

Chippewa County 2022 Nitrate Occurrence and Source Investigation Results
June 28, 2023

The meeting was called to order by L. Schweikert (LCFM) at 6:00 p.m.

Agency staff advisors present were K. Masarik (UW-Stevens Point), A. Wiersma (WGNHS), K. Klingberg and L. Schweikert (LCFM), and K. Walters (Public Health).

County Board supervisor present was K. Schmitt.

Others present, as identified, were D. Badman, S. Berg, D. & T. Bjork, L. Boland, M. & J. Brown, R. Crawford, A. Droske, M. Dupey, D. Hayden, C. Hilger, S. Hilger, W. Jackson, T. & D. Jaspersen, C. Kaiser, T. & M. Keretes, T. & S. Kolb, S. Larson, T. Leibham, R. & L. Liedl, J. Lynn, D. Masterpole, R. McFarlane, N. Nerdnum, B. Panzer, T. Piercy, D. Plecharek, P. Popple, T. Prill, W. & L. Rapienski, R. Rood, E. Schultz, W. Schulz, B. & L. Schweikert, B. Shorrel, B. Smith, K. Stahl, D. Tiry, J. Tiry, and L. Warrick.

Item #1 – Presentation

L. Schweikert introduced K. Masarik, Groundwater Education Specialist, Center for Watershed Science and Education, UW-Stevens Point.

K. Masarik presented an oral report. The report was supported by the following materials:

1. Power Point titled: Chippewa County Well Water Quality Inventory and Nitrate Source Occurrence, (2023, UW-Stevens Point- copy on file & attached).
2. Website link titled: Chippewa County Well Water Monitoring Project, (**Chippewa County Well Water Monitoring Project** (theopenwaterlog.com)).

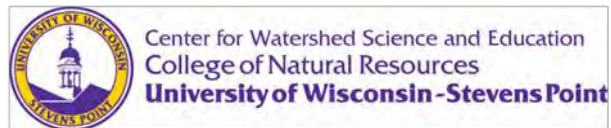
Item #2 – Q & A with Project Staff

K. Masarik and L. Schweikert answered questions from the public.

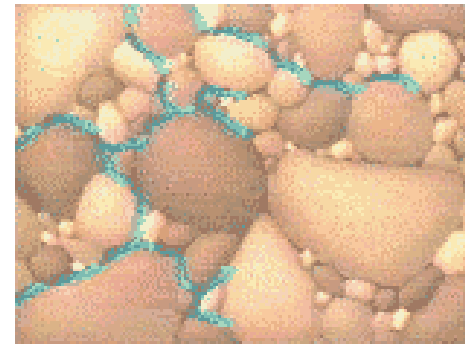
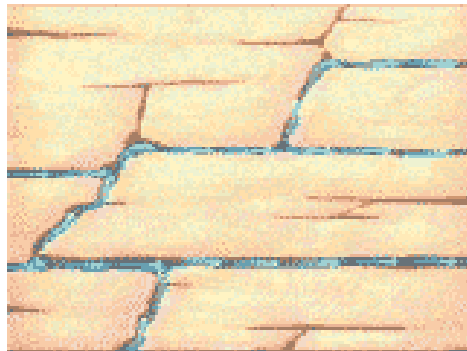
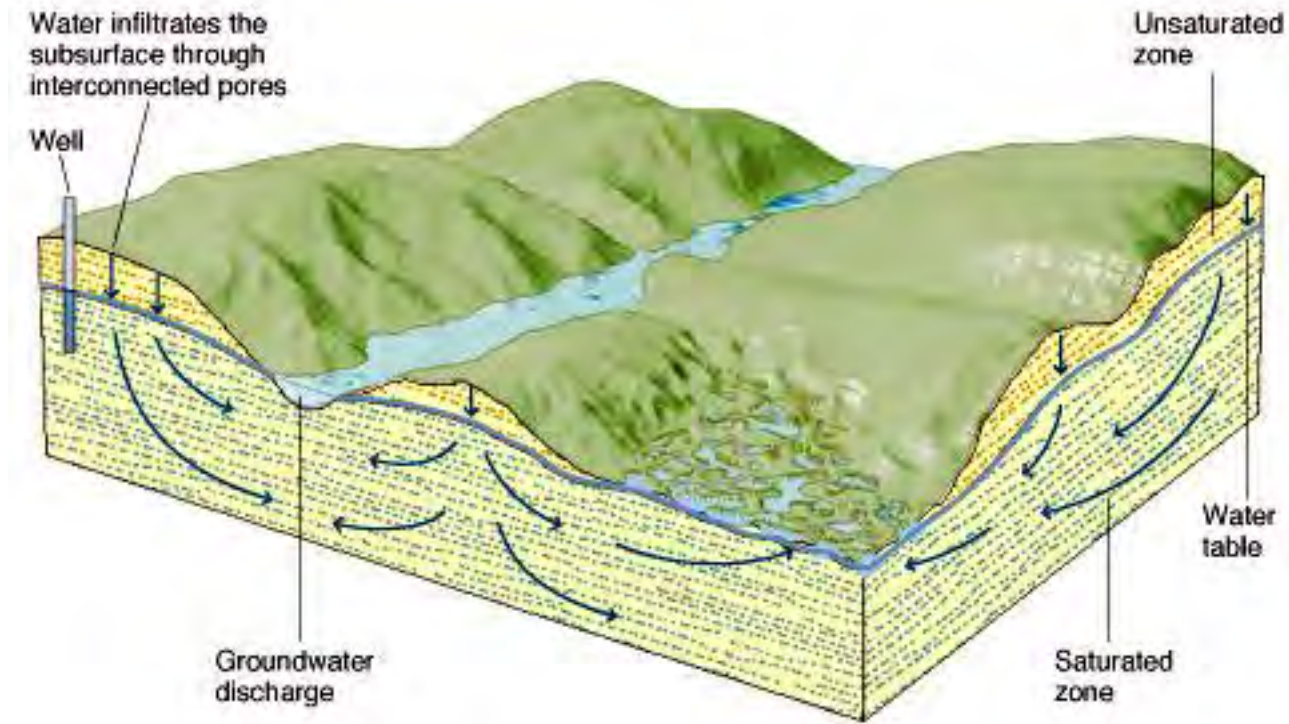
Item #3 – Adjourn.

The meeting was adjourned at approximately 8:00 p.m.

Chippewa County Well Water Quality Inventory & Nitrate Source Occurrence



Groundwater Movement

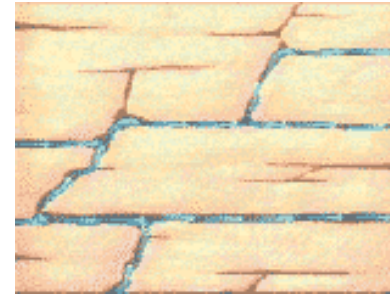


Aquifers: Our groundwater storage units

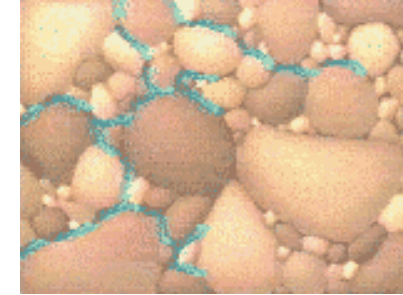
Aquifers are geologic formations that store and transmit groundwater.

The aquifer properties determine how quickly groundwater flows, how much water an aquifer can hold and how easily groundwater can become contaminated. Some aquifers may also contain naturally occurring elements that make water unsafe.

Wisconsin's geology is like a layered cake. Underneath all of Wisconsin lies the Crystalline bedrock which does not hold much water. Think of this layer like the foundation of your house. All groundwater sits on top of this foundation. Groundwater is stored in the various **sandstone, dolomite** and **sand/gravel** aquifers above the **crystalline bedrock** layer. The layers are arranged in the order which they formed, oldest on the bottom and youngest on top.



Water and contaminants can move quickly through cracks and fractures.



Water moving through tiny spaces in between sand particles or sandstone moves slower and allows for filtration of some contaminants.

Learn more about Wisconsin's geologic past by clicking the aquifer names

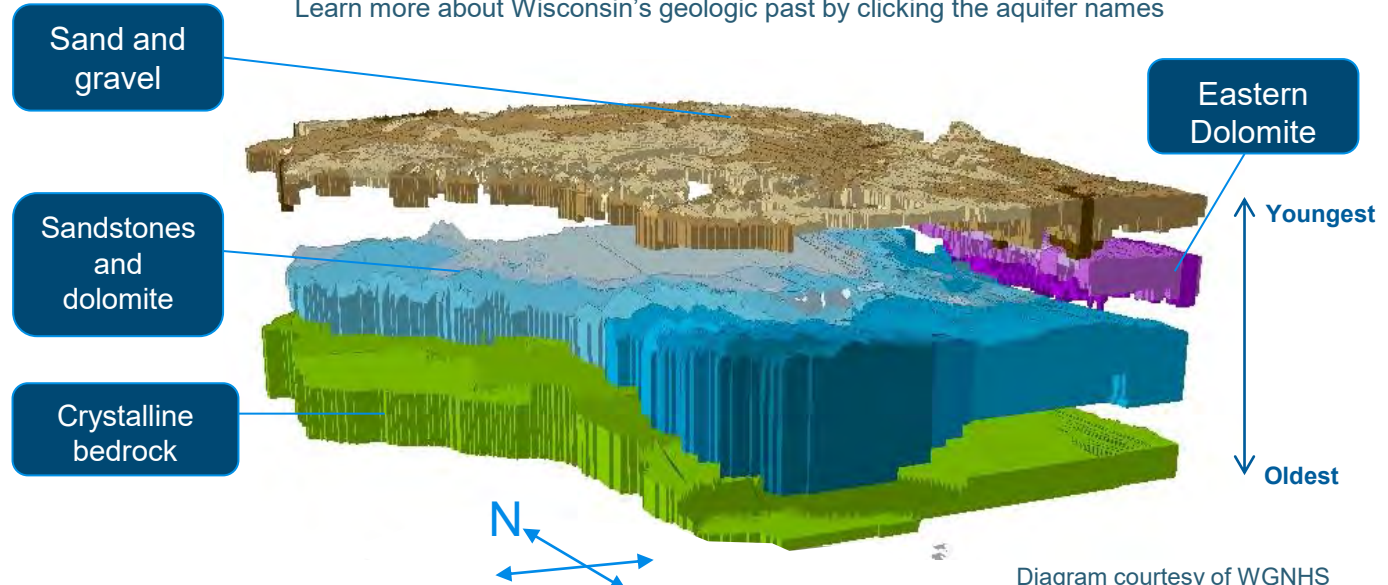
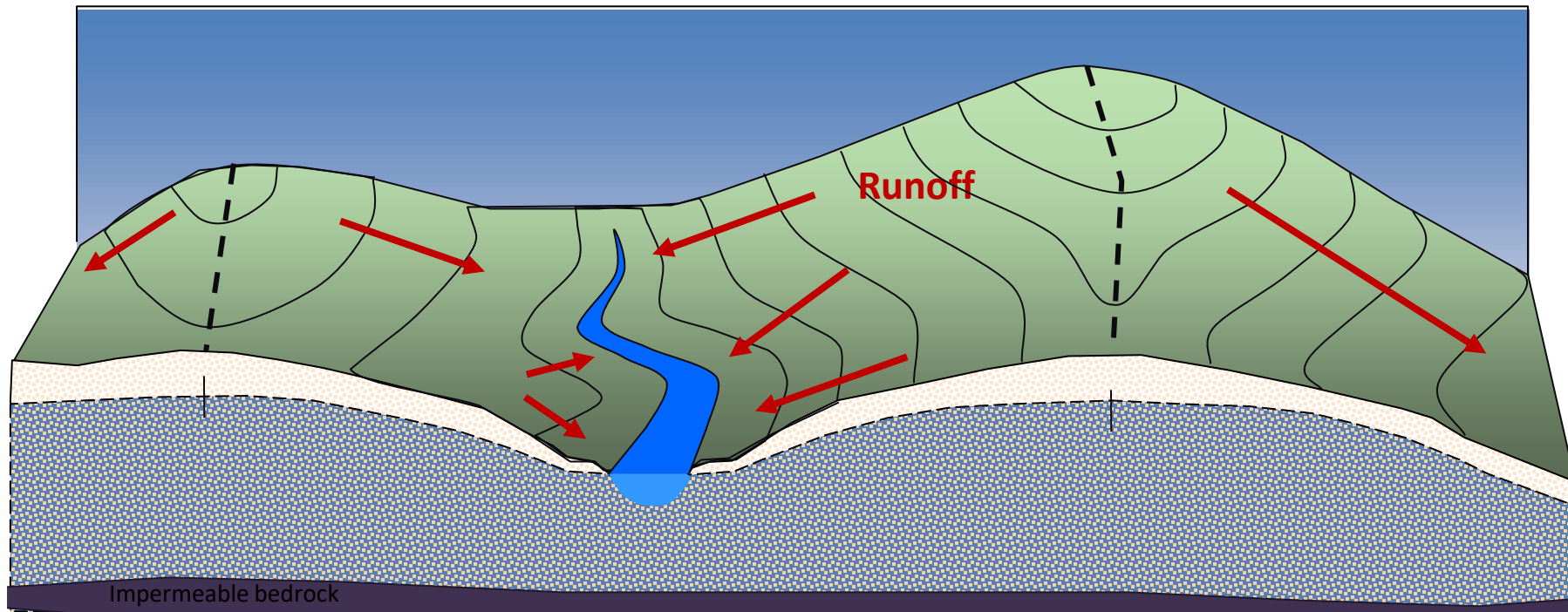
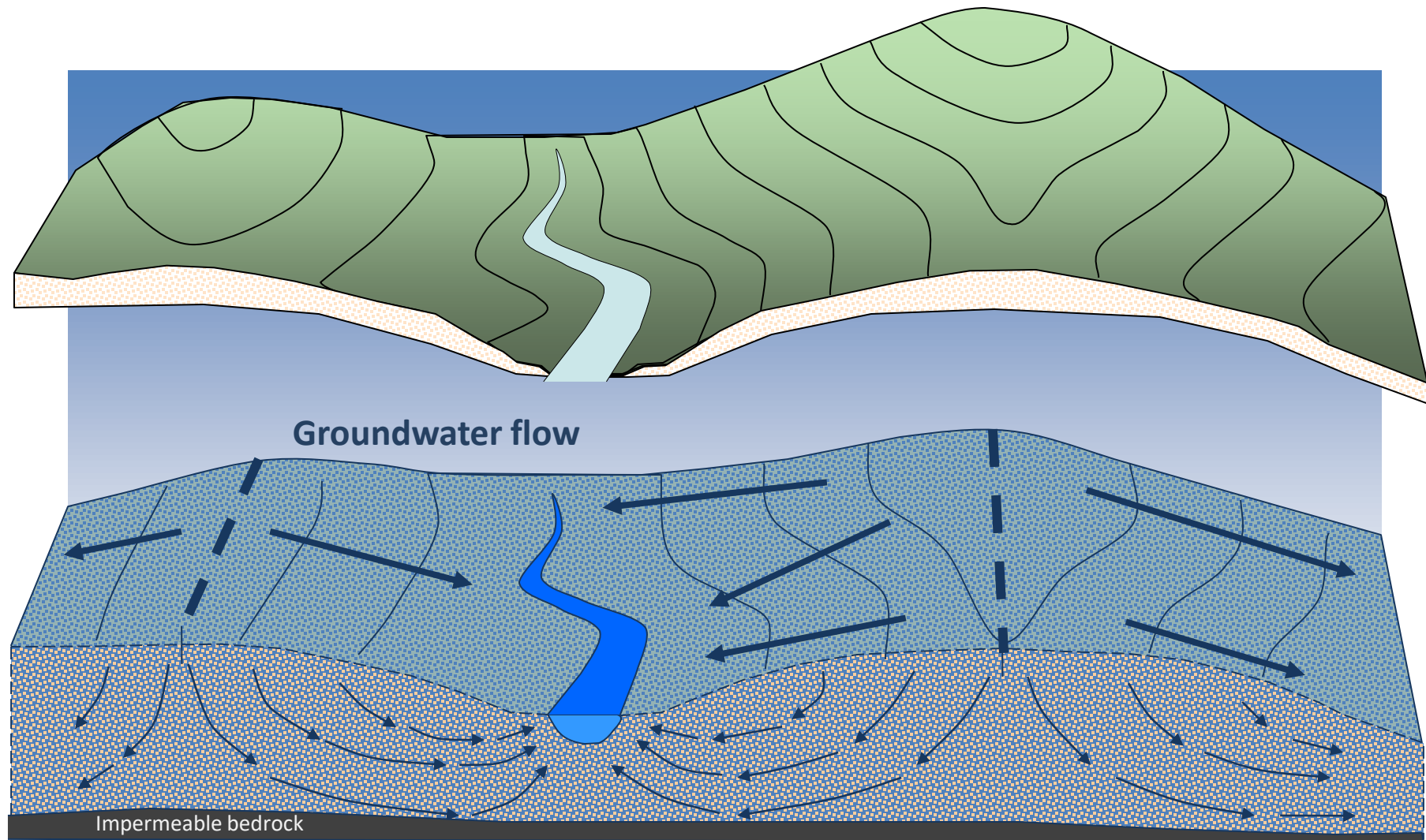


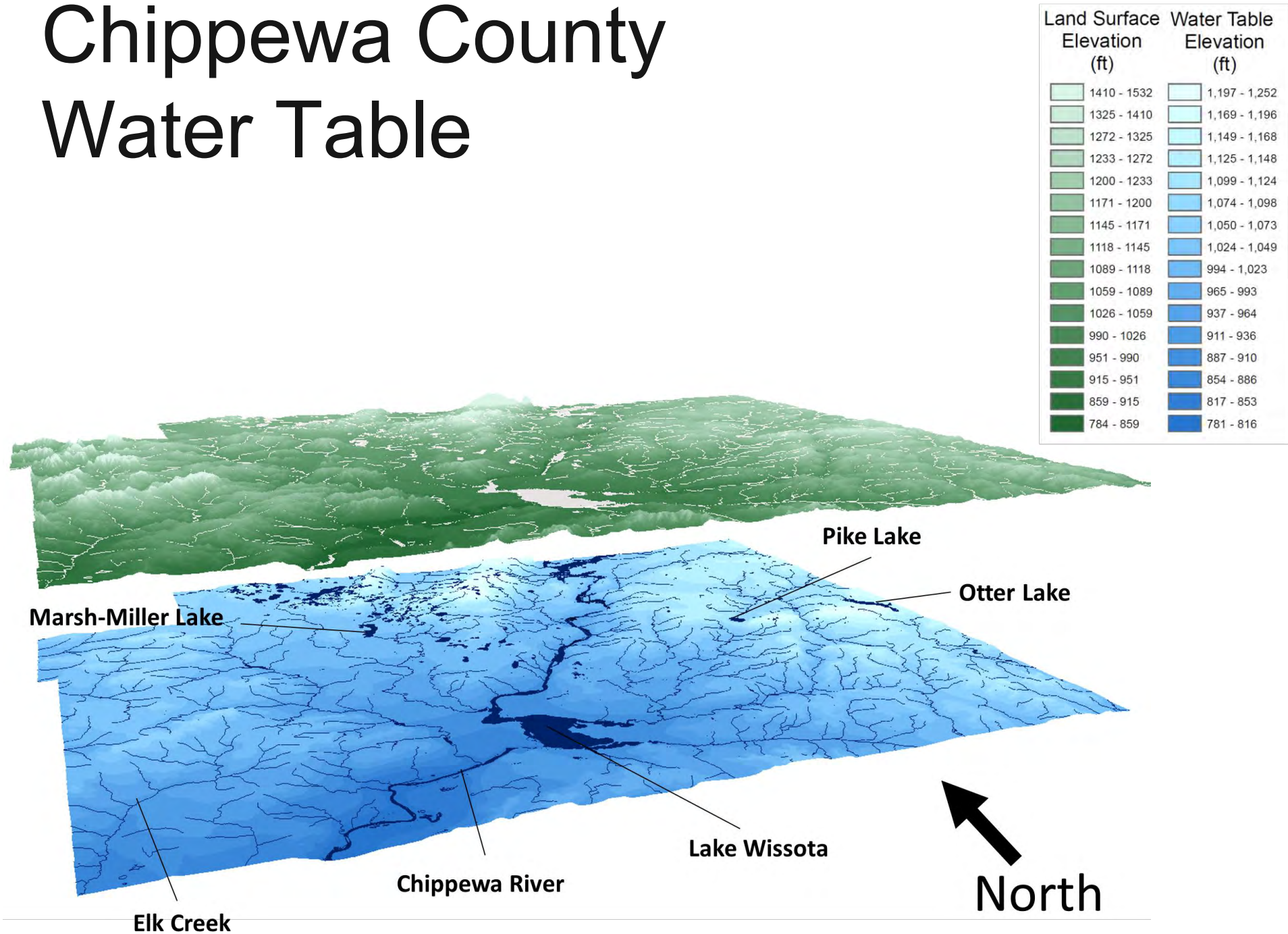
Diagram courtesy of WGNHS

Watershed – the land area where water originates for lakes, rivers or streams. Water flows from high elevation to low elevation.

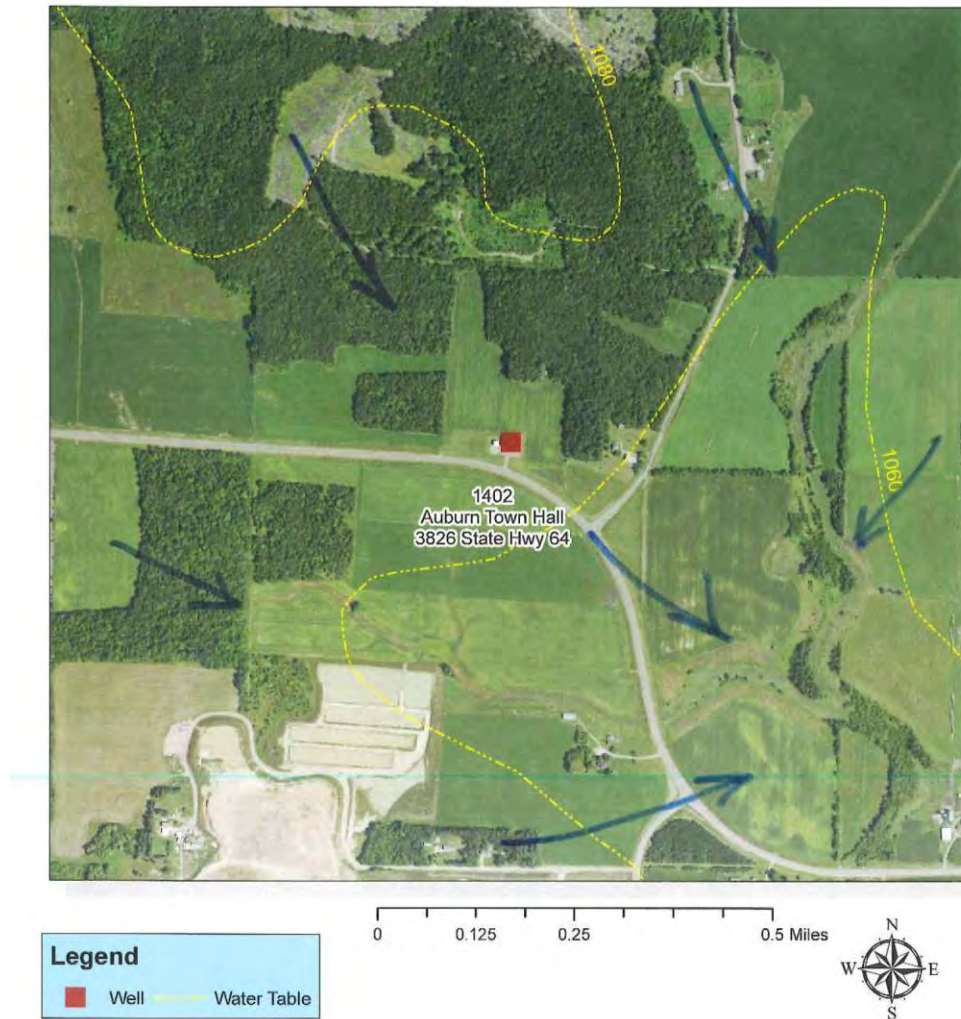




Chippewa County Water Table



General Groundwater Flow Direction



The black arrows show generalized groundwater flow direction in the area near your well. Groundwater flows perpendicular to the groundwater elevation lines and moves from high areas (hills) to low areas (streams, rivers). In general, residential wells impacted by land use are usually the result of those activities occurring within a roughly 1/2 mile distance from a well.

Disclaimer: This map is for educational purposes only. Groundwater flow is a best guess based on currently available information.

Cartography by Sean Piette

General Groundwater Flow Direction



Legend

Well Water Table

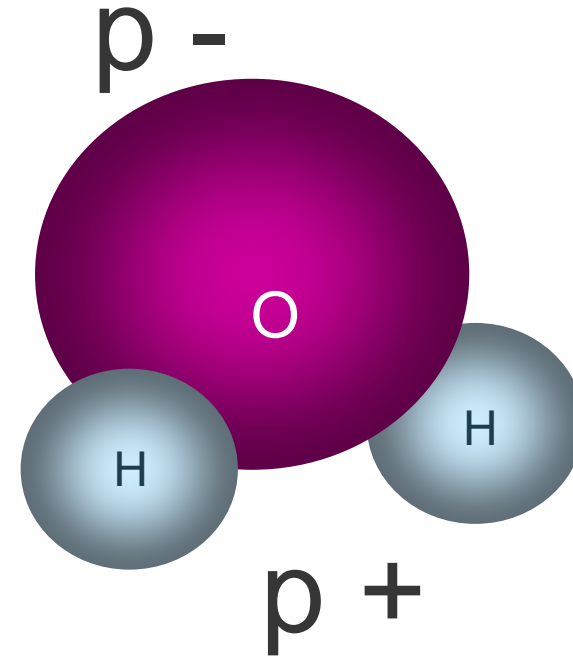
The black arrows show generalized groundwater flow direction in the area near your well. Groundwater flows perpendicular to the groundwater elevation lines and moves from high areas (hills) to low areas (streams, rivers). In general, residential wells impacted by land use are usually the result of those activities occurring within a roughly 1/2 mile distance from a well.

Disclaimer: This map is for educational purposes only. Groundwater flow is a best guess based on currently available information.

Cartography by Sean Piette

water basics

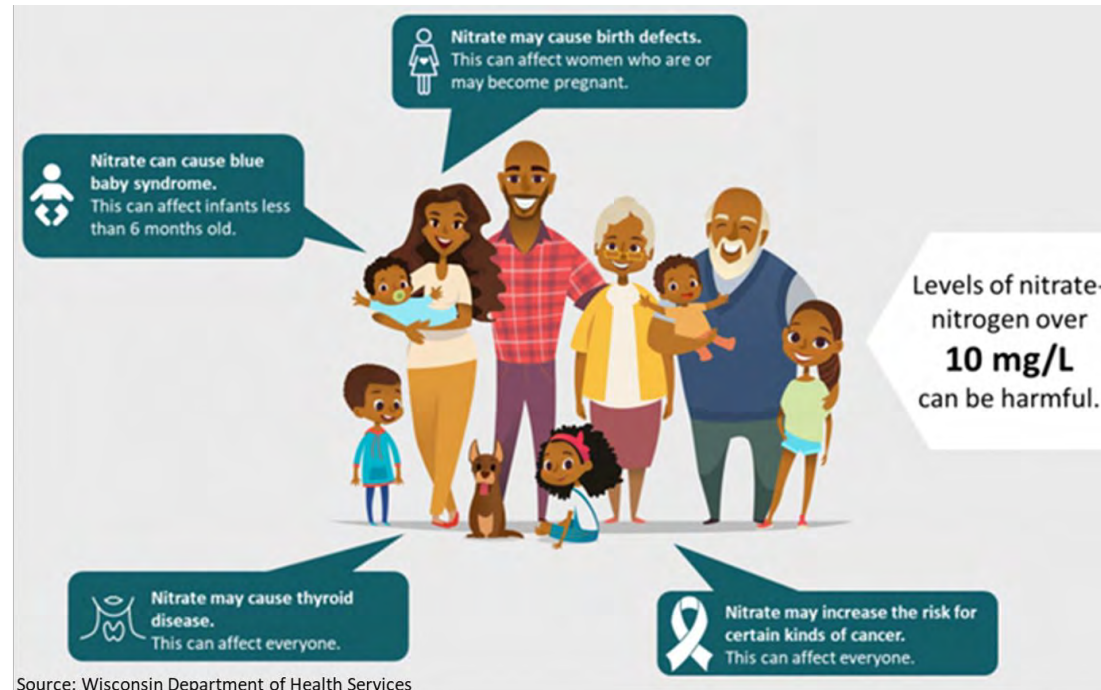
- “Universal Solvent”
- Naturally has “stuff” dissolved in it.
 - Impurities depend on rocks, minerals, land-use, plumbing, packaging, and other materials that water comes in contact with.
- Can also treat water to take “stuff” out



Nitrate-Nitrogen

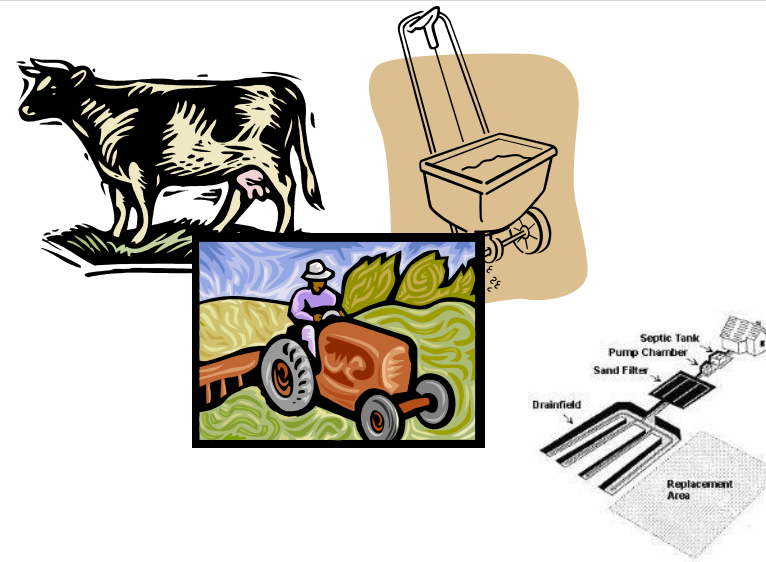
Health Effects:

- Methemoglobinemia (blue baby disease)
- Possible links to birth defects and miscarriages (humans and livestock)
- Indicator of other contaminants



Sources:

- Agricultural fertilizer
- Lawn fertilizer
- Septic systems
- Animal wastes



What to do if your nitrate levels are high?

Solution:

- Eliminate contamination source or reduce nitrogen inputs

Short term:

- Change well depth or relocate well
- Carry or buy water
- Water treatment devices
 - Reverse osmosis
 - Distillation
 - Anion exchange



**AMERICAN RESCUE
PLAN ACT WELL
COMPENSATION AND
WELL ABANDONMENT
GRANTS**

YOU COULD RECEIVE UP TO **\$16,000**

To replace, reconstruct, treat or abandon your well or water system

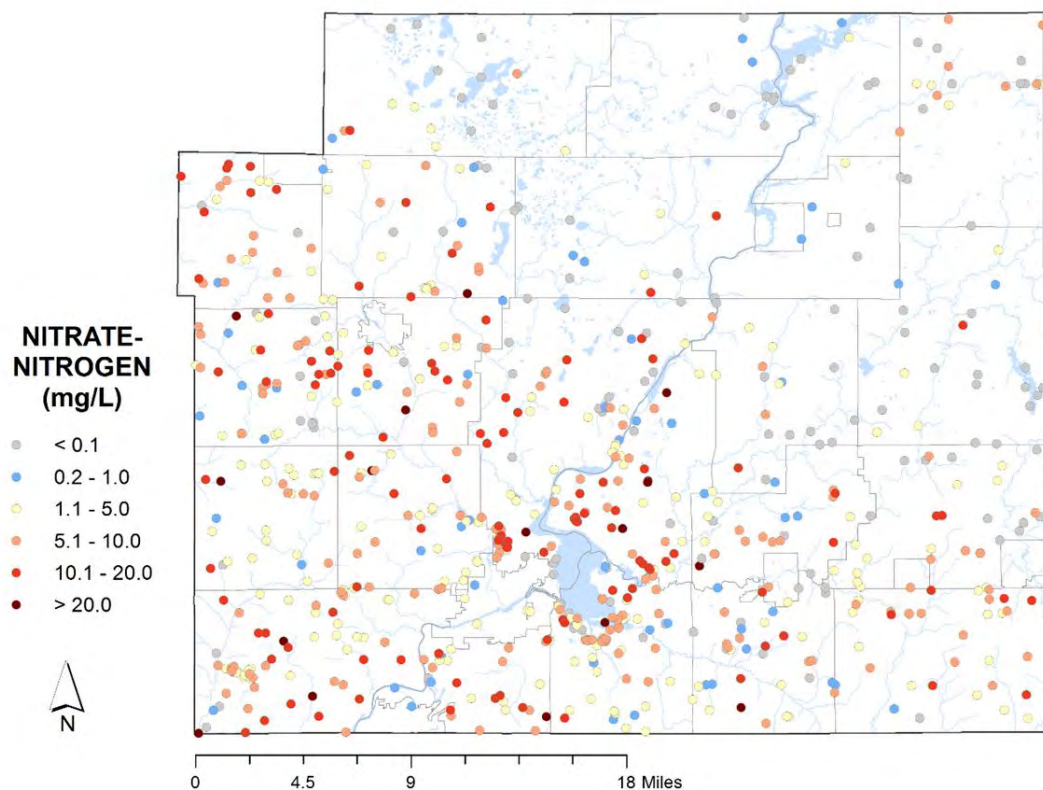
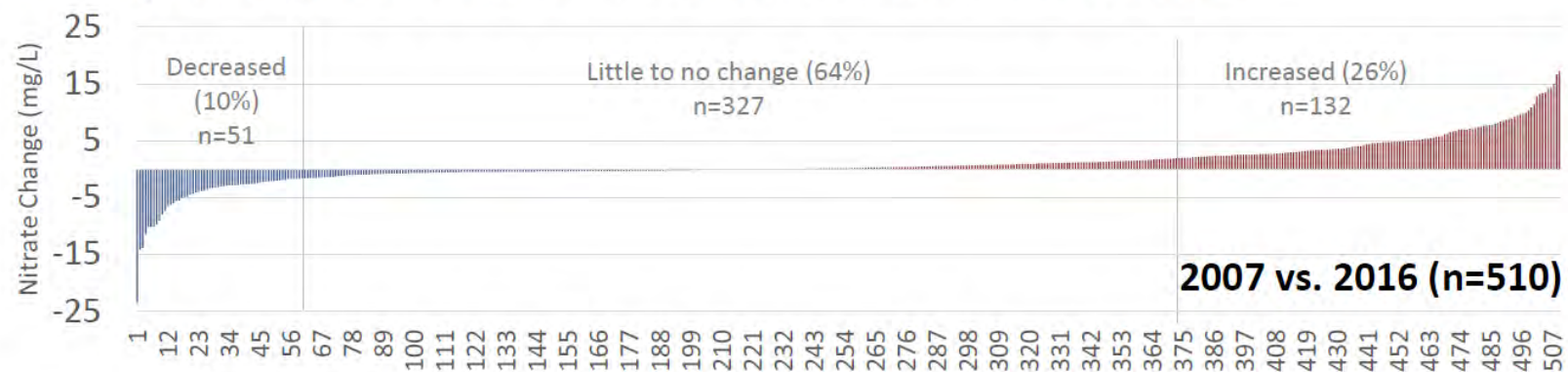
You might be eligible to apply if:

➔ You own a private well or non-community water system	➔ Your well or water system is contaminated with nitrate, arsenic, fecal bacteria or PFAS
➔ Your annual family or business income is \$100,000 or less	➔ You have not begun work on your well or water system yet

Apply by December 2024. To learn more about eligibility and how to apply:

VISIT dnr.wisconsin.gov/aid/WellCompensation.html
OR dnr.wisconsin.gov/aid/WellAbandonment.html,
CALL 608-577-3583 OR EMAIL DNRARPAWellGrants@wisconsin.gov

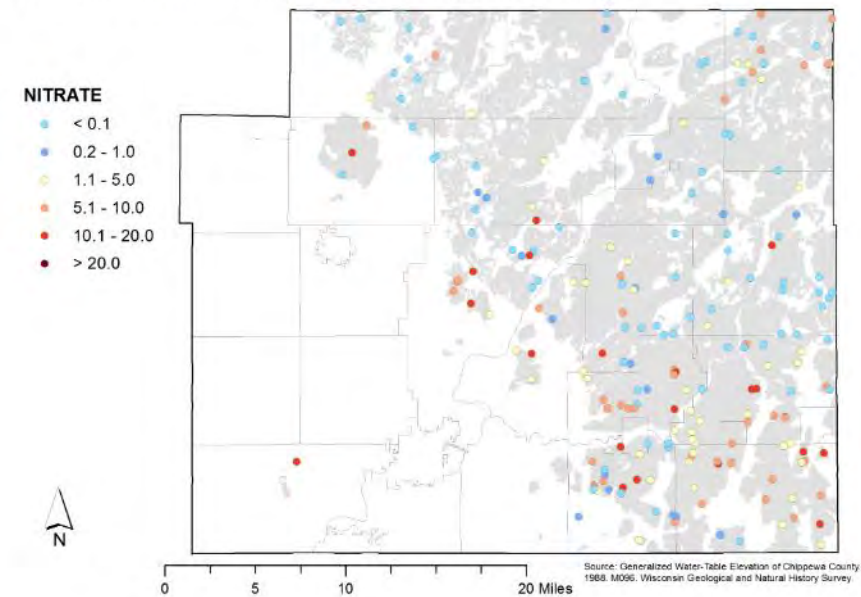
Comparing nitrate concentrations over time



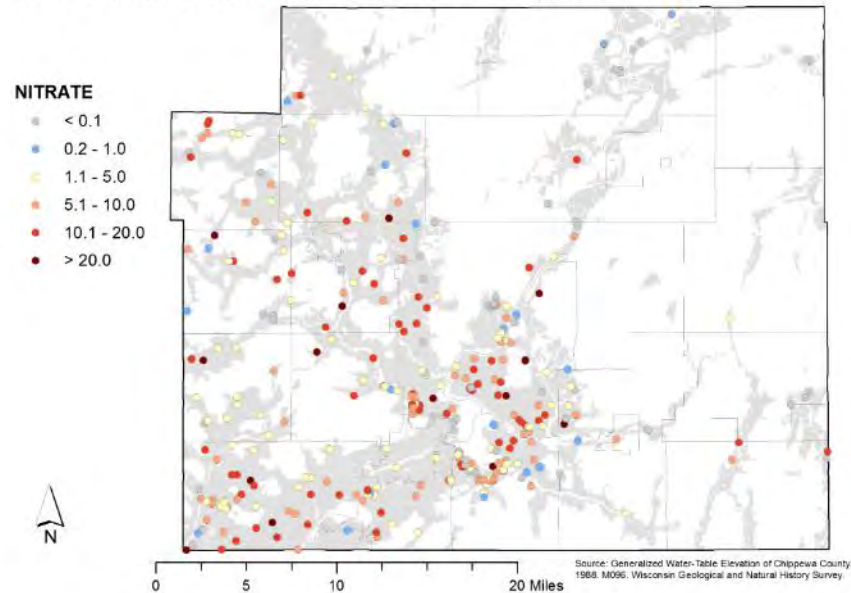
Year	Nitrate Average (mg N/L)	Greater than 10 mg/L
1985	4.2	11.3%
2007	4.7	12.3%
2016	5.5	18.3%

Aquifer Type	Nitrate-N		
	n	Mean	% > 10 mg/L
Meltwater Stream	360	6.4	24.2
Glacial Sediment	207	3.6	9.7
Cambrian	170	5.9	17.0

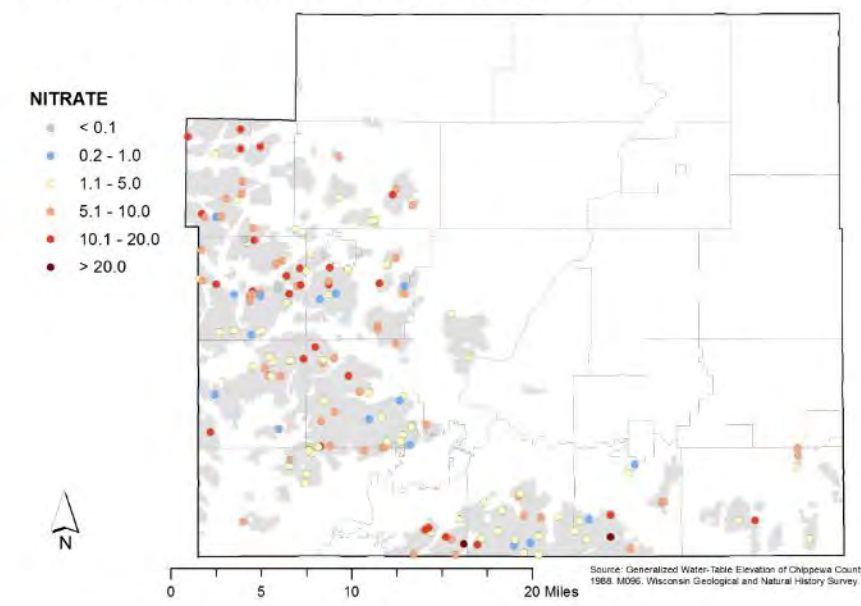
Wells in Glacial Sediment Areas of Chippewa County



Wells in Glacial Stream Sediment Areas of Chippewa County



Wells in Cambrian Bedrock Areas of Chippewa County



Chippewa Groundwater Quality Index

1985, 2007, 2016, 2019, 2020.....

GOAL: To learn how well water quality changes over time



How variable is well water quality from year to year?

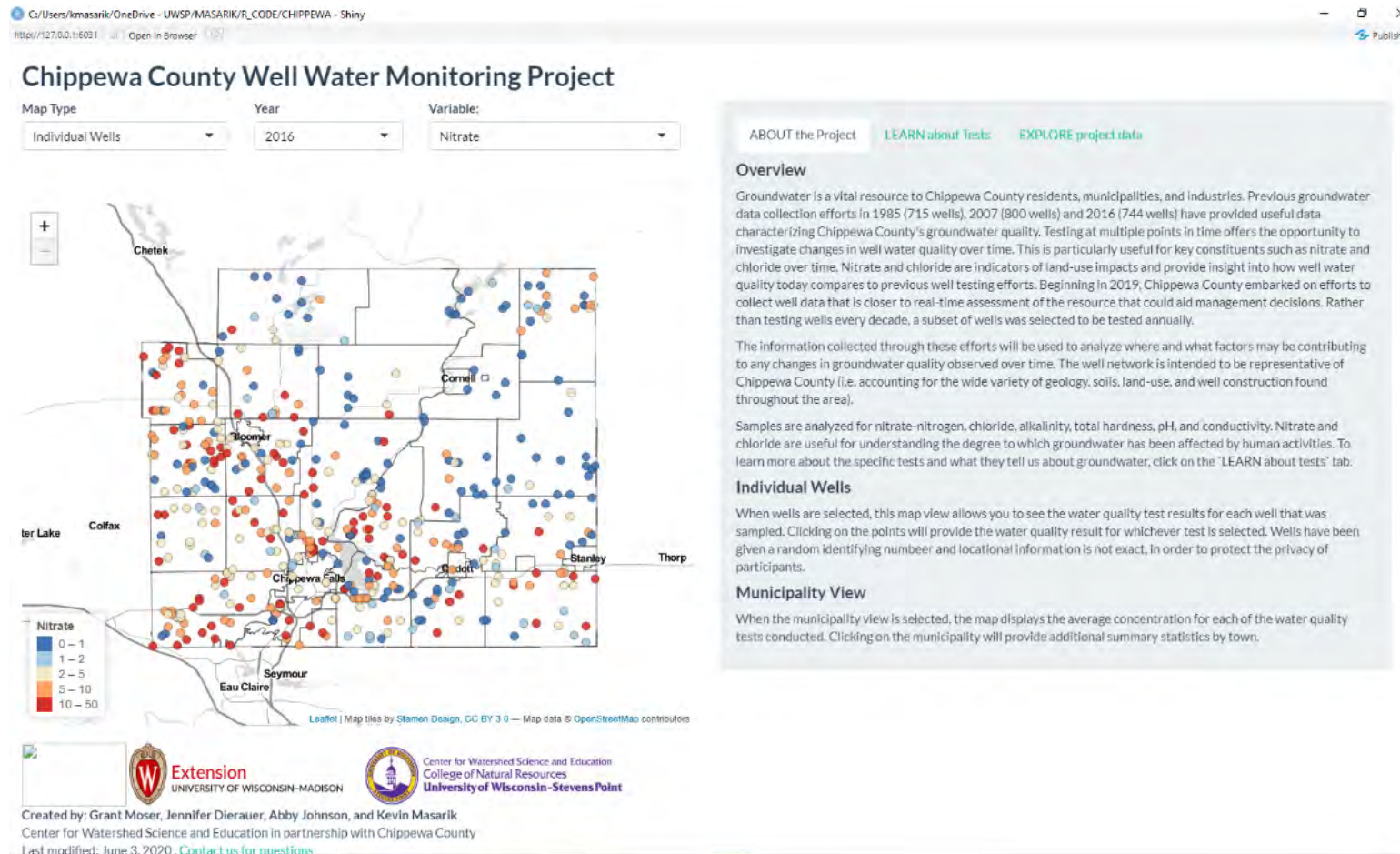
Is well water quality getting better, worse, or staying the same?

If changing, what can we learn about where and why

This project works best when:

- Wells are representative of diverse geology and land use
- The same wells are sampled every year

Chippewa County Well Water Quality Index



Beginning in 2019, annual well testing of up to 210 wells

- 70 wells each from each stratum (Cambrian, Meltwater Stream Sediment, Glacial)
- Wells will be selected to obtain representative land cover distribution
- Wells with known well construction

Nitrate / Chloride

- Useful for understanding land-use impacts on groundwater



Conductivity

- Overall water quality, combination of both land-use, rocks, and soils

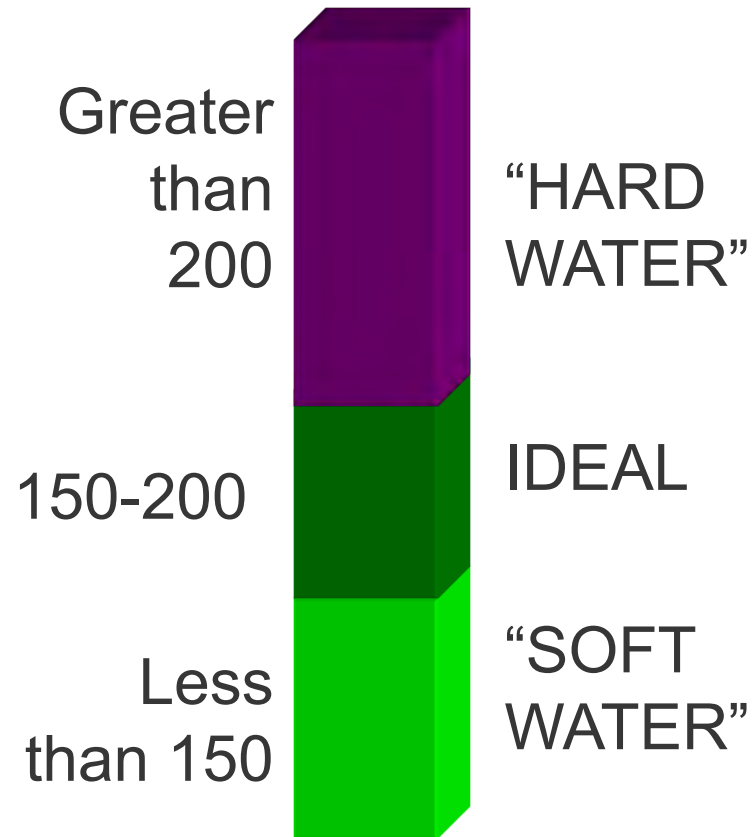
Total Hardness / Alkalinity / pH

- Help us understand how rocks and soils impact groundwater

Tests for Aesthetic Problems

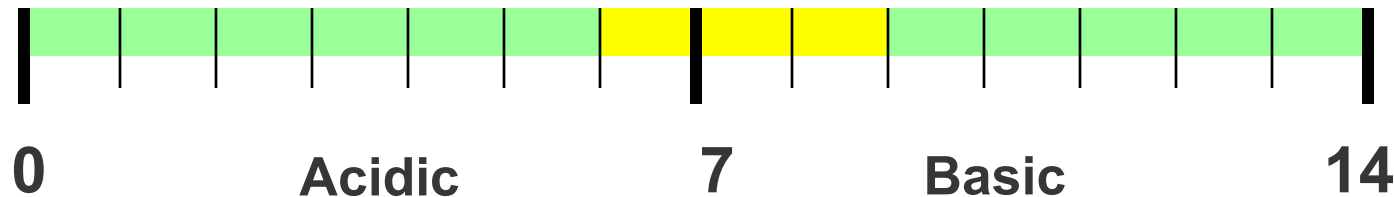
Hardness

- Natural (rocks and soils)
- Primarily calcium and magnesium
- Problems: scaling, scum, use more detergent, decrease water heater efficiency



Tests for Overall Water Quality

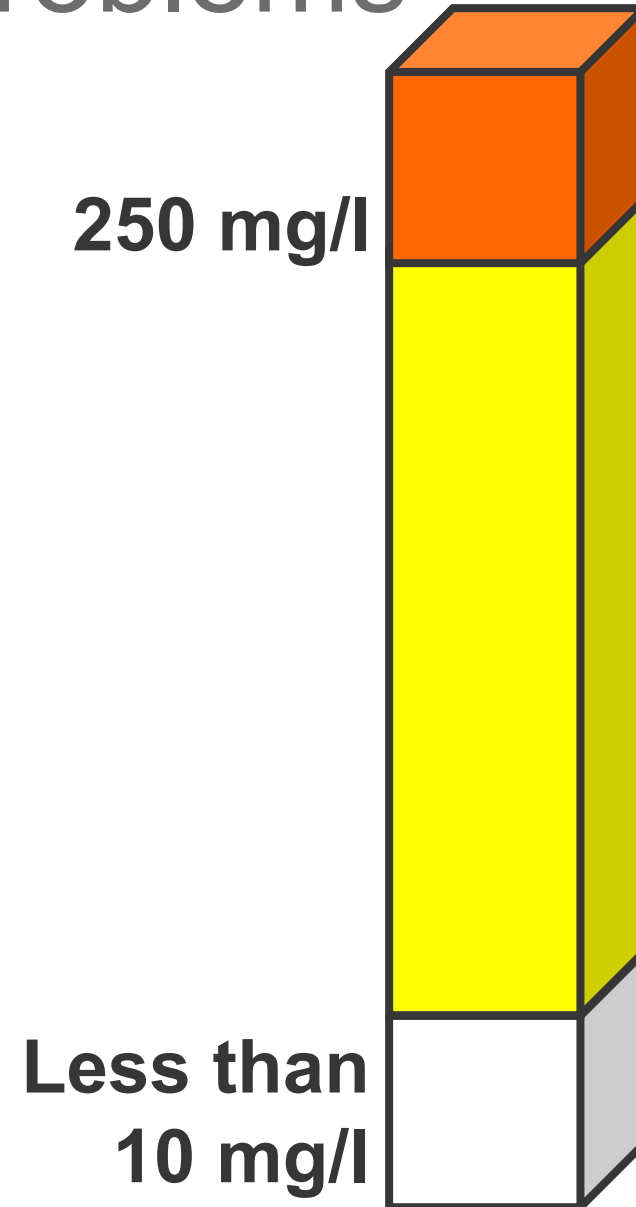
- **Alkalinity** – ability to neutralize acid
- **Conductivity** –
 - Measure of total ions
 - can be used to indicate presence of contaminants (~ twice the hardness)
- **pH** – Indicates water's acidity and helps determine if water will corrode plumbing



Tests for Aesthetic Problems

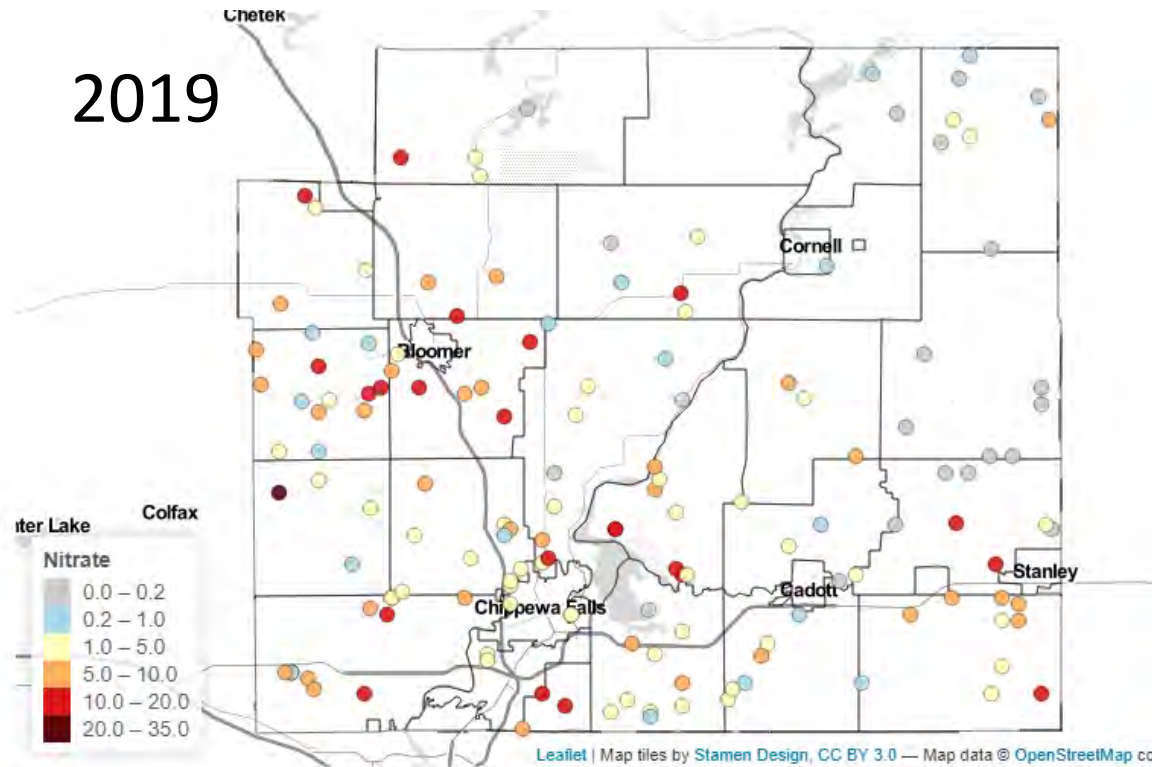
Chloride

- Greater than 250 mg/l
 - No direct effects on health
 - Salty taste
 - Exceeds recommended level
- Greater than 10 mg/l may indicate human impact
- Less than 10 mg/l considered “natural” in much of WI
- **Sources:** Fertilizers, Septic Systems and Road Salt



Nitrate in Chippewa County Wells

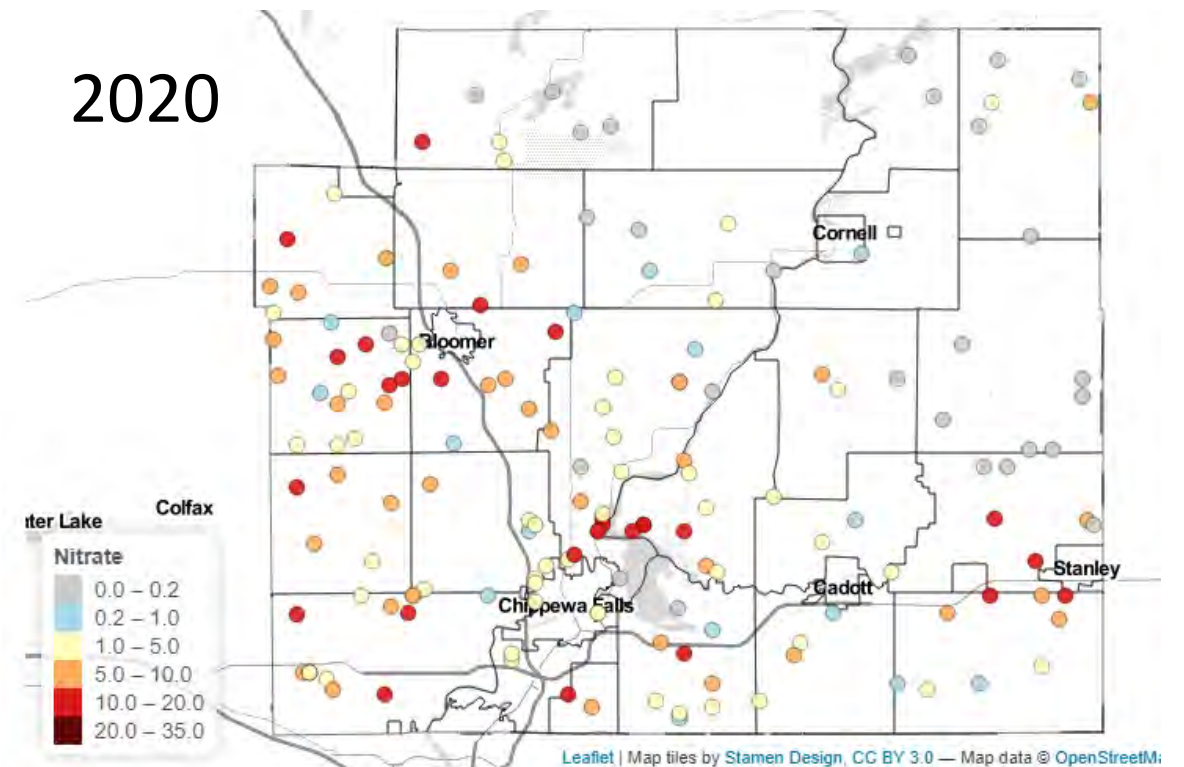
2019



Nitrate (mg/L as N)

None Detected	0	0 %
... 2.0	53	34 %
2.1 - 5.0	42	27 %
5.1 - 10.0	35	23 %
10.1 - 20.0	24	15 %
20.1 ...	1	<1 %
Avg: 4.8 for 155 Samples		

2020

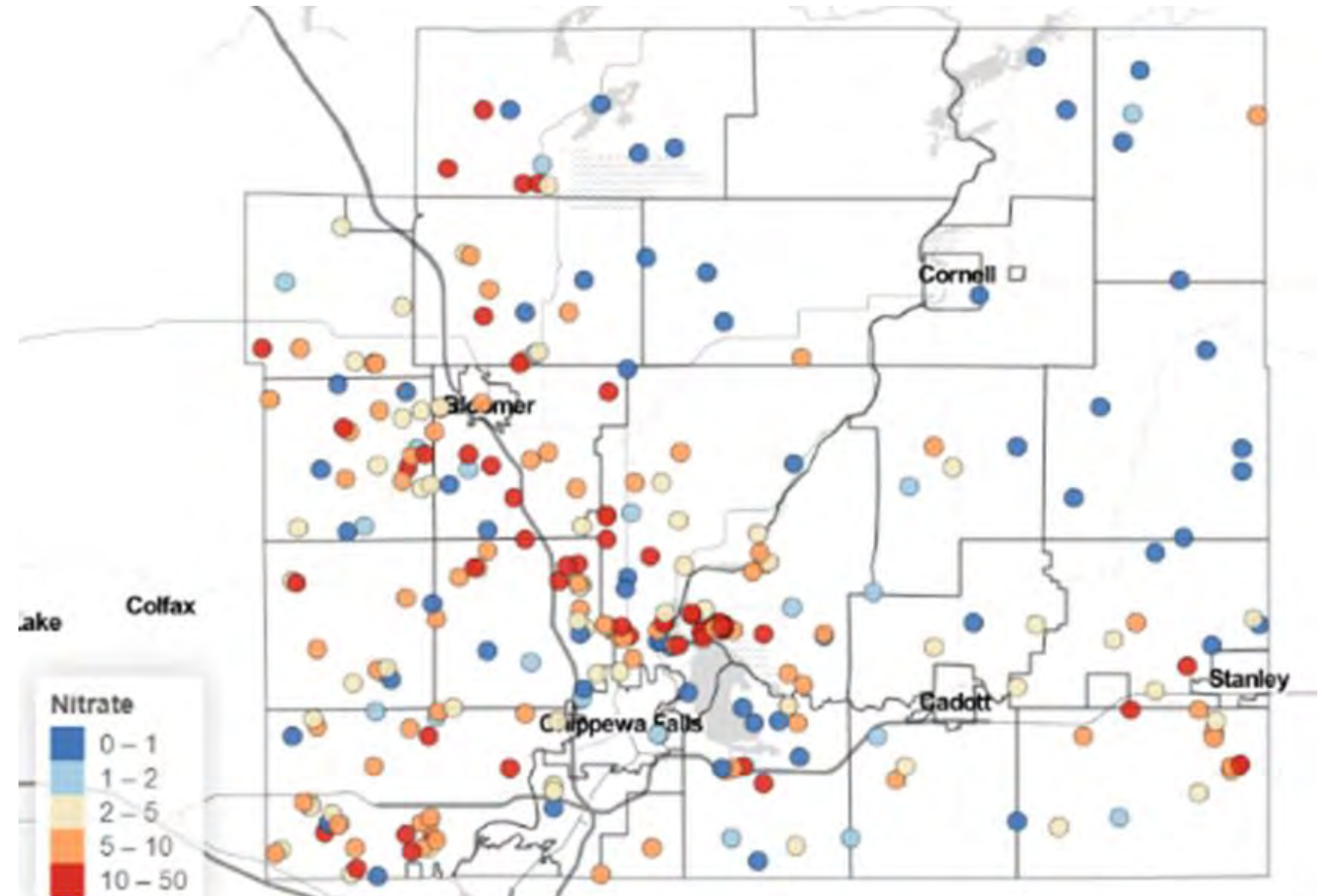


Nitrate (mg/L as N)

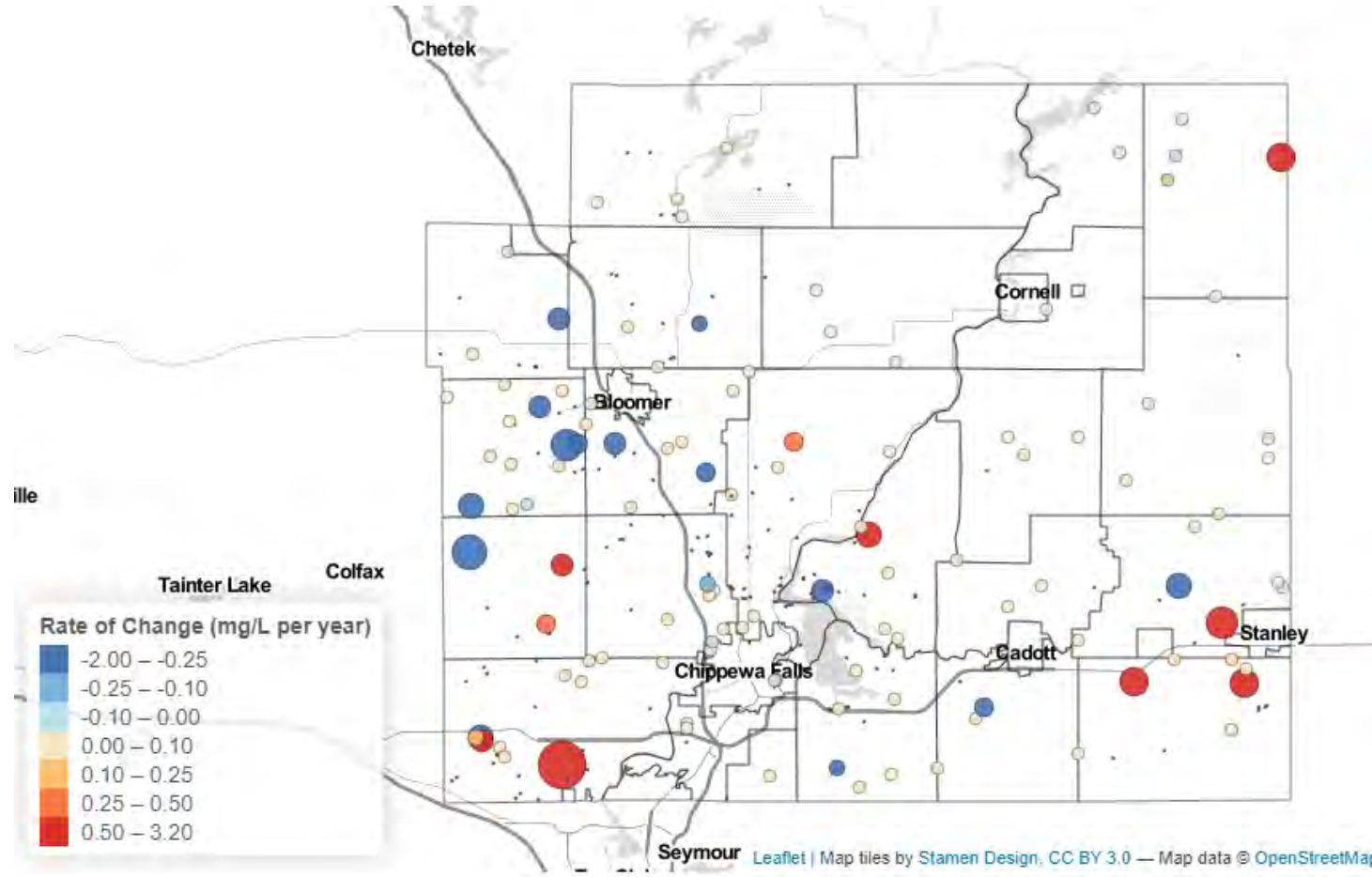
None Detected	26	16 %
... 2.0	37	23 %
2.1 - 5.0	32	20 %
5.1 - 10.0	39	24 %
10.1 - 20.0	28	17 %
20.1 ...	0	0 %
Avg: 4.9 for 162 Samples		

Chippewa County 2022 – Nitrate-Nitrogen

Nitrate-Nitrogen (mg/L)	Number of Samples	Percent
Less than 0.1	29	10%
0.1 – 2.0	52	18%
2.1 – 5.0	65	22%
5.1 – 10.0	78	27%
10.1 – 20.0	64	22%
Greater than 20.0	2	<1%

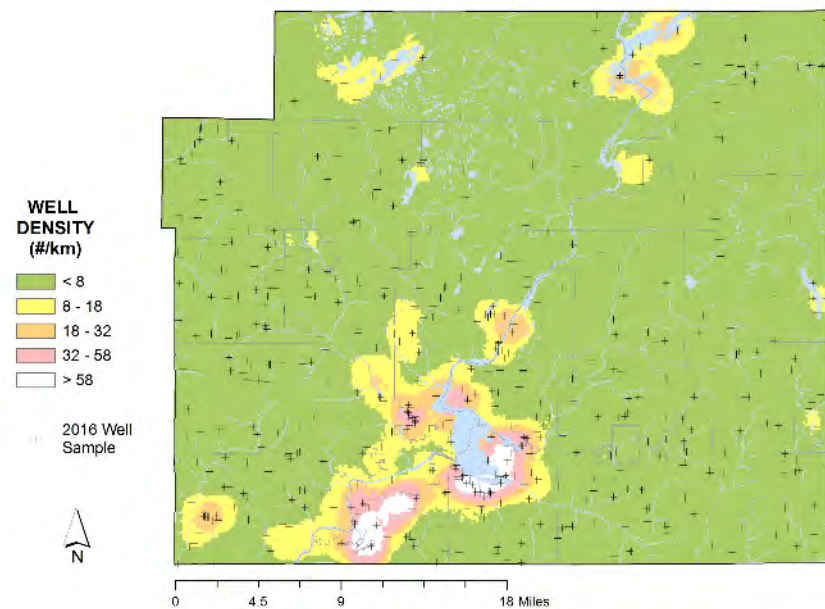
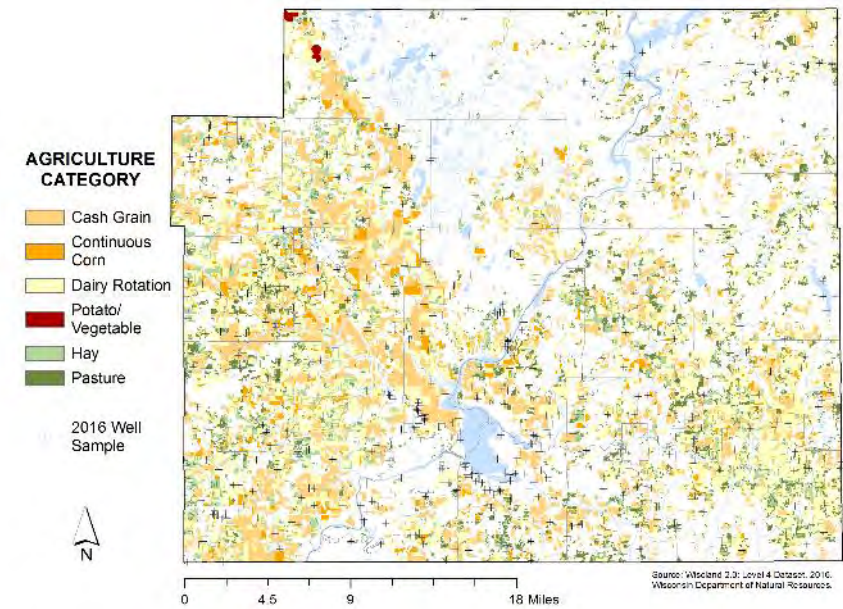
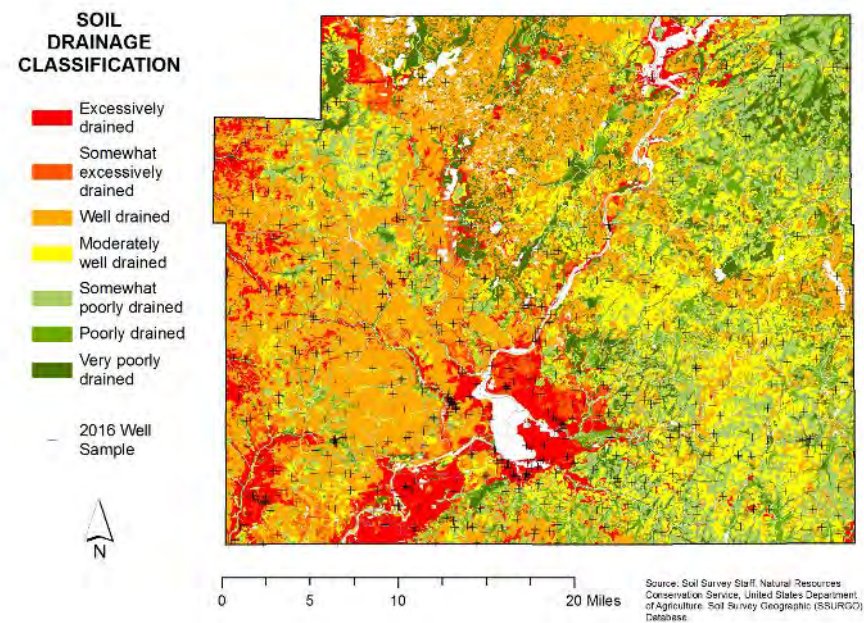


Preliminary Data - Chippewa County Trends



- Nitrate Trends
 - 26 wells decreasing (21%)
 - 15 wells increasing (12%)
 - 83 wells no trend (67%)

Modeling Nitrate Risk



Original Fit 5

#-----

Call:

```
lm(formula = NITRATE_SQRT ~ CORN_CASH + DAIRY + HAY + RLTIME_DNS +  
  Weighted.Average.Rank, data = chippewa_combined)
```

Residuals:

	Min	1Q	Median	3Q	Max
	-2.6939	-0.7798	-0.0012	0.7205	3.9679

Coefficients:

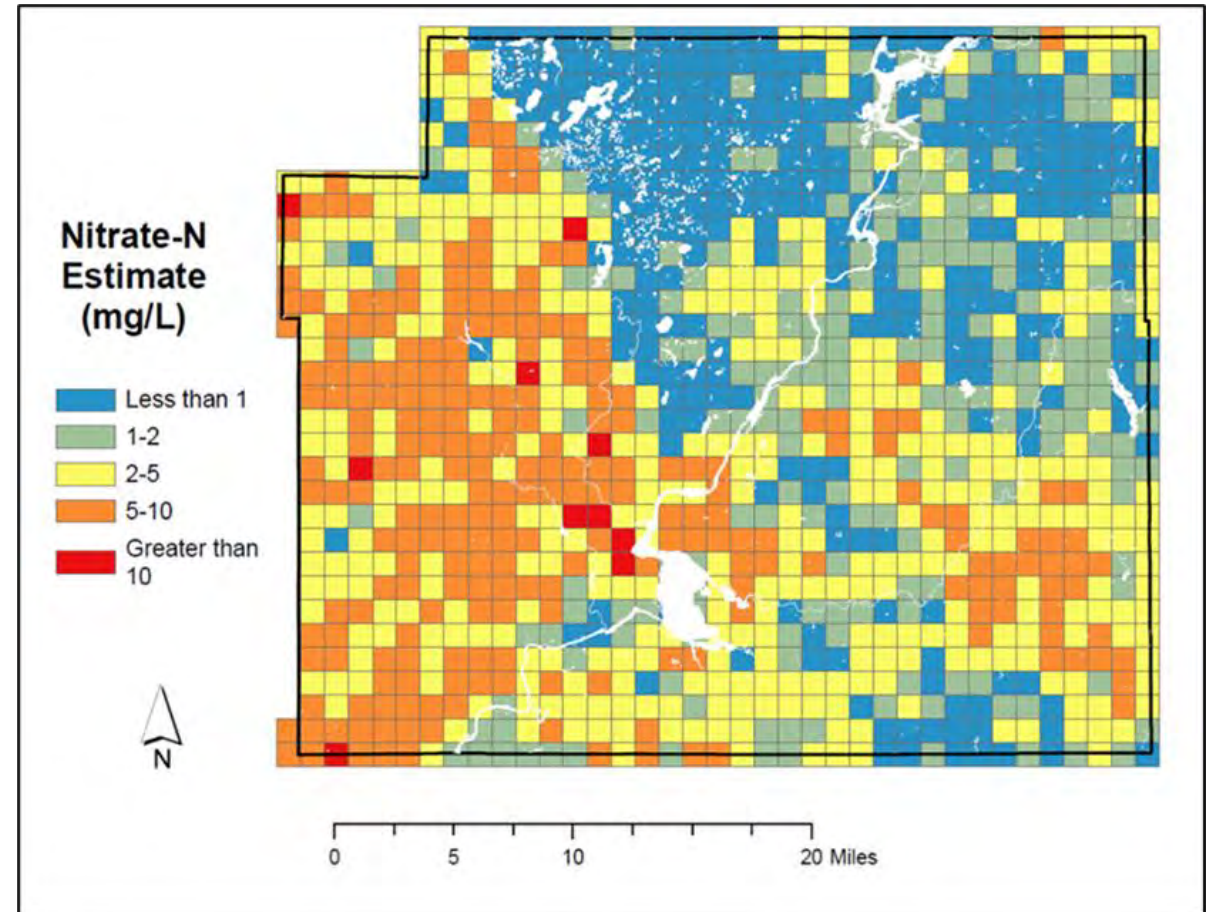
	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	0.21229	0.21826	0.973	0.3310
CORN_CASH	2.71980	0.27606	9.852	< 2e-16 ***
DAIRY	1.64863	0.28357	5.814	9.09e-09 ***
HAY	2.43170	0.49096	4.953	9.07e-07 ***
RLTIME_DNS	1.39460	0.32025	4.355	1.52e-05 ***
Weighted.Average.Rank	0.11734	0.05018	2.338	0.0196 *

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.12 on 738 degrees of freedom
Multiple R-squared: 0.2161, Adjusted R-squared: 0.2108
F-statistic: 40.68 on 5 and 738 DF, p-value: < 2.2e-16

Well Selection for Nitrate Source Occurrence

- County Trend Monitoring
 - Well owners that have submitted samples annually since 2019
 - 152 wells
- Nitrate Source Investigation
 - Additional wells selected from grid cells with a nitrate-N estimate greater than 5 mg/L
 - 141 wells

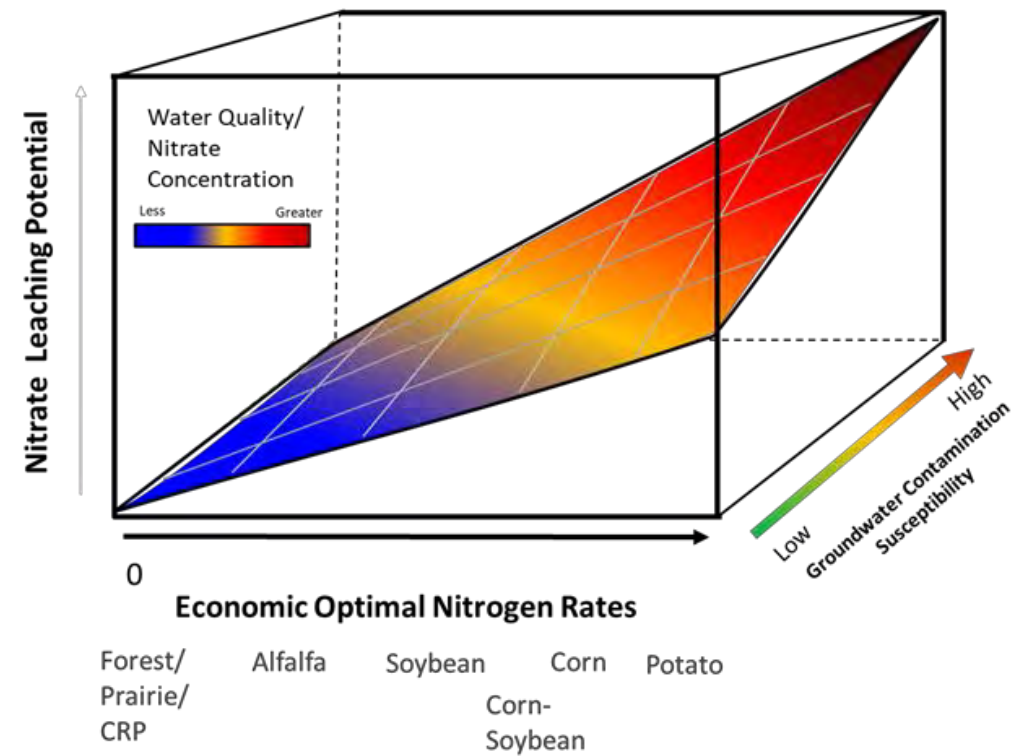
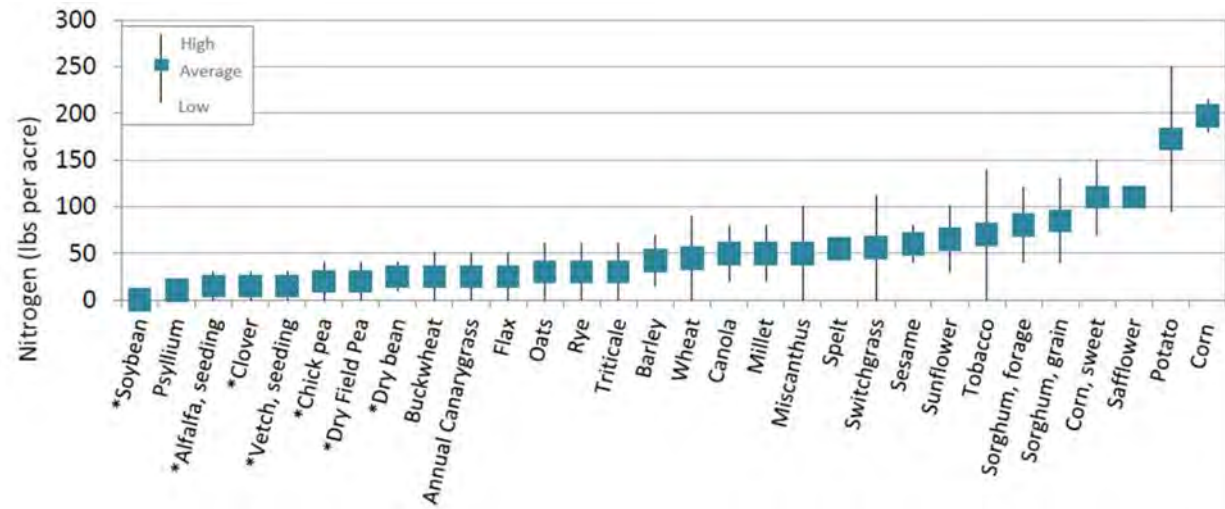


Annual Sampling (CTM) versus Nitrate Areas (NSI)

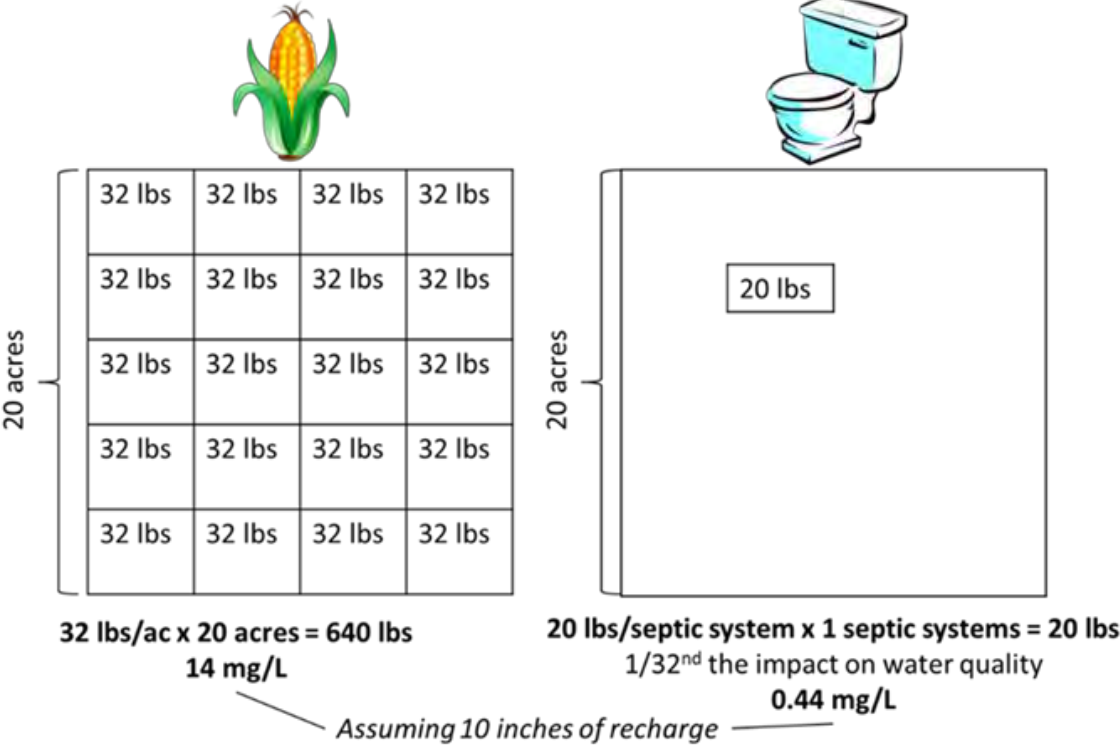
		Nitrate-Nitrogen			
	Samples	Mean Concentration	Greater than 2 mg/L	Greater than 5 mg/L	Greater than 10 mg/L
	n	mg/L	-----%-----		
CTM	151	4.7(4.4)	62	40	12
NSI	142	7.6(5.5)	82	59	34

Overall, gridded predictive model did a better job of identifying areas of elevated nitrate than random sampling would have.

Nitrate losses from agricultural systems



Nitrate leaching losses from septic systems



Nitrate Source Tracers

Parameter	Samples	Limit of Detection	Samples with detections		Health value*	Min	Median	Mean	Max
	n	ug/L	n	%	ug/L or parts per billion				
Alachlor OA ¹	24	0.08	0	0		NA	NA	NA	NA
Alachlor ESA ¹	24	0.08	10	42		0.13	0.49	0.53	1.28
Metolachlor OA ¹	24	0.08	2	8		0.12	0.17	0.17	0.22
Metolachlor ESA ¹	24	0.08	21	88		0.12	0.61	0.95	6.01
	n	ng/L	n	%	ng/L or parts per trillion				
Acesulfame ²	24	5	10	42		5.6	10.8	1,500	13,100
Sucralose ²	24	25	11	46		27	43	1934	16,100
Caffeine ²	24	12	3	13		12	12.3	14	18.7
Paraxanthine ²	24	5	0	0		NA	NA	NA	NA
Carbamazepine ²	24	2	1	4		7.6	7.6	7.6	7.6
Sulfamethoxazole ²	24	5	2	8		64	117.5	117.5	171
Acetamiprid ³	24	1.7	0	0		NA	NA	NA	NA
Clothianidin ³	24	1.5	4	17	1,000,000	2.5	18.1	18.2	34.1
Dinotefuran ³	24	0.7	0	0		NA	NA	NA	NA
Imidacloprid ³	24	2.4	1	4	200	18.7	18.7	18.7	18.7
Thiamethoxam ³	24	1.5	1	4	1,200,000	47.9	47.9	47.9	47.9

¹Common pesticides

²Pharmaceuticals and personal care products (PPCPs)

³Neonicotinoid compounds

*If this column is absent it means that there is no recommended health value available due to low risk or lack of health/toxicity research on those compounds.

		Nitrate-Nitrogen	Chloride
	n	mg/L	
Agricultural Tracers	21	9.8(5.1)	20.4(13.8)
PPCPs	17	8.8(5.4)	35.8(60.1)
Only Agricultural Tracers	6	10.0(5.2)	19.2(14.9)
Only PPCP	3	4.7(5.2)	105(137)

Take aways:

- Agriculture has greater influence on nitrate concentrations
- Developed areas have greater influence on chloride concentrations

PFAS

What are PFAS?

- PFAS are a group of chemicals made by humans. Since the 1950s, PFAS have been used in many consumer products and industrial processes. They have properties that resist heat, grease, and water.

Where are PFAS found?

- While PFOA and PFOS have been phased out from their use in commercial products, they are still found in the environment from historical uses and in some firefighting foams. In addition, products are often made with other PFAS as replacements for PFOA and PFOS. These PFAS can be found in everyday products, such as:
 - Cleaning products.
 - Water-resistant fabrics, such as rain jackets, umbrellas and tents.
 - Grease-resistant paper.
 - Nonstick cookware.
 - Personal care products, like shampoo, dental floss, nail polish, and eye makeup.
 - Stain-resistant coatings used on carpets, upholstery, and other fabrics.
- Most studies have analyzed only a small number of chemicals. Research suggests that high levels of some PFAS may:
 - Increase cholesterol levels.
 - Decrease how well the body responds to vaccines.
 - Increase the risk of thyroid disease.
 - Decrease fertility in women.
 - Increase the risk of serious conditions like high blood pressure or pre-eclampsia during pregnancy.
 - Lower infant birth weights (the decrease in weight is small and may not affect health).

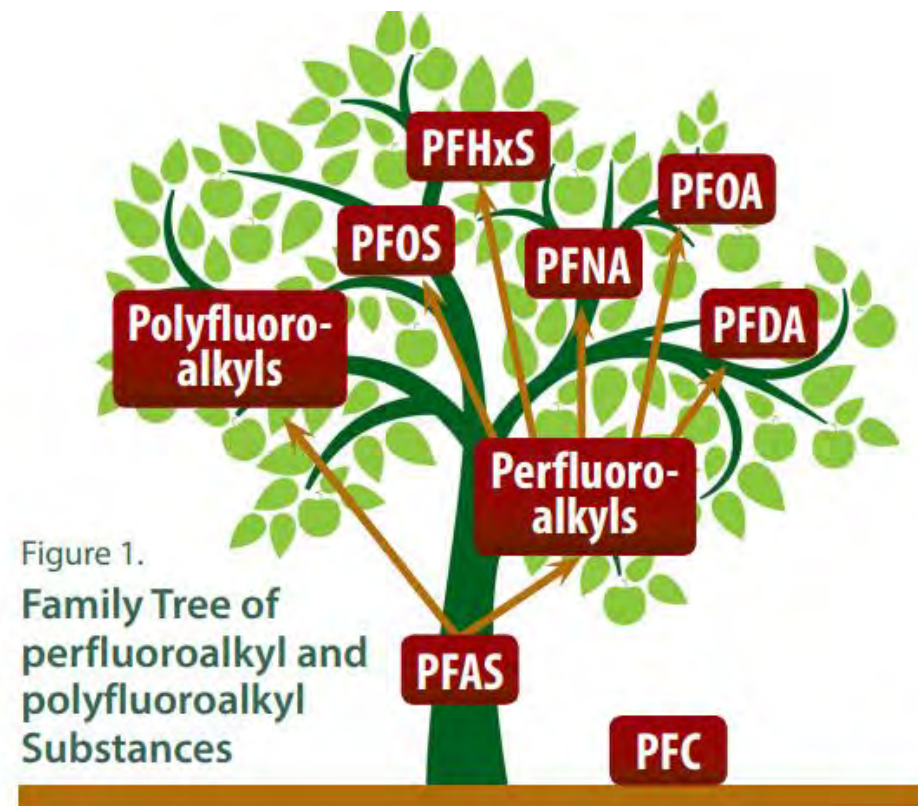


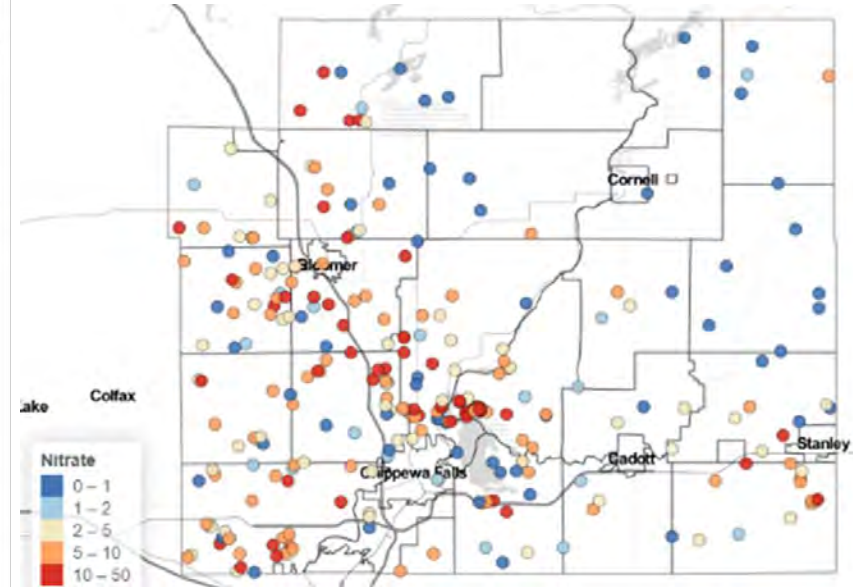
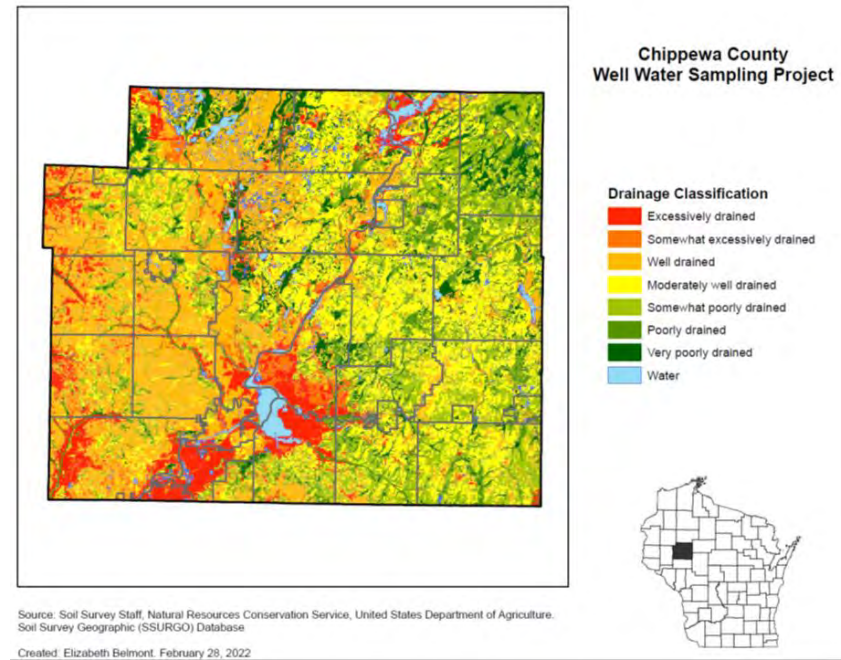
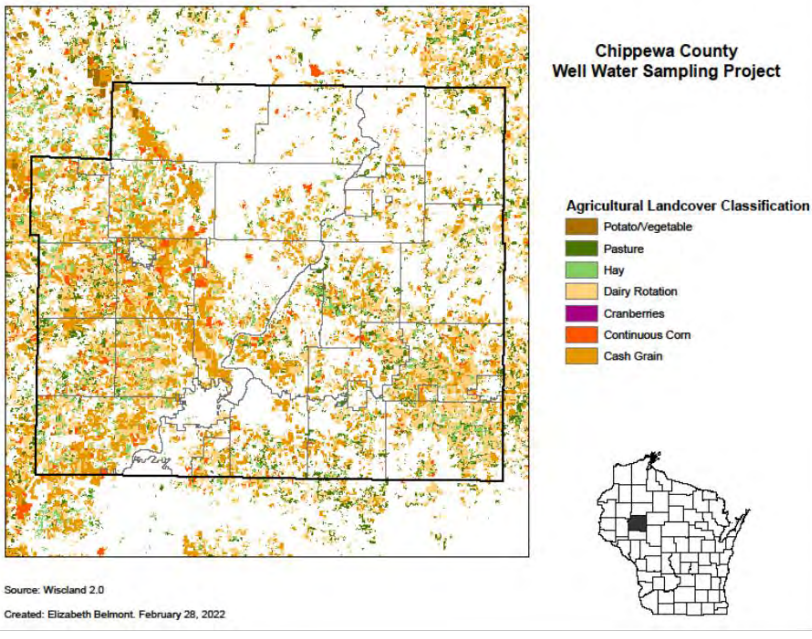
Figure 1.
Family Tree of
perfluoroalkyl and
polyfluoroalkyl
Substances

Perfluoroalkyl and Polyfluoroalkyl Substances

Parameter	Samples	Limit of Detection	Samples with detections		Health value*	Min	Median	Mean	Max
	n	ng/L	n	%	ng/L	ng/L or parts per trillion			
PFOA	24	0.107	3	13	20	2.94	3.19	8.78	20.20
PFOS	24	0.141	2	8	20	0.17	0.61	0.61	1.04
FOSA	24	0.153	0	0		NA	NA	NA	NA
N-EtFOSA	24	0.686	0	0		NA	NA	NA	NA
N-EtFOSE	24	0.21	0	0		NA	NA	NA	NA
N-EtFOSAA	24	0.21	0	0		NA	NA	NA	NA
Total of 6 above					20				
PFNA	24	0.146	1	4	30	0.19	0.19	0.19	0.19
PFHxS	24	0.14	3	13	40	0.19	1.22	3.21	8.23
HFPO-DA	24	0.19	0	0	300	NA	NA	NA	NA
PFDA	24	0.161	1	4	300	0.149	0.149	0.149	0.149
PFDoA	24	0.268	0	0	500	NA	NA	NA	NA
DONA	24	0.127	0	0	3,000	NA	NA	NA	NA
PFUnA	24	0.219	0	0	3,000	NA	NA	NA	NA
PFBA	24	0.342	4	17	10,000	1.23	6.35	15.31	47.30
PFTeDA	24	0.173	0	0	10,000	NA	NA	NA	NA
PFHxA	24	0.202	3	13	150,000	0.67	0.91	1.05	1.57
PFBS	24	0.228	3	13	450,000	0.26	2.05	4.77	12.00
PFPeA	24	0.148	3	13		0.26	0.80	0.76	1.22
PFHpA	24	0.148	2	8		0.36	3.42	3.42	6.49
PFPrS	24	0.255	1	4		0.46	0.46	0.46	0.46
PFPeS	24	0.134	2	8		0.39	1.41	1.41	2.43
FHpPA	24	0.435	1	4		1.11	1.11	1.11	1.11
PFBSA	24	0.427	1	4		1.23	1.23	1.23	1.23

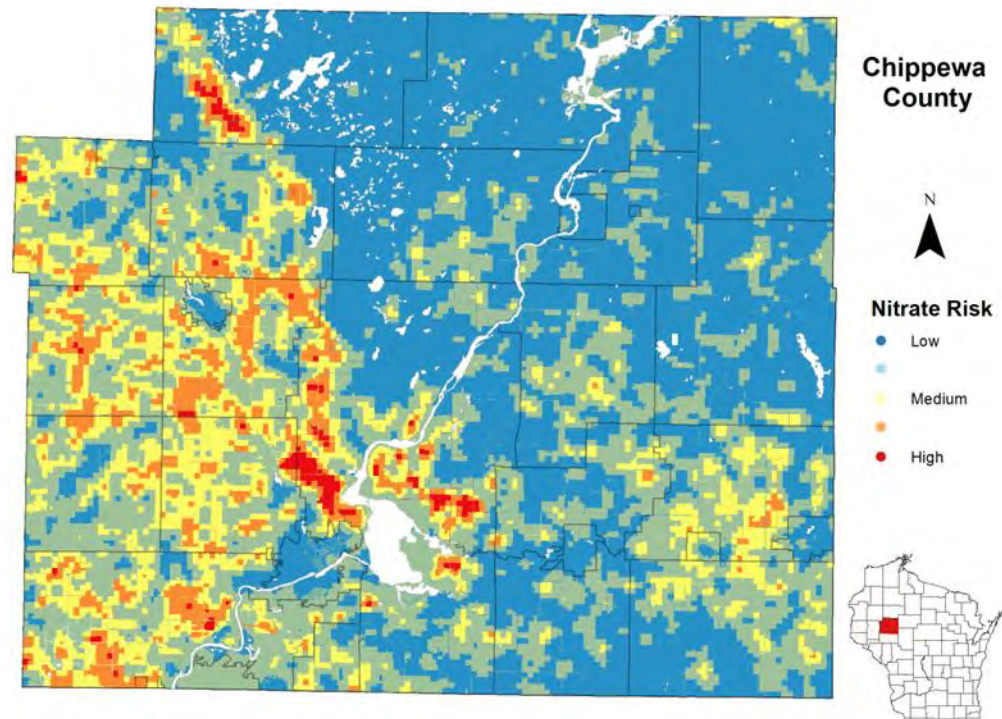
The one sample that detected PFAS above the health standard only contained PPCPs, no agricultural tracers

Landcover + Soil Drainage = Nitrate-N

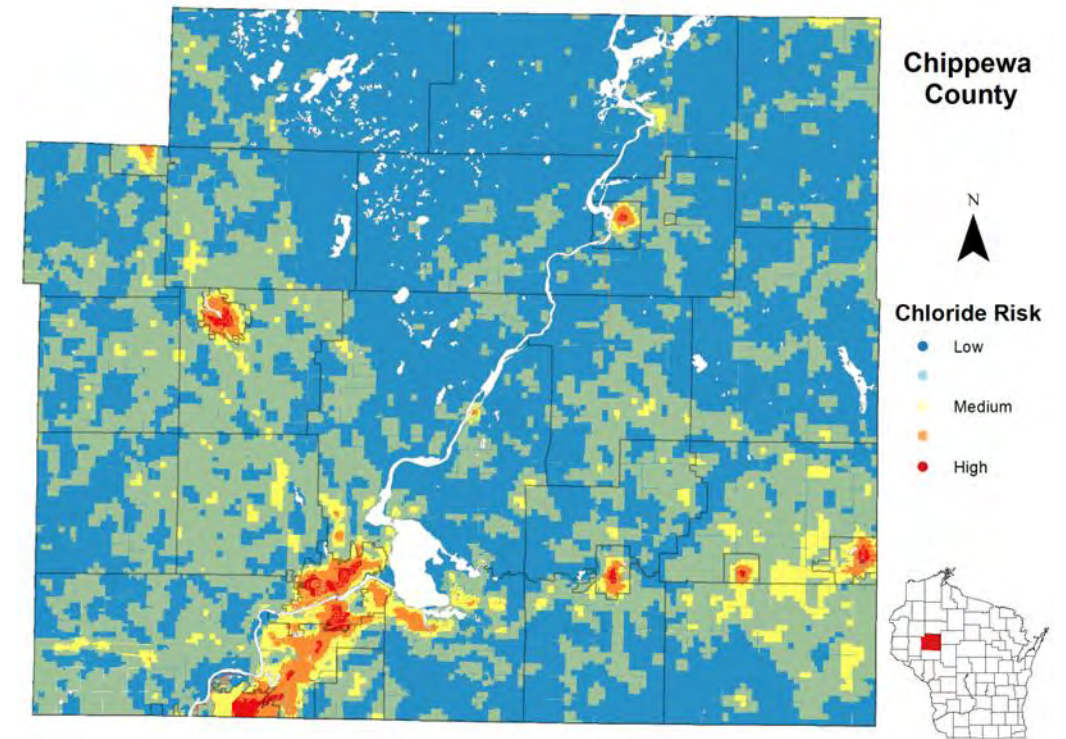


2022

Nitrate Risk Model



Chloride Risk Models



What's next for the project?

- Test kits for 2023 will be sent sometime in October
- **Coming in Year 5:**
 - Add new functionality to dashboard:
 - Land use, well construction, trends, etc.
 - Continue to analyze for trends in nitrate/chloride data
 - Investigate factors that might be contributing to trends
 - Utilize data to target outreach and management

Operating your private water utility:

- ***Periodically inspect and maintain*** the area around your well
- ***Test your water regularly*** to evaluate common water quality concerns
- ***If necessary, take corrective actions****

*Know when to call a licensed well driller or pump installer



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