Nitrate in Groundwater in the Carson Valley

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Carson Water Subconservancy District

Board of Directors Meeting April 21, 2020

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Nevada Water Science Center

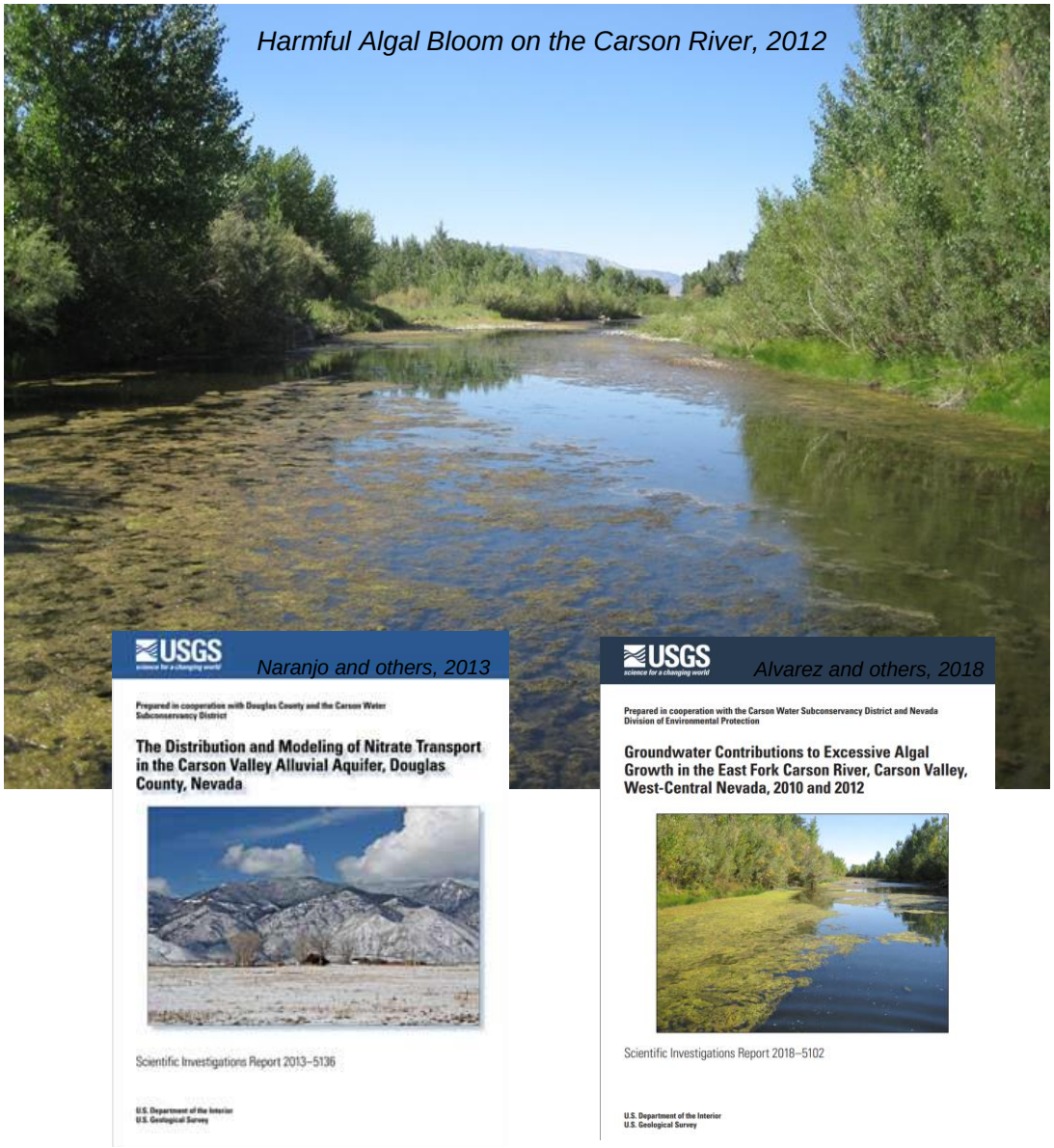
Nitrate

Health and Ecological Risks

Household waste contains bacteria, viruses, chemicals, and high levels of Nitrogen and Phosphorous (EPA, 2019)

Nitrate in drinking water more severely affects infants. Blue baby syndrome, hypertension, central nervous system birth defects, diabetes and cancer. EPA MCL 10 mg/L (EPA, 2019)

Nutrient enrichment from groundwater causes stream eutrophication (Alvarez and others, 2018)



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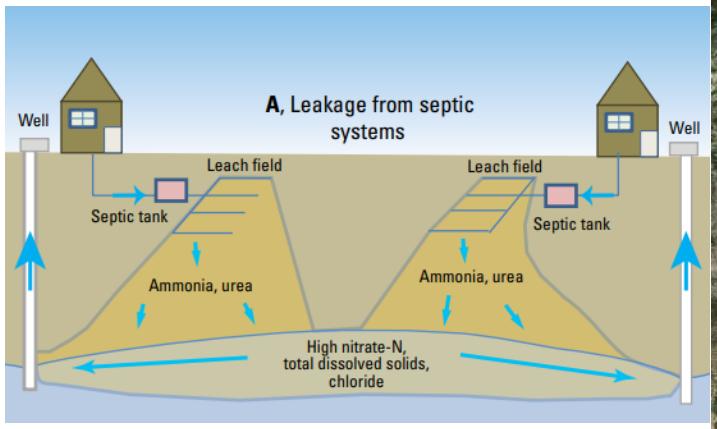
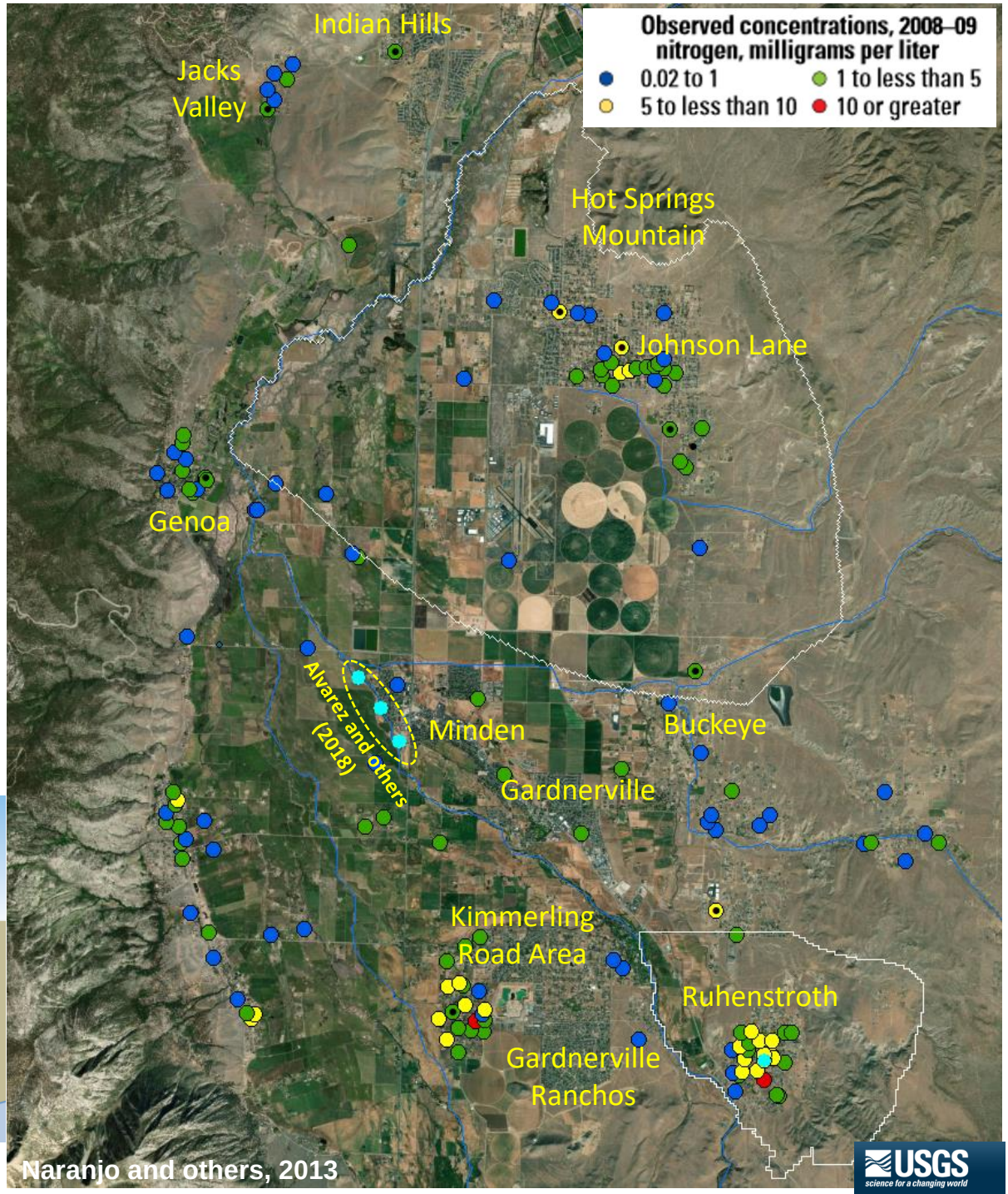
Background

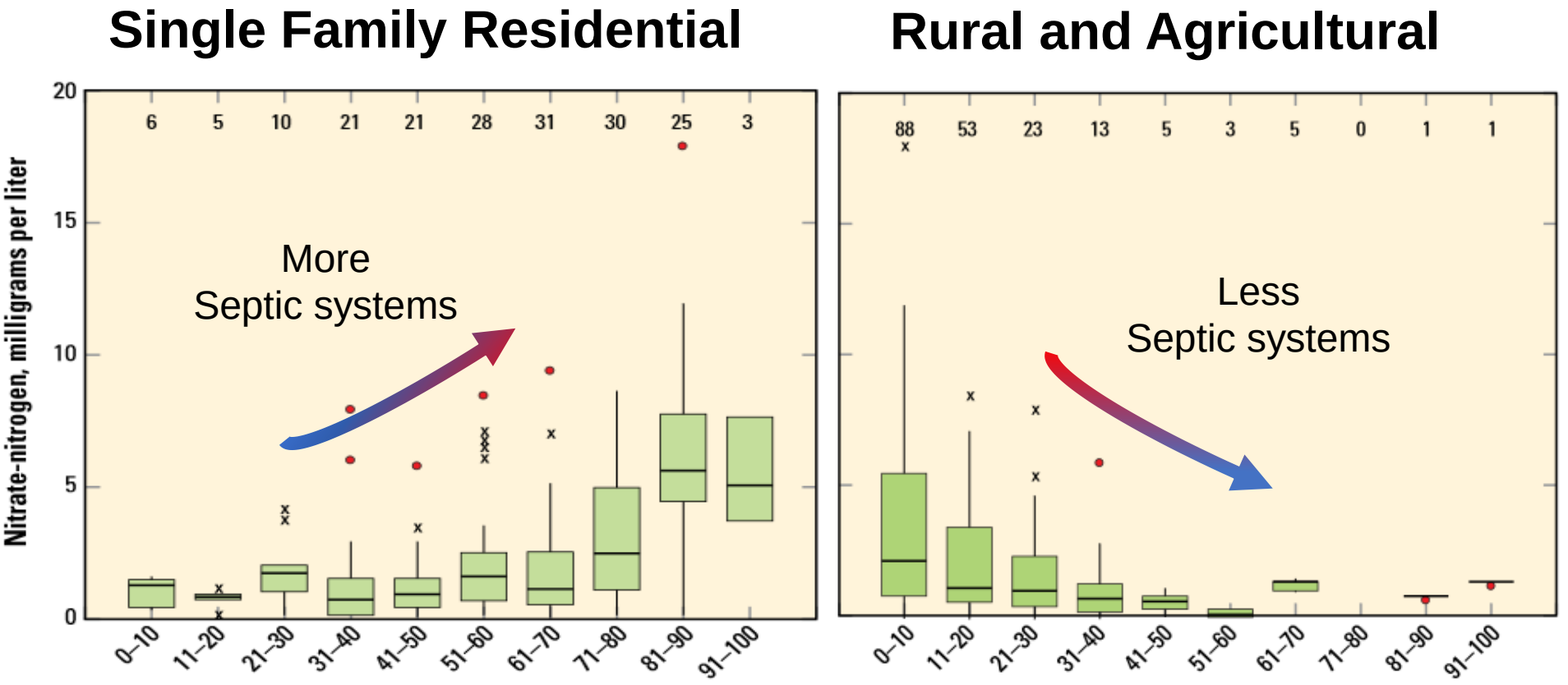
Wells with elevated nitrate are in areas with highest septic system density

Low nitrates in agricultural areas except for areas near residential development





Nitrate Concentration vs Land Use



Naranjo and others, 2013

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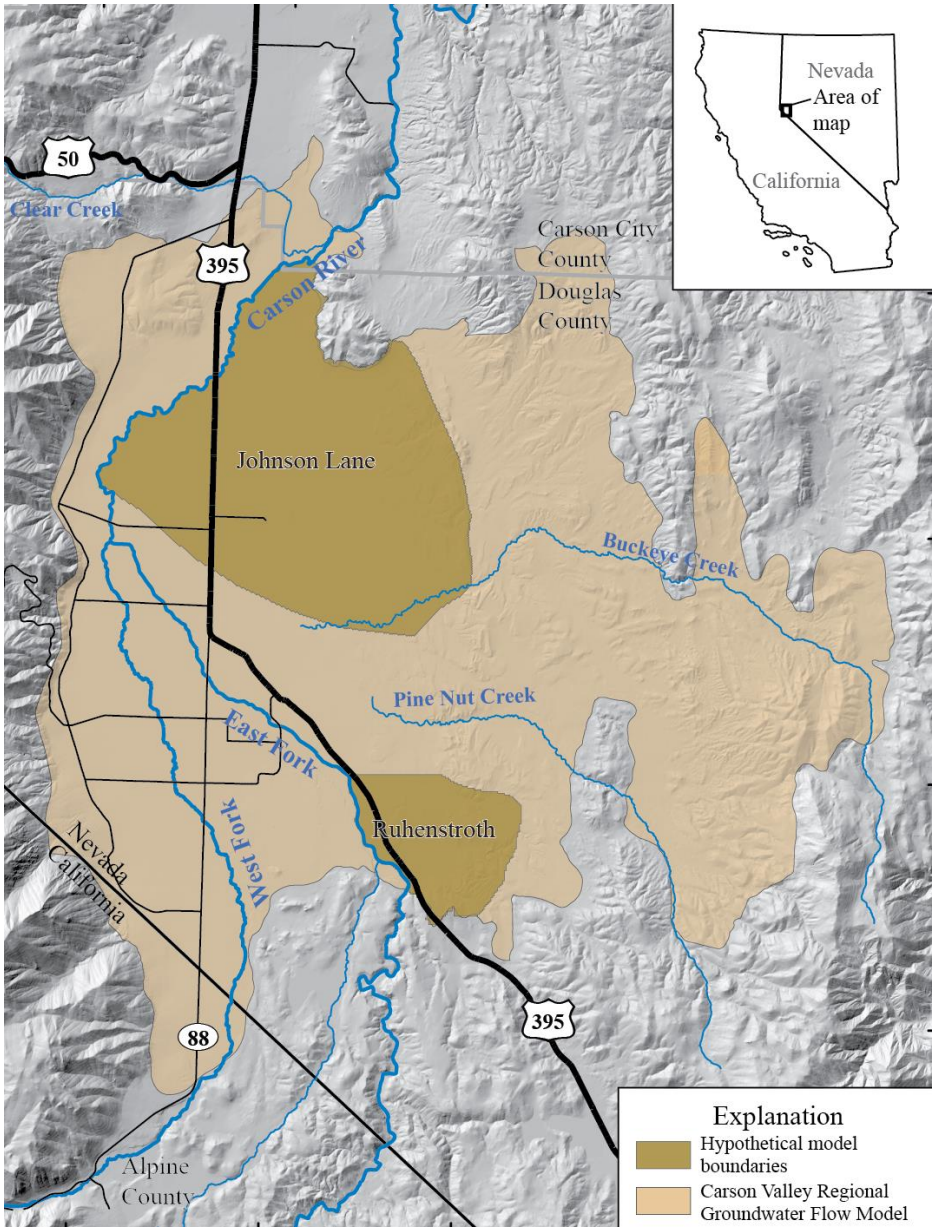
Transport Study Areas

- Johnson Lane
  - 62 mi²
  - 1,433 septic systems
  - 23 septic systems/ mi²
  - 2,627 wells
- Ruhenstroth
  - 14 mi²
  - 500 septic systems
  - 36 septic systems/ mi²
  - 511 wells



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Simulated Results - Johnson Lane (2059)

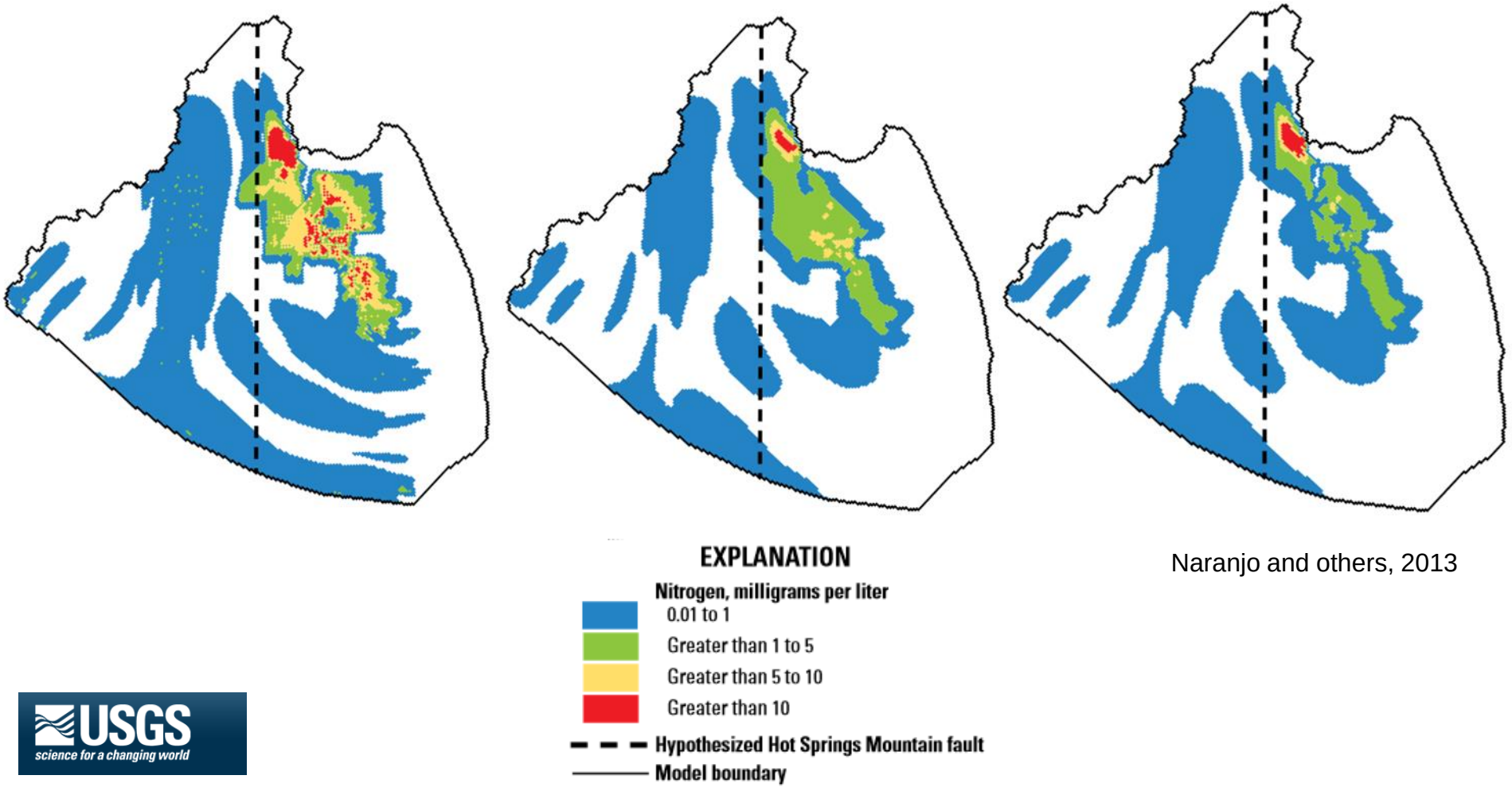
Baseline Prediction
Continue Septic System Use and Domestic Pumping

H1

No Septic Systems, Continue Domestic Pumping

H2

Septic Systems Removed in 2030, No Domestic Pumping



Naranjo and others, 2013

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Simulated Results - Ruhenstroth (2059)

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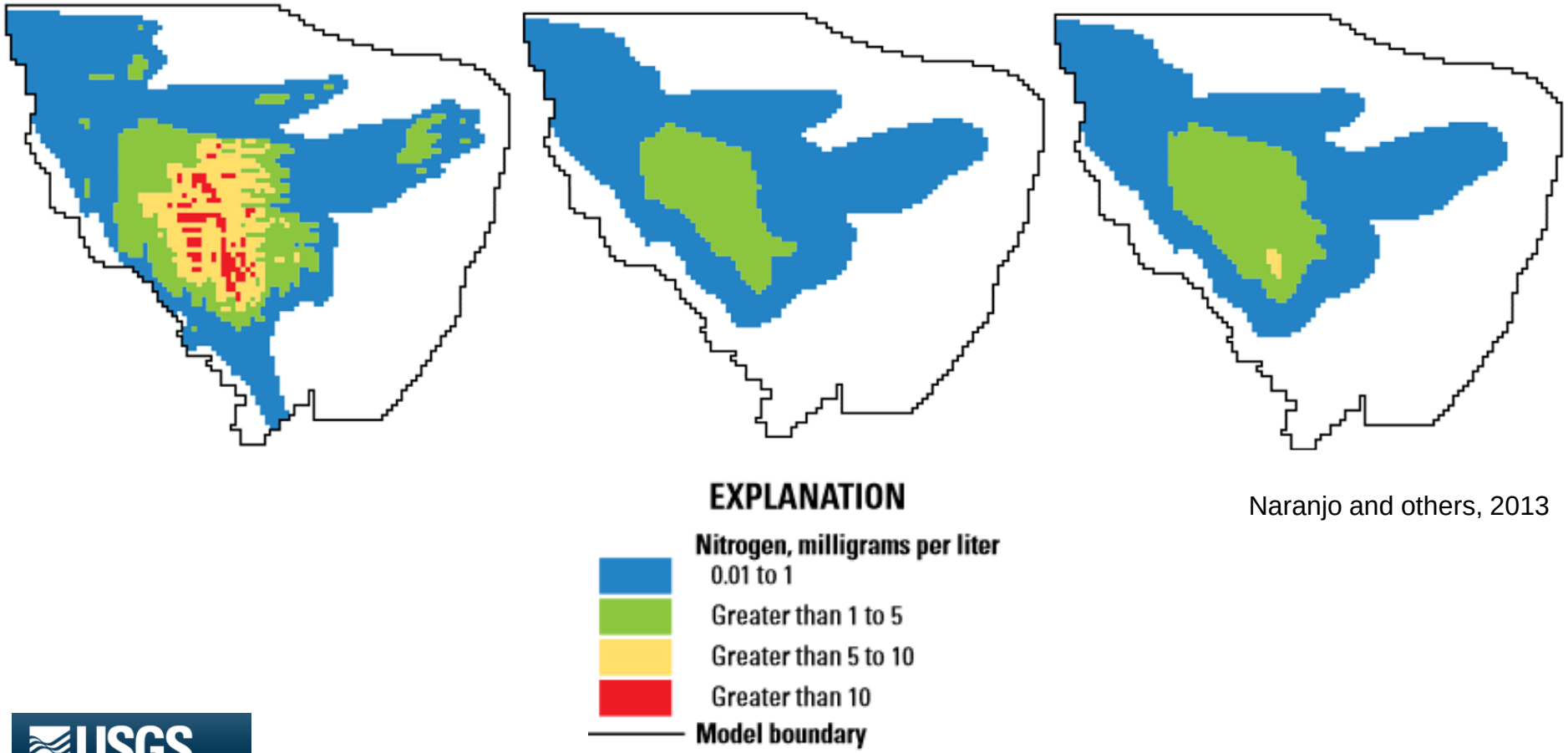

Naranjo and others, 2013

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Naranjo and others, 2013

Summary of Report Findings

Septic tank systems contribute main source of Nitrate

Nitrate concentrations are dependent on well depth, septic system density, age, and proximity to up-gradient septic systems.

The ability of the aquifer to dilute the leachate concentration has been reduced due to high use of septic systems (i.e. Ruhenstroth)

Nitrate concentrations reduce rapidly when septic systems are removed and domestic wells continued to pump.

If no action is taken, nitrate will eventually increase above the USEPA's MCL.

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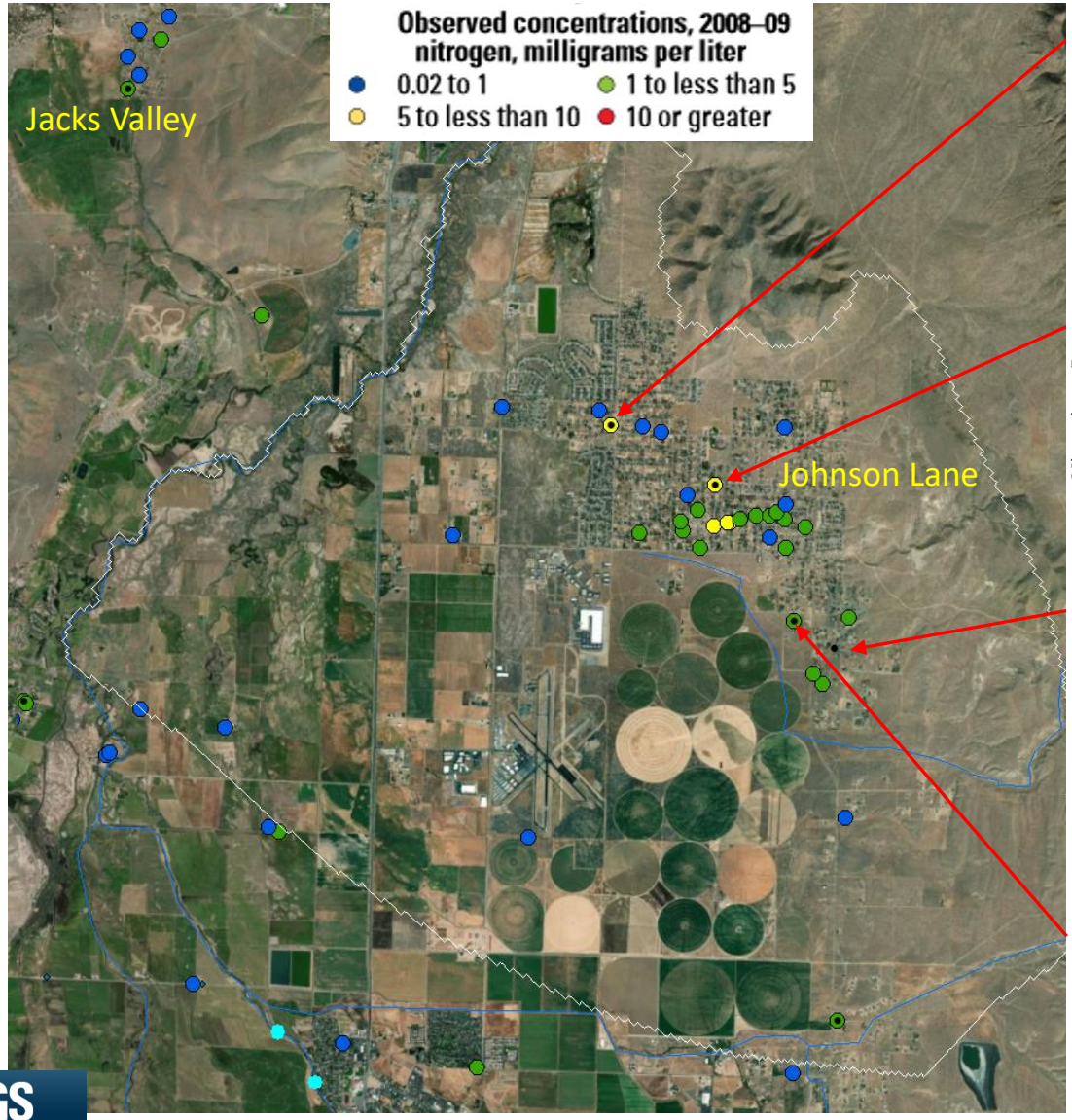
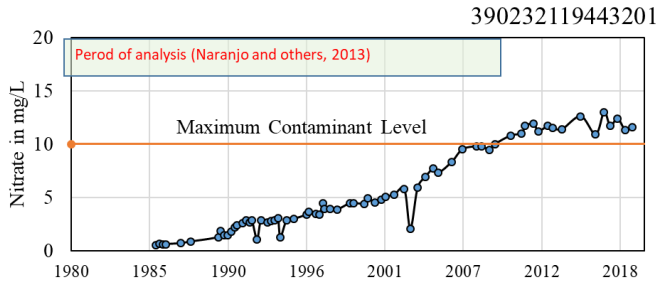
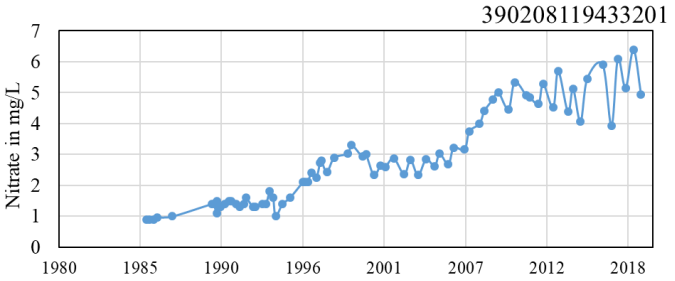
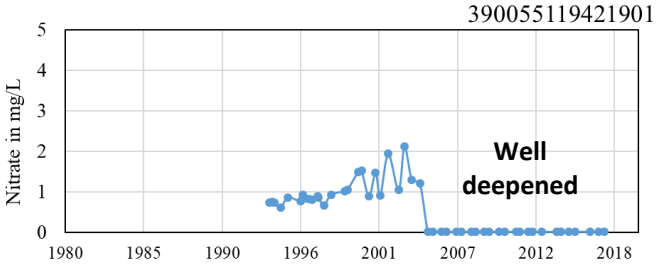
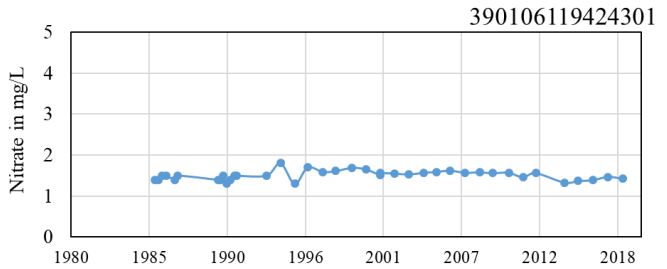
Trends in Nitrate Concentrations











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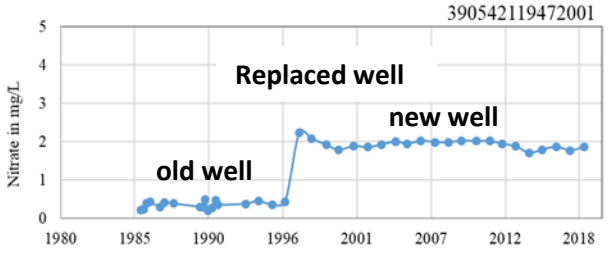

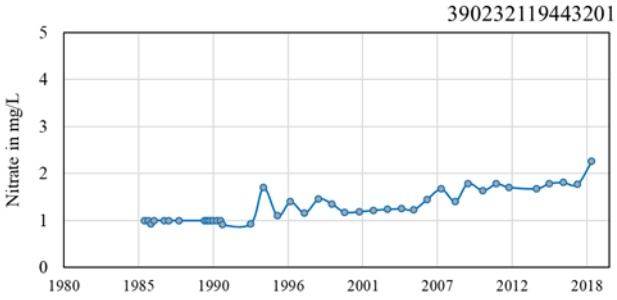

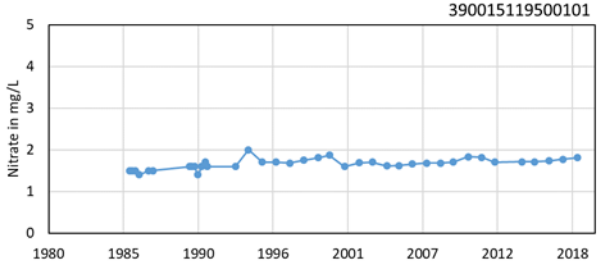

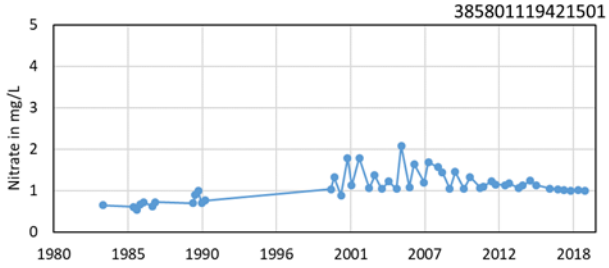

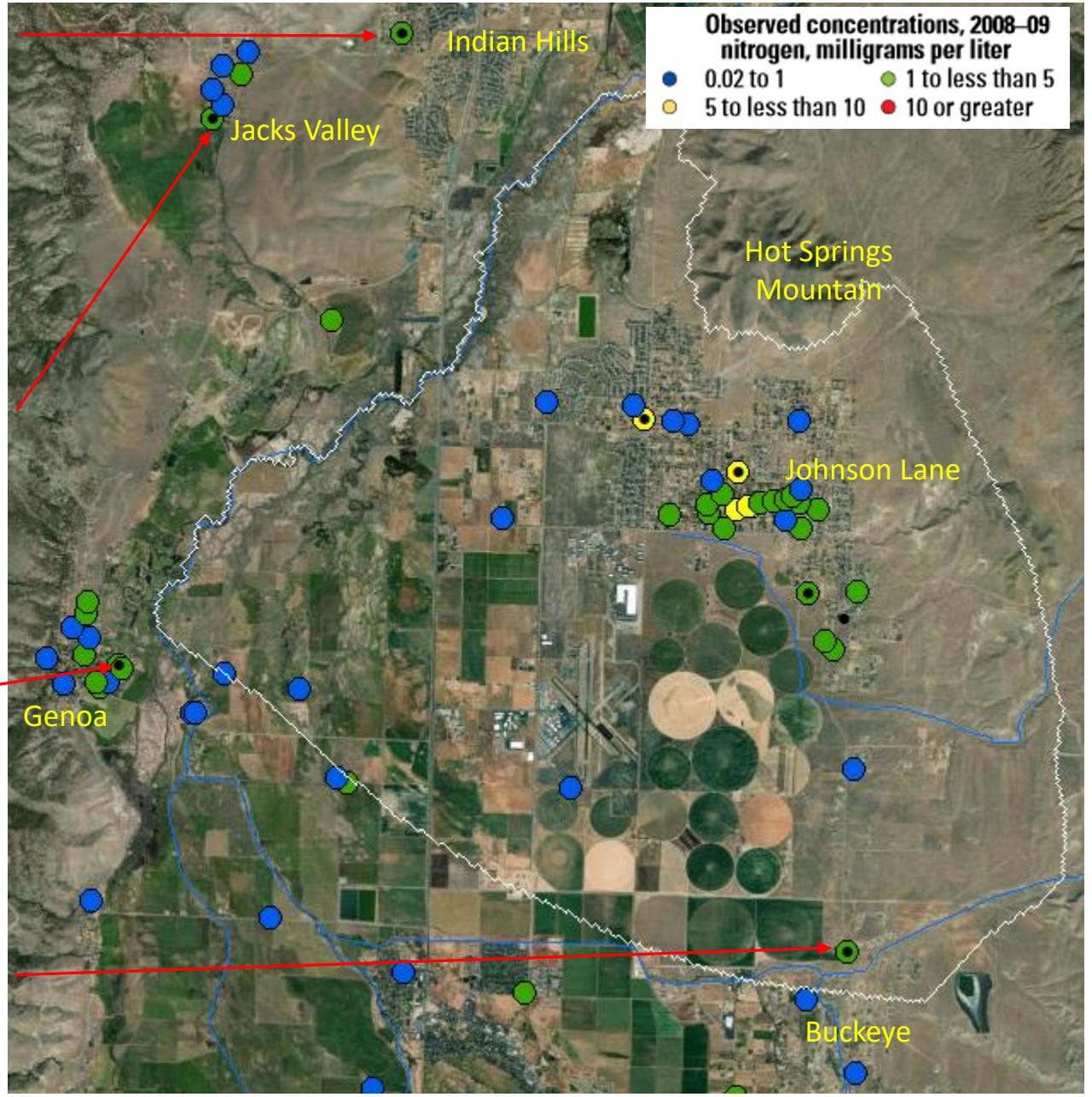

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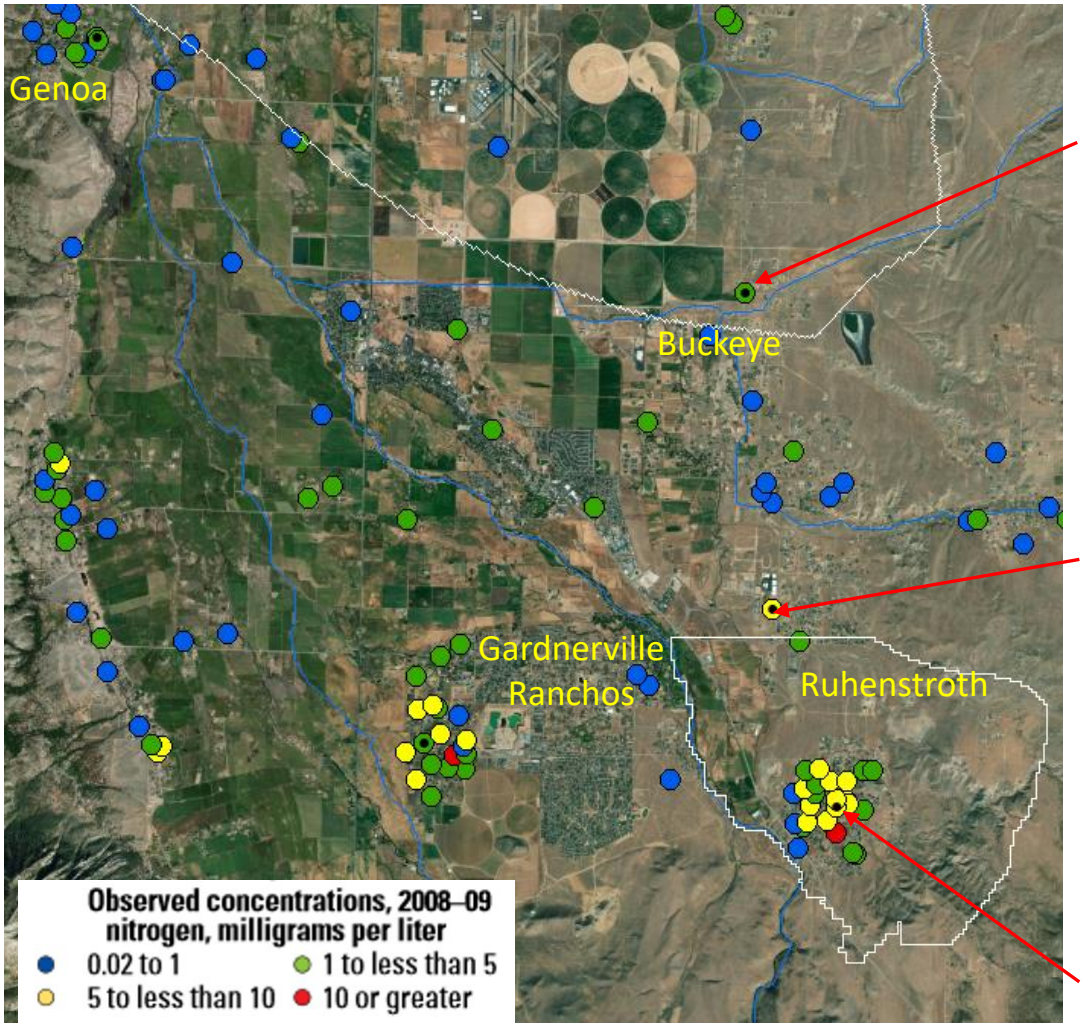

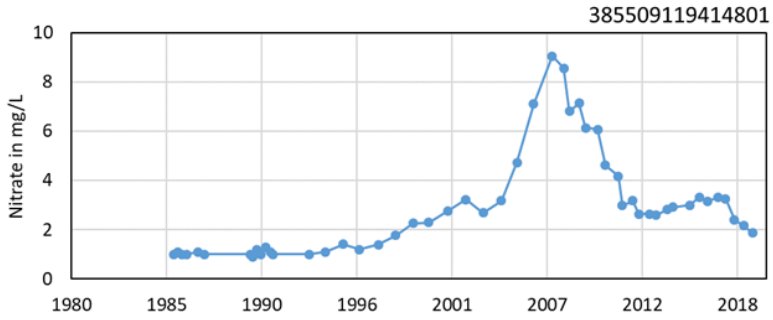

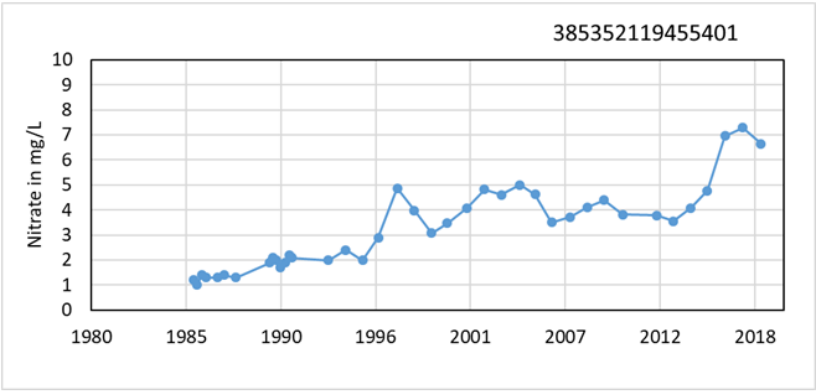

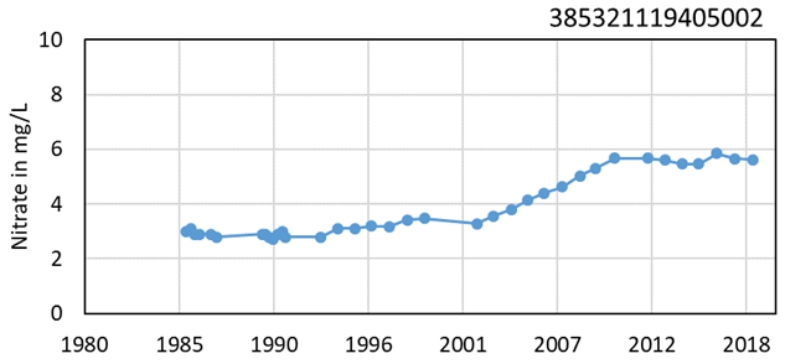

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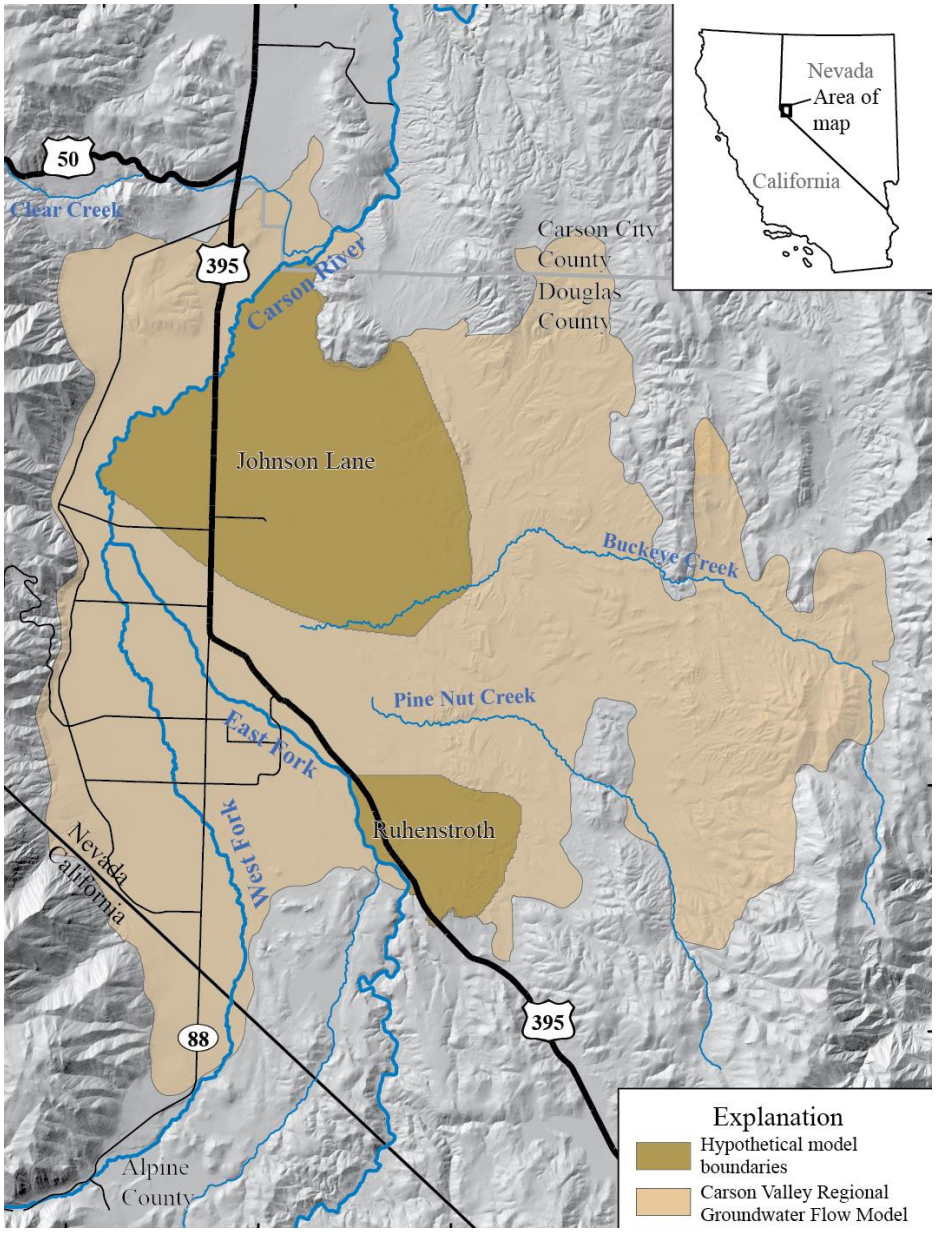
Application of Nitrate Transport Model

Naranjo and others, 2013

How have concentrations changed in since 2009?



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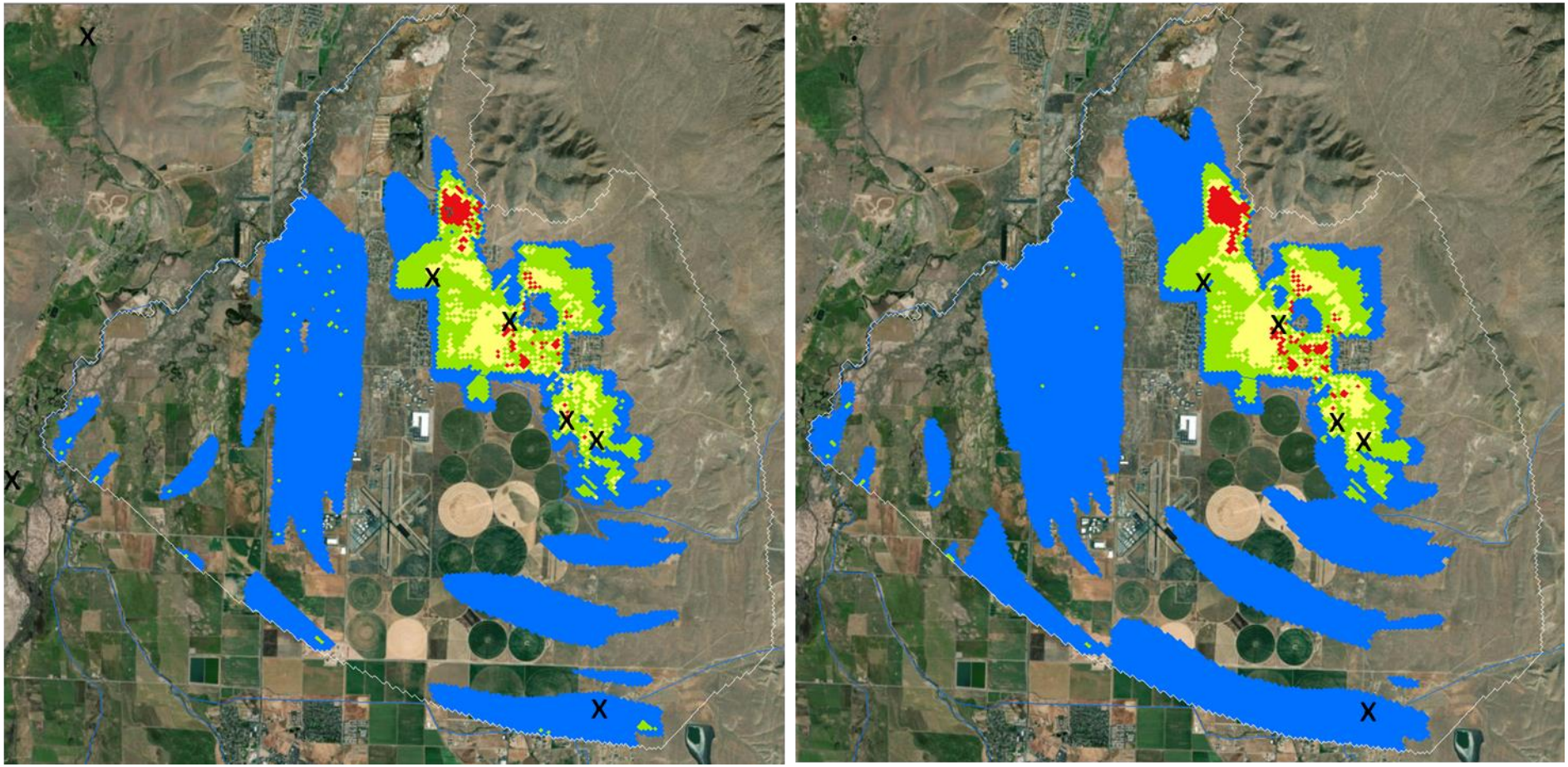
Simulated Change in Nitrate Concentration

Johnson Lane

2009

2019



Simulated Nitrate (mg/L)

- 0.01 to 1
- Greater than 1 to 5
- Greater than 5 to 10
- Greater than 10

X are active monitoring wells

Information for 2019 is preliminary and subject to revision

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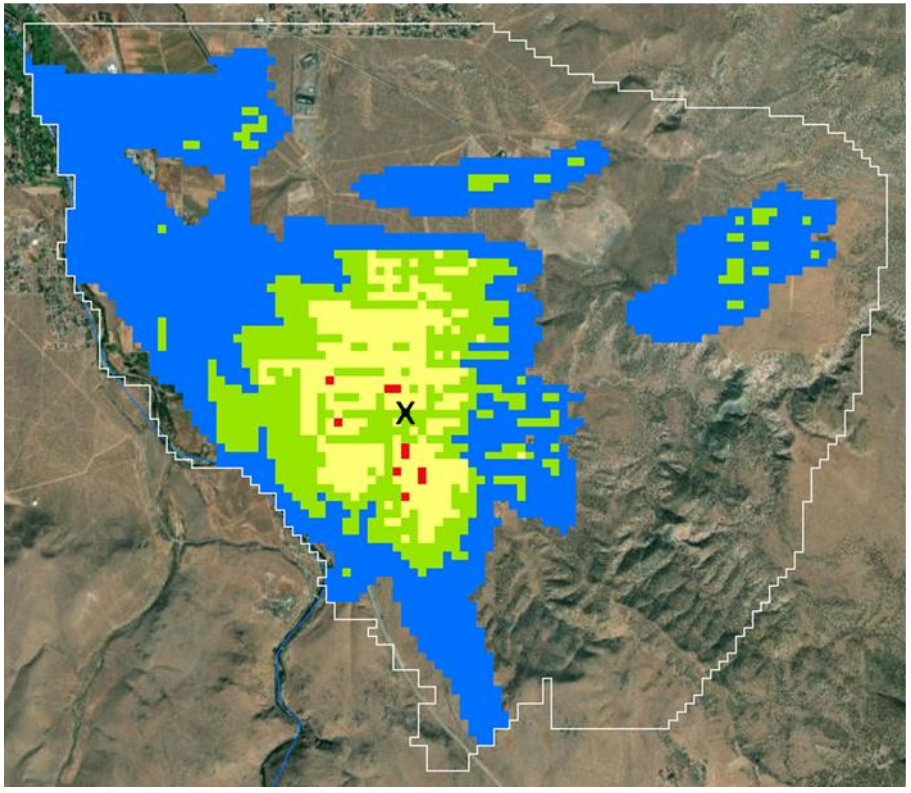
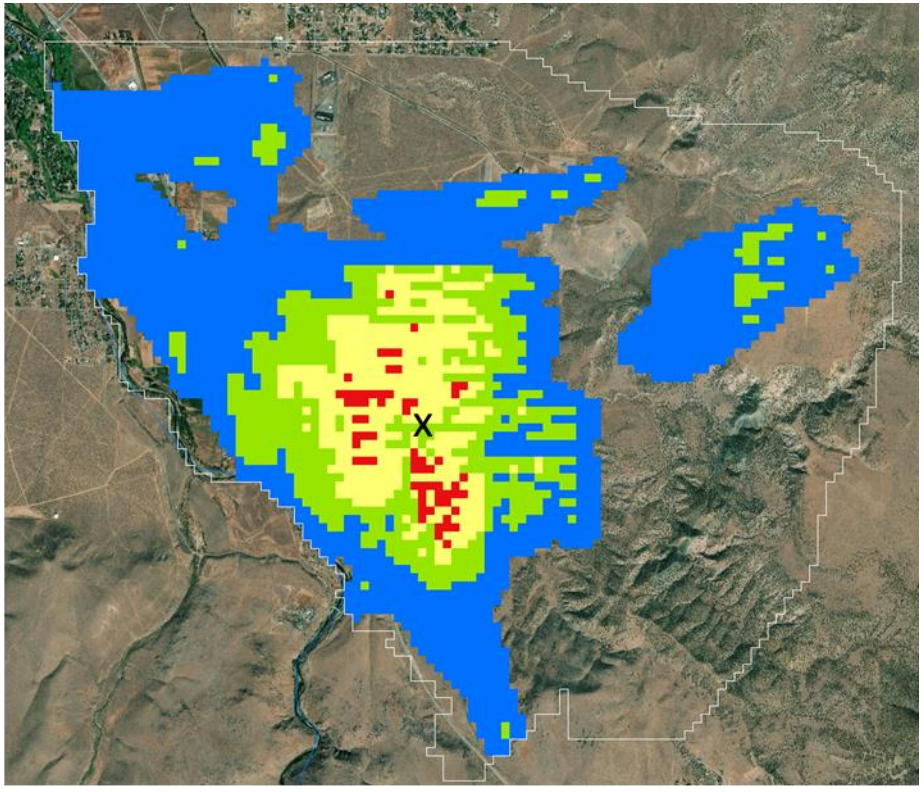
Simulated Change in Nitrate Concentration

Ruhenstroth

2009



2019



Simulated Nitrate (mg/L)

- 0.01 to 1
- Greater than 1 to 5
- Greater than 5 to 10
- Greater than 10

X is active monitoring well

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Summary of Simulated Results

	2009	2019	2059
Johnson Lane			
Maximum Nitrate (mg/L)	18	20	30
Percent change in maximum[1]	-	12	38
Acres > MCL (10 mg/L)[2]	156	227	373
Percent change in area[1]	-	46	139
Ruhenstroth			
Maximum Nitrate (mg/L)	12	17	19
Percent change in maximum[1]	-	42	62
Acres > MCL (10 mg/L)[2]	13	71	112
Percent change in area[1]	-	450	769

[1] *Calculated as a percentage from prediction at 2059*

[2] *Total simulated acres exceeding MCL of 10 mg/L nitrate*

Information for 2019 is preliminary and subject to revision

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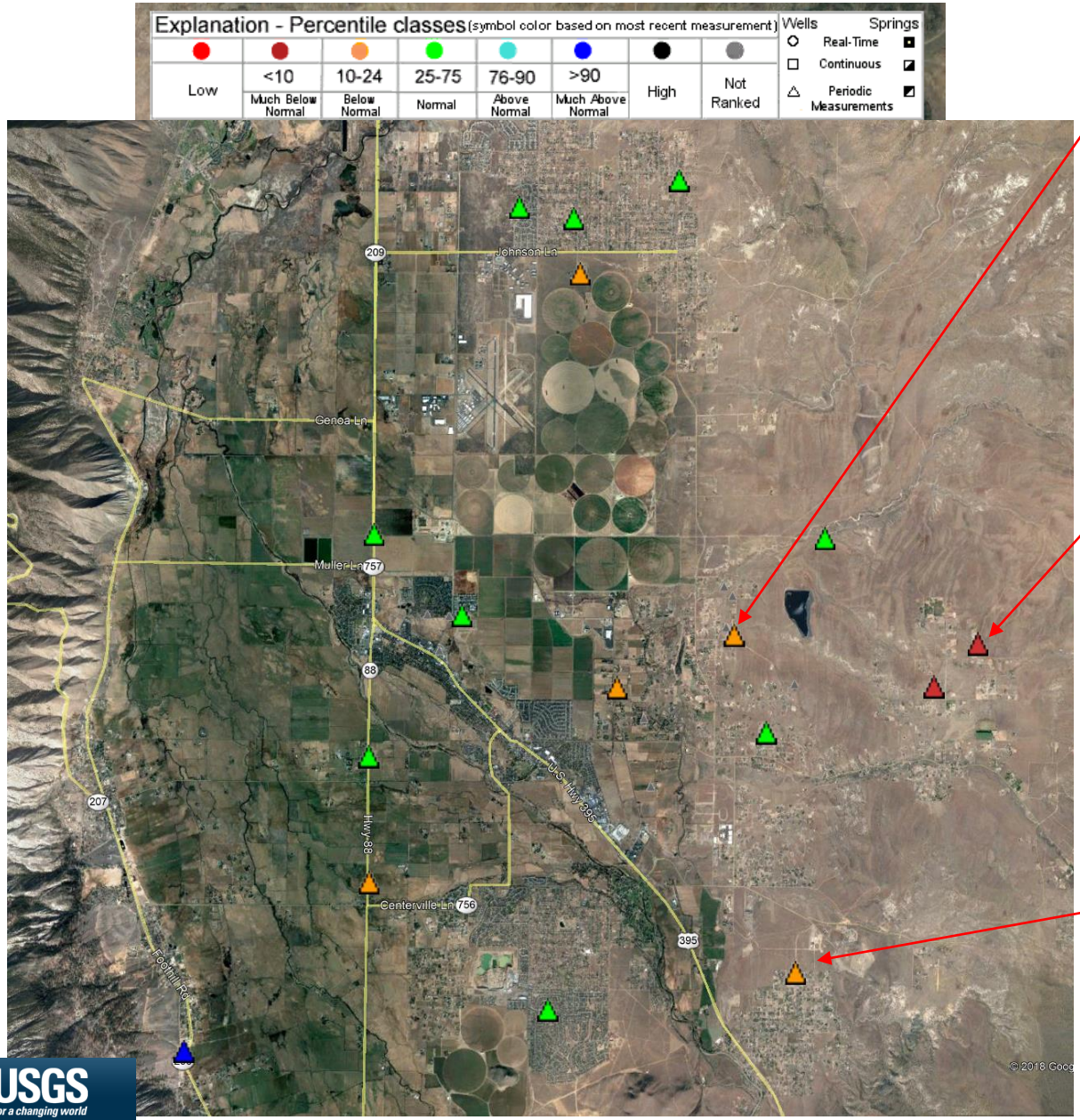
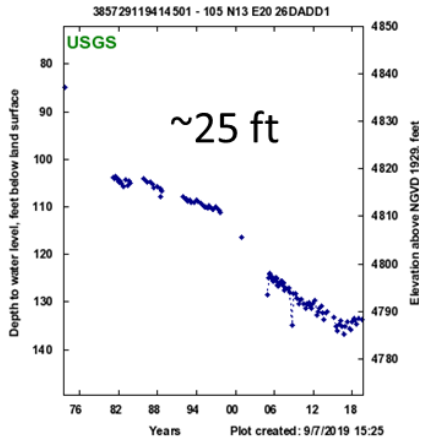
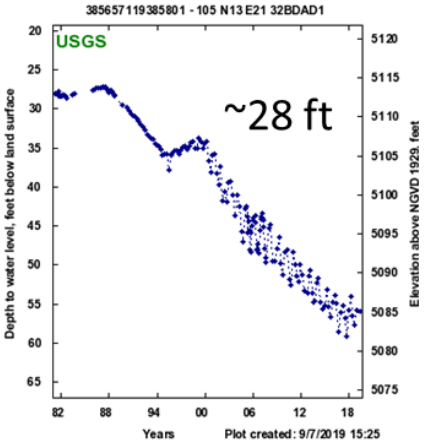
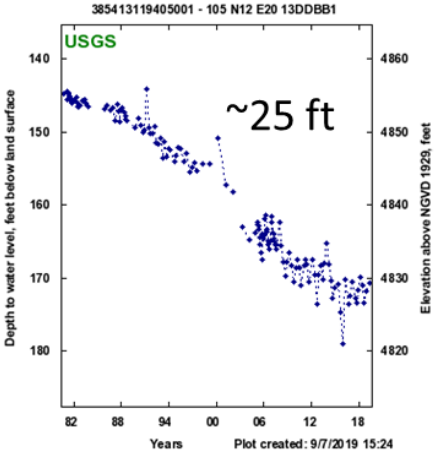
Trends in Water Levels

- **Declining at ~1 ft/yr on East side of Carson Valley**









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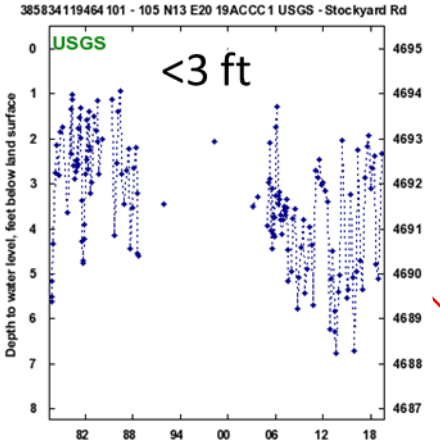
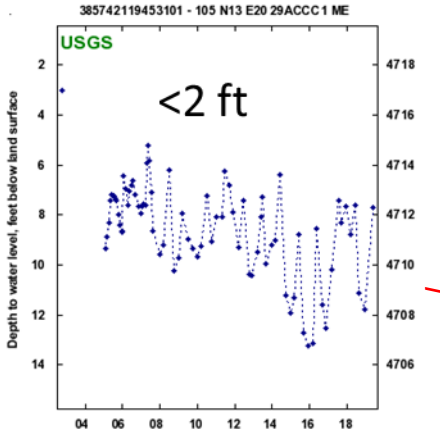
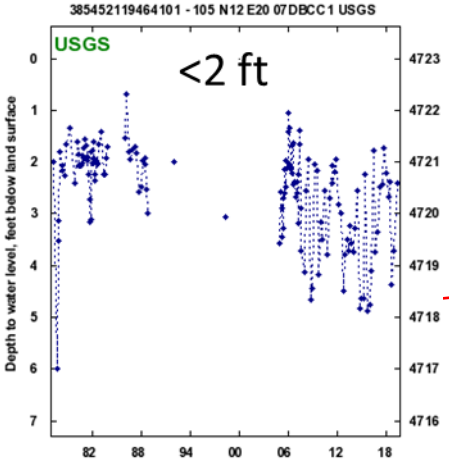
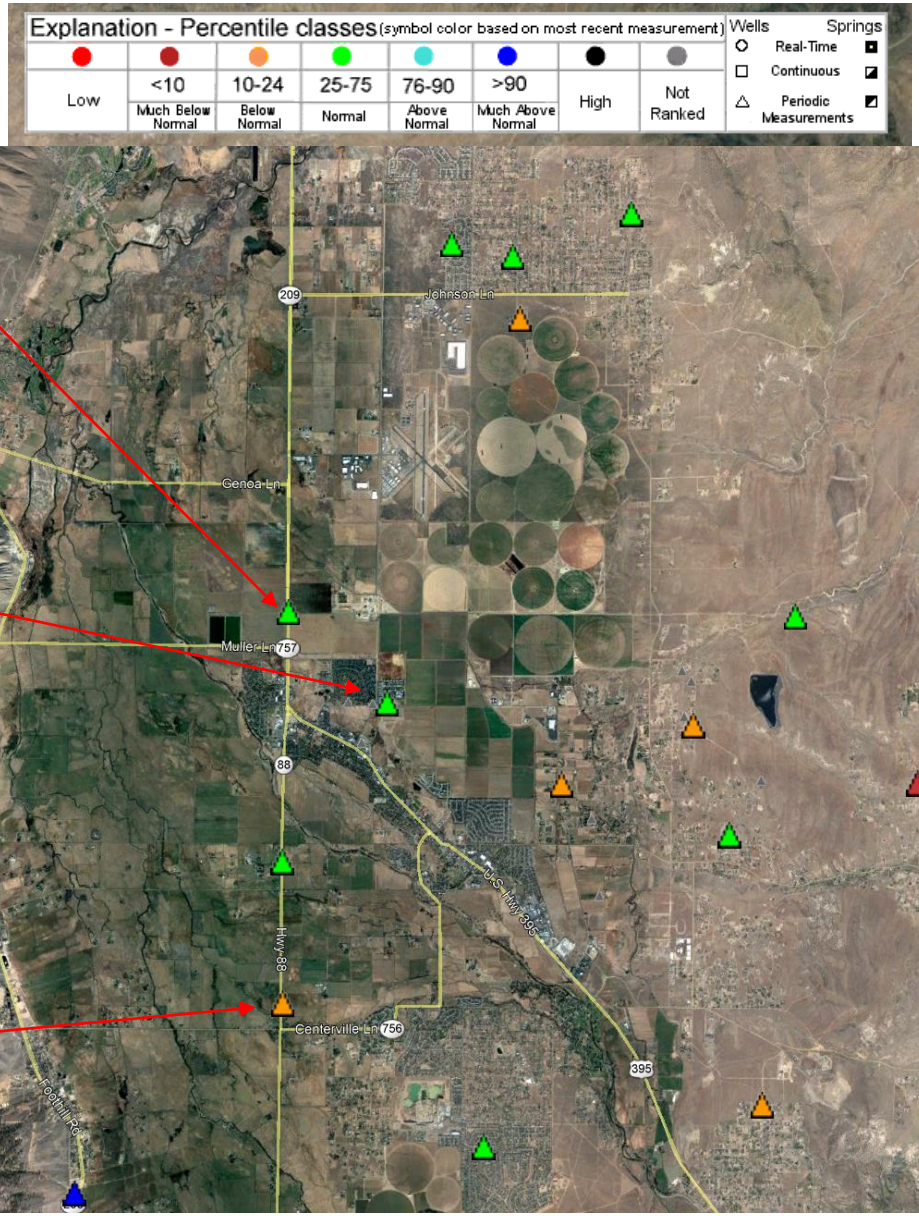
Trends in Water Levels

- **Declining at ~0.1 ft/yr closer to River**









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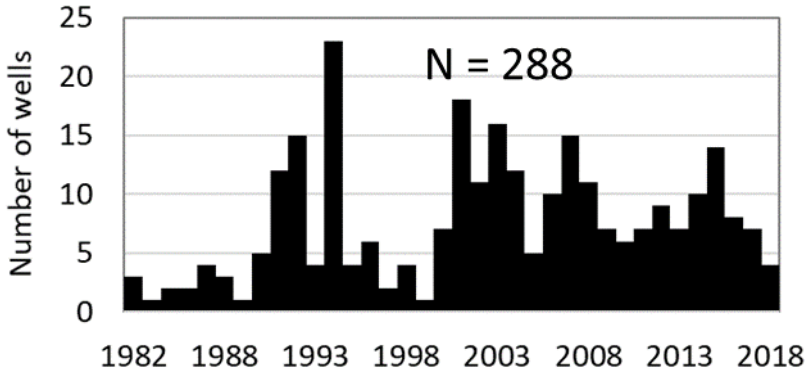
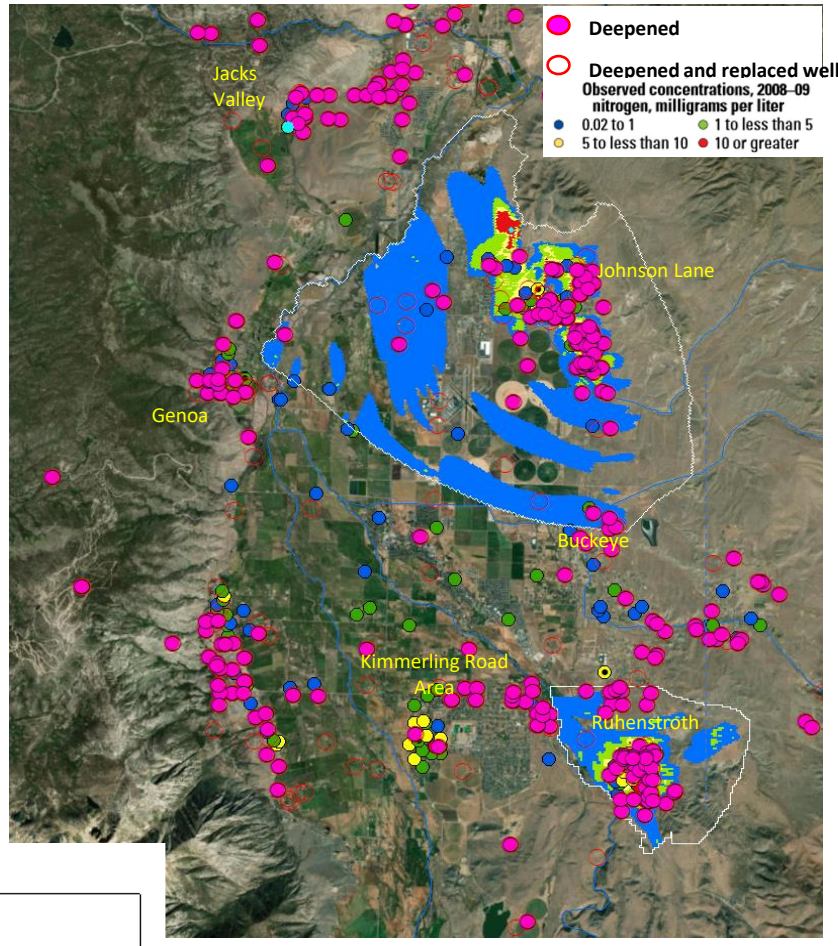
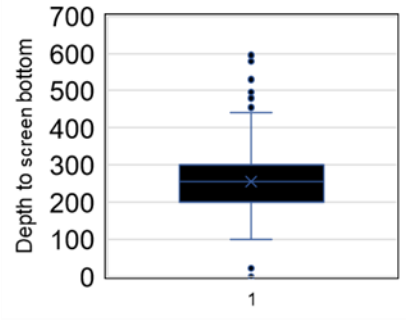
Wells Deepened or Deepened and Replaced in the Carson Valley

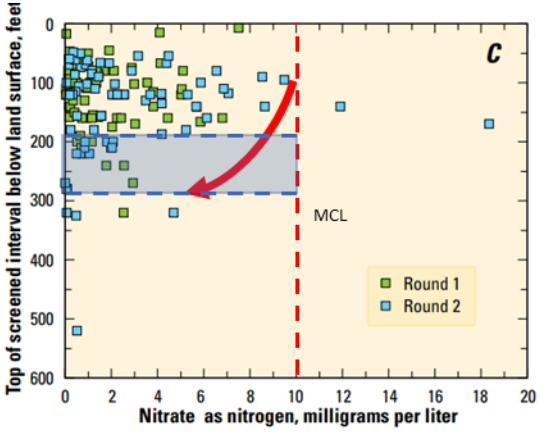
Source: Nevada State Engineers Database

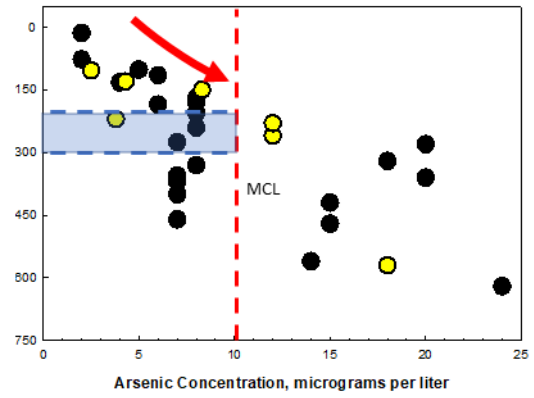




Average depth 260 ft







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Summary of Monitoring Data

- Nitrate concentrations are increasing in 8 of 11 monitoring wells.
- Since 2007, well in Johnson Lane area has nitrate concentrations greater than MCL of 10 mg/L
- Are monitoring well locations appropriate?
- Are we collecting enough data to evaluate risk to domestic wells, municipal wells, and Carson River?

Summary of Nitrate Transport

- Transport model indicates a 1.5 (Johnson Lane) and 5.5 (Ruhenstroth) fold increase in acres with nitrate concentrations greater than 10 mg/L since last reported in 2009 (Naranjo and others, 2013).

- It has been 10 years since comprehensive sampling of rural areas in Douglas County. New data could be used to evaluate hot spots, changes in nitrate concentrations, and evaluate transport predictions.

- Develop transport models of other hot spot areas and evaluate risk to municipal wells and Carson River.