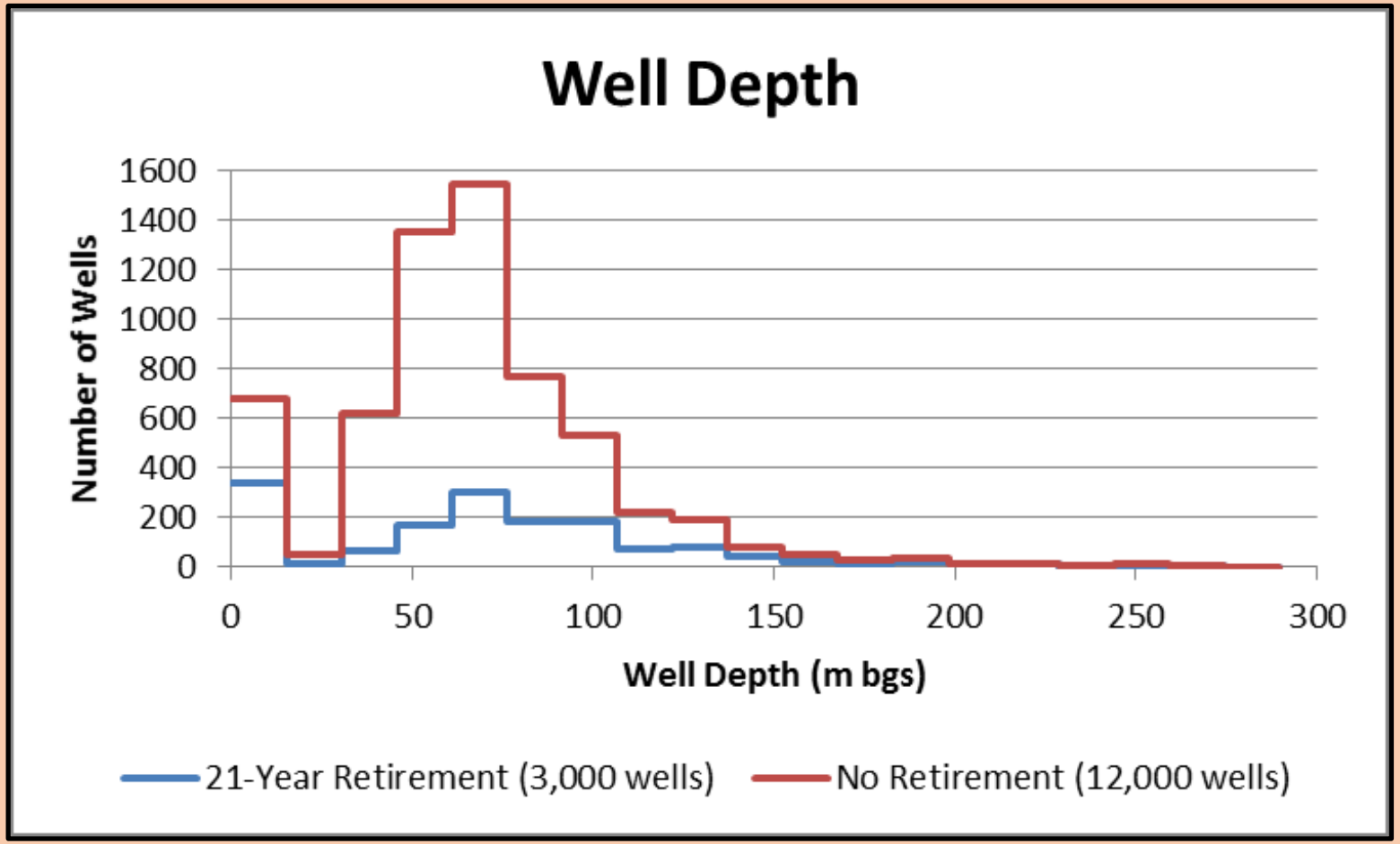

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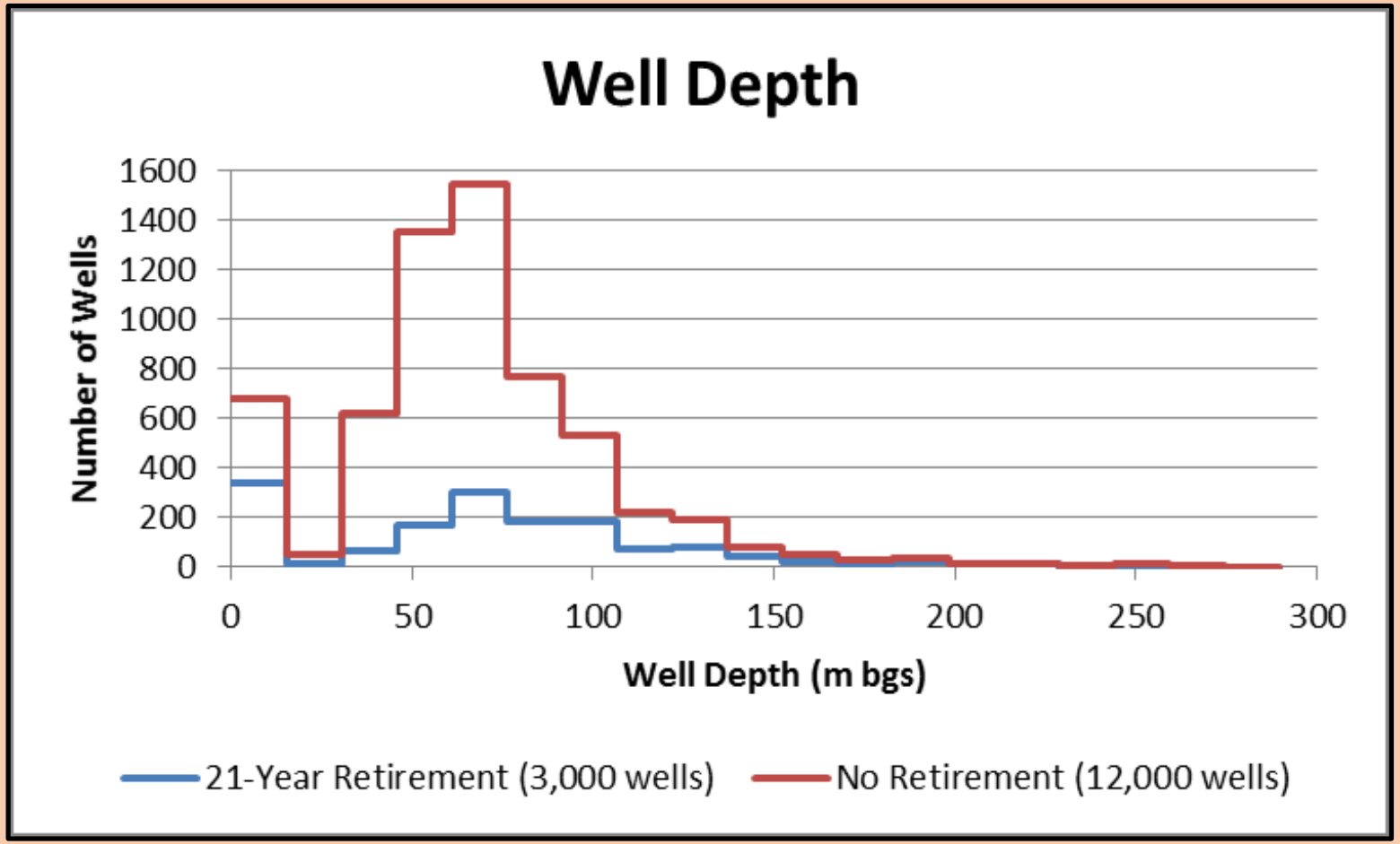

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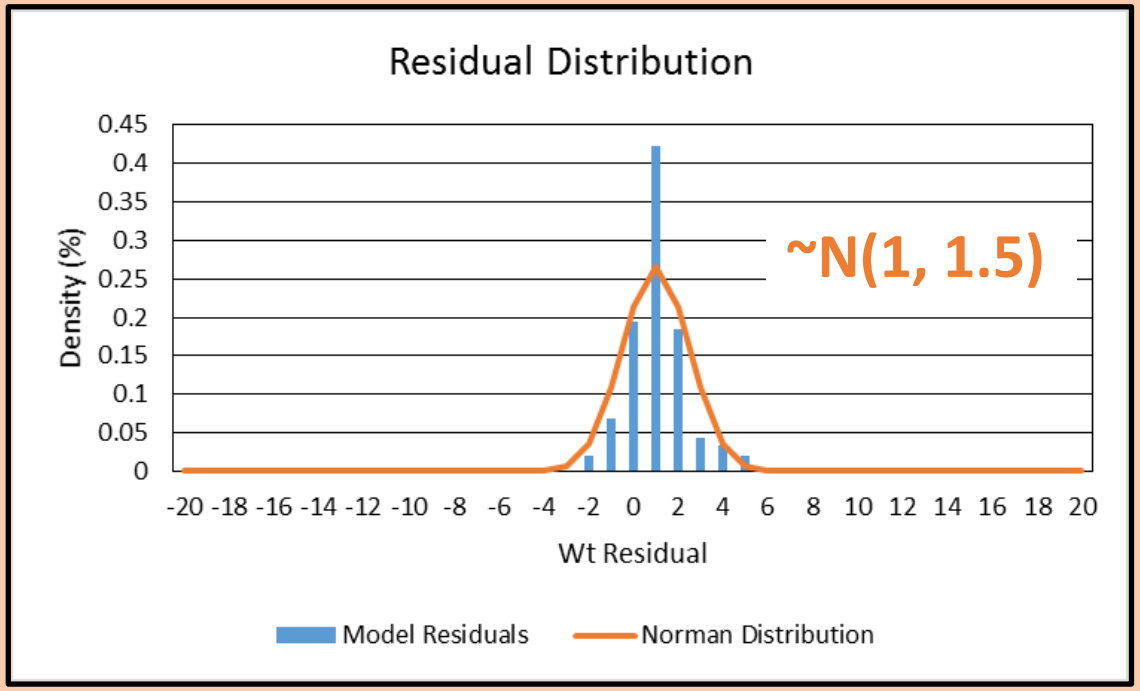
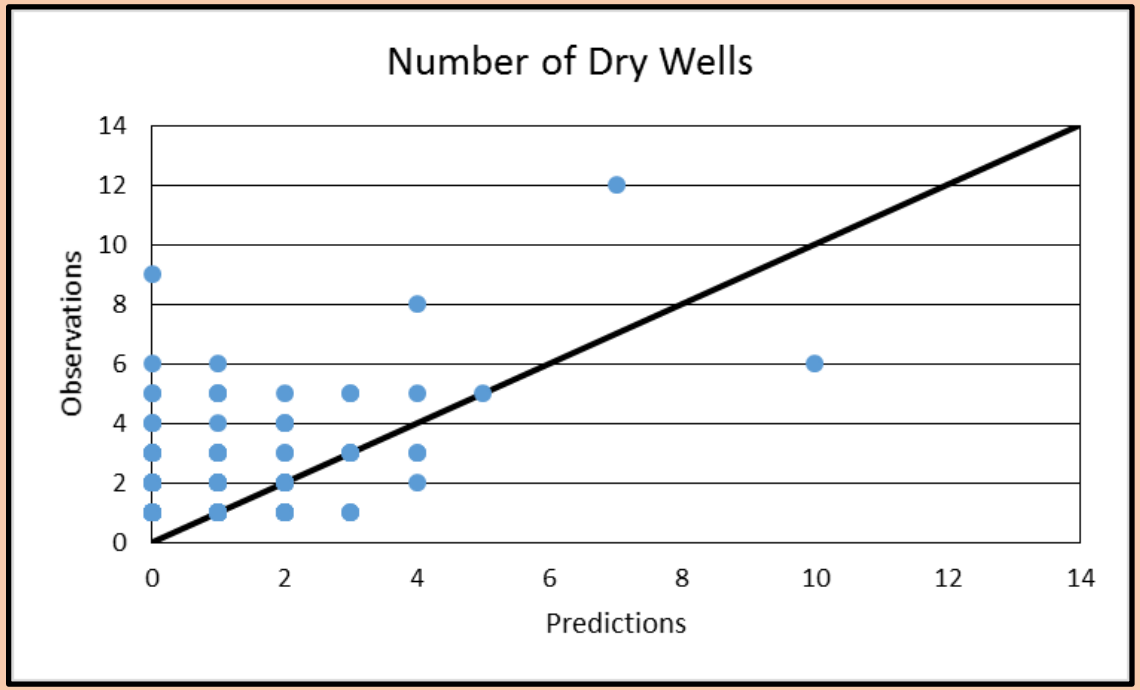
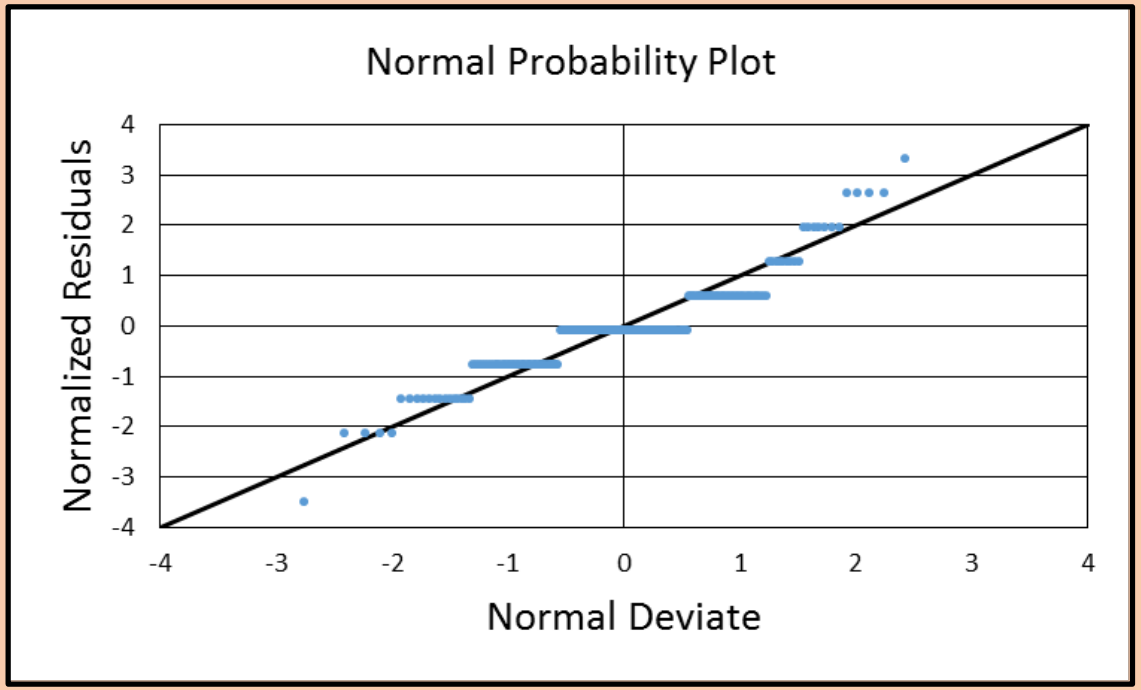
Calibration challenges

- Well inventory outputs integers
- Observation under-reporting and conversion from houses to wells

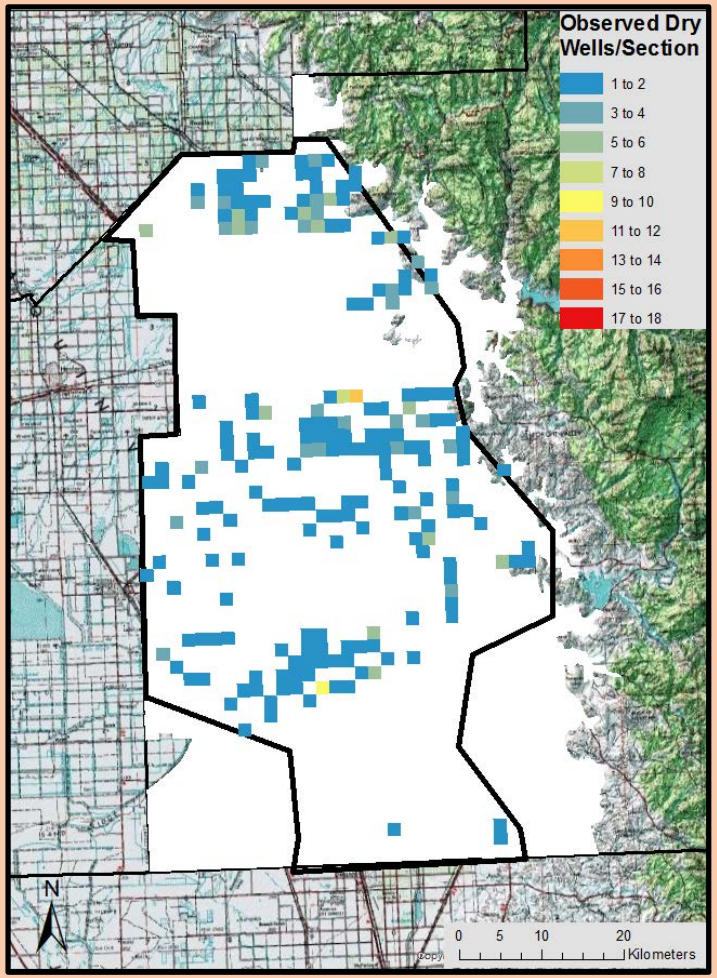




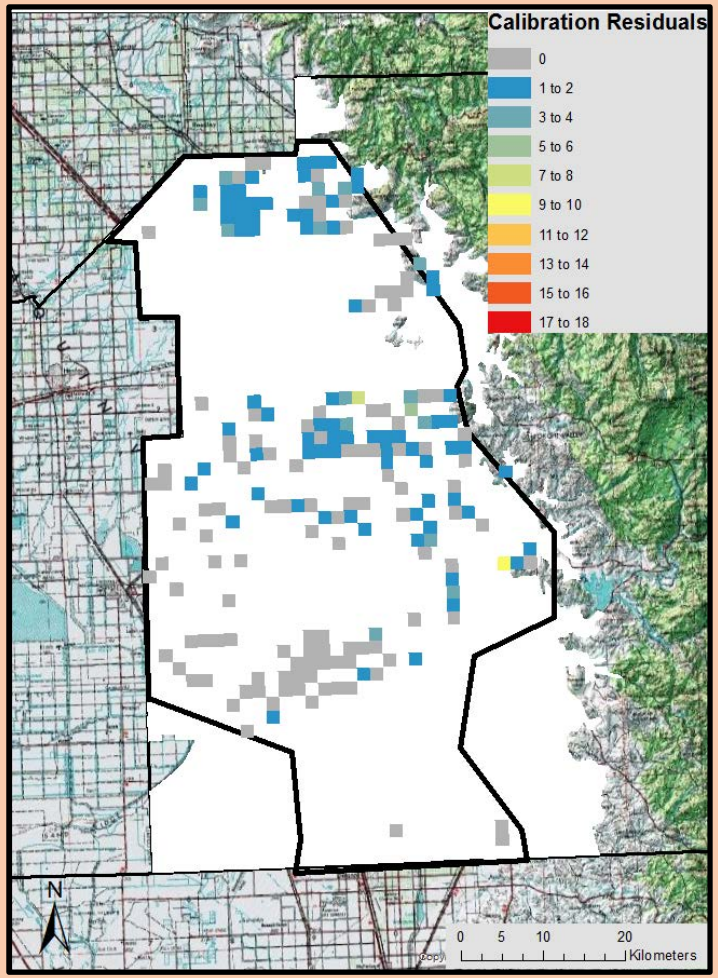


Some Details

Observations



Predictions



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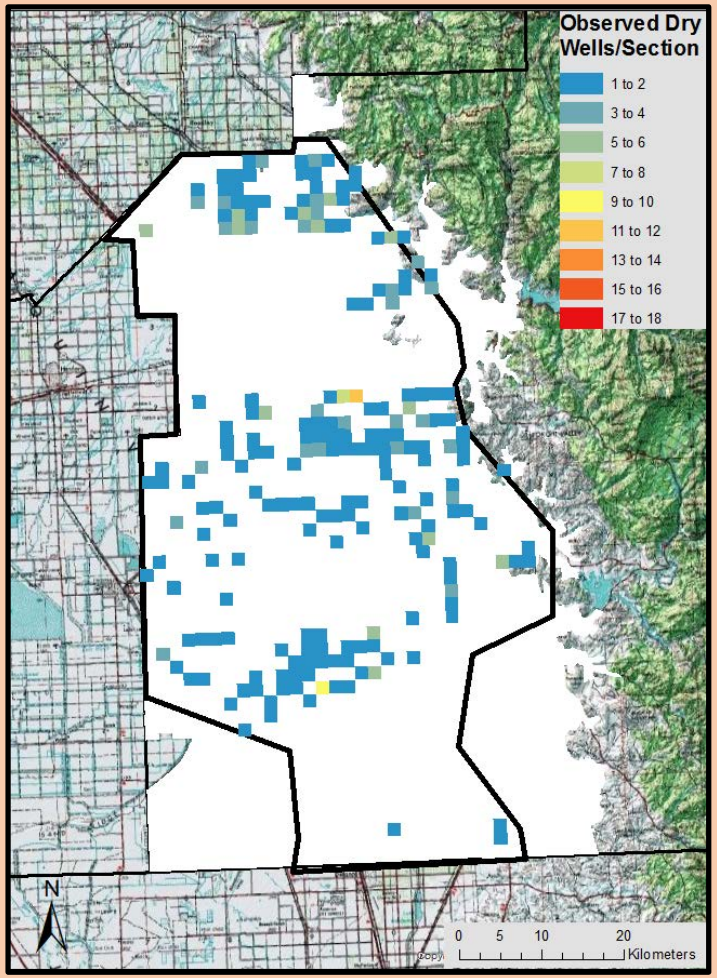
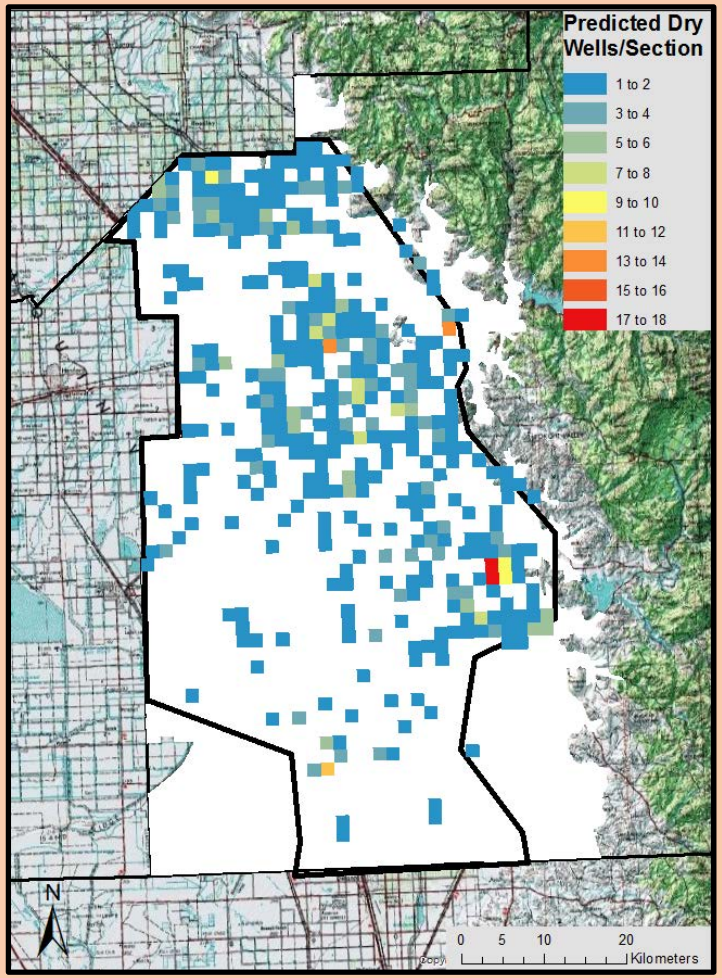
Under-Reported Observations



Full Set of Predictions



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- Guidance on calibrated parameter values from this work (not presented because of time limitations)

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- Many useful contributions can be made fairly directly
- Estimation of economic externalities for groundwater management is an example
- GIS skills significantly enhance depth and ease of analysis
- In addition to “data scraping” skills, “data groveling” can be extremely useful

Want More Details?

- Paper soon to be in review at Hydrogeology Journal
- Will be Public Access when published (free PDF from journal site)
- Many more details in paper than could be presented here
- In the meantime: rmgailey@ucdavis.edu