Comparing
Results of a Survey of Well Water Quality
with
Archived Homeowner-Submitted Well Water Samples

- or -

"A Call to Action" x 2

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Introduction

Introduce the 2017 Portage County Well Water Quality Survey: *the survey's purpose, procedures, and results.*

Discuss reporting of the survey's results: *ground-water making headlines.*

Introduce the Center for Watershed Science & Education's Private Wells Database: *an ongoing "crowdsourced" well water quality survey.*

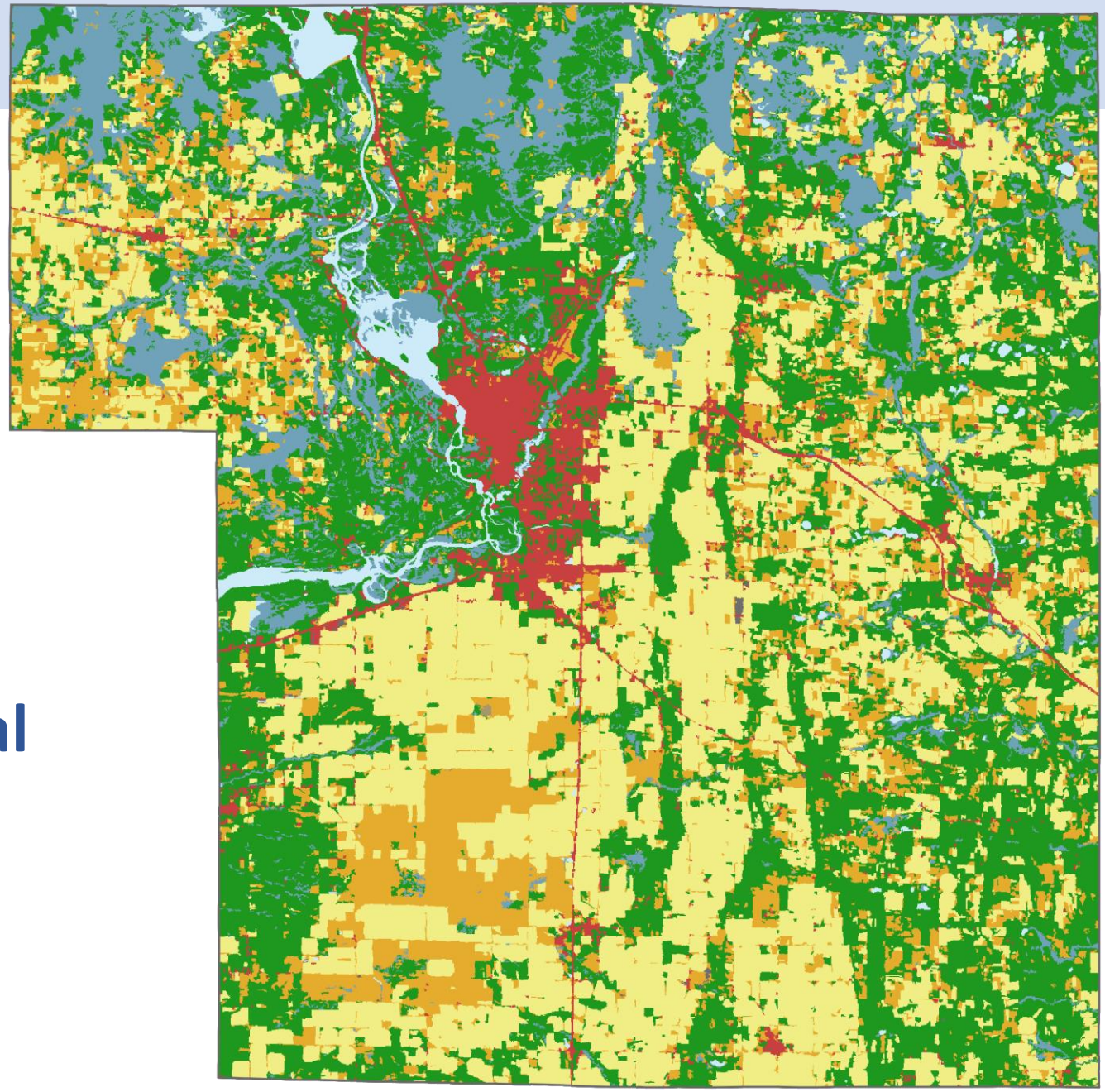
Compare the survey and database: *do differing sampling strategies, sample sizes, and sample collection periods yield differing results?*

Portage County

Part of Wisconsin's **"Central Sands"** region.

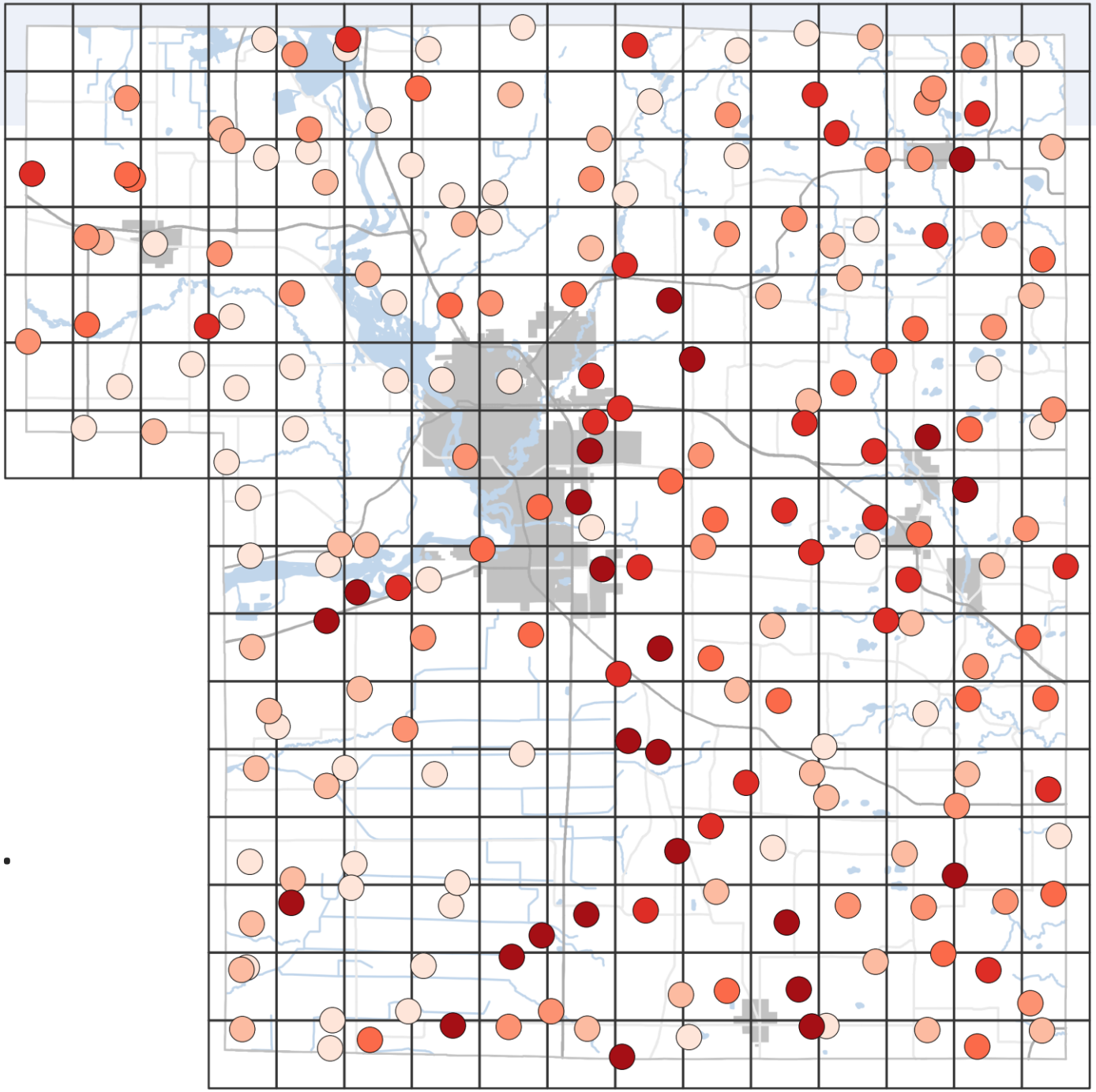
Uppermost aquifer composed of **unconsolidated sand and gravel**; serves as the county's primary aquifer.

Landscape primarily **agricultural** or **forested**.



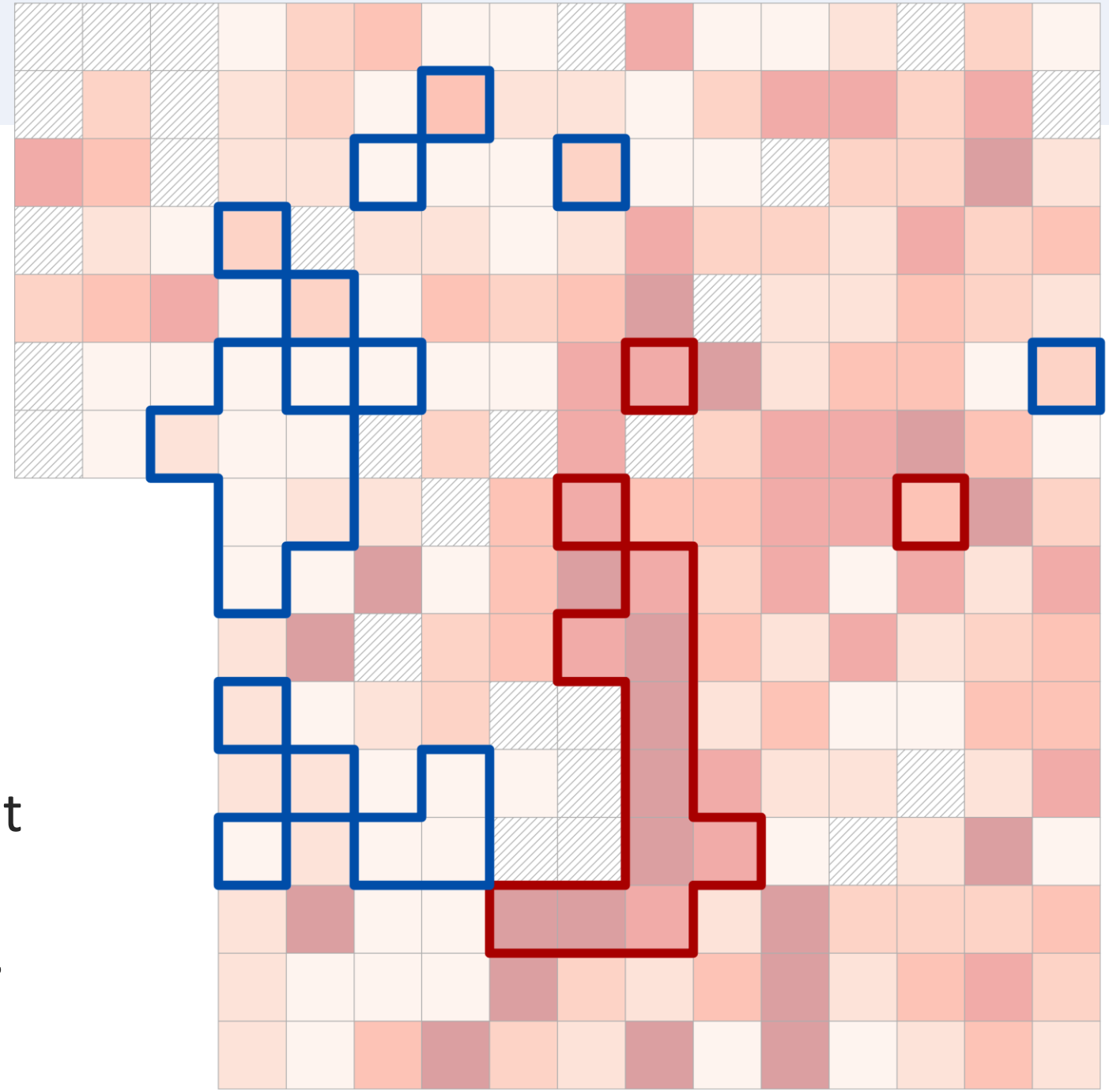
Well Water Survey

- Collaboration with **Portage County** government.
- **Stratified sampling** strategy. County divided into **229 4-square-mile cells**.
- Samples collected **6** to **9/2017**.
- Samples processed at **Water & Environmental Analysis Lab**.
- 6 **"Homeowners Package"** analytes tested.



Well Water Survey

- Observations: **214**
- Minimum: **<0.1**
- Maximum: **44.1**
- Mean: **6.5 ±1.2**
- Standard Deviation: **8.9**
- % Exceeding Standard: **24.3%**
- Moran's I: **0.2265**
  Weak, but statistically significant positive global spatial auto-correlation (*pseudo p* = 0.0001).



Stevens Point Journal
PART OF THE USA TODAY NETWORK

Portage County Water Study Finds Nitrates above Safe Levels in Quarter of Wells

Alan Hovorka. Nearly a quarter of tested wells in Portage County exceed safe drinking water standards for nitrates, according to a new county study. … It was the first comprehensive study of well water in the county's history …

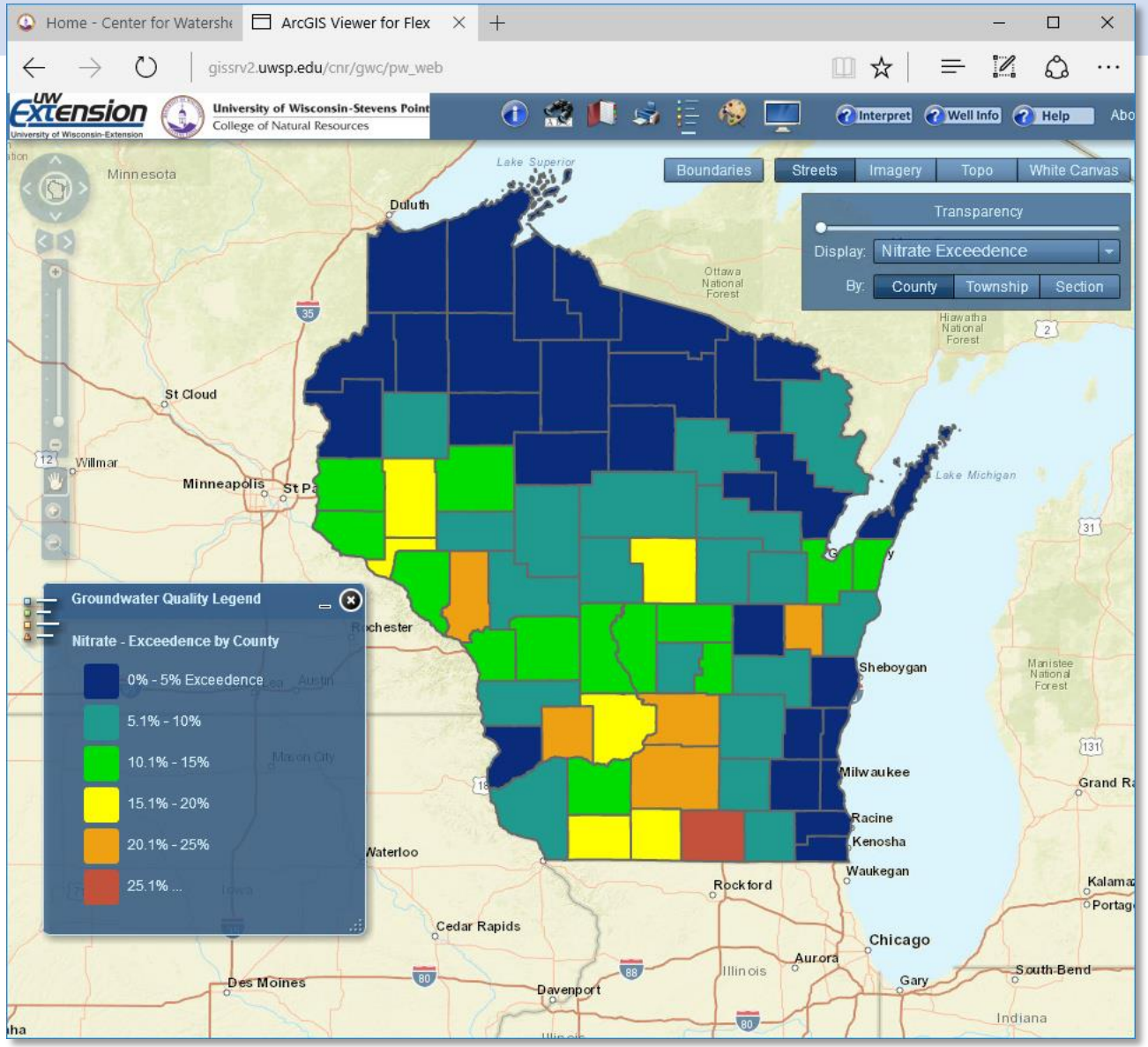
The Portage County Gazette

Some County Wells over Safe Nitrate Levels

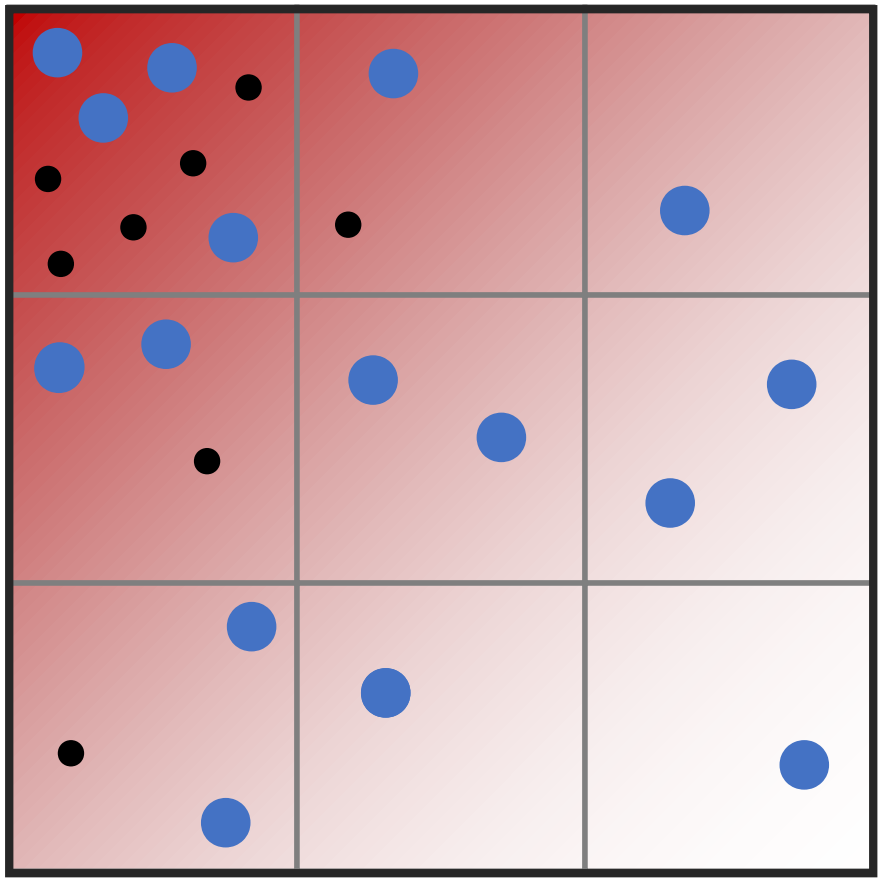
Heather McDonald. Results of the first Portage County-wide well sampling show about a quarter of those wells have higher than standard safe levels of nitrates, an element that could affect health. On the flip side, just more than a quarter had no nitrates detected. …

Private Wells Database

- Archives samples processed at the **Water & Environmental Analysis Lab**.
- Contains **99,546** samples and **844,317** analyses.
- Covers **6/1972** to the present, and all **72 counties**.
- Primary dataset behind the **Well Water Quality Viewer**.
- **"Crowdsourced"** dataset.



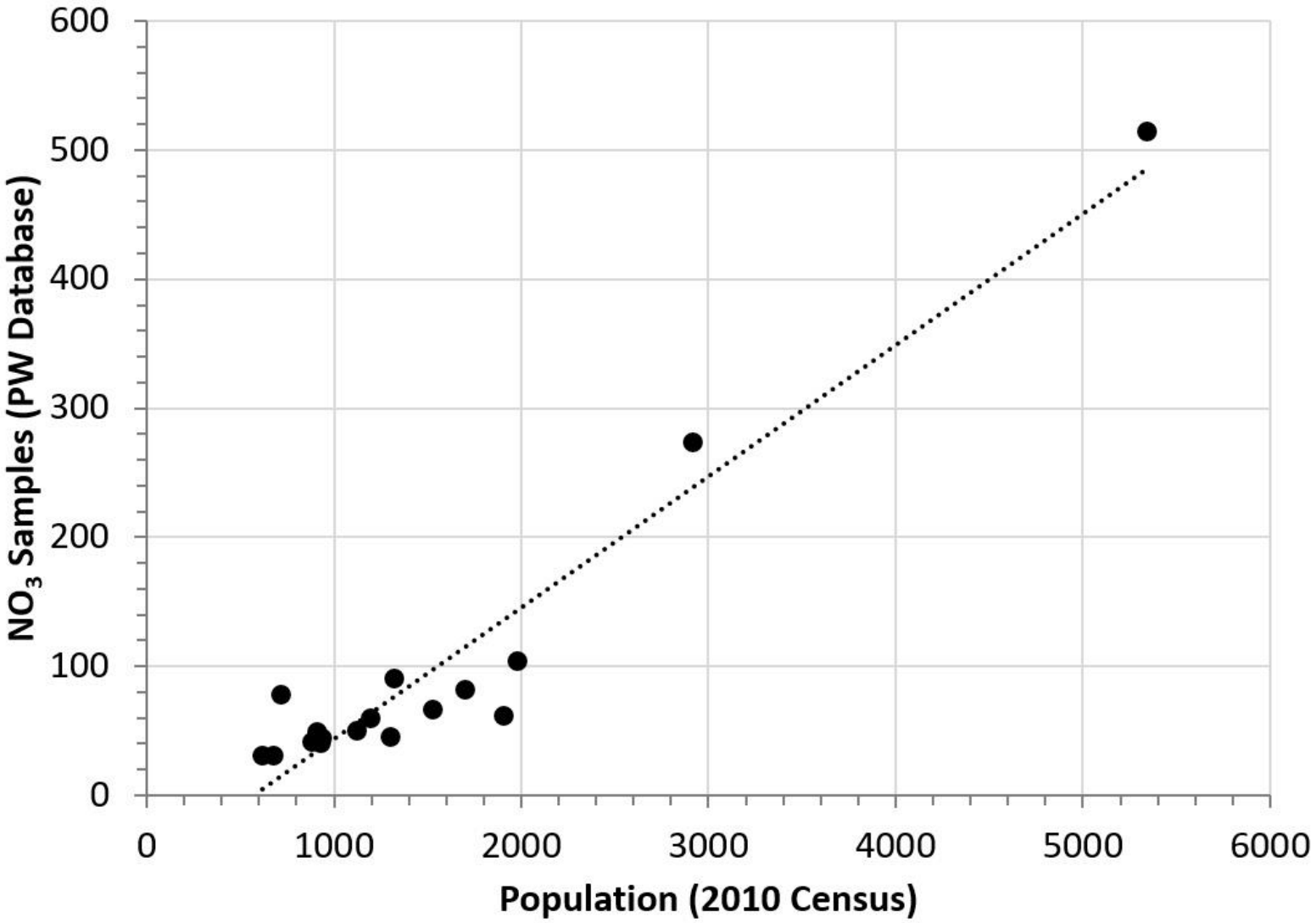
Stratified vs Simple Random Sampling



- Strategy selected for a study must yield a sample representative of the real-world phenomenon in question.
- Stratified sampling yields a sample representative of the county's ground-water.
- Simple random sampling yields a sample representative of the county's wells.
- In this scenario, summary statistics are higher for the simple random sample.

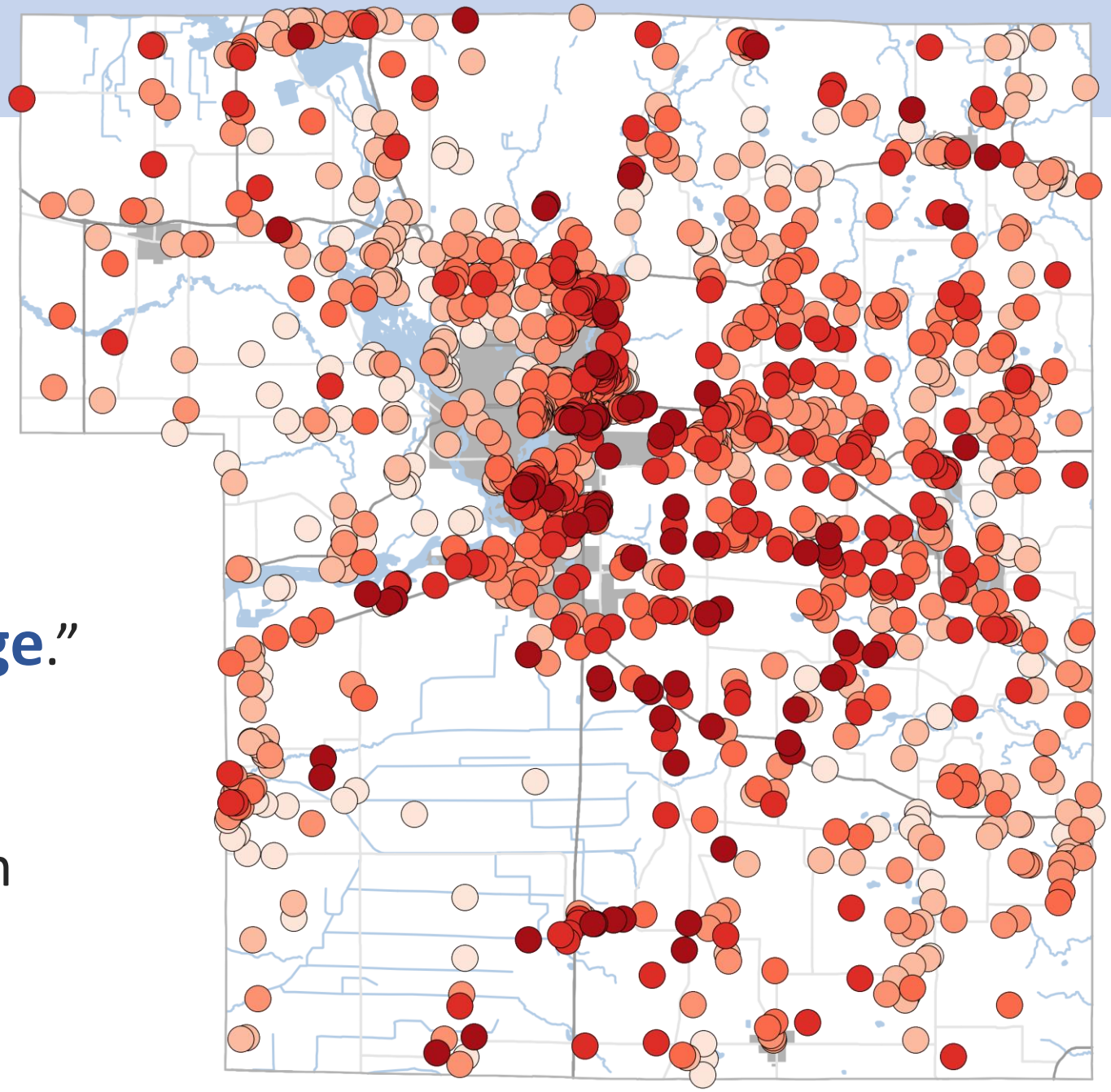
Stratified vs Simple Random Sampling

- In Private Wells Database, strong linear relationship between number of NO_3 samples from each of 17 civil towns and the towns' populations.
- m: **0.102**
  Approximately 1 sample for every 10 additional residents.
- r^2: **0.925**



Wells Database

- Examined the period **1/2010** to **12/2017**.
- Located samples to **parcels** (81%).
- For most samples, NO_3 tested as part of "**Homeowners Package**."
- Treated samples excluded.
- Results of multiple samples from single parcels averaged.

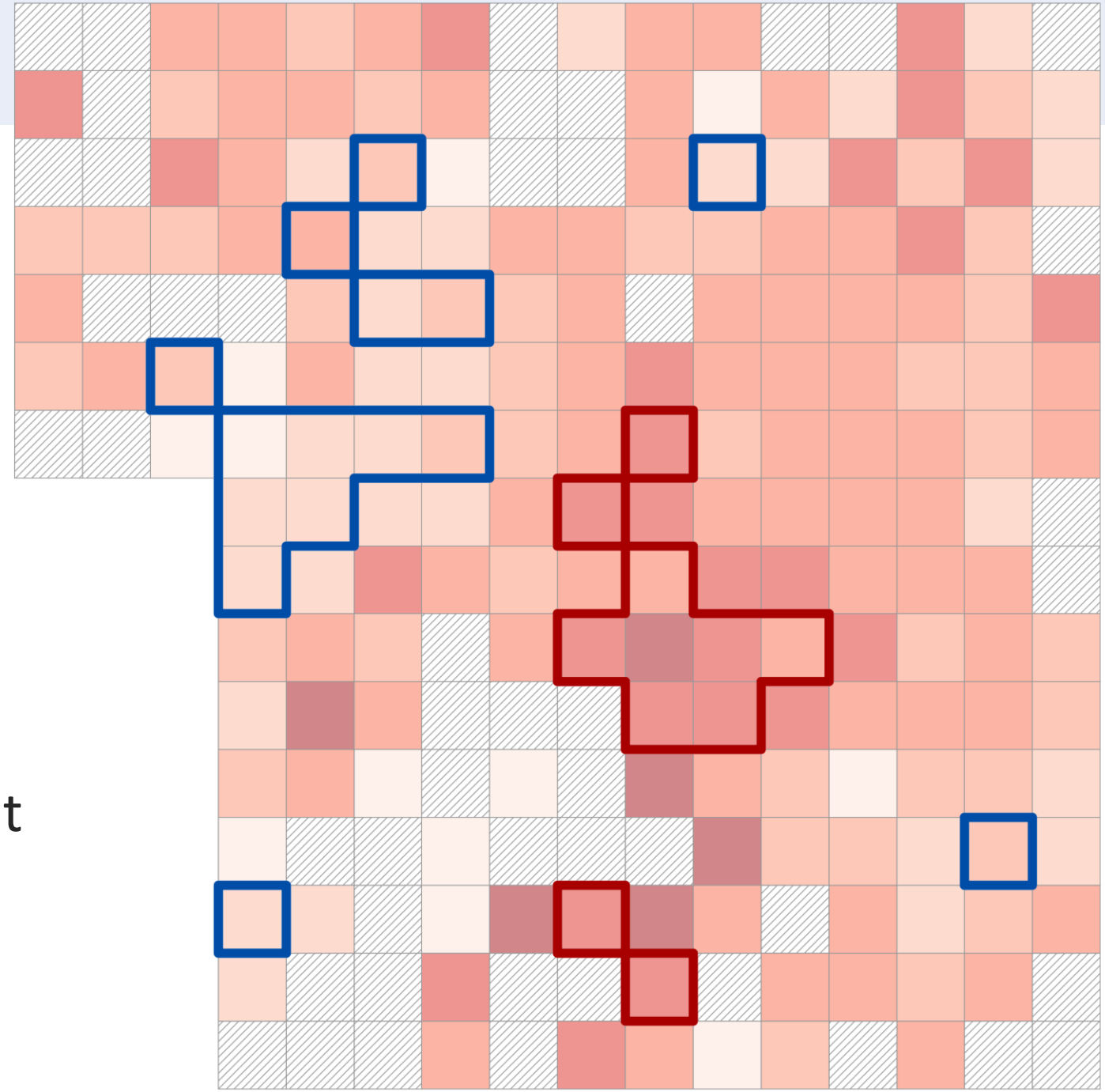


Wells Database

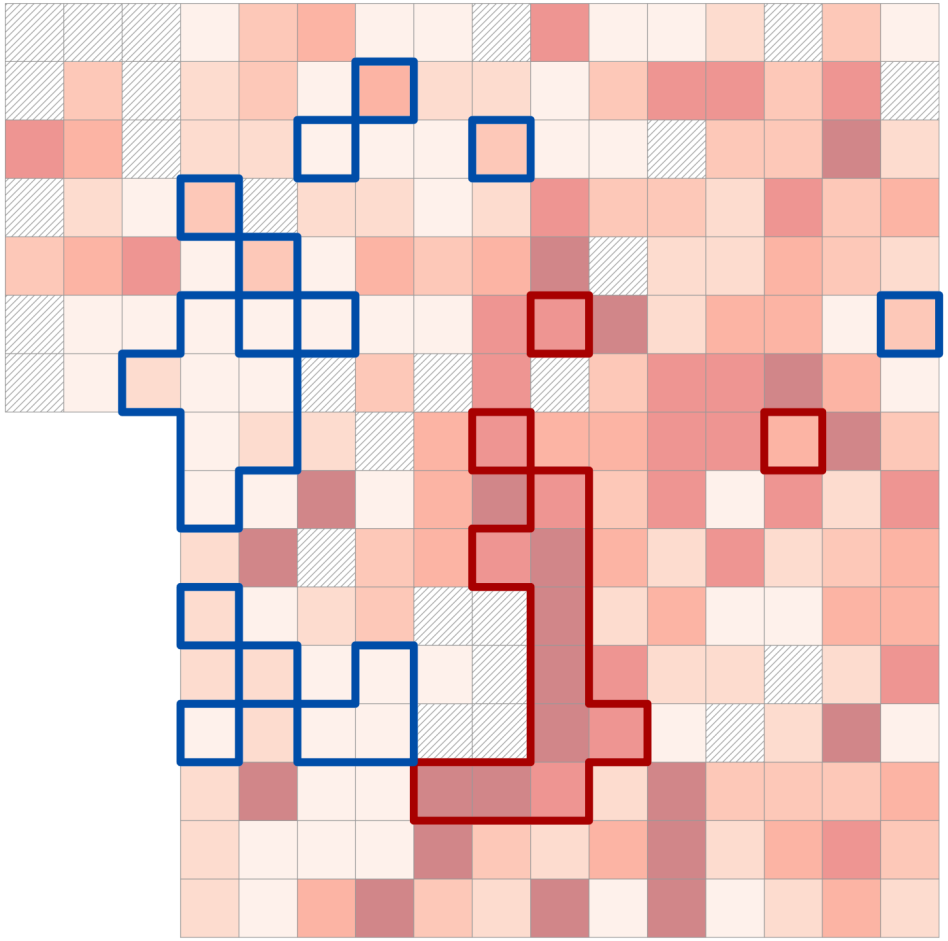
- Observations: **1,366 (1,930)**
- Minimum: **<0.1**
- Maximum: **49.6**
- Mean: **6.3 ±0.4**
- Standard Deviation: **6.9**

- % Exceeding Standard: **20.6%**

- Moran's I: **0.2673**
  Weak, but statistically significant positive global spatial auto-correlation (*pseudo p* = 0.0001)

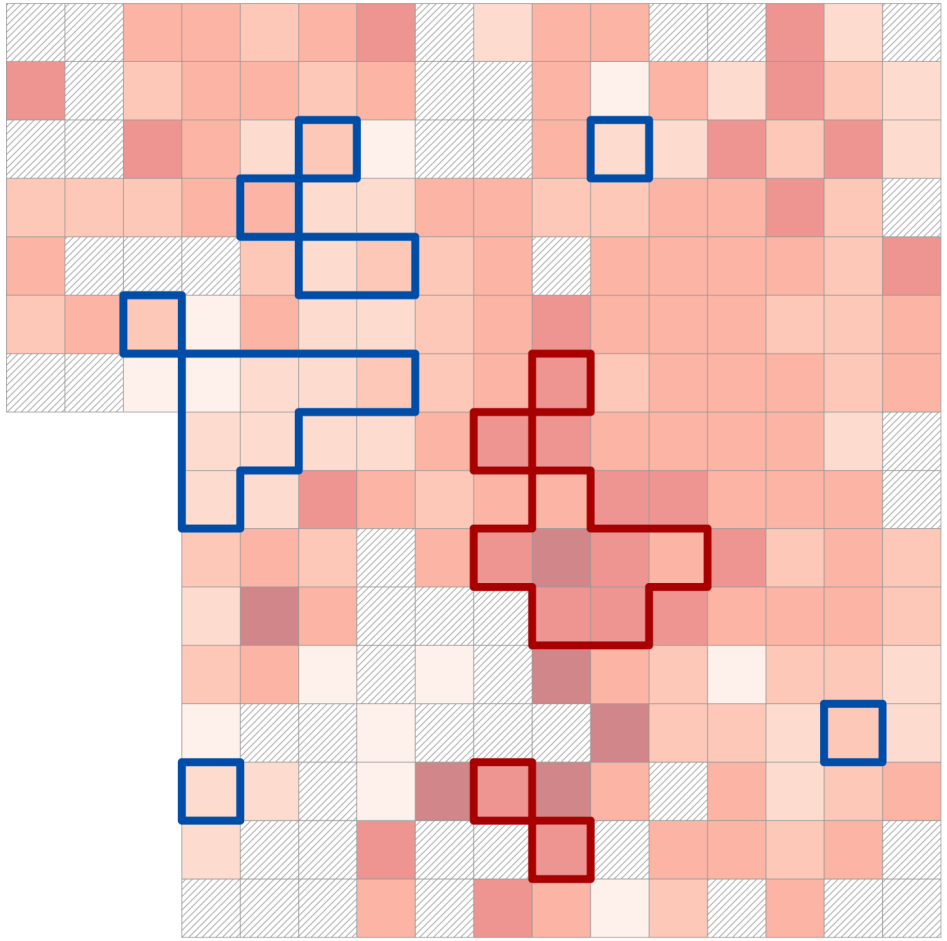


Well Water Survey vs Private Wells Database



Mean: **6.5 ±1.2**

% Exceeding Standard: **24.3%**



Mean: **6.3 ±0.4**

% Exceeding Standard: **20.6%**

Conclusions

Survey and database yield effectively identical global summary statistics, despite differing sampling strategies, sample sizes, and sample collection periods, and a highly variable real-world phenomenon.

If survey results are “a call to action,” database provides another.

Future research might attempt to resolve local discrepancies between the two datasets.