Update on Nitrate in Groundwater in the Carson Valley

Ramon Naranjo, Ph.D.

September 16, 2019

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Nevada Water Science Center

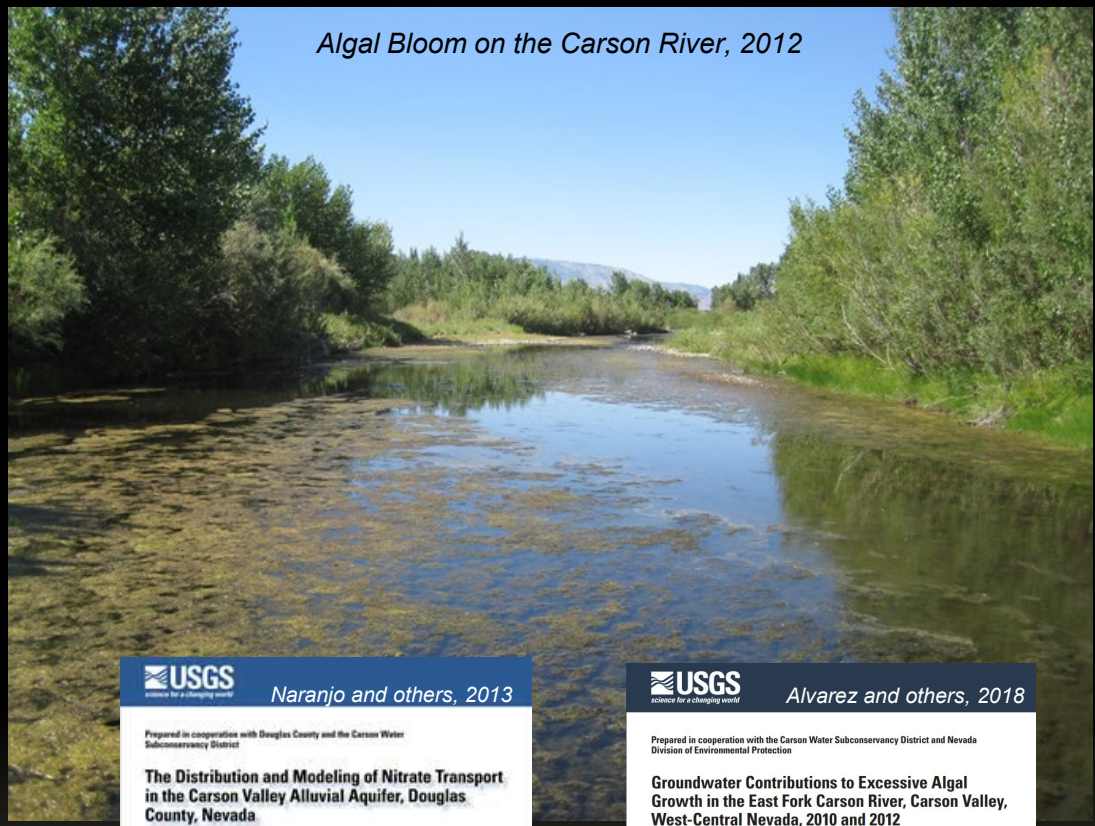
Nitrate

Health and Ecological Risks

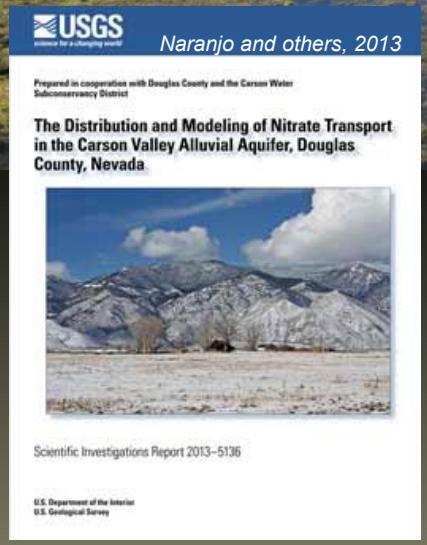
Household waste contains bacteria, viruses, chemicals, and high levels of Nitrogen and Phosphorous (EPA, 2019)

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

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



Algal Bloom on the Carson River, 2012



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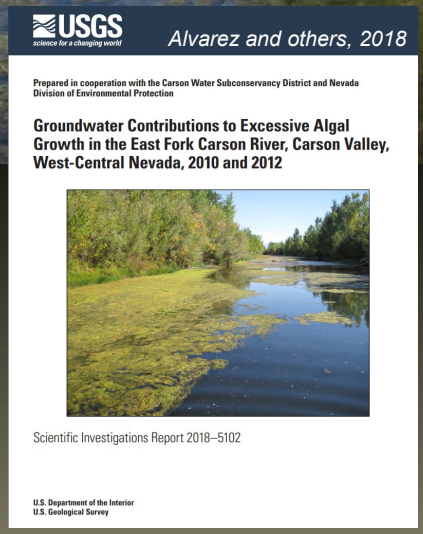
Naranjo and others, 2013

Prepared in cooperation with Douglas County and the Carson Water Subconservancy District

The Distribution and Modeling of Nitrate Transport in the Carson Valley Alluvial Aquifer, Douglas County, Nevada

Scientific Investigations Report 2013–5136

U.S. Department of the Interior
U.S. Geological Survey



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Alvarez and others, 2018

Prepared in cooperation with the Carson Water Subconservancy District and Nevada Division of Environmental Protection

Groundwater Contributions to Excessive Algal Growth in the East Fork Carson River, Carson Valley, West-Central Nevada, 2010 and 2012

Scientific Investigations Report 2018–5102

U.S. Department of the Interior
U.S. Geological Survey

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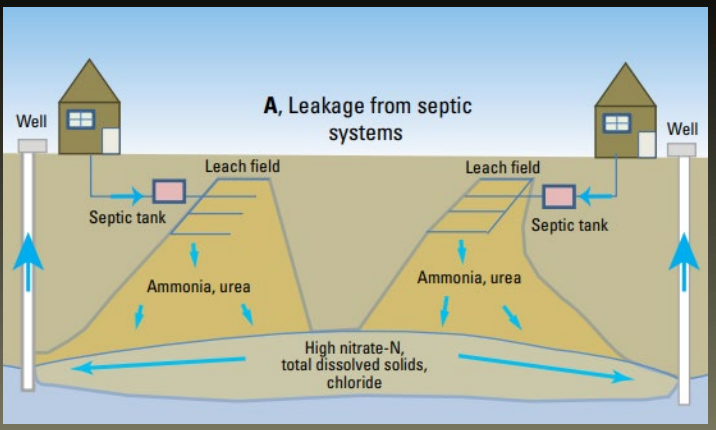
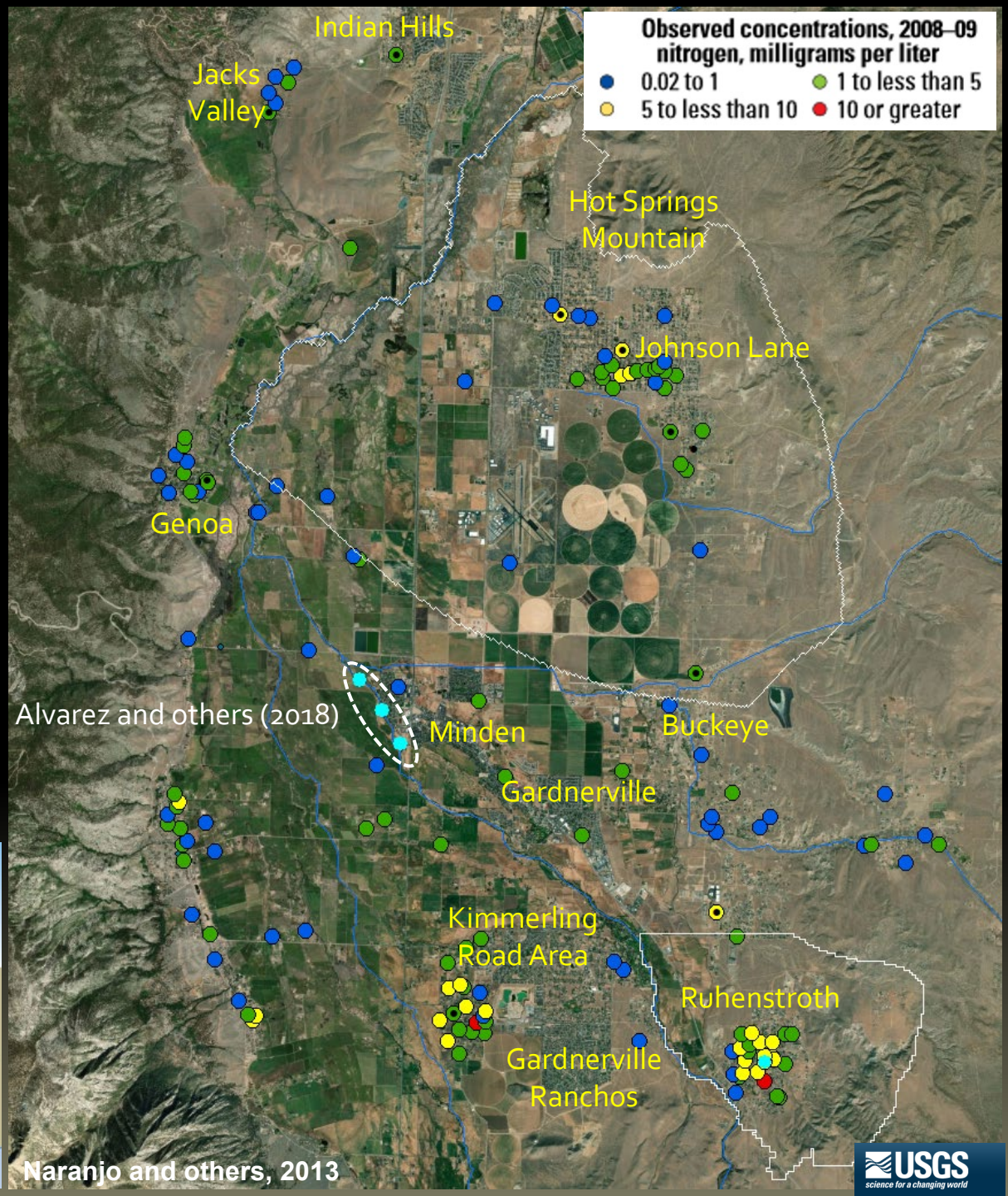
Background

Wells with elevated Nitrate are in areas with highest septic density

Low nitrates in agricultural areas except for areas near development

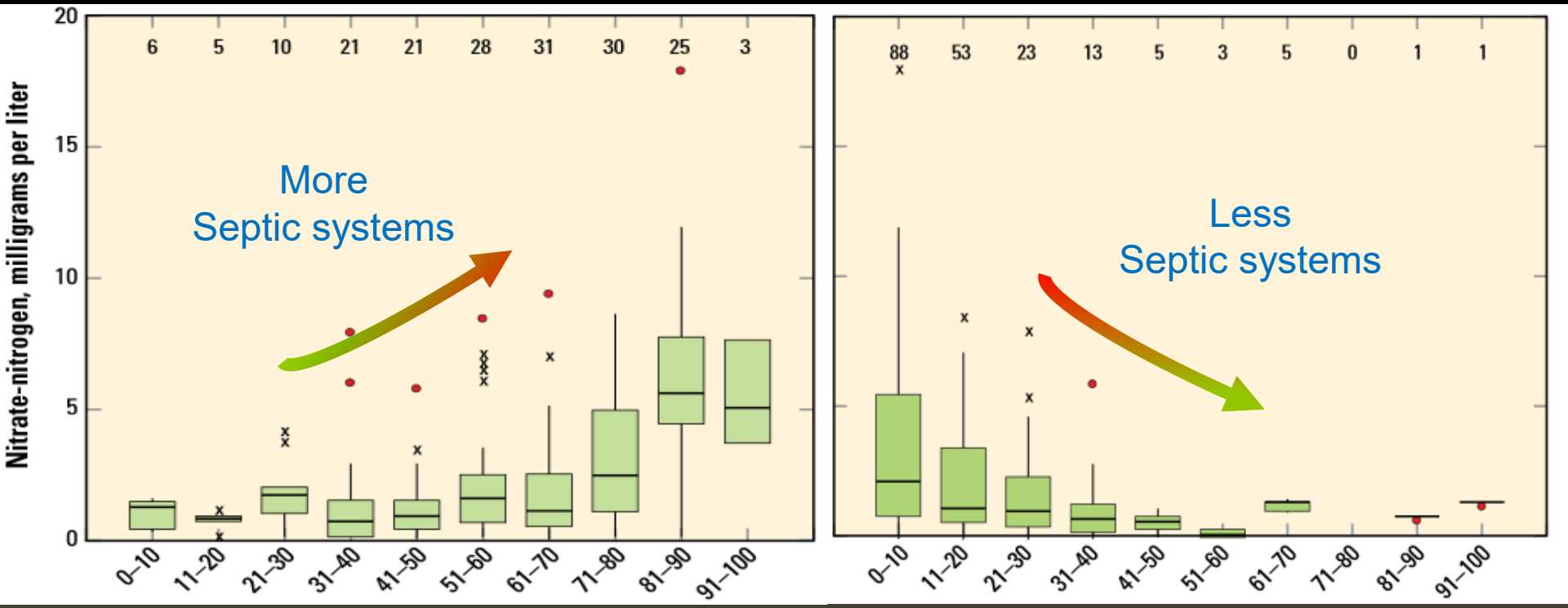




Nitrate vs Land Use

Single Family Residential

Rural and Agricultural



Naranjo and others, 2013

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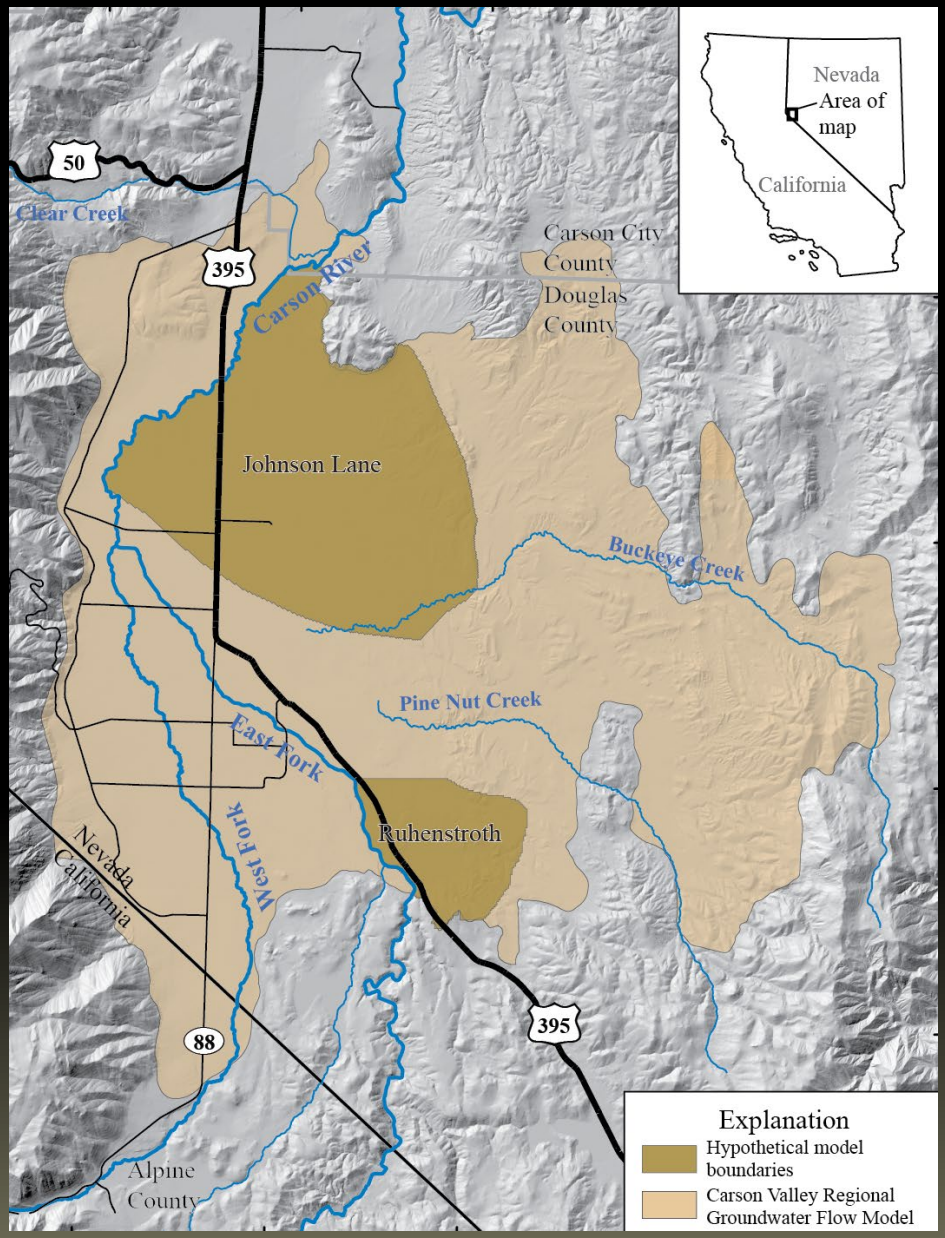
Transport Study Areas

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



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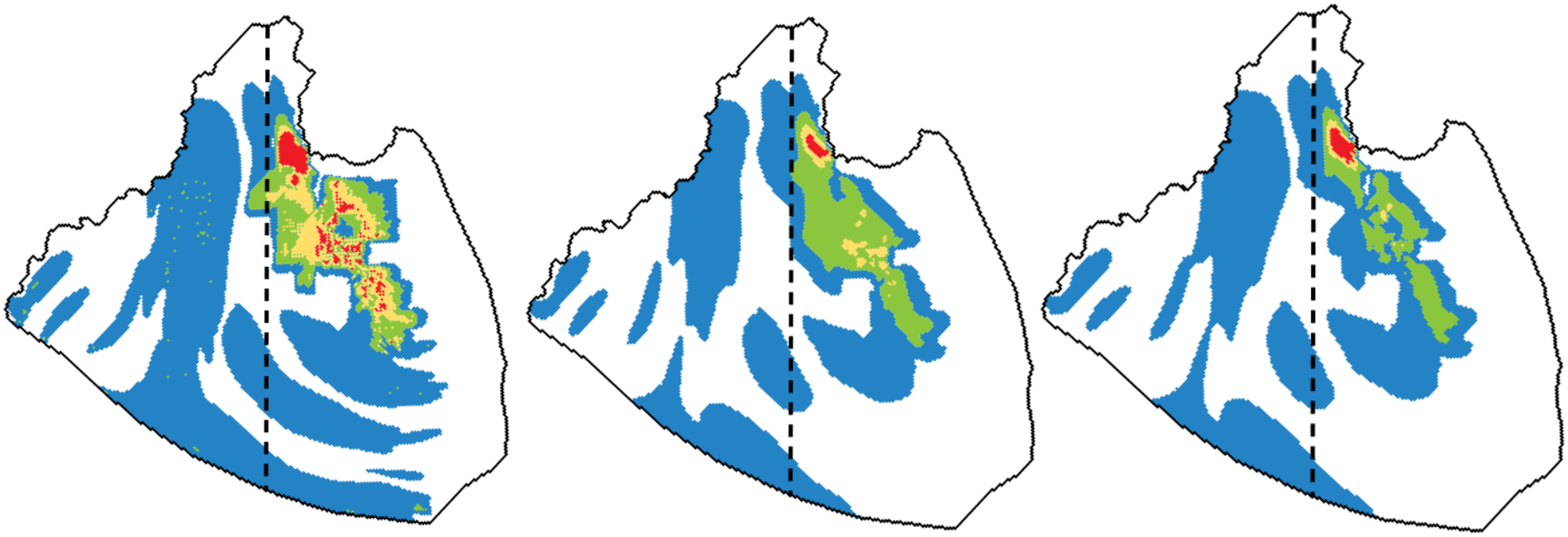
Simulated Results - Johnson Lane (2059)

Baseline Prediction
Continue Septics and Pumping

H1
No Septics, Continue Domestic Pumping

H2
Septics Removed in 2030, No Domestic Pumping



Naranjo and others, 2013

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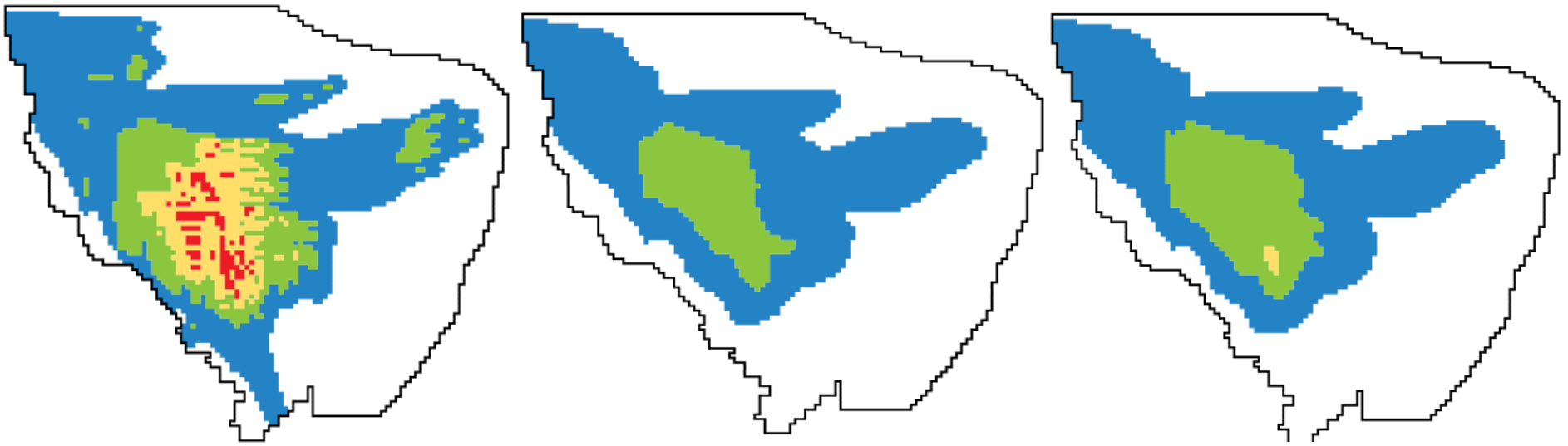
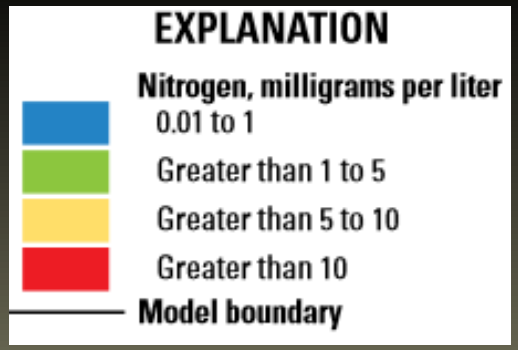
Simulated Results - Ruhenstroth (2059)

Baseline Prediction Continue Septics and Pumping	H1 No Septics, Continue Domestic Pumping	H2 Septics Removed in 2030, No Domestic Pumping





Naranjo and others, 2013

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Summary of Scenario Results

	2009	2059 Prediction	2059 H1	2059 H2
Johnson Lane				
Maximum (mg/L)	18	30	20	19
Percent change in maximum[1]	-	69	-34	-39
Acres > MCL (10 mg/L)	156	373	92	48
Percent change in area[1]	-	139	-75	-87
Ruhenstroth				
Maximum (mg/L)	12	19	4	5
Percent change in maximum[1]	-	62	-79	-72
Acres > MCL (10 mg/L)	13	112	0	0
Percent change in area[1]	-	769	-100	-100

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

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 tank 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)

Concentrations reduce rapidly when septic tanks 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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Current Groundwater Monitoring

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Active Monitoring Wells

Frequency of sampling in Wells in Douglas County (Only Water Quality)

Annual well water-quality sampling (6)

Site ID	Area
390542119472001	Indian Hills
385352119455401	Minden
390106119424301	Johnson lane
385321119405002	Ruhenstroth
390457119491301	Jack's Valley
390015119500101	Genoa

Bi-Annual (two per year) water-quality sampling (5)

Site ID	Area
390055119421901	Johnson lane
390232119443201	Johnson lane
390208119433201	Johnson lane
385801119421501	Buckeye
385509119414801	Gardnerville

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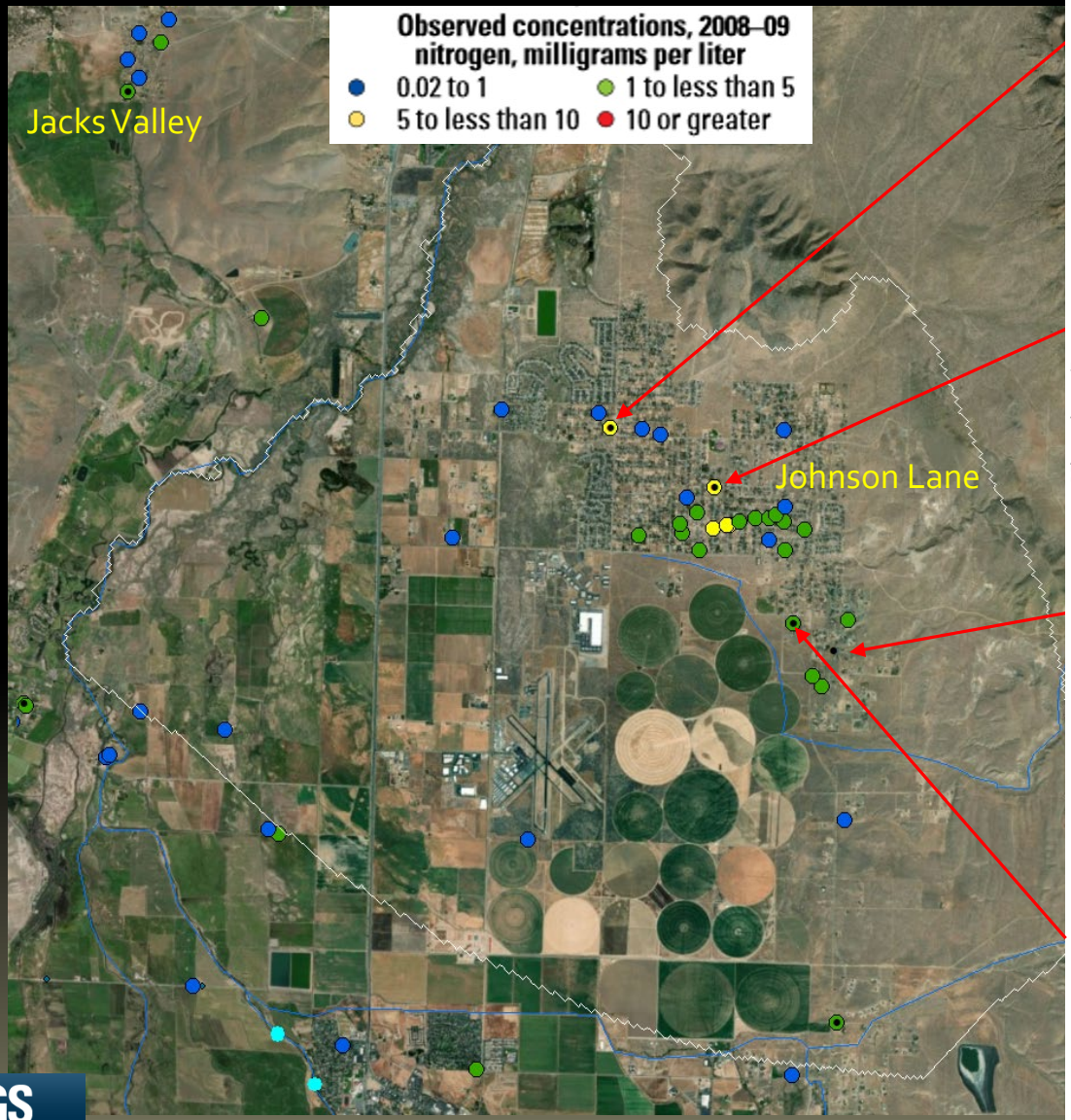
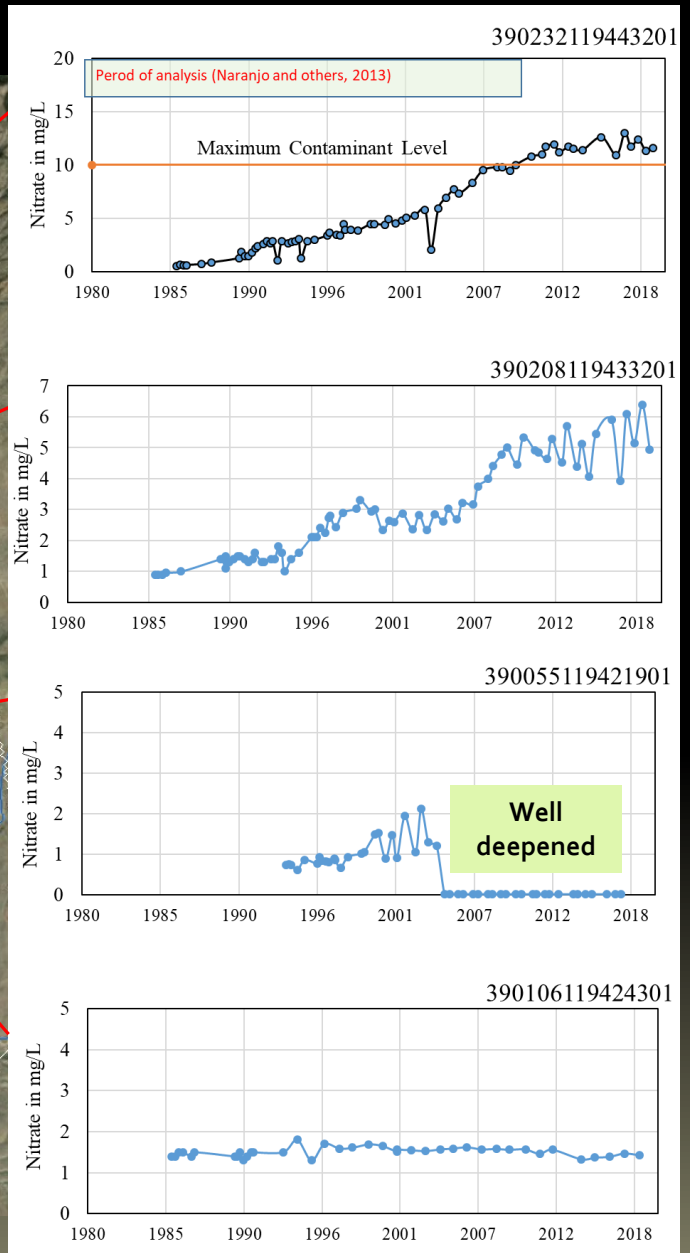
Trends in Nitrate





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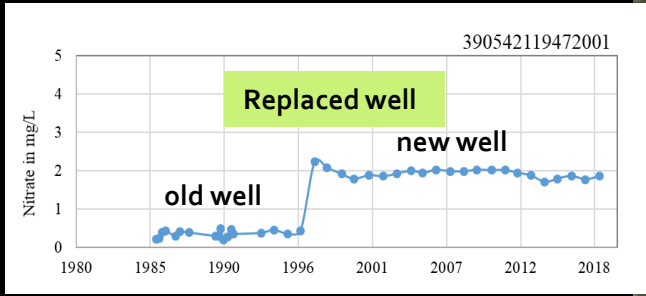
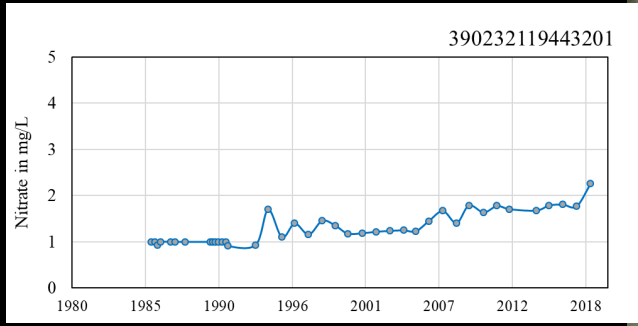
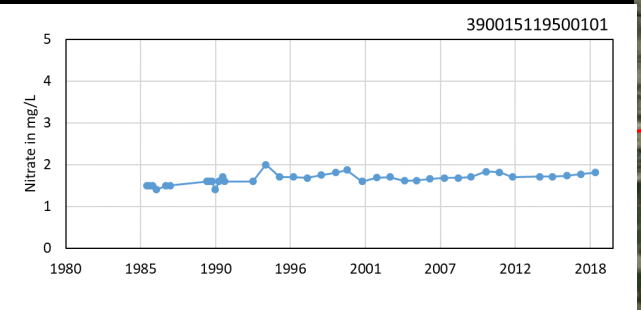
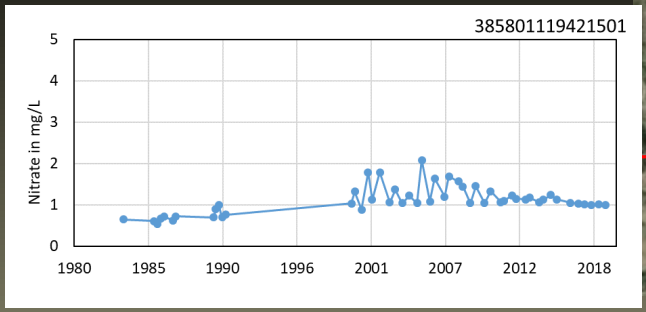
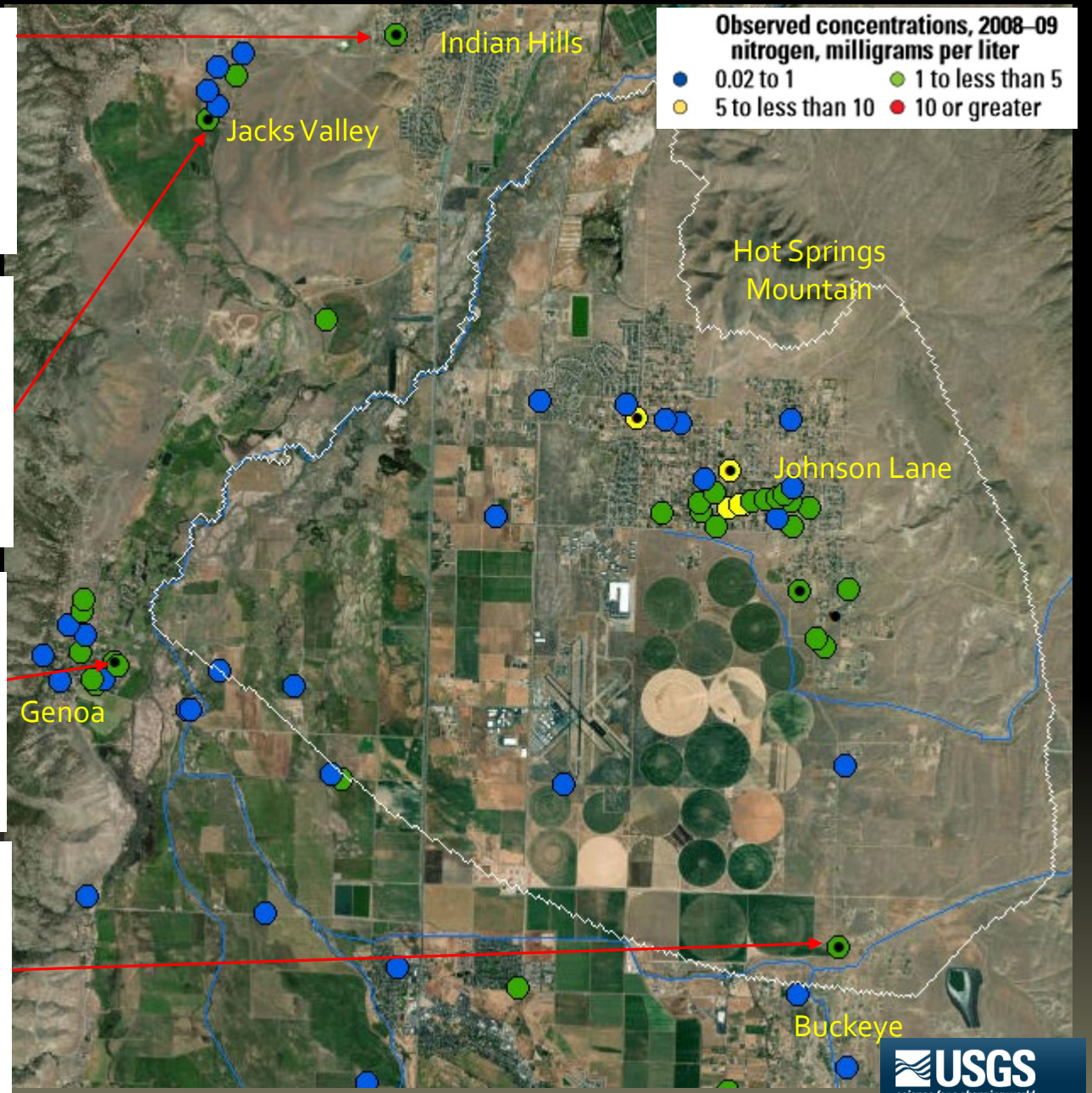
Trends in Nitrate











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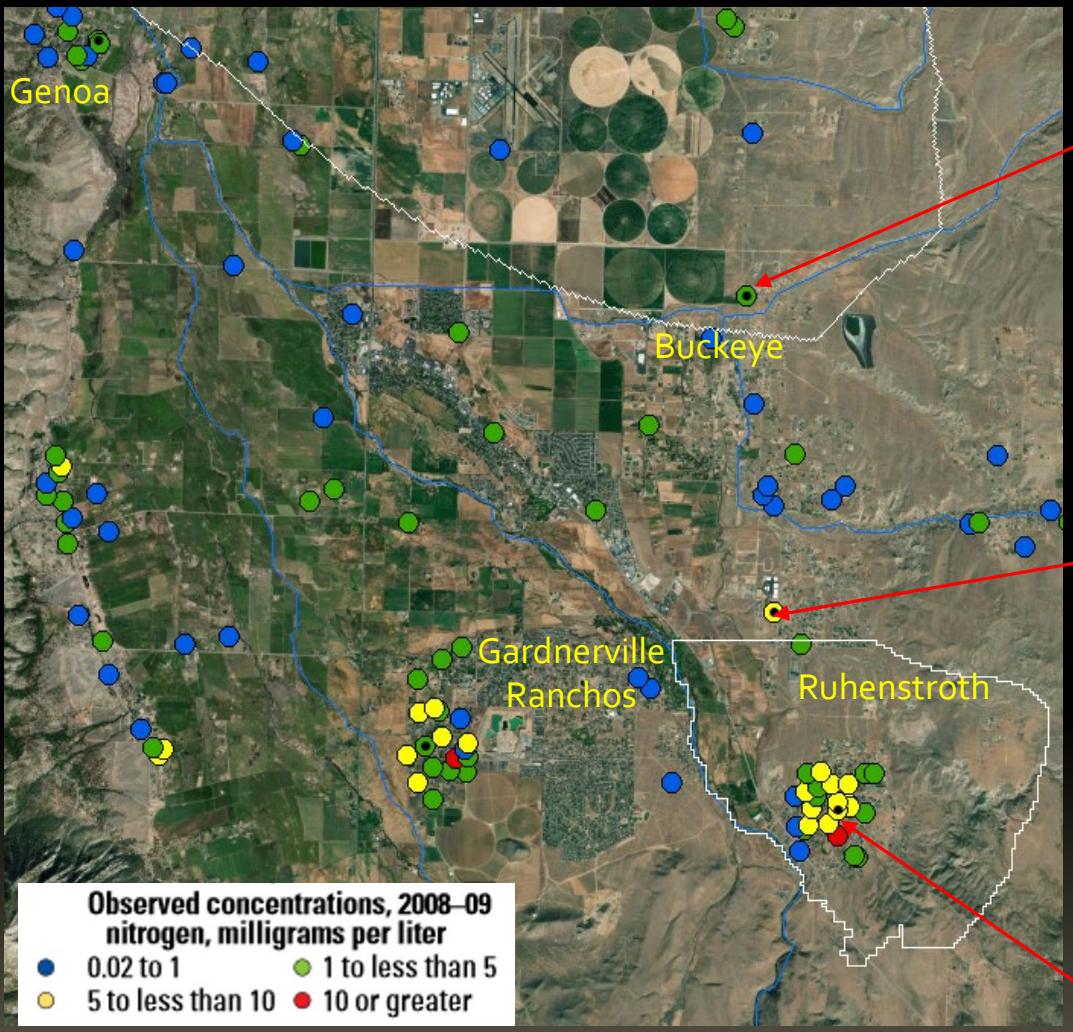
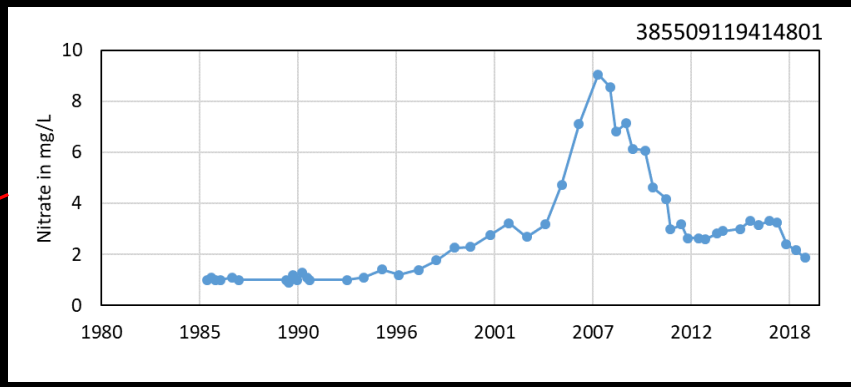
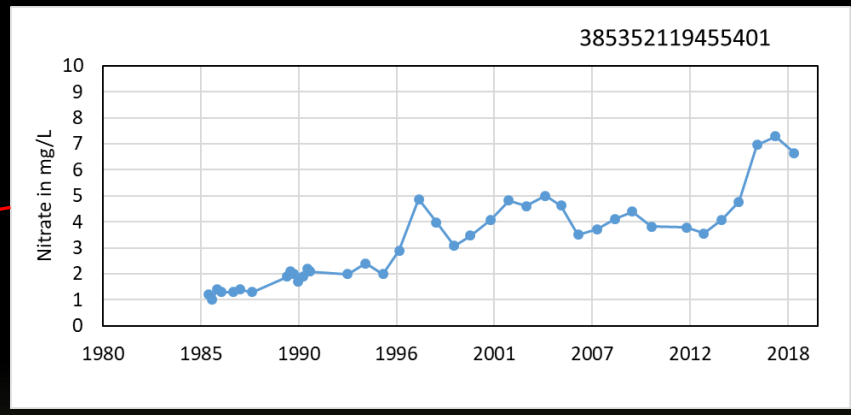
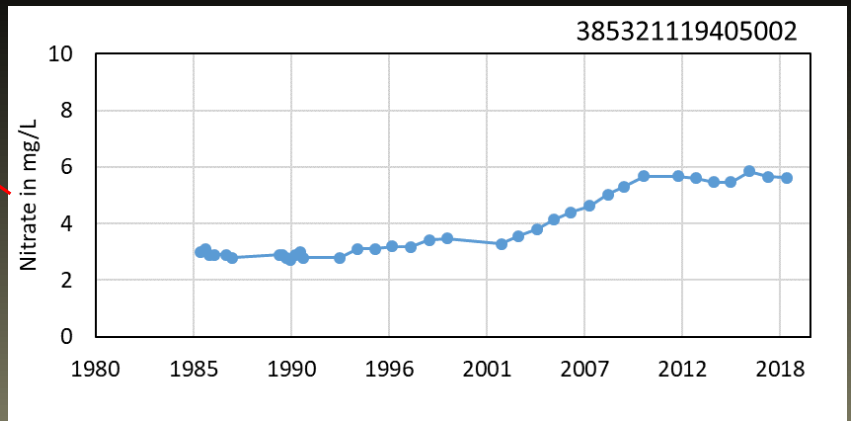
Trends in Nitrate









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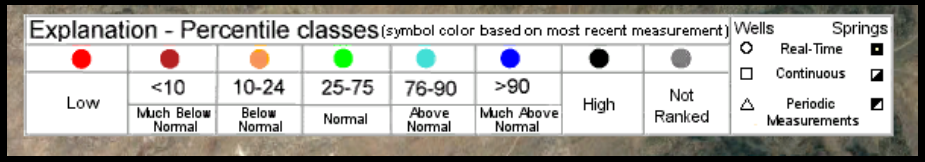
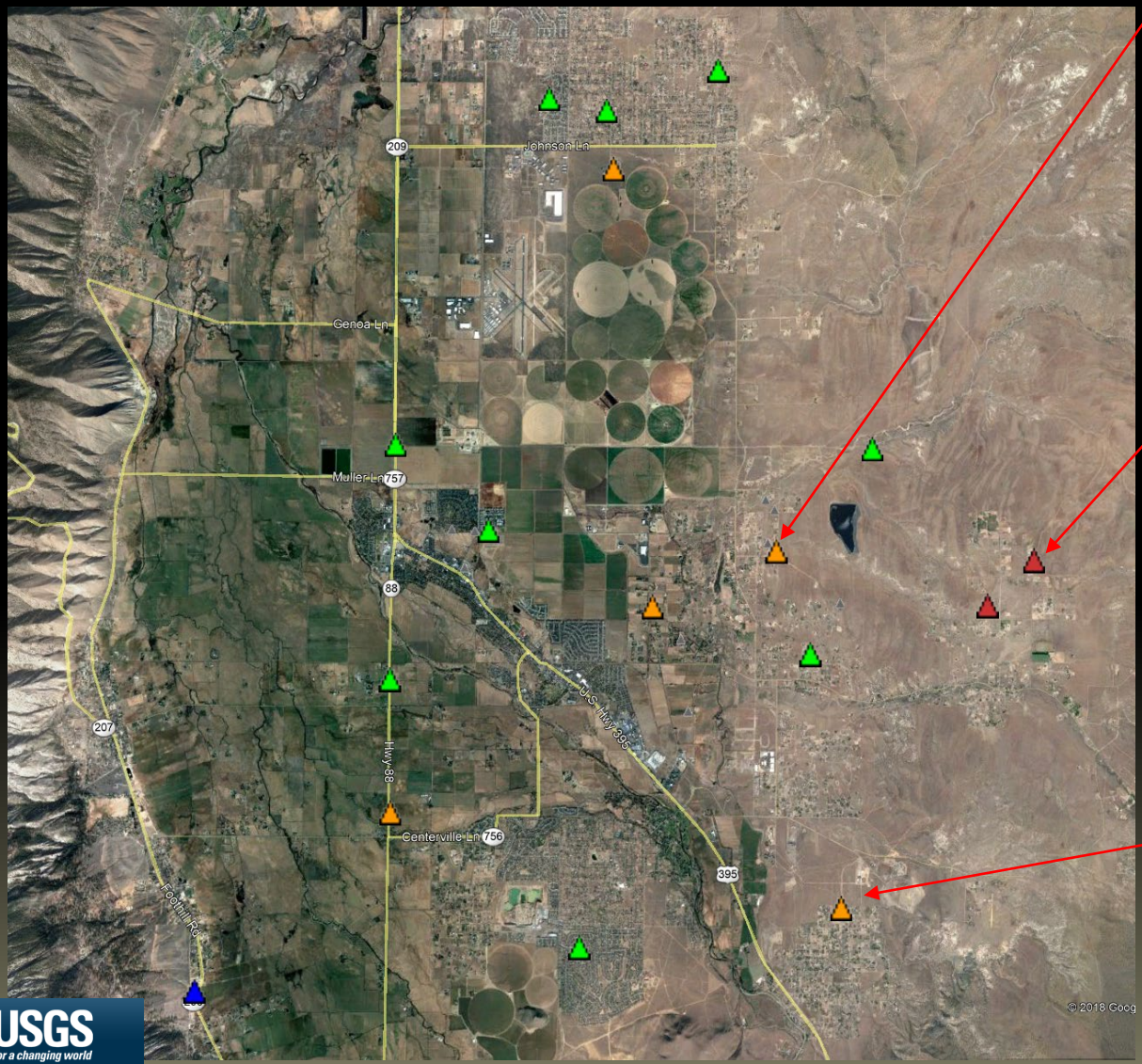
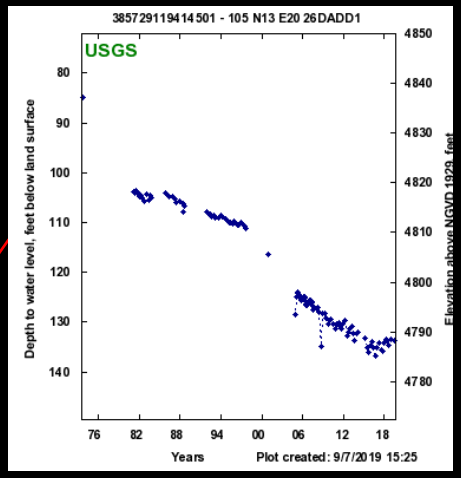
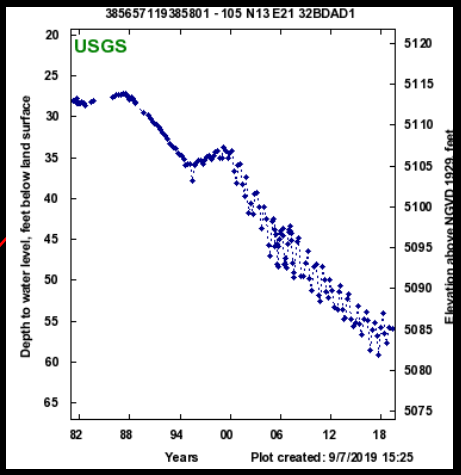
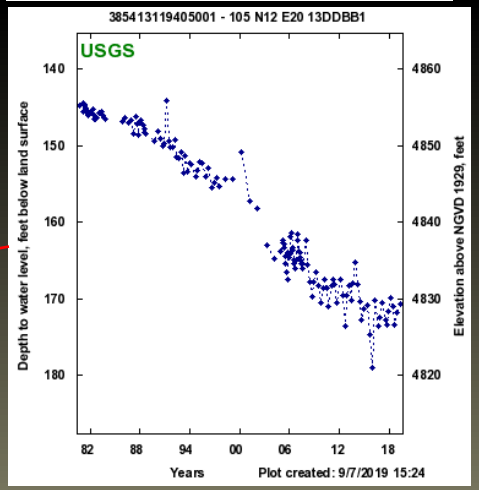
Trends in Water Levels











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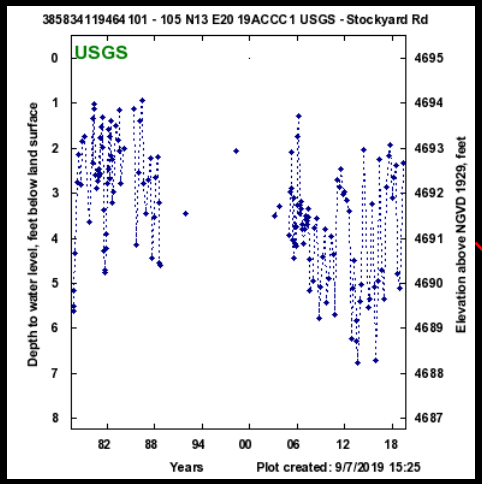

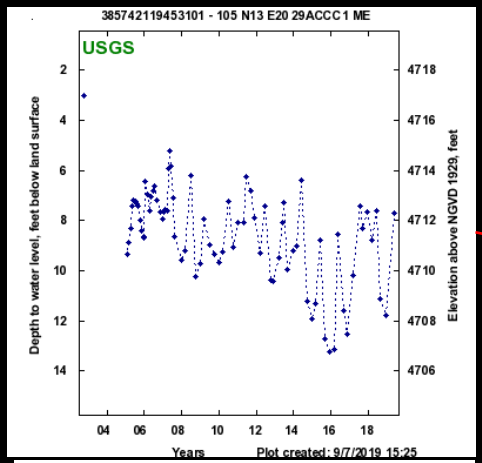

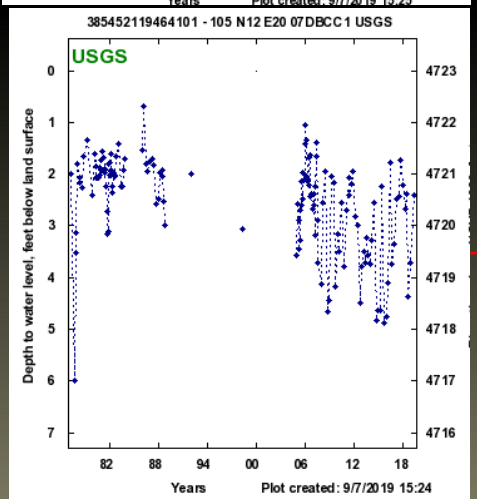

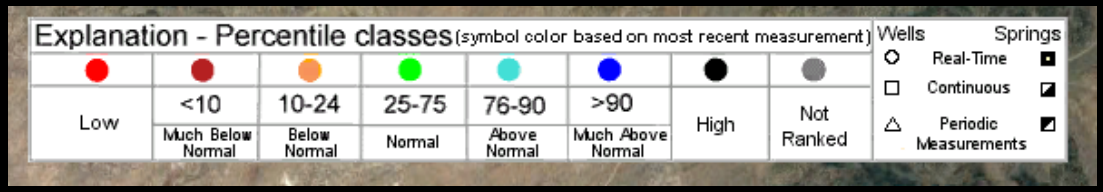

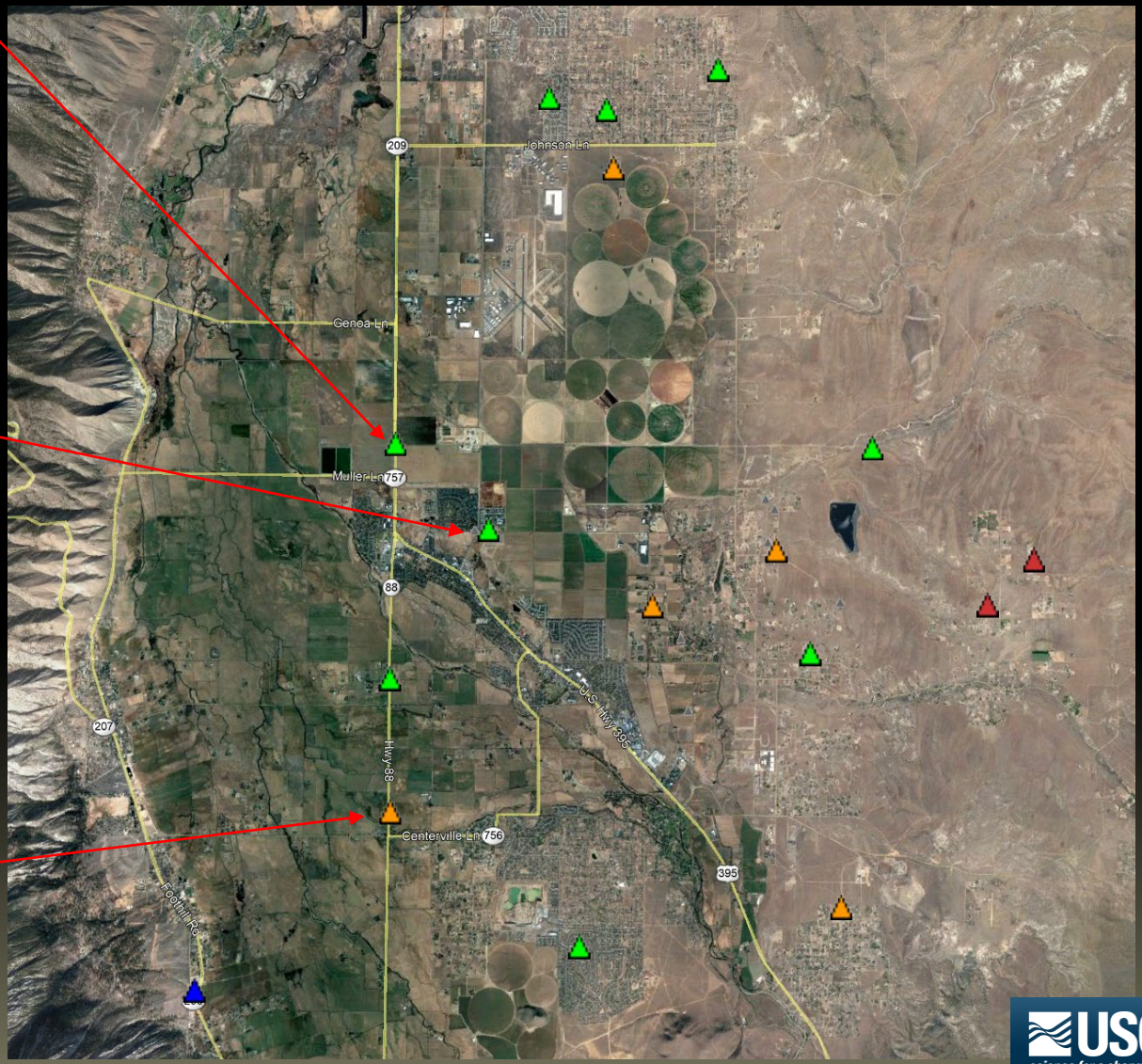

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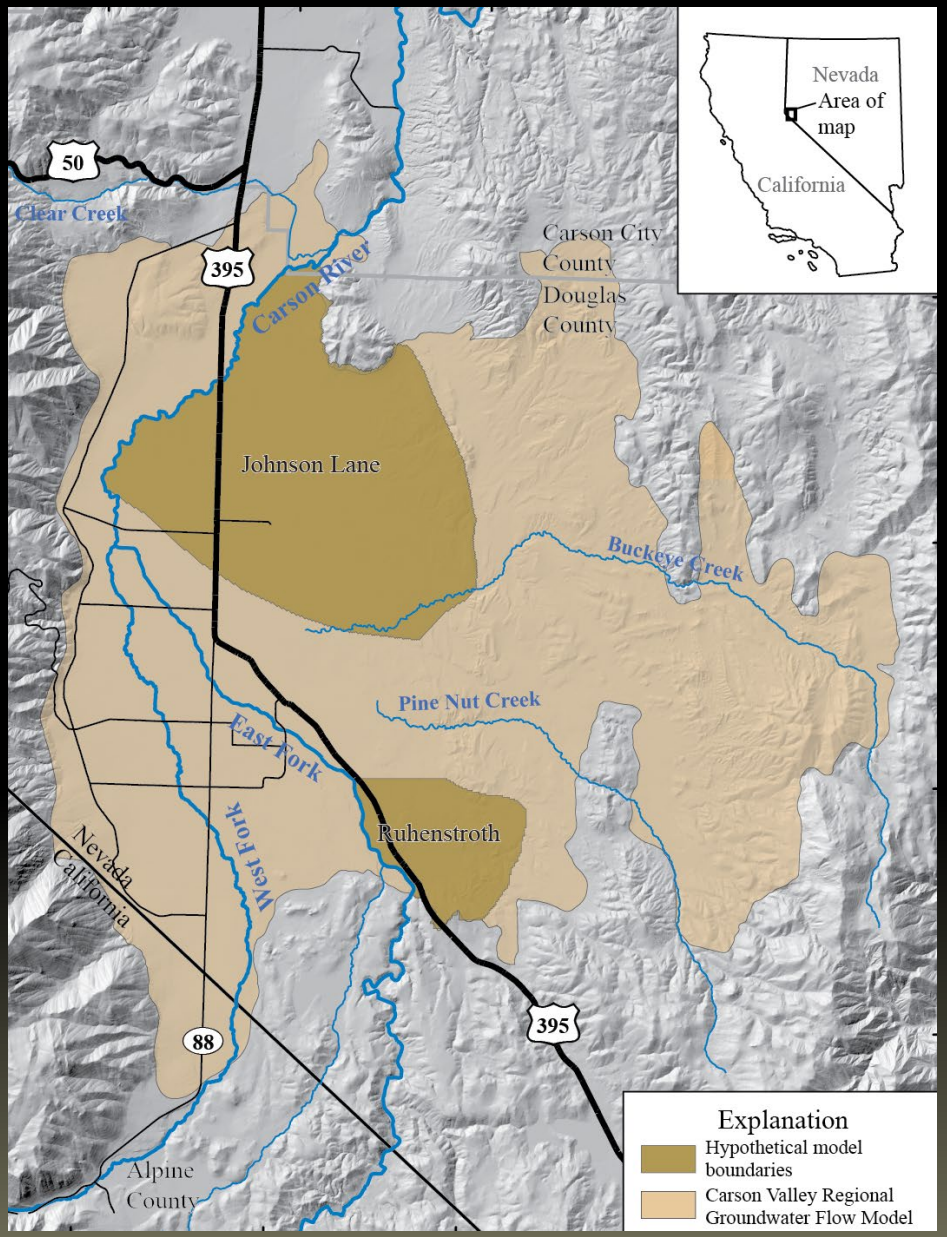
Transport Study Areas

Naranjo and others, 2013

How have concentrations changed in since 2009?



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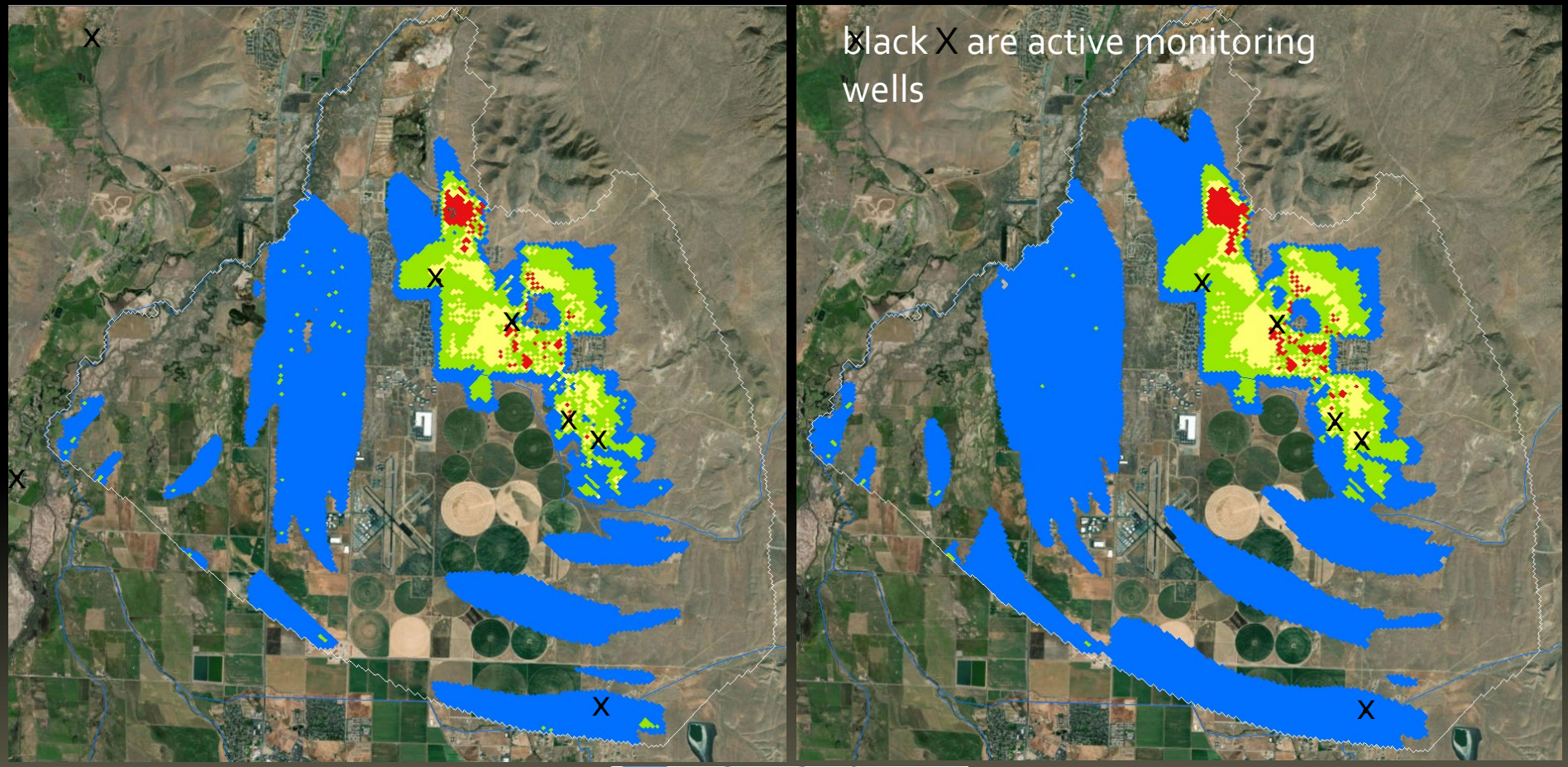
Simulated Change in Concentration – Johnson Lane

2009

2019



Naranjo and others, 2013

Information for 2019 is preliminary and subject to revision

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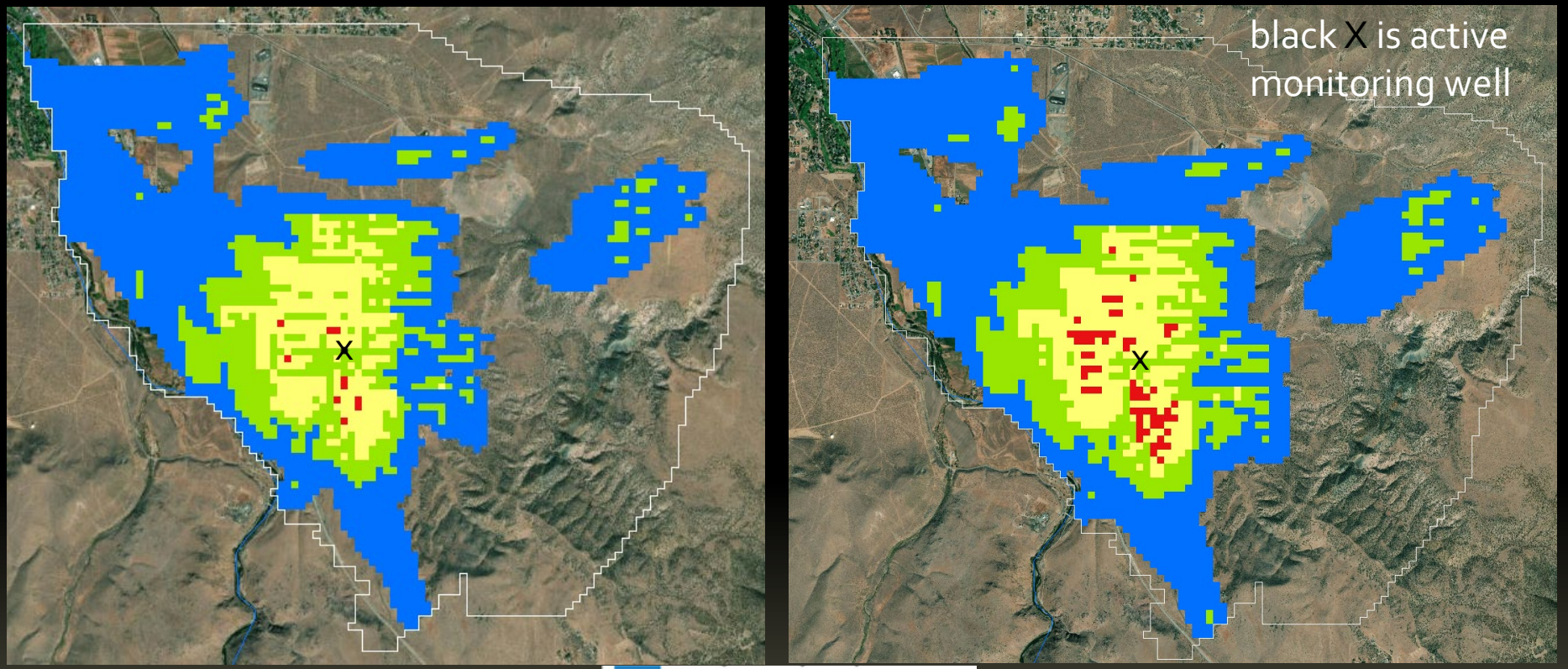
Simulated Change in Concentration - Ruhenstroth

2009

2019



Naranjo and others, 2013

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Simulated Increase in Acres > MCL
2009 to 2019

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

Information for 2019 is preliminary and subject to revision

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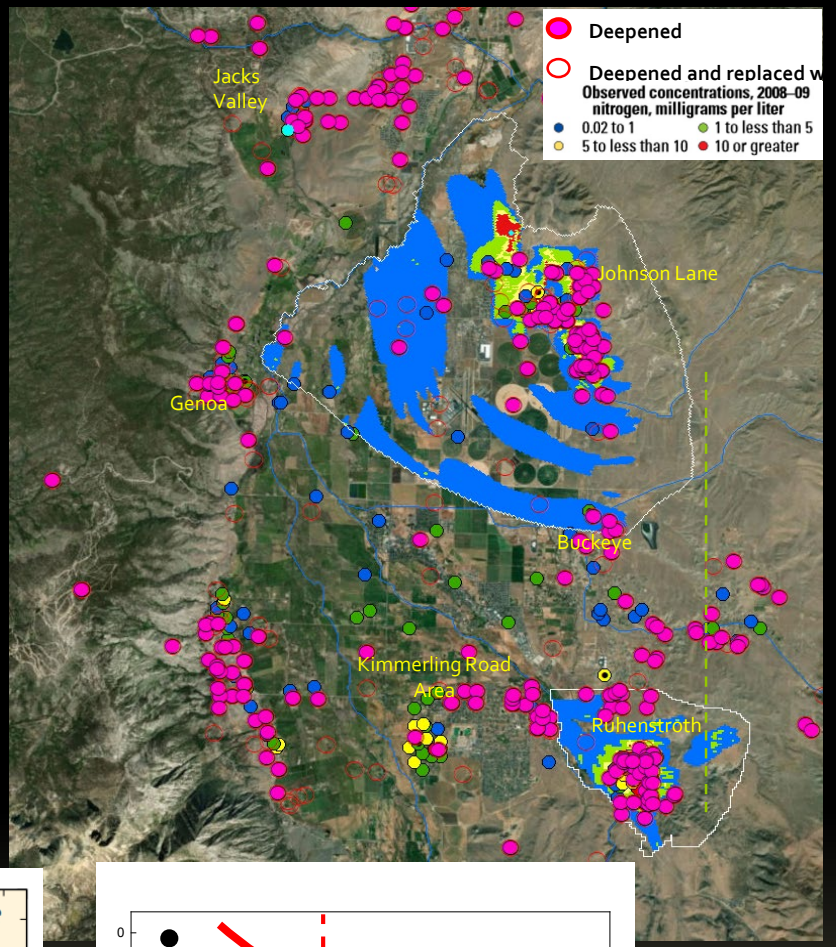
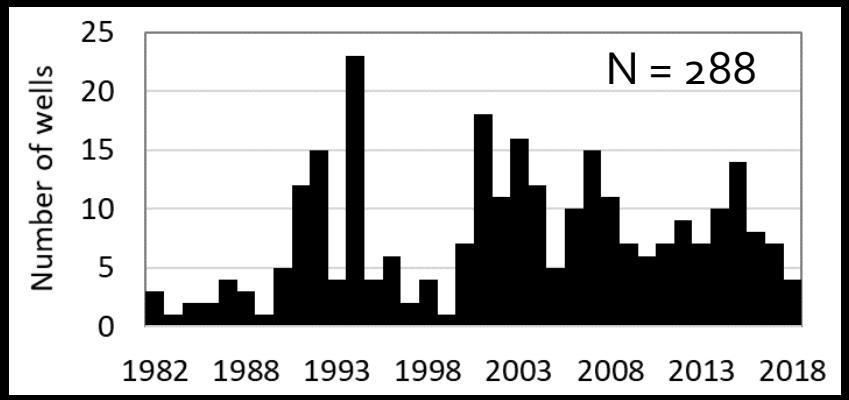
Wells Deepened and Replaced in the Carson Valley

Source: Nevada State Engineers Database





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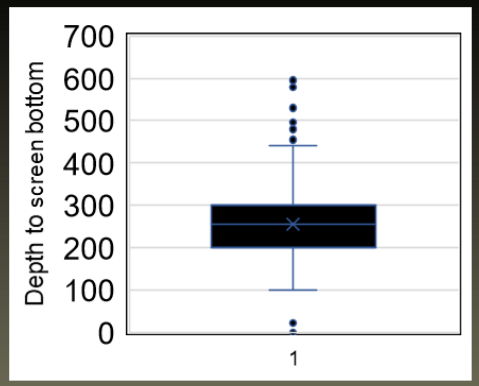

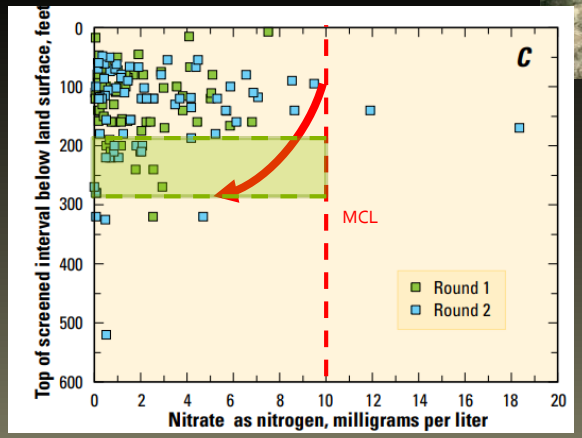

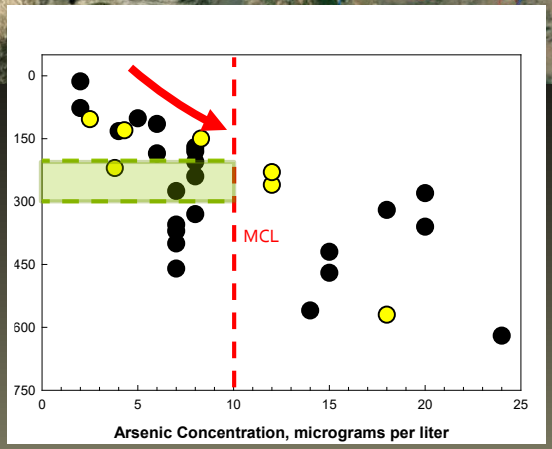

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Summary of Monitoring Data

- Nitrates 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? Should wells be added in high risk areas (domestic use wells). Include monitoring Arsenic?
- Are we collecting enough data to evaluate risk?

Summary of Nitrate Transport Model

- Transport model indicates an 1.5 (Johnson Lane) and 5.5 (Ruhenstroth) fold increase in acres with 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. This type of data could be used to evaluate changes in concentrations and evaluate transport predictions

- Revise transport model using newly refined Carson Valley model by Water for The Seasons project (Kitlasten and others, in preparation) to simulate transport in other hot spot areas