

Groundwater quality on the Fort Peck Reservation: A three-decade evaluation of nitrate extent, magnitude and sources related to land use

Meryl B. Storb and Sheree J. Watson

U.S. Geological Survey

WY-MT Water Science Center, Northern Rocky Mountain Science Center

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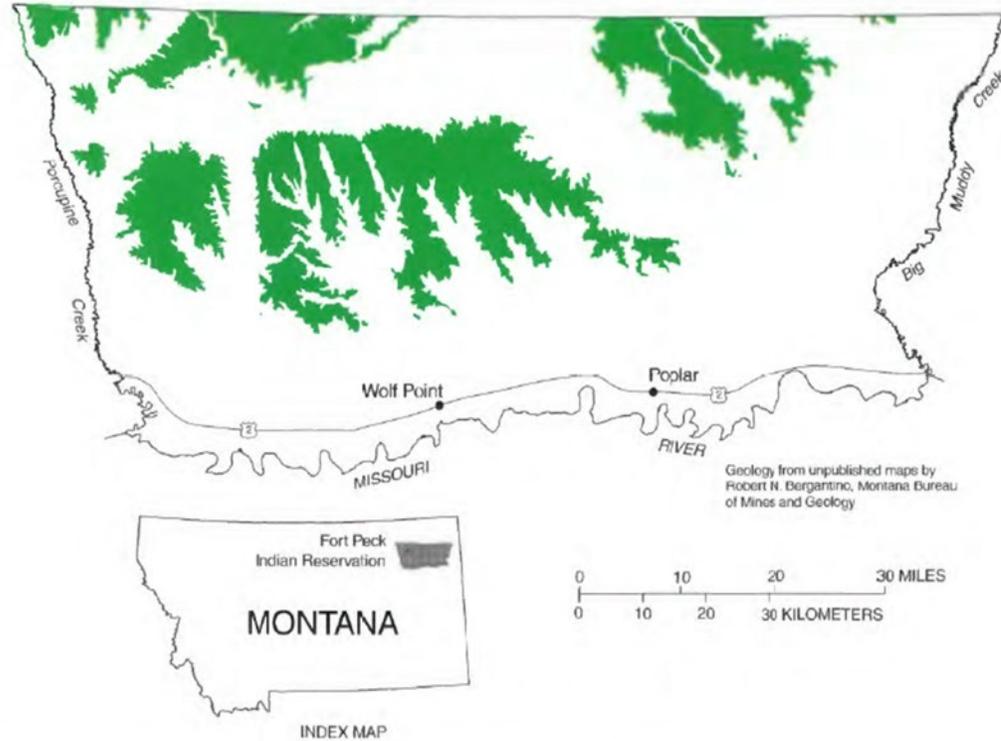
Fort Peck Tribes – Assiniboine and Sioux



- Fort Peck Agency, established in 1871 reservation was not part of original Indigenous lands
- Reservation lands ~2 million acres, 9th largest in the U.S., tribal members own ~1 million acres
- Allotment (Dawes Act) 1887-1908 opened native land to homesteaders due to prime farming and grazing lands
- Estimated 10,000 enrolled tribal members
- Oil discovered on lands in 1951 leading to oil extraction by both Tribes and private companies



Flaxville Aquifer on the Fort Peck Reservation

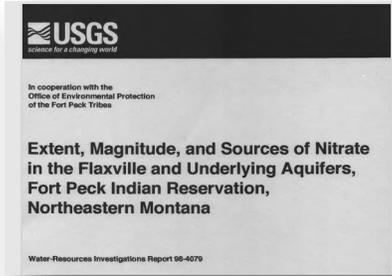


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Investigating relationship between dryland agriculture and elevated nitrate in groundwater

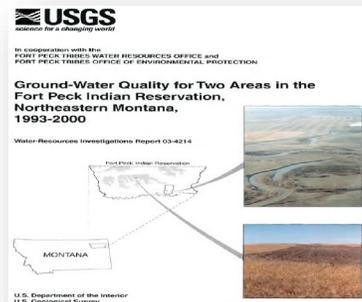
1998



1979

Fort Peck Tribes reached out to USGS regarding some occurrences of blue babies in and around the reservation

2003

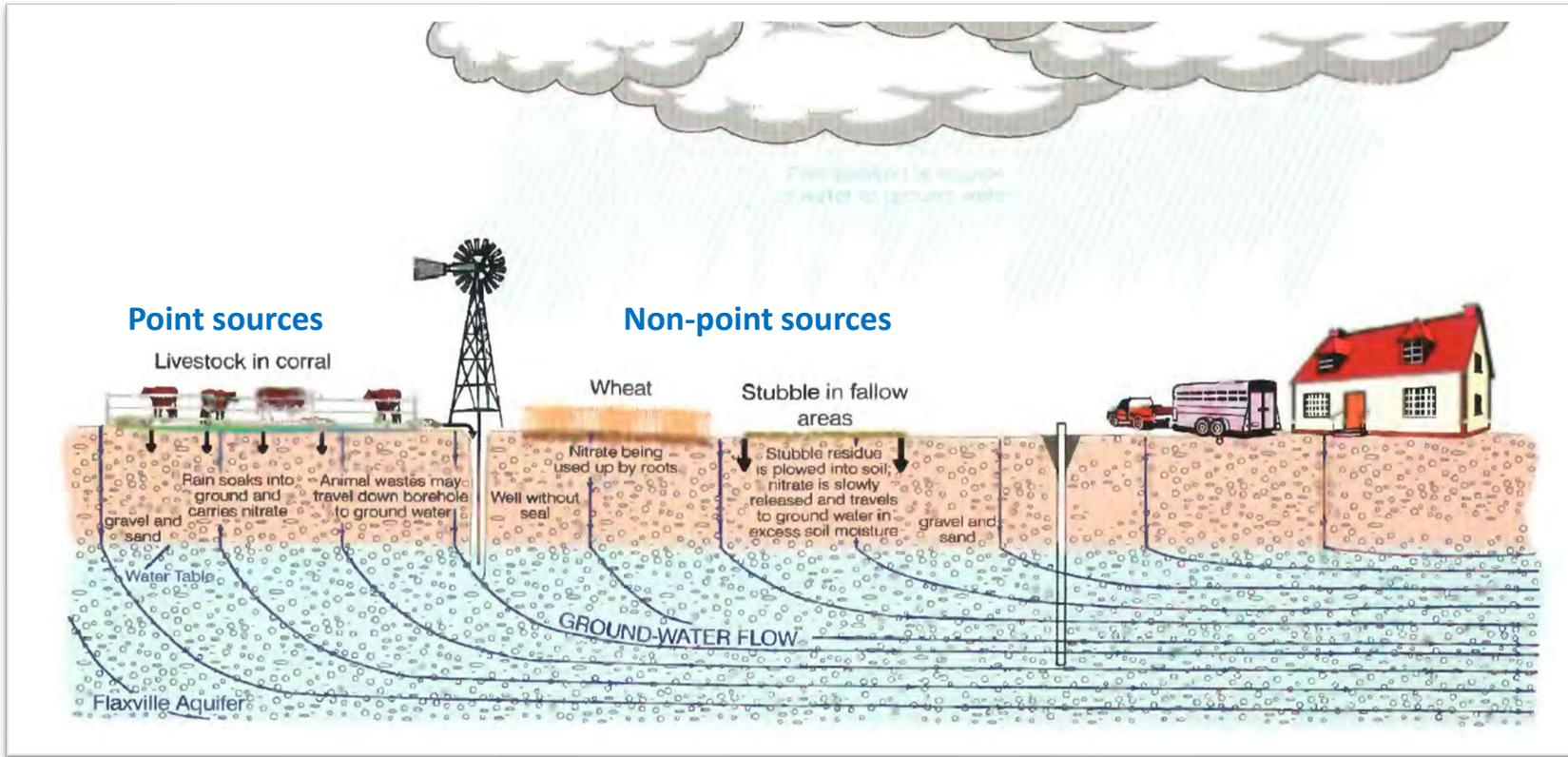


Major Findings:

- Nitrate concentrations above 10 mg L⁻¹ in 84% wells sampled in the Flaxville aquifer
- δ¹⁵N_{NO3} values support soil organics from crop fallow as main source of nitrate
- Dryland farming (crop-fallow) and livestock sources of nitrate to groundwater
- Groundwater age ranges from 6-30 years
- Seasonal nitrate concentrations had minimal changes

2019

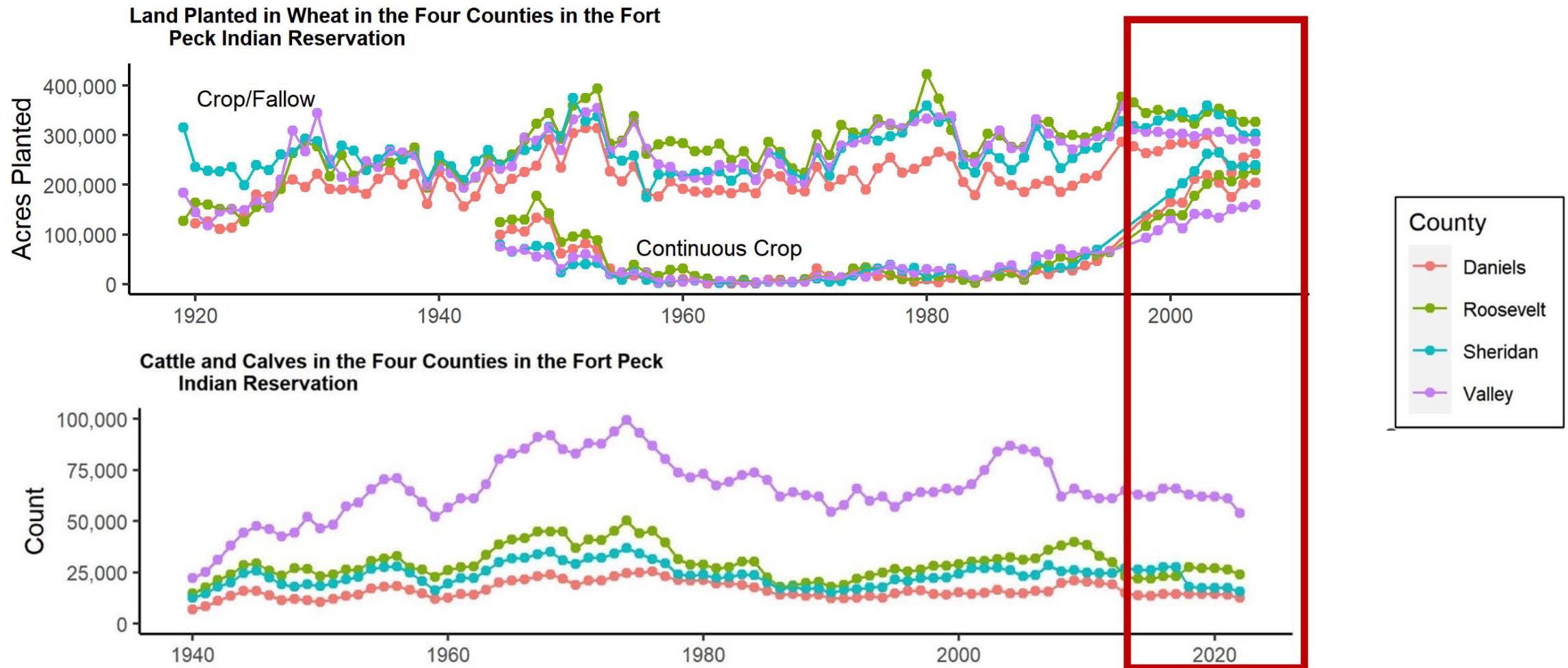
Potential sources of nitrate from agriculture



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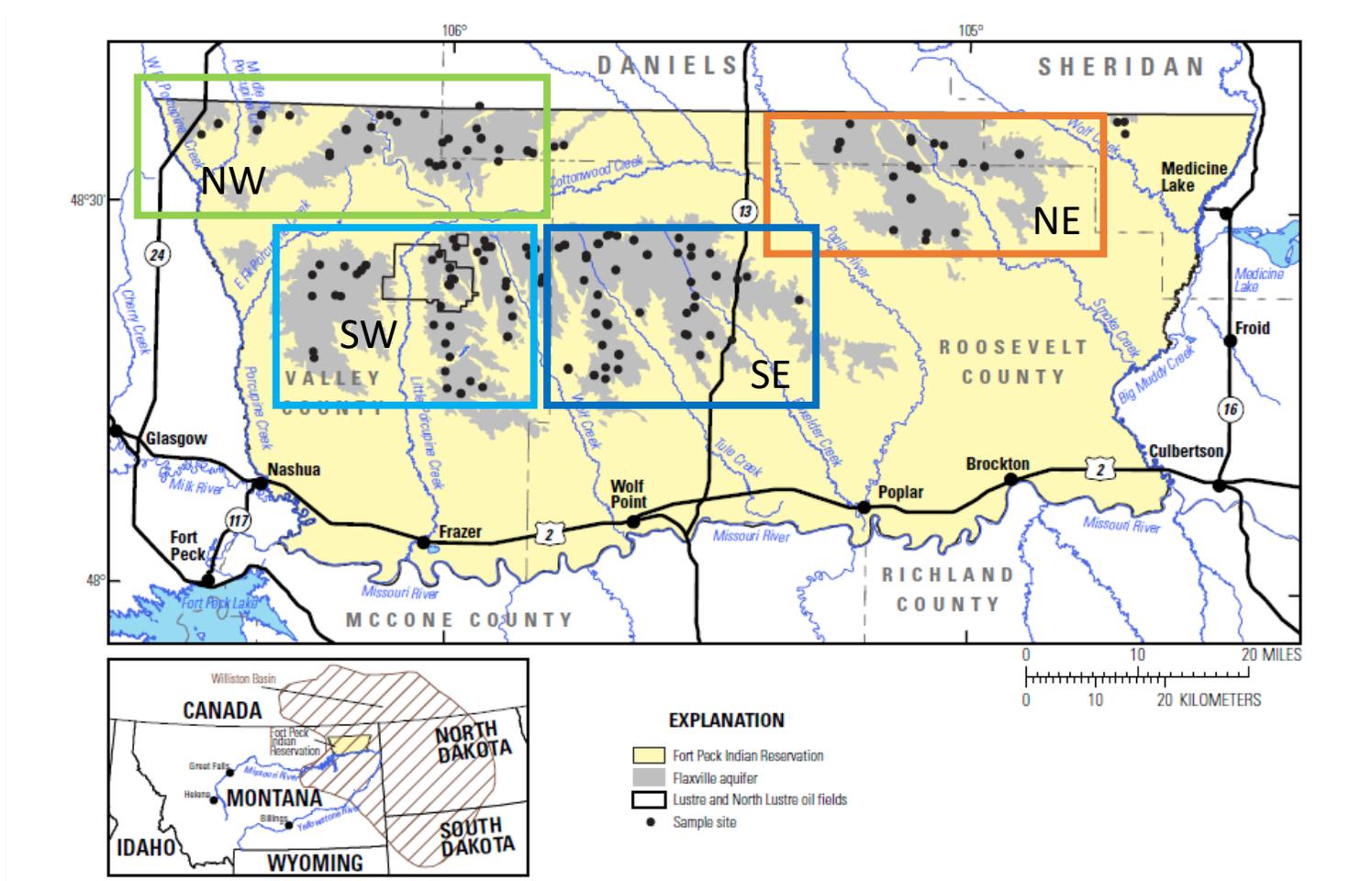
Less crop-fallow and livestock motivated study in 2019



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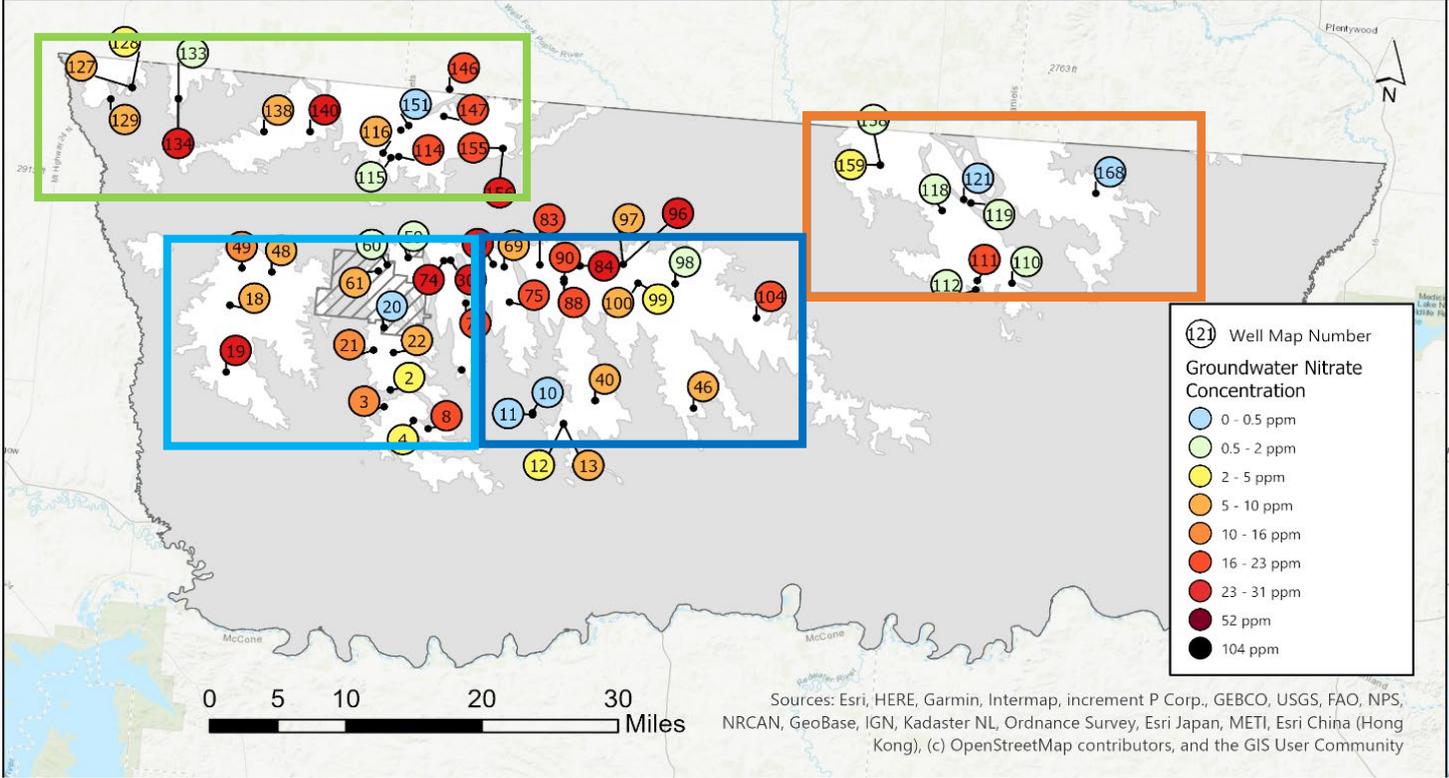
Study initiated in 2019 – 2023 to reevaluate nitrate



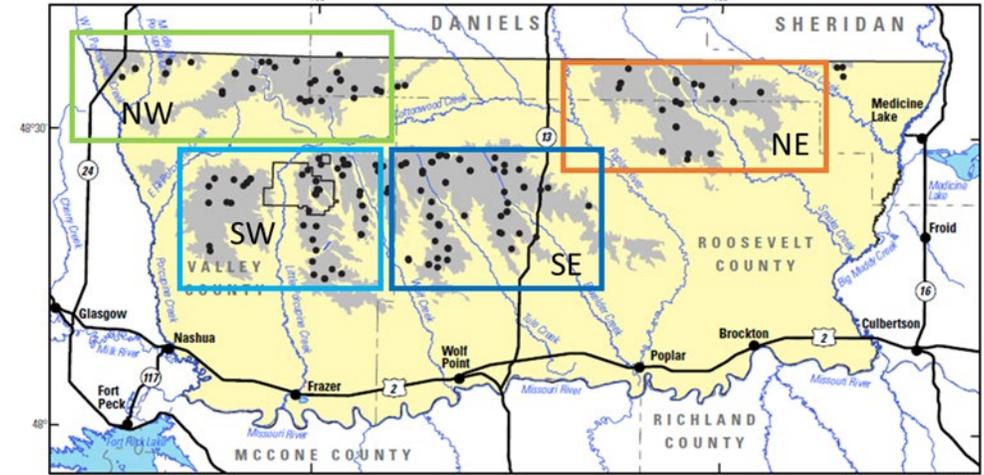
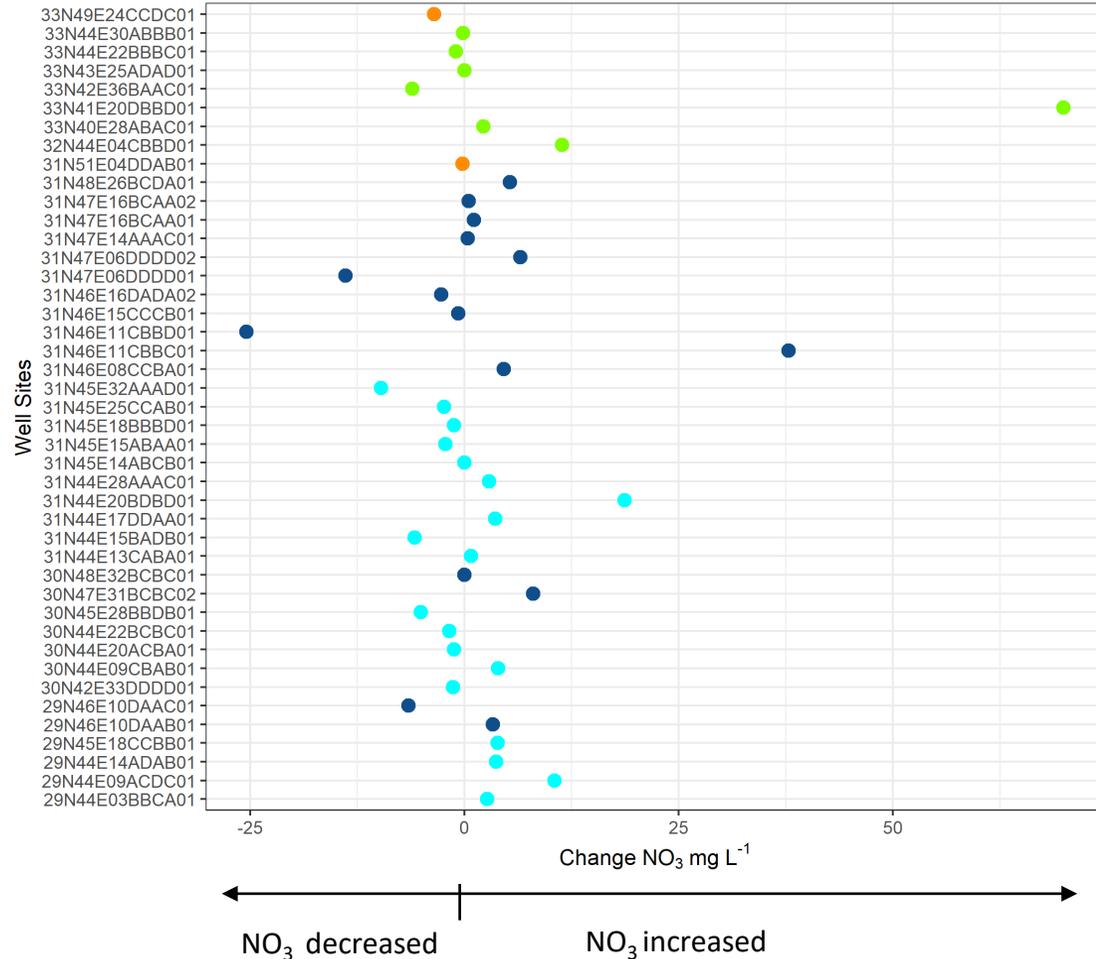
- Inventoried 200+ well sites (domestic and stock) from initial study
- 57 wells sampled
- Samples analyzed for nutrients, major ions, age dating, N isotopes
- Wells were divided up into lobes (colors) to compare spatial differences

Nitrate concentrations vary but high (orange and red)

First Sample Period 1989 - 1999



Nitrate concentrations not significantly different over 20+ years



Number of sites = 43

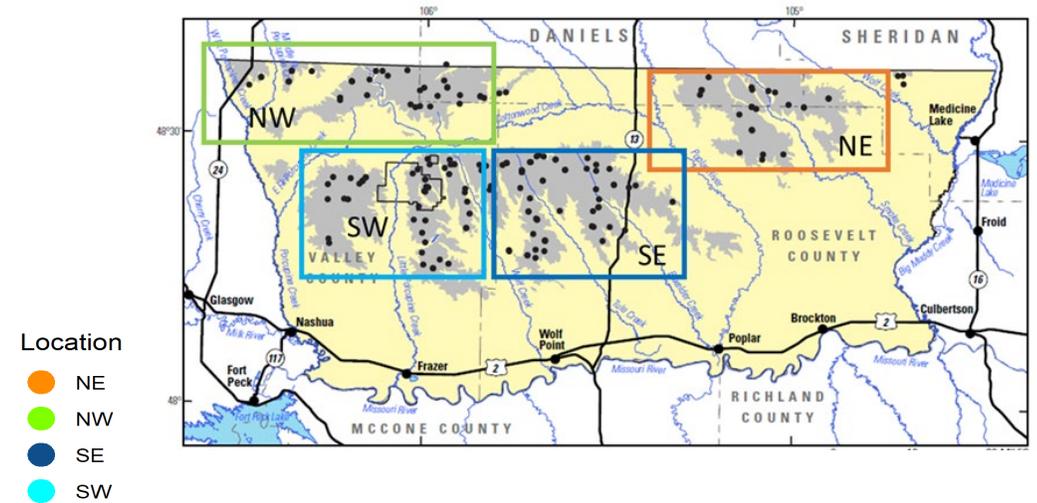
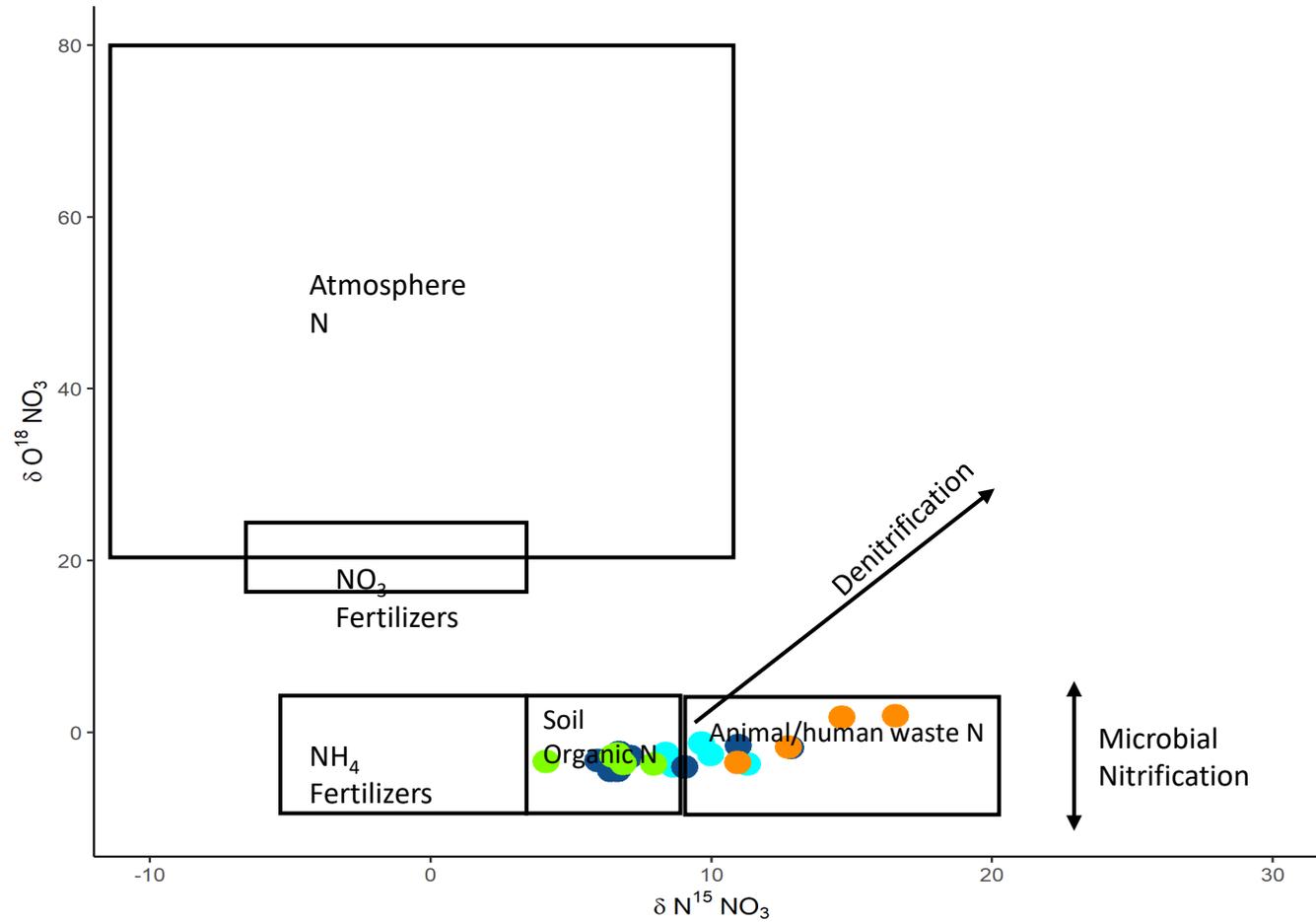
Wilcoxon-Pratt signed-rank test pvalue = 0.398

Modified sign p-test value = 0.850

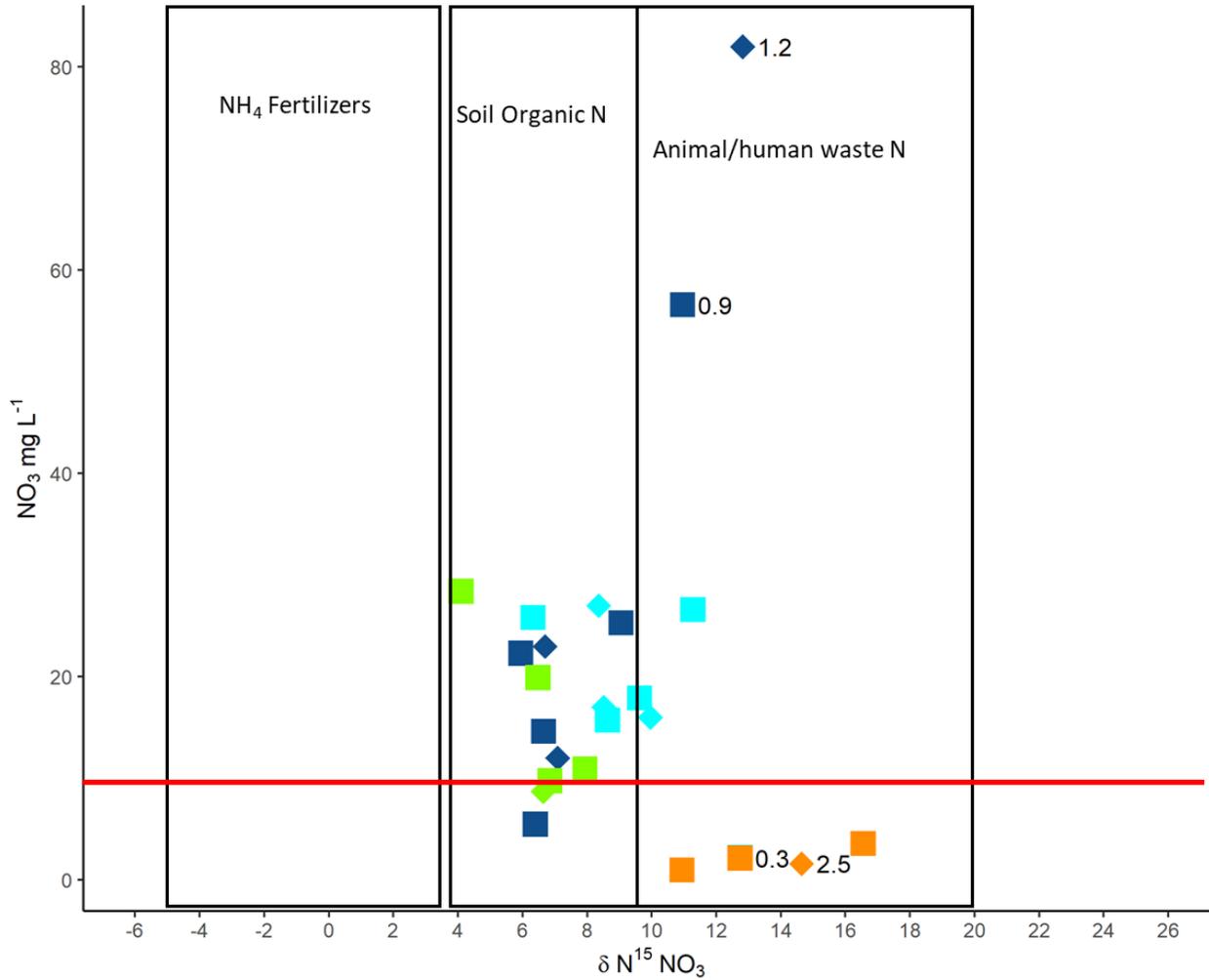
1990s sampled wells – 56% above MCL

2021 sampled wells – 58% above MCL

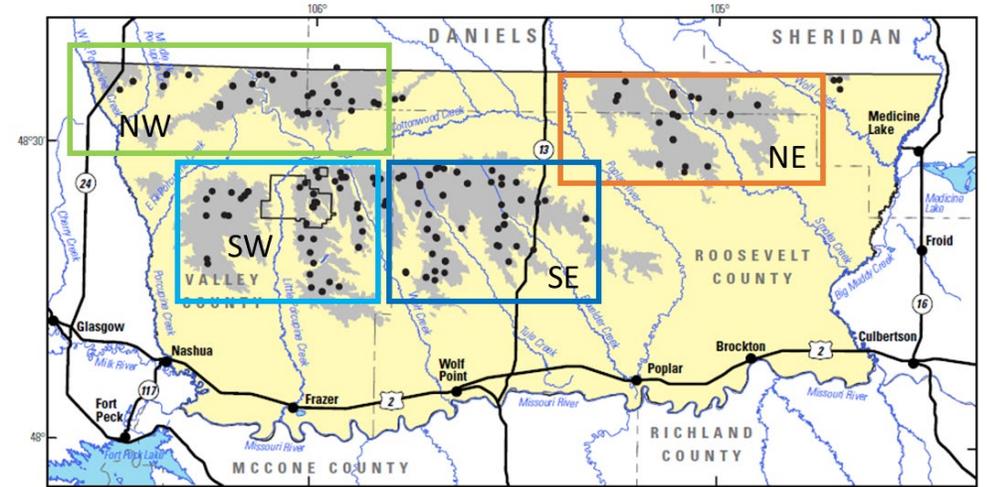
Sources of nitrate still soil organics and animal waste



Geographic differences in nitrate sources

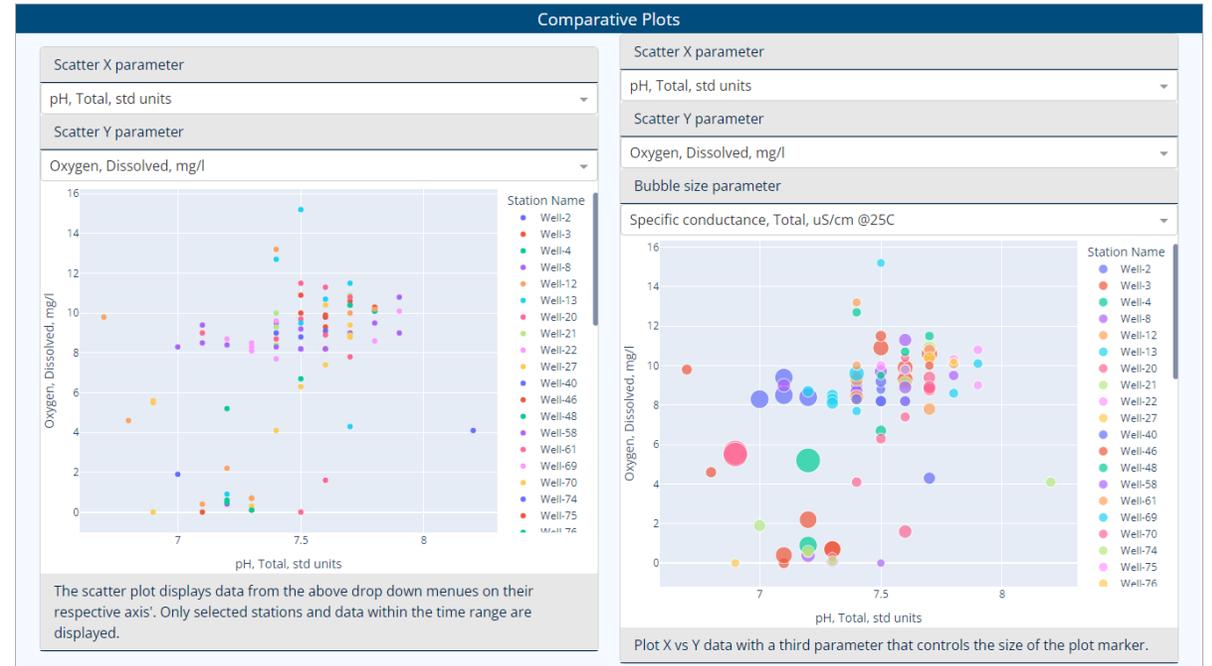
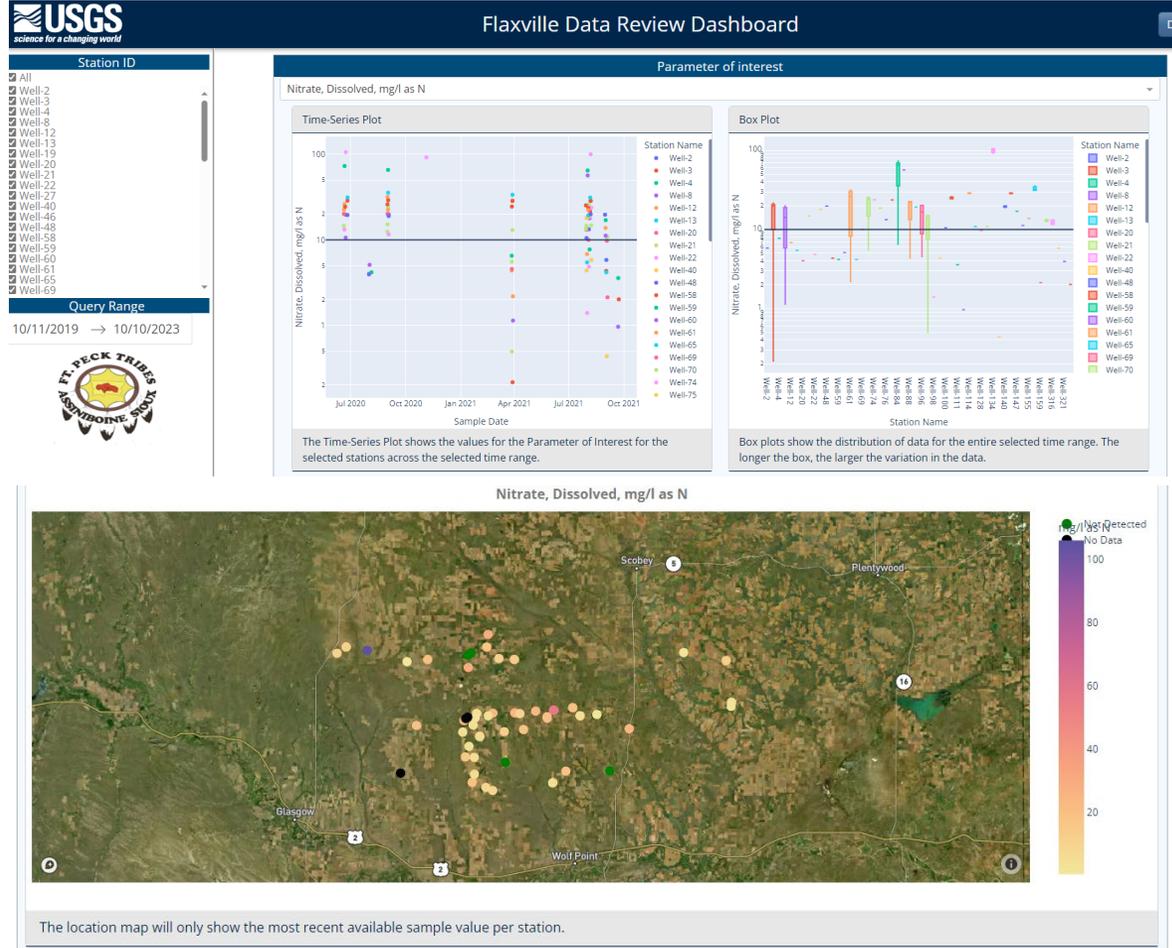


- Location
- NE
 - NW
 - SE
 - SW
- Year
- ◆ 1995
 - 2021



EPA Maximum Contaminant Level (MCL)
 10 mg L^{-1}

Data Visualization created for Fort Peck



Key Takeaways: not much has changed in 20 years

- Change in nitrate concentrations varied spatially
- Nitrate still exceeds standard (10 mg L^{-1}) in >50% of wells sampled
- Soil organics are still primary source of nitrate in most areas, NE area primarily animal waste sourced
- Continuous cropping has increased but total acreage of cropland has also increased
- Water in the Flaxville and other shallow aquifers may be older than anticipated



Questions or Comments

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