

# Green County Water WELLness 2023

Decatur-Spring Grove-Sylvester



Center for Watershed Science and Education  
College of Natural Resources  
**University of Wisconsin-Stevens Point**

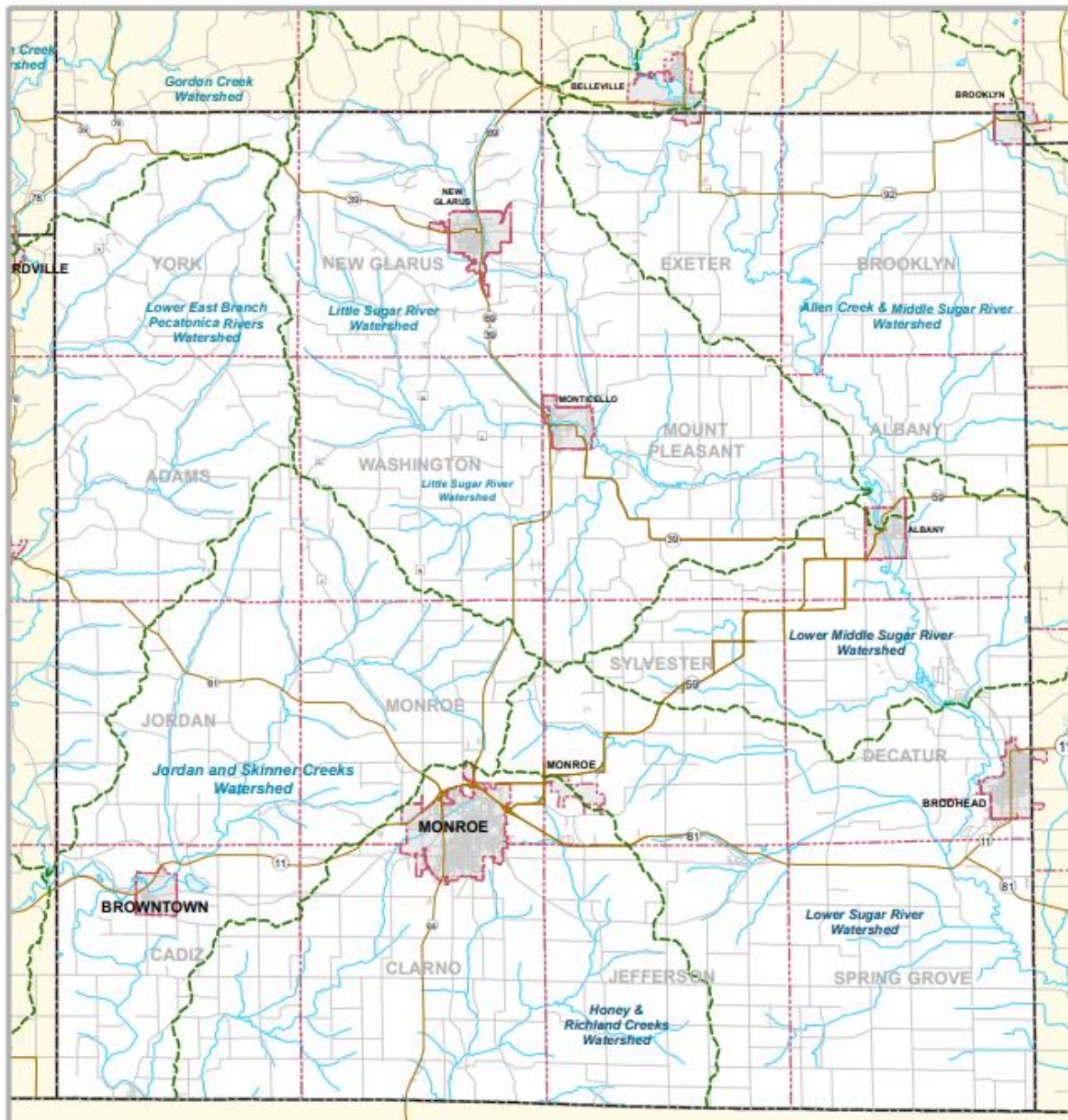


**Extension**  
UNIVERSITY OF WISCONSIN-MADISON

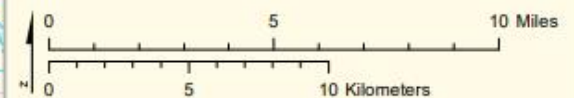
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# Green County

2013 - 2023



- Watershed Boundary
- Streams
- Lakes/Reservoirs
- Wetlands
- State/US Highways
- Other Roads
- Town Boundaries
- Municipalities



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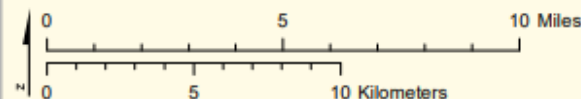
# Green County

2013 - 2023



## SAMPLE DISTRIBUTION

NUMBER OF SAMPLES  
per 1/4 1/4 SECTION



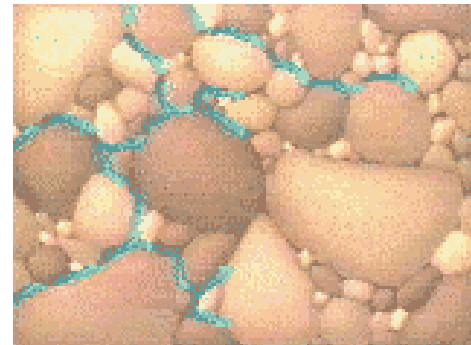
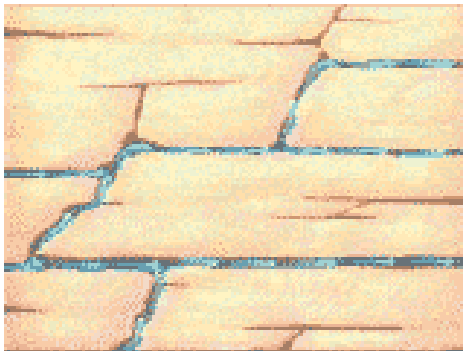
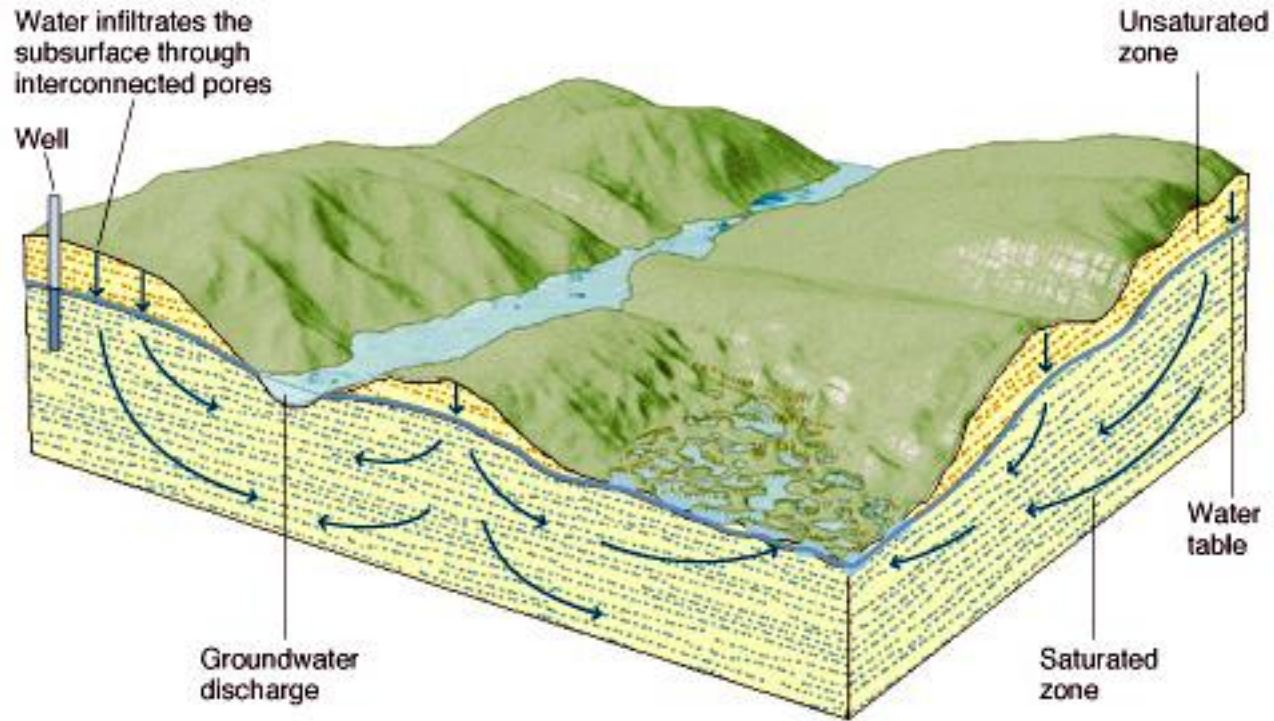
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# Today's presentation

- Groundwater Basics: Where does my water come from
- Well Construction
- What do my individual test results mean?
- General groundwater quality in Green County
- Improving your water quality



# Groundwater Movement



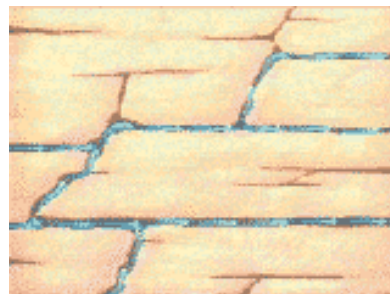


# Aquifers: Our groundwater storage units

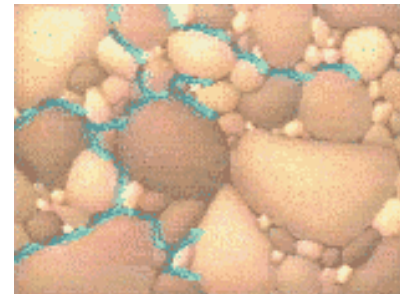
Aquifers are geologic formations that store and transmit groundwater.

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 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

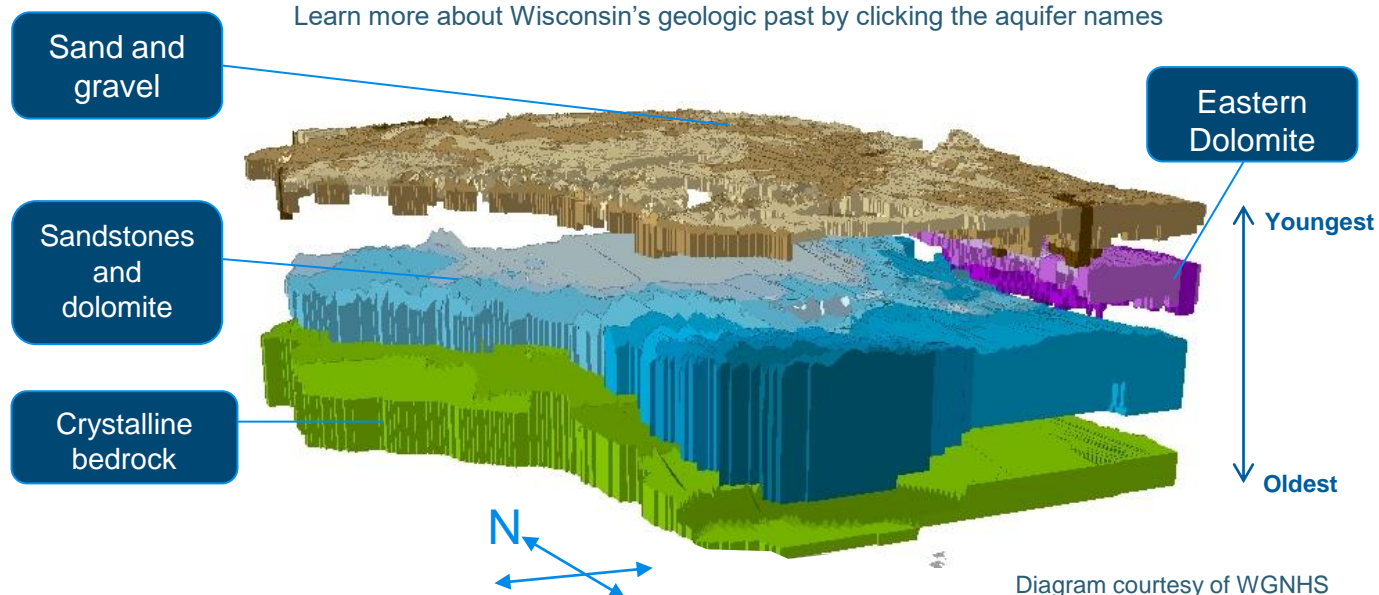
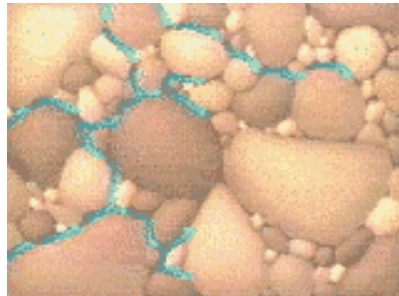
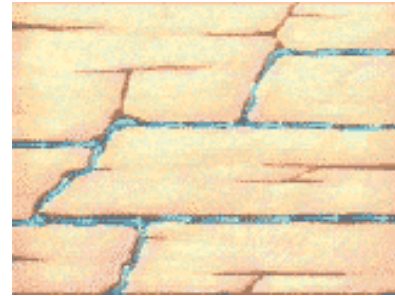


Diagram courtesy of WGNHS

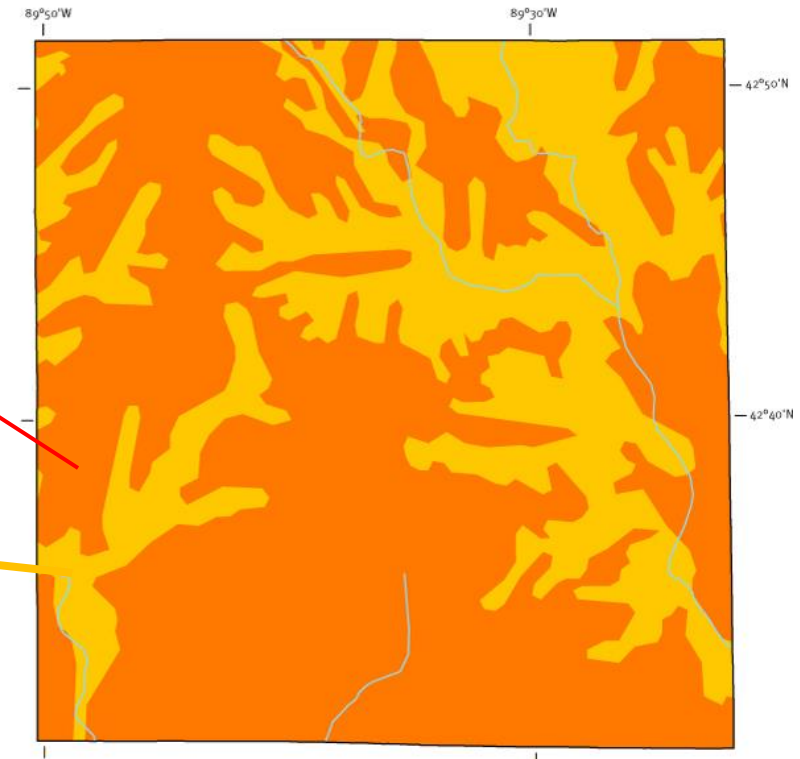
# Green County Geology



- EXPLANATION**
- Bedrock Type**
- Carbonate
  - Sandstone
  - Igneous/metamorphic
  - Shale
- Water
- Stream
- County boundary

0 5 MILES  
0 5 KILOMETERS

Green County – Bedrock Type



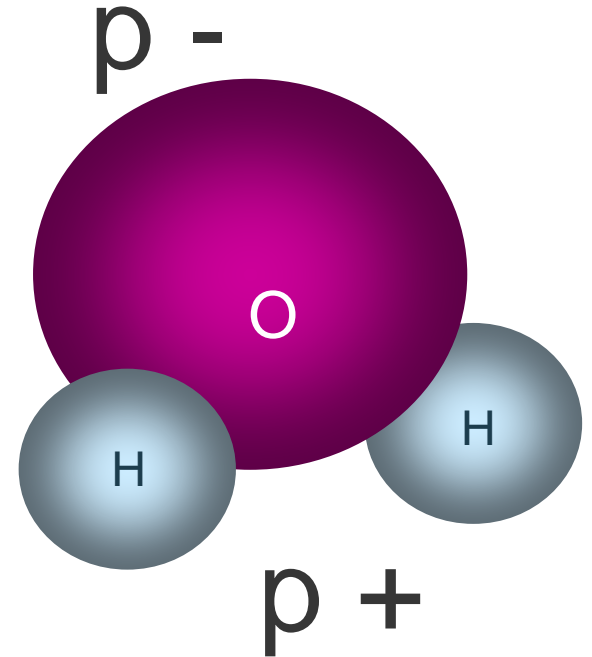
This resource characteristic map was derived from generalized statewide information at small scales, and cannot be used for any site-specific purposes.

Map source: Schmidt, R.R., 1987, Groundwater contamination susceptibility map and evaluation: Wisconsin Department of Natural Resources, Wisconsin's Groundwater Management Plan Report 5, PUBL-WR-177-87, 27 p.

Figure created for the "Protecting Wisconsin's Groundwater Through Comprehensive Planning" web site, 2007, <http://wi.water.usgs.gov/gwcomp/>

# 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





# Interpreting Drinking Water Test Results

## Tests important to health:

- Bacteria
- Sodium
- Nitrate
- Copper
- Lead
- Triazine
- Zinc
- Sulfate
- Arsenic

## Tests for aesthetic (taste,color,odor) problems:

- Hardness
- Iron
- Manganese
- Chloride

## Other important indicator tests:

- Saturation Index
- Alkalinity
- Conductivity
- Potassium

**Red** = human-influenced    **Blue** = naturally found

# Health Concern Categories

## Acute Effects

- Usually seen within a short time after exposure to a particular contaminant or substance.

(ex. Bacteria or viral contamination which may cause intestinal disease)

## Chronic Effects

- Result from exposure to a substance over a long period of time.
- Increase risk of developing health complications later in life.

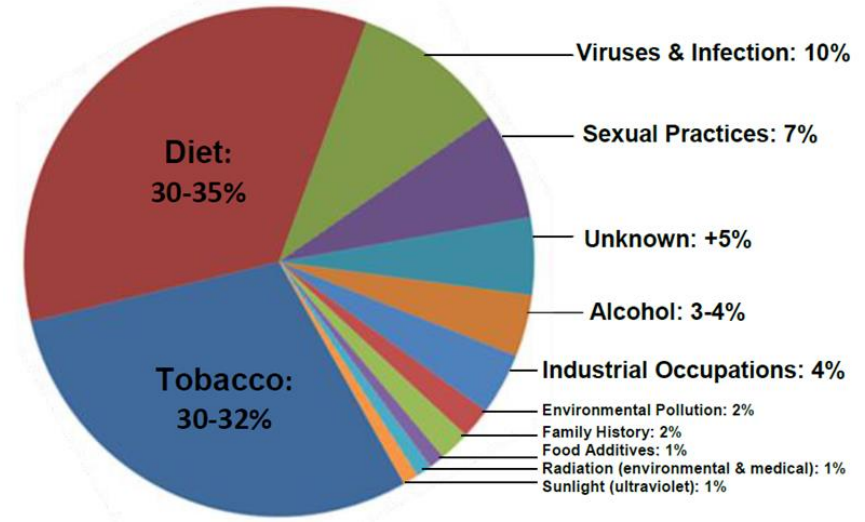
(ex. Arsenic or pesticides can increase the risk of developing certain cancers)



# Chronic related health concerns are generally about risk management

## National Cancer Risk Factors with Percentages

*Adapted from Everyone's Guide to Cancer Therapy*



Being struck by lightning	0.16 in 1,000 chance.
0.010 mg/L of arsenic in drinking water.	3 out of 1,000 people likely to develop cancer.
2 pCi of indoor radon level.	4 out of 1,000 people likely to develop lung cancer. <sup>1</sup>
2 pCi of indoor radon combined with smoking.	32 out of 1,000 people could develop lung cancer. <sup>1</sup>

Drinking water quality is only one part of an individual's total risk.

<sup>1</sup><http://www.epa.gov/radon/healthrisks.html>



# Private vs. Public Water Supplies

## Public Water Supplies

- Regularly tested and regulated by drinking water standards.



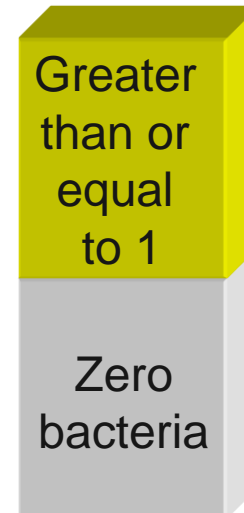
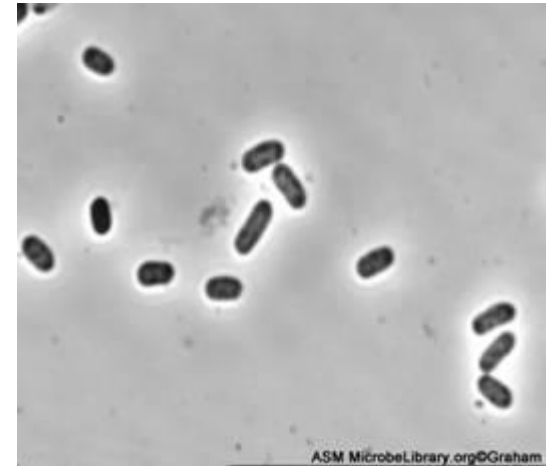
## Private Wells

- Not required to be regularly tested.
- Not required to take corrective action
- Owners must take special precautions to ensure safe drinking water.



# Coliform bacteria

- Generally do not cause illness, but indicate a pathway for potentially harmful microorganisms to enter your water supply.
  - Harmful bacteria and viruses can cause gastrointestinal disease, cholera, hepatitis
- Well Code: “Properly constructed well should be able to provide bacteria free water continuously without the need for treatment”
- Recommend using an alternative source of water until a test indicates your well is absent of coliform bacteria
- Sources:
  - Live in soils and on vegetation
  - Human and animal waste
  - Sampling error



Present = Unsafe

Absent = Safe

# If coliform bacteria was detected, we also checked for e.coli bacteria test

- Confirmation that bacteria originated from a human or animal fecal source.
- E. coli are often present with harmful bacteria, viruses and parasites that can cause serious gastrointestinal illnesses.
- Any detectable level of E.coli means your water is unsafe to drink.

Information Sources: United States Department of Health and Human Services – Centers for Disease Control and Prevention ([www.cdc.gov](http://www.cdc.gov)) and United States Environmental Protection Agency ([www.epa.gov](http://www.epa.gov))

Contaminants	Sources	Symptoms
<b>BACTERIA</b>		
<i>Escherichia coliform (E. coli)</i> <i>Salmonella</i> <i>Campylobacter</i> <i>E. coli</i> 0157 (Requires a special water test for detection. Causes similar, but more serious illness than other E.coli strains. Requires medical treatment.)	<ul style="list-style-type: none"> <li>• Infected human and animal feces</li> <li>• Manure</li> <li>• Septic systems</li> <li>• Sewage</li> </ul>	<ul style="list-style-type: none"> <li>• Gastrointestinal illness</li> <li>• Low-grade fever</li> <li>• Begins 12 hrs - 7 days after exposure</li> </ul>
<i>Leptosporidia</i>	<ul style="list-style-type: none"> <li>• Urine of livestock, dogs and wildlife</li> <li>• Manure</li> </ul>	<ul style="list-style-type: none"> <li>• High fever, severe headache and red eyes</li> <li>• Gastrointestinal illness</li> <li>• Begins 2-28 days after exposure</li> </ul>
<b>MICROSCOPIC PARASITES</b>		
<i>Cryptosporidia</i> <i>Giardia</i>	<ul style="list-style-type: none"> <li>• Infected human and animal feces</li> <li>• Manure</li> <li>• Septic systems</li> <li>• Sewage</li> </ul>	<ul style="list-style-type: none"> <li>• Gastrointestinal illness</li> <li>• Begins 2-14 days after exposure</li> </ul>
<b>VIRUSES</b>		
Norovirus	<ul style="list-style-type: none"> <li>• Infected human feces and vomit</li> <li>• Septic systems</li> <li>• Sewage</li> </ul>	<ul style="list-style-type: none"> <li>• Gastrointestinal illness</li> <li>• Low-grade fever &amp; headache</li> <li>• Begins 12-48 hrs after exposure</li> </ul>
<b>CHEMICALS</b>		
Nitrate	<ul style="list-style-type: none"> <li>• Fertilizers</li> <li>• Manure</li> <li>• Bio-solids</li> <li>• Septic systems</li> </ul>	Methemoglobinemia or "Blue Baby Syndrome" – No documented cases in Door County, but elevated nitrate levels in well water may indicate risk of contamination by additional pathogens.
Atrazine (trade-name herbicide for control of broadleaf and grassy weeds)	Estimated to be most heavily used herbicide in the U.S. in 1987/89, with its most extensive use for corn and soybeans in the Midwest, including WI. In 1993, it became a restricted-use herbicide nationally. U.S. EPA set a max. contaminant level (MCL) at 3 parts per billion for safe drinking water.	Short-term exposure above the MCL may cause: congestion of heart, lungs and kidneys; low blood pressure; muscle spasms; weight loss; damage to adrenal glands.  Long-term exposure above MCL may cause: weight loss, cardiovascular damage, retinal and some muscle degeneration; cancer.



# Well Construction Defects



- Is the well cap or casing cracked?

# Well Construction Defects

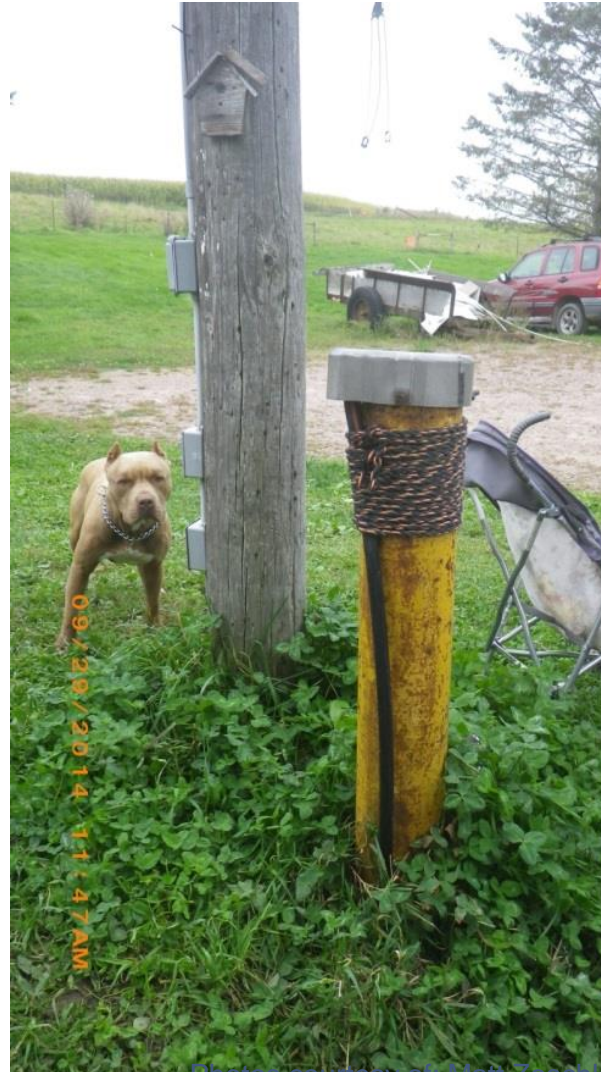


- Does your well have a vermin-proof cap?





# Other Well Construction Defects



- Electrical conduit not installed correctly
- Don't leash pets within 10 feet of the well
- Avoid bird feeders and other decorations directly above the well

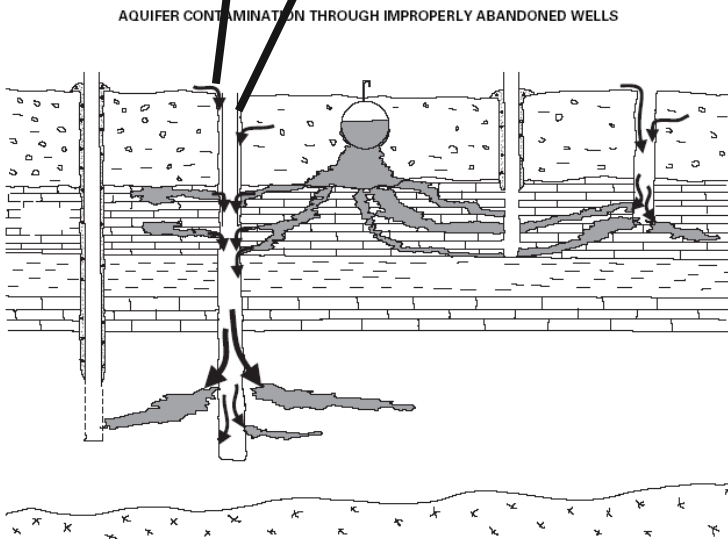
Photos courtesy of: Matt Zoschke



# Well Construction Defects



- Are there old wells on the property?
  - Wells are a direct conduit to groundwater
  - Consider having them properly filled and sealed

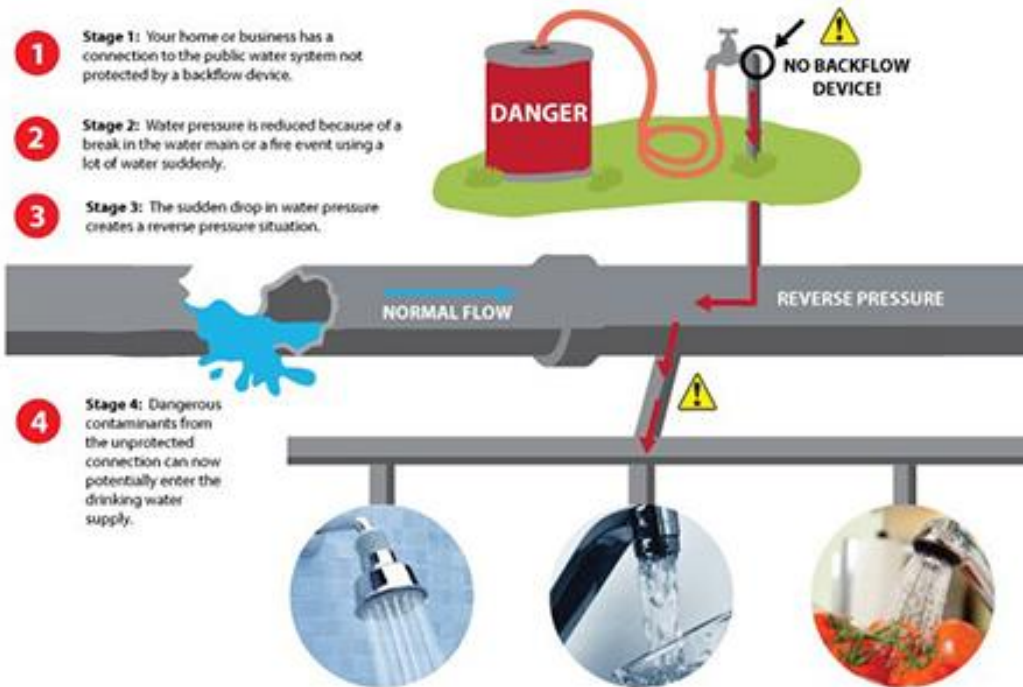


# Well Construction Defects

- Do yard hydrants, livestock waterers, and service to outbuildings have proper backflow prevention?



## HOW BACKFLOW CAN HAPPEN



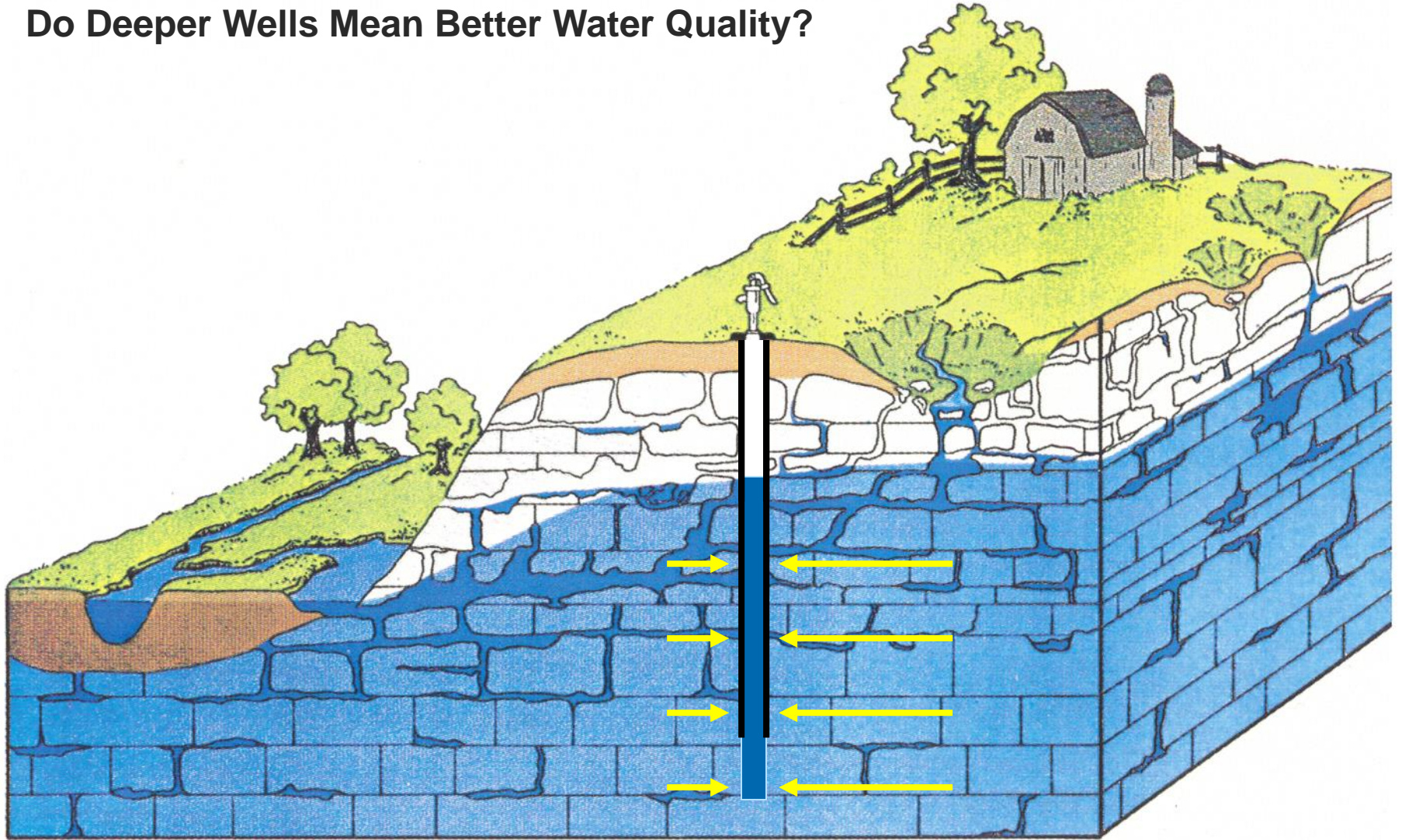
# What makes a good well....



- Vermin proof cap
- Casing extends at least 12" above grade
- Area around well free and clear of debris or other obstructions
- Down spouts or runoff from driveways/other surfaces not directed towards the well



## Do Deeper Wells Mean Better Water Quality?





# What should I do if coliform bacteria was present?

1. Use alternative source of water for drinking
2. Retest
3. Try to identify any sanitary defects
  - Loose or non-existent well cap
  - Well construction faults
  - A nearby unused well or pit
  - Inadequate filtration by soil
4. Disinfect the well
5. Retest to ensure well is bacteria free.

➤ *For reoccurring bacteria problems the best solution may be a new well or if new well is unlikely to remedy the problem because of geology, may seek approval for treatment.*

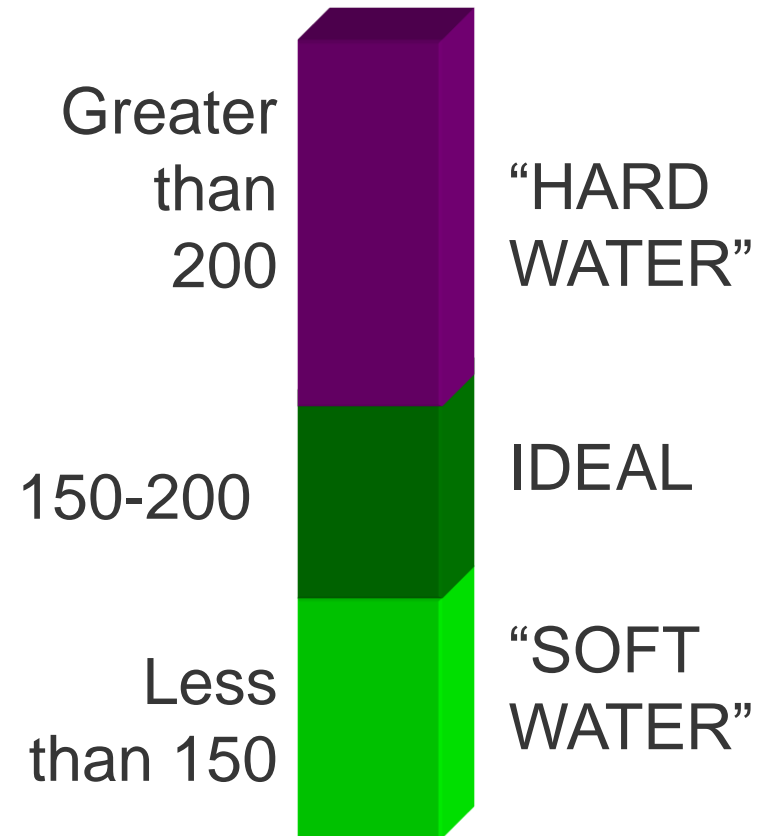


# **Rock and Soil Impacts on Water Quality**

# Tests for Aesthetic Problems

## Hardness

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





# Green County

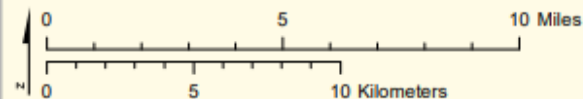
2013 - 2023



## TOTAL HARDNESS (ppm CaCO<sub>3</sub>)

A	... 50	161	13%
B	51 - 100	21	2%
C	101 - 200	72	6%
D	201 - 300	173	14%
E	301 - 400	608	51%
F	401 ...	163	14%

Mapped value is the average for the 1/4 1/4 section  
Treated samples not mapped



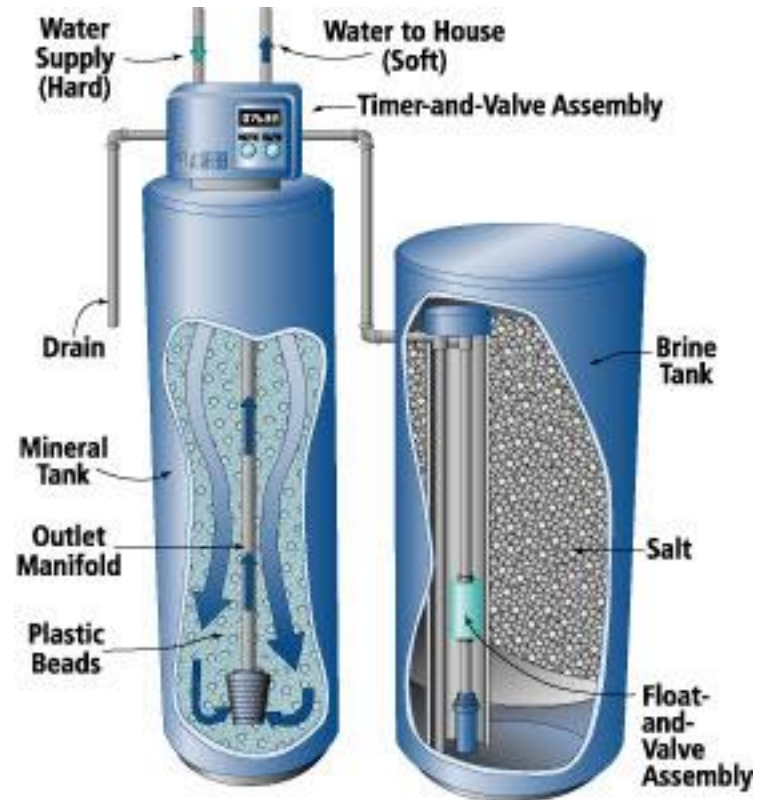
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# Water Softening

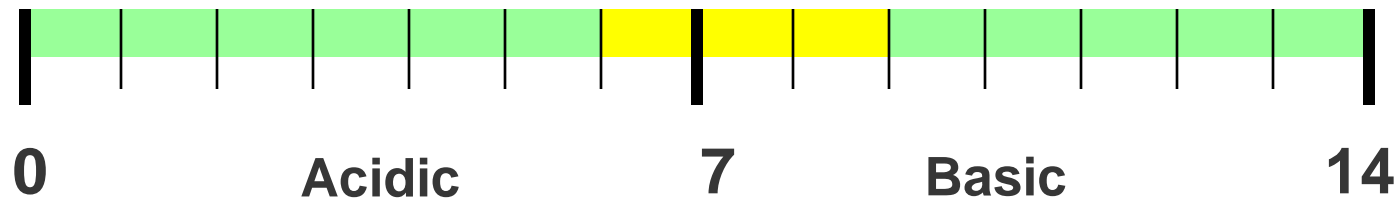
Water softeners remove calcium and magnesium which cause scaling and exchange it for sodium (or potassium).

- **Negative:** Increases sodium content of water.
- **Suggestions:**
  - Bypass your drinking water faucet.
  - Do not soften water for outdoor faucets.
  - If you are concerned about sodium levels – use potassium chloride softener salt.



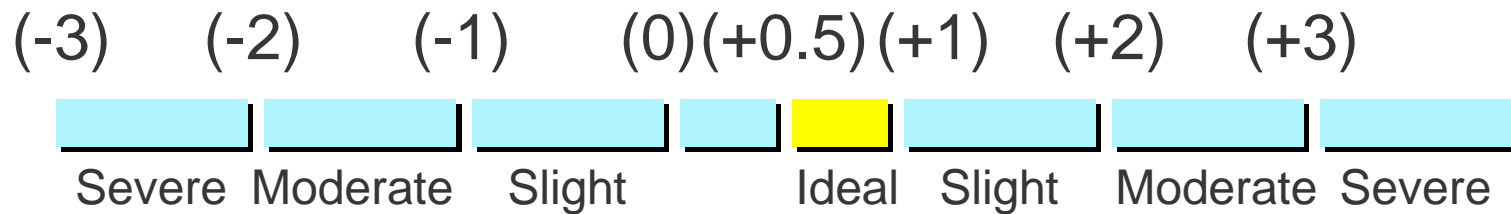
# Tests for Overall Water Quality

- **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 Overall Water Quality

## Saturation Index



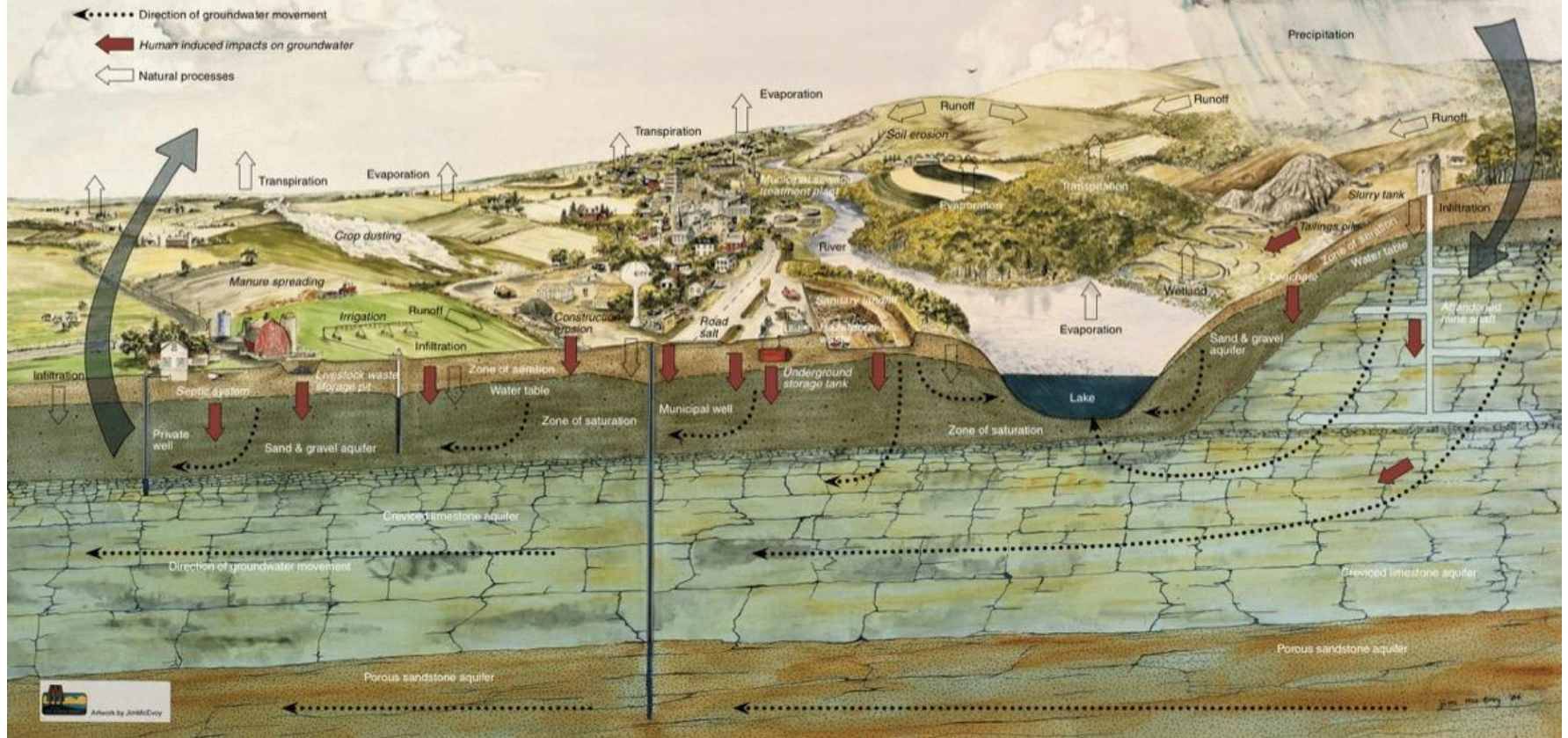
Corrosion occurs



Scaling occurs



# Groundwater and land use in the water cycle

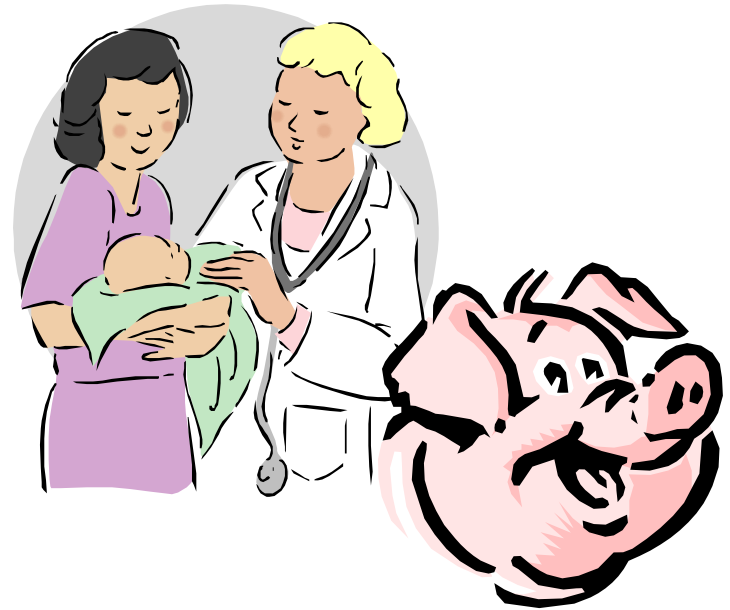




# Nitrate-Nitrogen

## Health Effects:

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



## Sources:

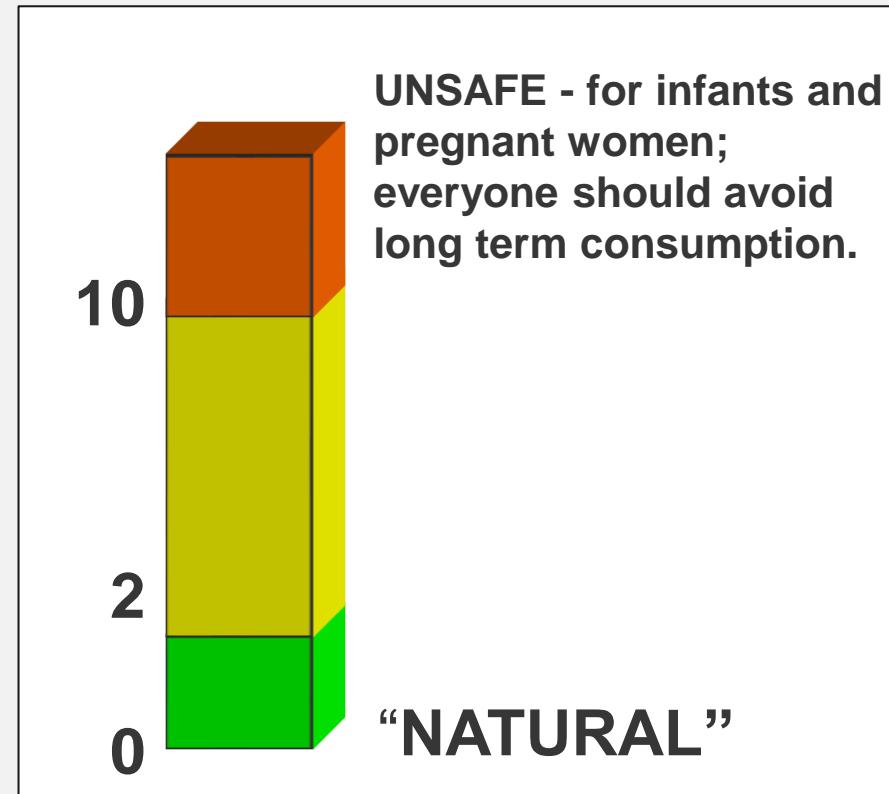
- Agricultural fertilizer
- Lawn fertilizer
- Septic systems
- Animal wastes



# Test Important to Health

## Nitrate Nitrogen

- **Greater than 10 mg/L**  
*Exceeds State and Federal Limits for Drinking Water*
- **Between 2 and 10 mg/L**  
*Some Human Impact*
- **Less than 2.0 mg/L**  
*“Transitional”*
- **Less than 0.2 mg/L**  
*“Natural”*



# Green County

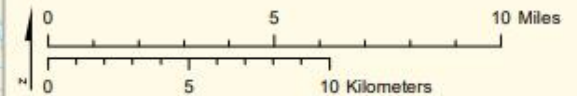
2013 - 2023



## NITRATE-NITRITE (ppm N)

<b>A</b>	<b>None Detected</b>	<b>124</b>	<b>10 %</b>
<b>B</b>	<b>... 2.0</b>	<b>211</b>	<b>17 %</b>
<b>C</b>	<b>2.1 - 5.0</b>	<b>289</b>	<b>23 %</b>
<b>D</b>	<b>5.1 - 10.0</b>	<b>386</b>	<b>31 %</b>
<b>E</b>	<b>10.1 - 20.0</b>	<b>212</b>	<b>17 %</b>
<b>F</b>	<b>20.1 ...</b>	<b>15</b>	<b>1 %</b>

Mapped value is the average for the 1/4 1/4 section  
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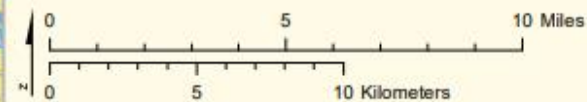


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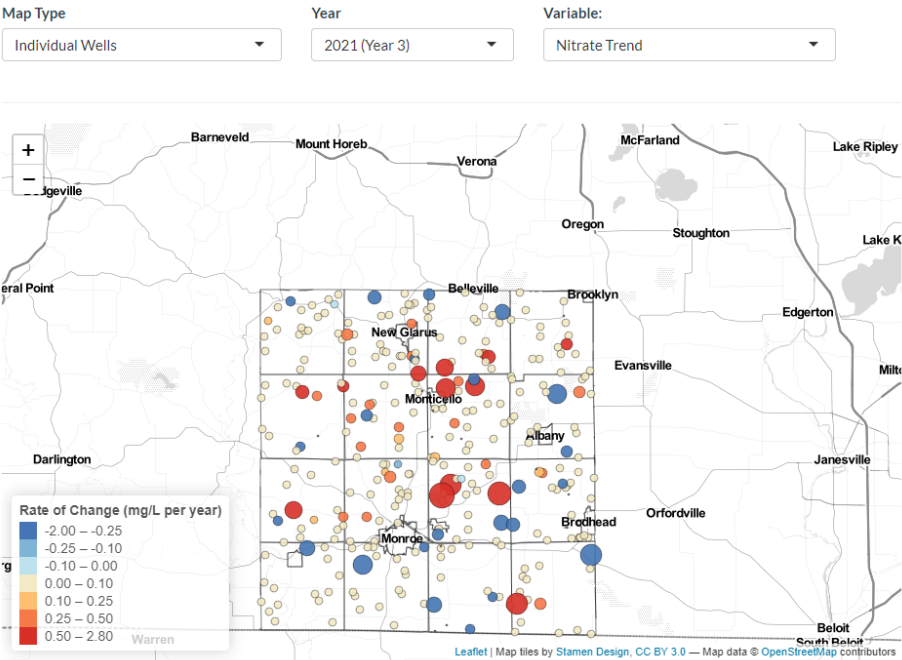
## Land Use:



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# Nitrate Trends

## Green County Well Water Monitoring Project



Center for Watershed Science and Education in partnership with Green County  
Created by: Kevin Masarik, Abby Johnson, Grant Moser, and Jennifer Dierauer  
Last modified: February 16, 2023. [Contact us for questions](#)

[ABOUT the Project](#) [LEARN about Tests](#) [LEARN about other Variables](#) [EXPLORE project data](#)

### Overview

Green County is conducting a five-year project to gather information on well water quality. The water quality data collected is intended to understand whether groundwater quality is changing over time. This project has established a network of private well owners to perform annual testing for a period of five years.

- 2019 - 348 well owners participated in Year 1
- 2020 - 323 well owners participated in Year 2
- 2021 - 307 well owners participated in Year 3
- 2022 - 294 well owners participated in Year 4

The information collected through these efforts will be used to analyze where and what factors may be contributing to any changes in groundwater quality observed over time. The well network is intended to be representative of Green County (i.e. accounting for the wide variety of geology, soils, land-use, and well construction found throughout the area).

### Using the Map

#### Map Type

Individual Wells: When individual wells are selected, this map view allows you to see the water quality test results for each well that was sampled. The well points are approximate locations in order to protect the privacy of participants. Clicking on the points will provide the water quality result for whichever test is selected.

Municipality: When the municipality view is selected, the map displays the average concentration for each of the water quality tests conducted. Clicking on the municipality will provide summary statistics by town.

#### Year

This drop down menu allows you to see results from different years. Additional data will be made available as the project progresses.

#### Variable

This drop down menu switches allows you to view the different analytes or various attributes associated with the wells

### LEARN about tests

Samples are analyzed for nitrate-nitrogen, chloride, alkalinity, total hardness, pH, and conductivity. Nitrate and chloride are useful for understanding the degree to which groundwater has been affected by human activities. Click on the 'LEARN about tests' tab To learn more about the specific tests and what they tell us about groundwater.

### LEARN about other variables

Other attributes associated with the well construction or land use are can be useful for understanding what factors may be influencing well water quality. Other variables include: Percent Agriculture, Percent Dairy Rotation, Percent Row Crops, Percent Hay/Pasture, Uppermost Bedrock Type, and Casing Depth Below the Water Table. Click on the 'LEARN about other variables' tab To learn more about other variables and what they tell us about groundwater.

# What can I do to reduce my nitrate levels?

## **Solution:**

- **Eliminate contamination source or reduce nitrogen inputs**

## **Short term:**

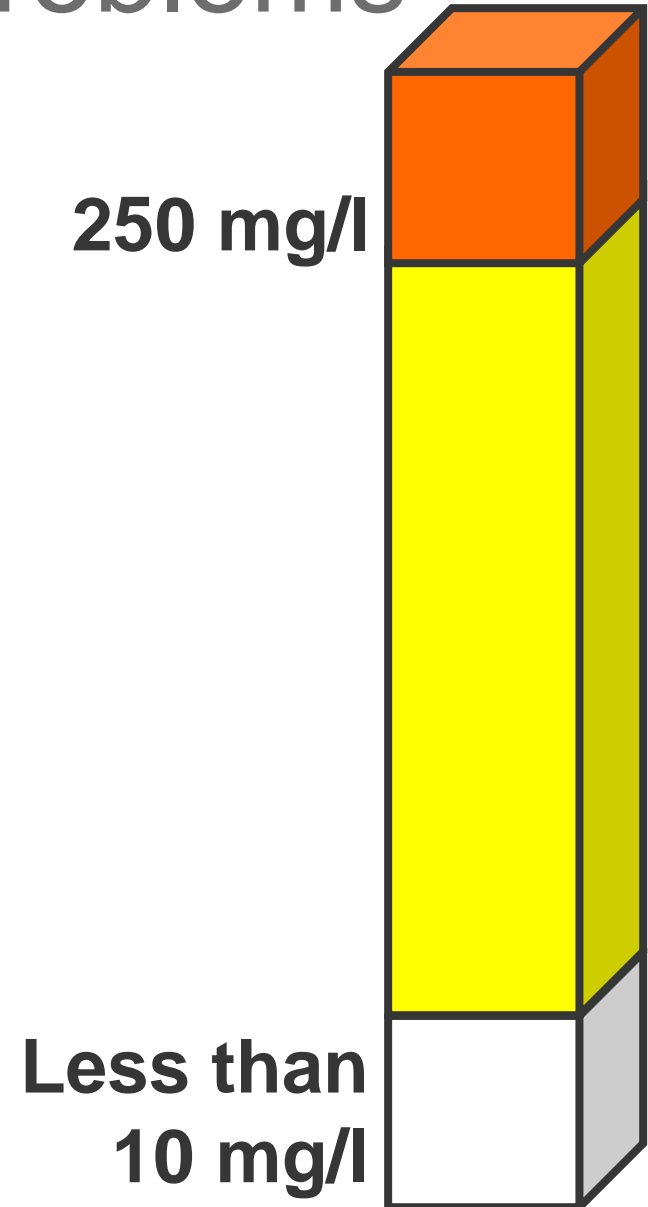
- **Change well depth or relocate well**
- **Carry or buy water**
- **Water treatment devices**
  - **Reverse osmosis**
  - **Distillation**
  - **Anion exchange**



# 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



# Green County

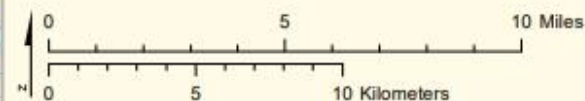
2013 - 2023



## CHLORIDE (ppm)

A	None Detected	2	<1 %
B	... 10	437	36 %
C	11 - 50	644	54 %
D	51 - 100	101	8 %
E	101 - 200	17	1 %
F	201 ...	0	0 %

Mapped value is the average for the 1/4 1/4 section  
Treated samples not mapped



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# Test Important to Health

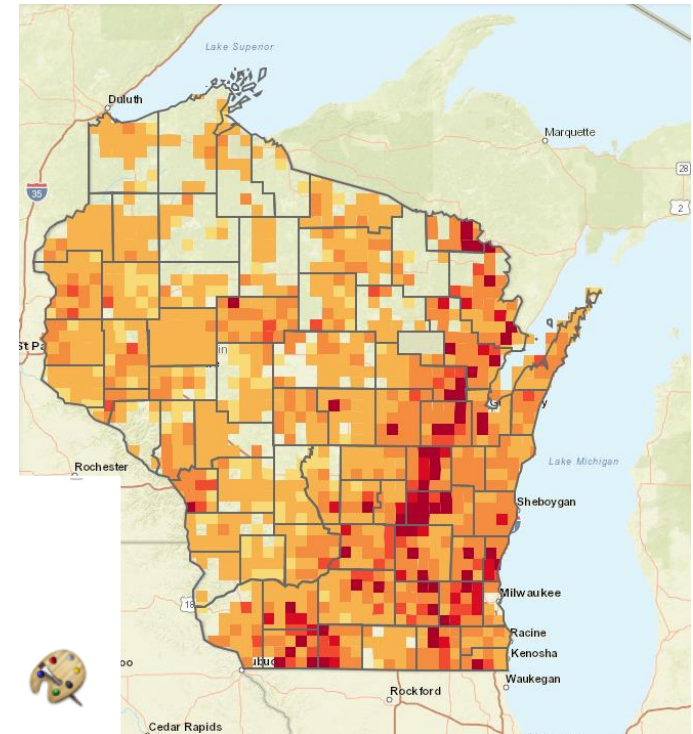
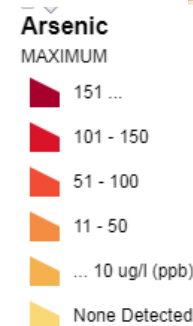
## Arsenic

**Sources:** Naturally occurring in mineral deposits

**Standard:** 0.010 mg/L (10 ppb)

### Health Effects:

- Increased risk of skin cancers as well as lung, liver, bladder, kidney, and colon cancers.
- Circulatory disorders
- Stomach pain, nausea, diarrhea
- Unusual skin pigmentation





# Green County

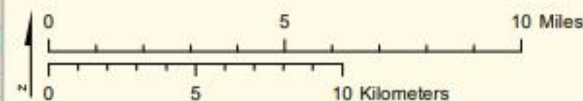
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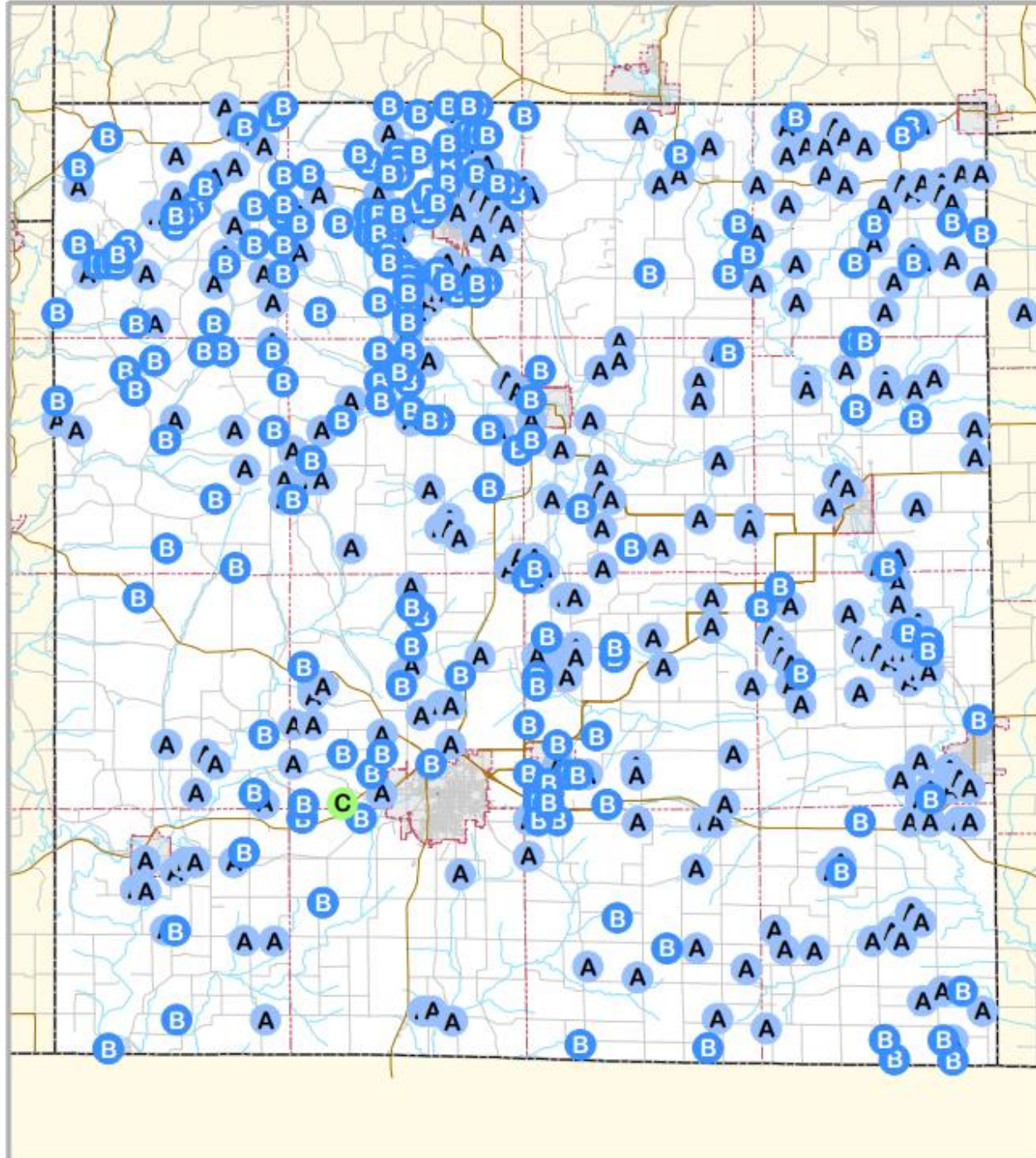
## ARSENIC (mg/l)

A	None Detected	390	61 %
B	... 0.010	243	38 %
C	0.011 - 0.050	6	<1 %
D	0.051 - 0.100	0	0 %
E	0.101 - 0.150	0	0 %
F	0.151 ...	0	0 %

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# Tests for Aesthetic Problems

## Iron

- Natural (rocks and soils)
- May benefit health
- Red and yellow stains on clothing, fixtures
- If iron present, increases potential for iron bacteria
  - Slime, odor, oily film



**Greater  
than 0.3  
mg/L**

**Aesthetic  
problems  
likely**

**Less  
than 0.3 mg/L**

# Test Important to Health

## Copper

- **Sources:** Copper water pipes
- **Standard:** Less than 1.3 mg/L is suitable for drinking



### Health Effects:

- Some copper is needed for good health
- Too much may cause problems:
  - Stomach cramps, diarrhea,
  - vomiting, nausea
  - Formula intolerance in infants



# Test Important to Health

## Lead

**Sources:** Lead solder joining copper pipes (pre-1985) or brass fixtures

**Standard:** 0.015 mg/L (15 ppb)

### Health Effects:

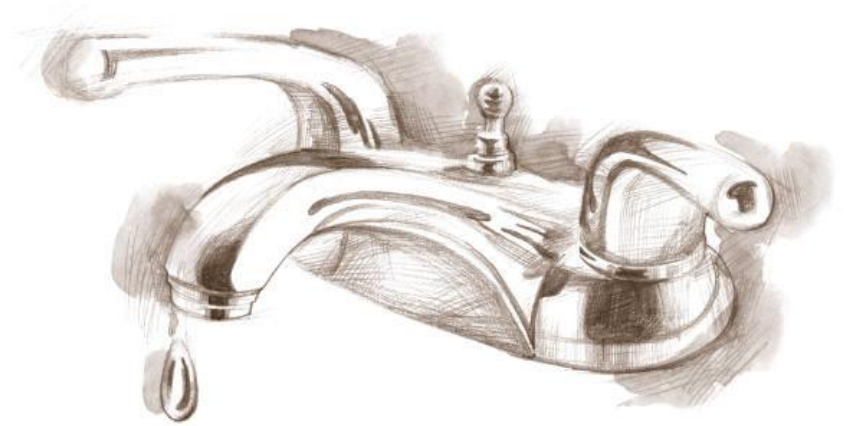
- Young children, infants and unborn children are particularly vulnerable.
- Lead may damage the brain, kidneys, nervous system, red blood cells, reproductive system.



# Lead and Copper

## Solutions:

- Allow water to run for a minute or two before using for drinking or cooking  
or
- Use a treatment device, but generally not necessary



# Pesticides in Drinking Water

- Pesticides include: insecticides, herbicides, fungicides and other substances used to control pests.
- Health standards usually only account for parent compound.
- Parent compounds breakdown over time.
- Little research into health effects from the combination of chemicals..
- **Most frequently detected pesticides in Wisconsin:**
  - Alachlor\* and its chemical breakdown products
  - Metolachlor and its chemical breakdown products
  - Atrazine\*\* and its chemical breakdown products
  - Metribuzin
  - Cyanazine and its chemical breakdown products.





# Tests Important to Health

## DACT Screen

**Sources:** Triazine pesticides (mainly atrazine used on corn crops)

**DACT Screen:** Only measures the diaminochlorotriazine (DACT) residue levels of triazine type pesticides (atrazine, simazine, propazine, cyanazine, etc)

Specific to diaminochlorotriazine (DACT), does not account for parent compound or other breakdown components

Drinking water limit:

- **3 ppb of total atrazine** (*atrazine + the 3 breakdown components*)



# Green County

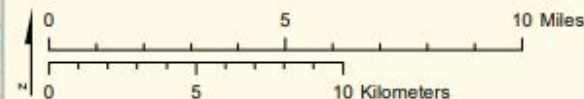
2013 - 2023



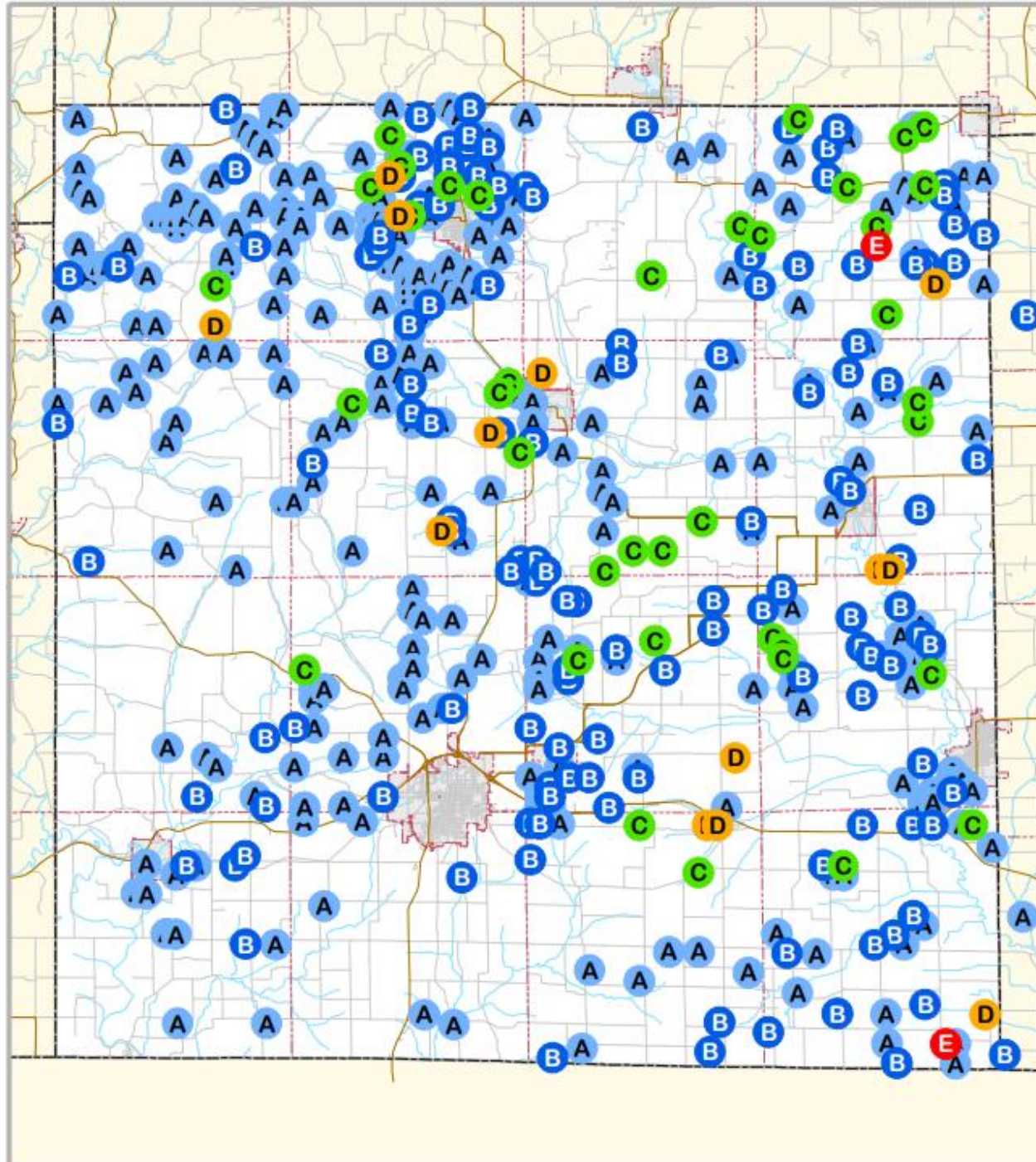
## DACT (ug/l)

A	None Detected	368	62 %
B	... 0.3	165	28 %
C	0.4 - 1.0	48	8 %
D	1.1 - 2.0	13	2 %
E	2.1 - 3.0	2	<1 %
F	3.1 ...	0	0 %

Mapped value is the maximum for the 1/4 1/4 section  
Treated samples not mapped



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# Improving water quality

## ➤ Long-term improvements

- Eliminate sources of contamination

## ➤ Short-term improvements

- Repair or replace existing well
- Connect to public water supply or develop community water system
- Purchase bottled water for drinking and cooking
- Install a water treatment device
  - Often the most convenient and cost effective solution



# Where do you go from here:

## Recommended next steps

- Test well annually for bacteria, or if water changes color or clarity.
- Consider testing annually for nitrate, particularly if your levels are approaching 10 mg/L.
- If your nitrate level was greater than 5 mg/L consider testing for pesticides
- If you haven't checked for arsenic consider testing.
- If arsenic was present, test again in 15 months to see if levels have changed significantly.

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**Thanks to you and the following for  
helping sponsor this program:**

- **Green County Extension**
  - **Towns of Decatur**
- **Town of Spring Grove**
  - **Town of Sylvester**



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