

# Groundwater Quality Overview

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&

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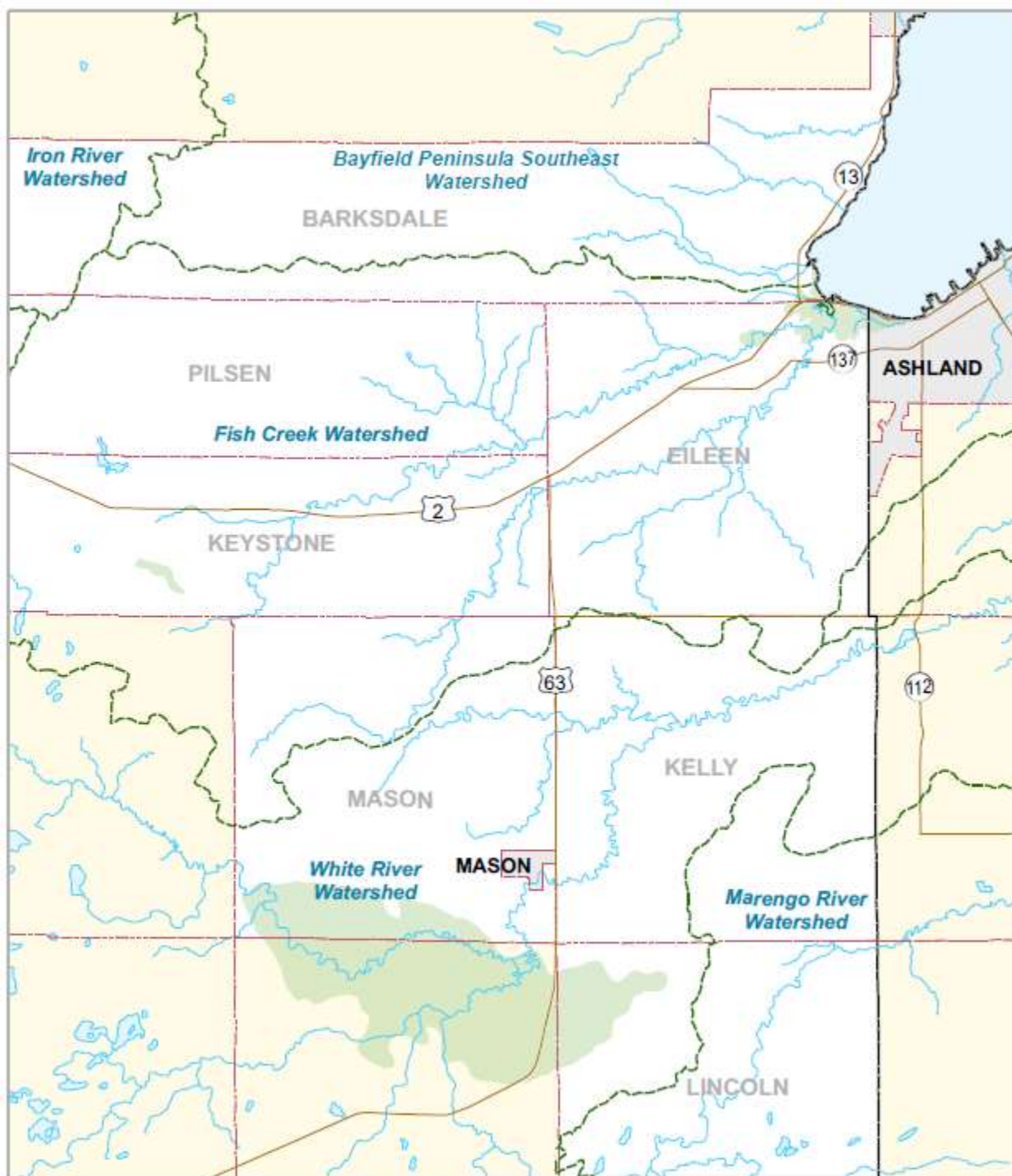


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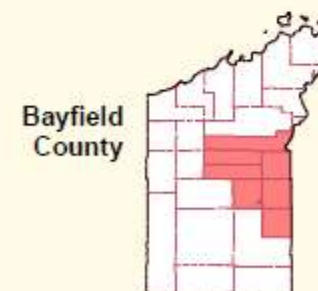
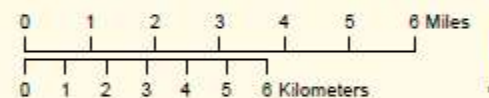
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## Bayfield County

Sept - Oct 2015

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



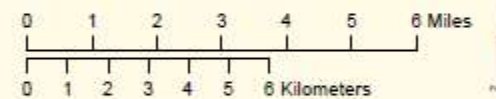
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### SAMPLE DISTRIBUTION

NUMBER OF SAMPLES  
per 1/4 1/4 SECTION



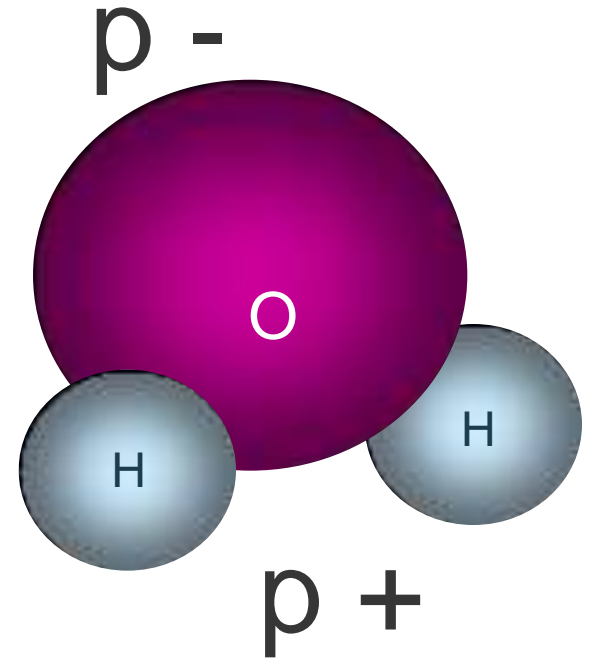
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# water basics

- “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:

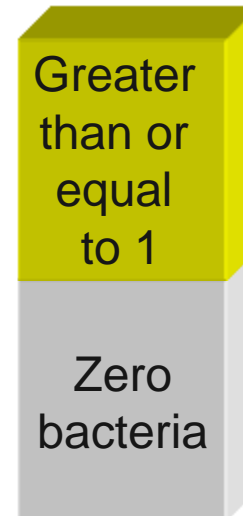
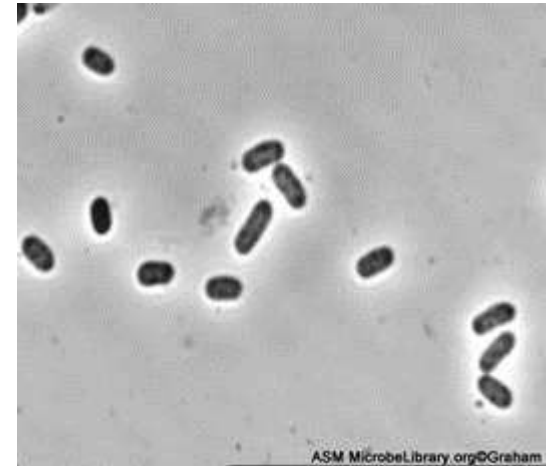
- Saturation Index
- Alkalinity
- Conductivity
- Potassium

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



# 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.

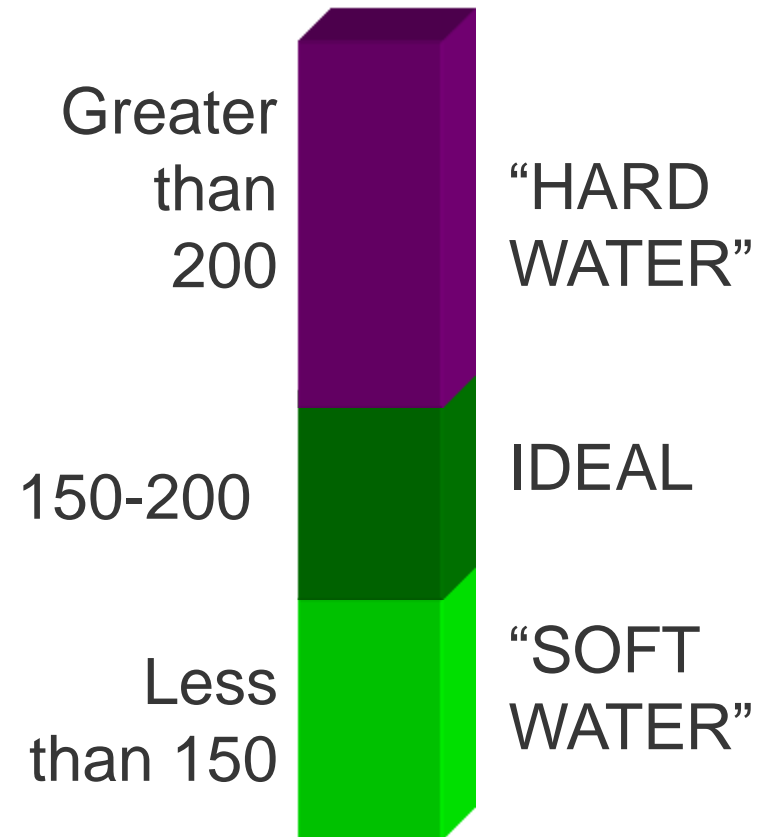
Information Sources: United States Department of Health and Human Services – Centers for Disease Control and Prevention ([www.cdc.gov](http://www.cdc.gov)) and United States Environmental Protection Agency ([www.epa.gov](http://www.epa.gov))

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.

# Tests for Aesthetic Problems

## Hardness

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





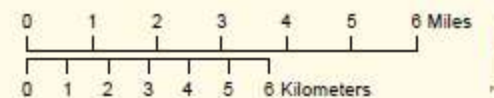
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### TOTAL HARDNESS (ppm $\text{CaCO}_3$ )

A	... 50	7	11 %
B	51 - 100	16	24 %
C	101 - 200	38	58 %
D	201 - 300	3	5 %
E	301 - 400	2	3 %
F	401 ...	0	0 %

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



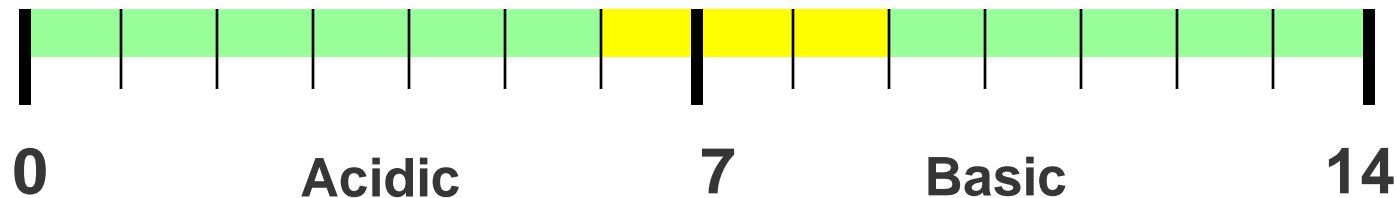
Bayfield County

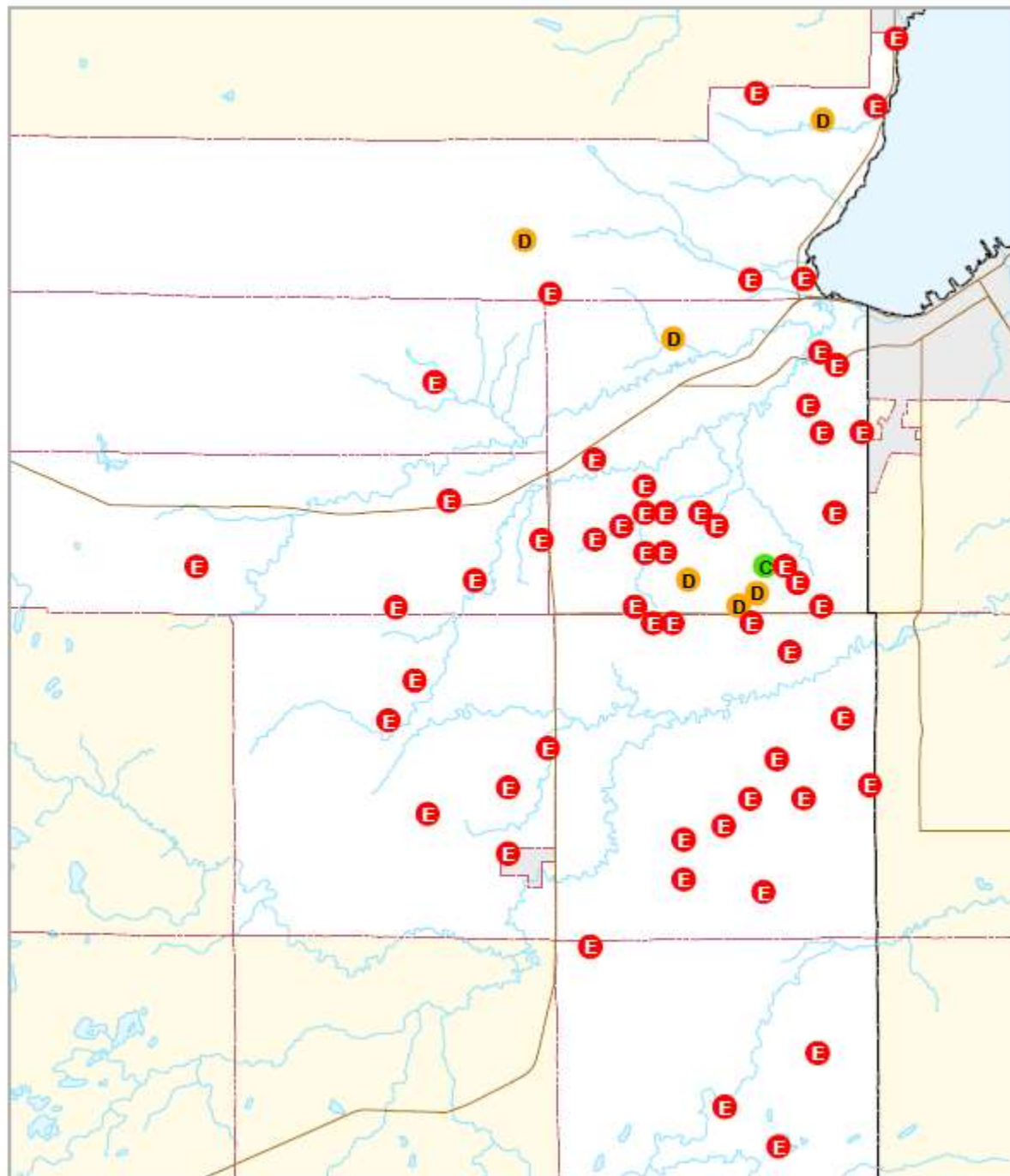


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# Tests for Overall Water Quality

- **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





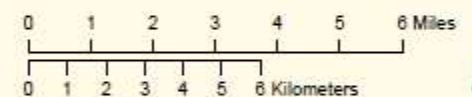
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pH

A	... 5.00	0	0 %
B	5.01 - 6.00	0	0 %
C	6.01 - 7.00	1	2 %
D	7.01 - 8.00	6	9 %
E	8.01 - 9.00	59	89 %
F	9.01 ...	0	0 %

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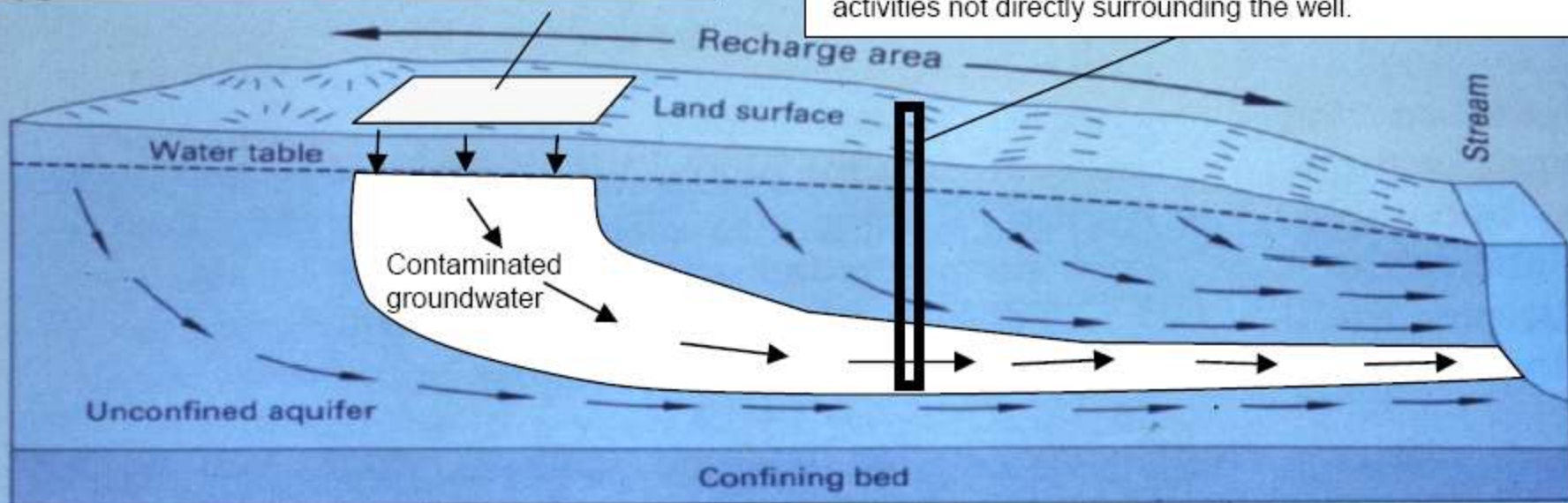


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Land-use activity that pollutes groundwater.

Because groundwater moves, wells located far from the contamination source can sometimes be polluted from activities not directly surrounding the well.

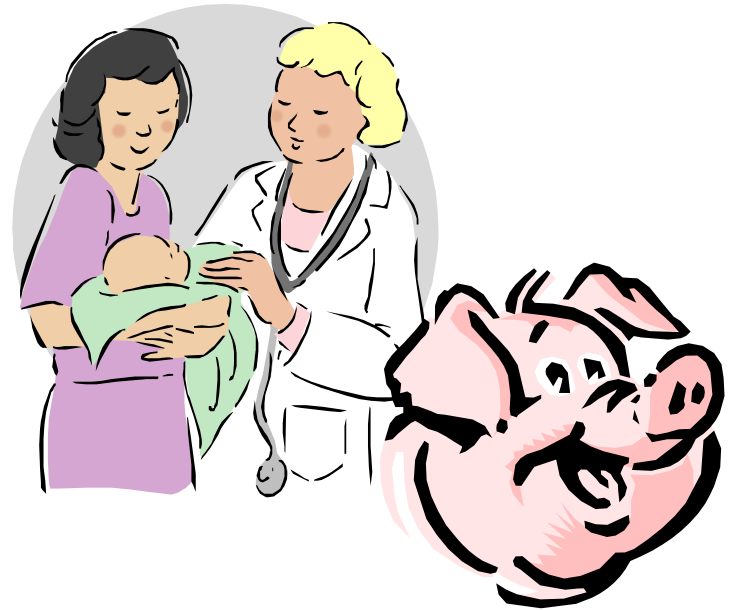




# Nitrate-Nitrogen

## Health Effects:

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



## Sources:

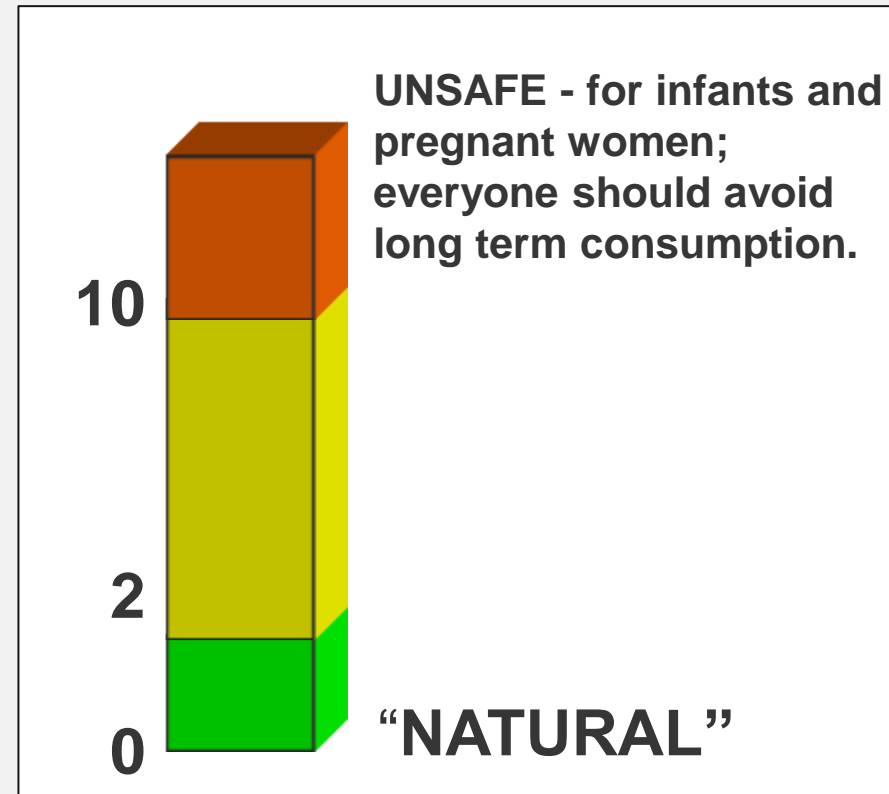
- Agricultural fertilizer
- Lawn fertilizer
- Septic systems
- Animal wastes



# 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”*





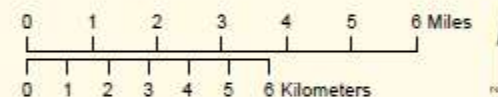
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### NITRATE-NITRITE (ppm N)

<b>A</b>	<b>None Detected</b>	<b>49</b>	<b>74 %</b>
<b>B</b>	<b>... 2.0</b>	<b>14</b>	<b>21 %</b>
<b>C</b>	<b>2.1 - 5.0</b>	<b>3</b>	<b>5 %</b>
<b>D</b>	<b>5.1 - 10.0</b>	<b>0</b>	<b>0 %</b>
<b>E</b>	<b>10.1 - 20.0</b>	<b>0</b>	<b>0 %</b>
<b>F</b>	<b>20.1 ...</b>	<b>0</b>	<b>0 %</b>

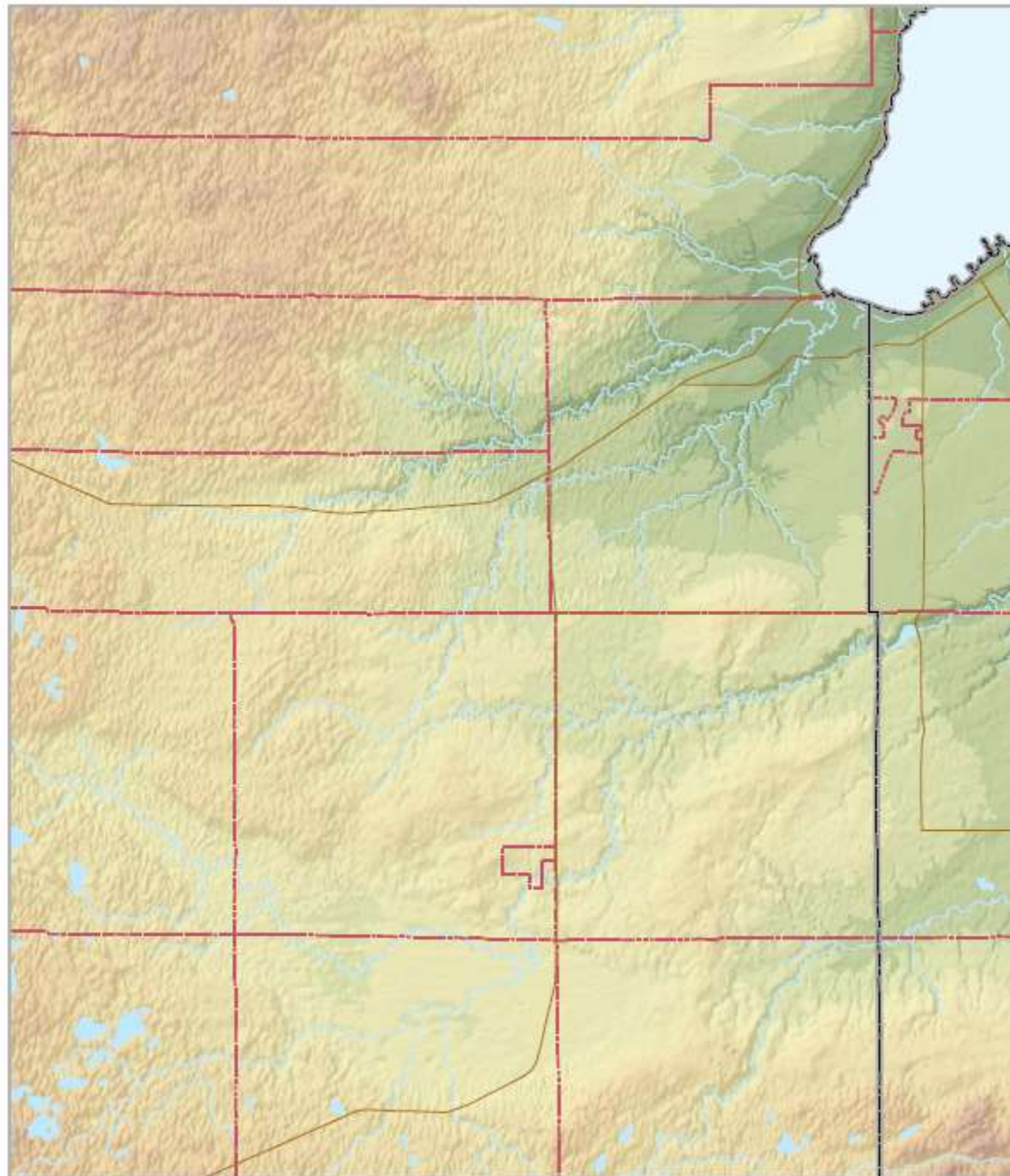
Mapped value is the average for the 1/4 1/4 section  
Treated samples not mapped



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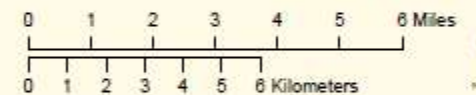
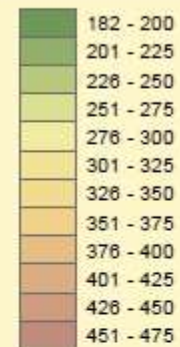
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**Elevation:**  
(meters)



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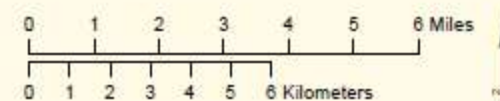
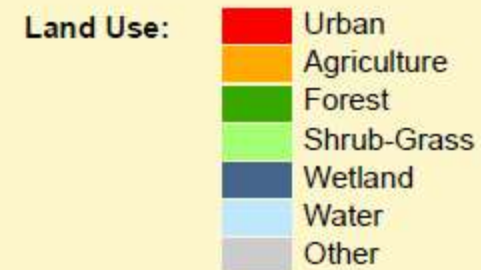


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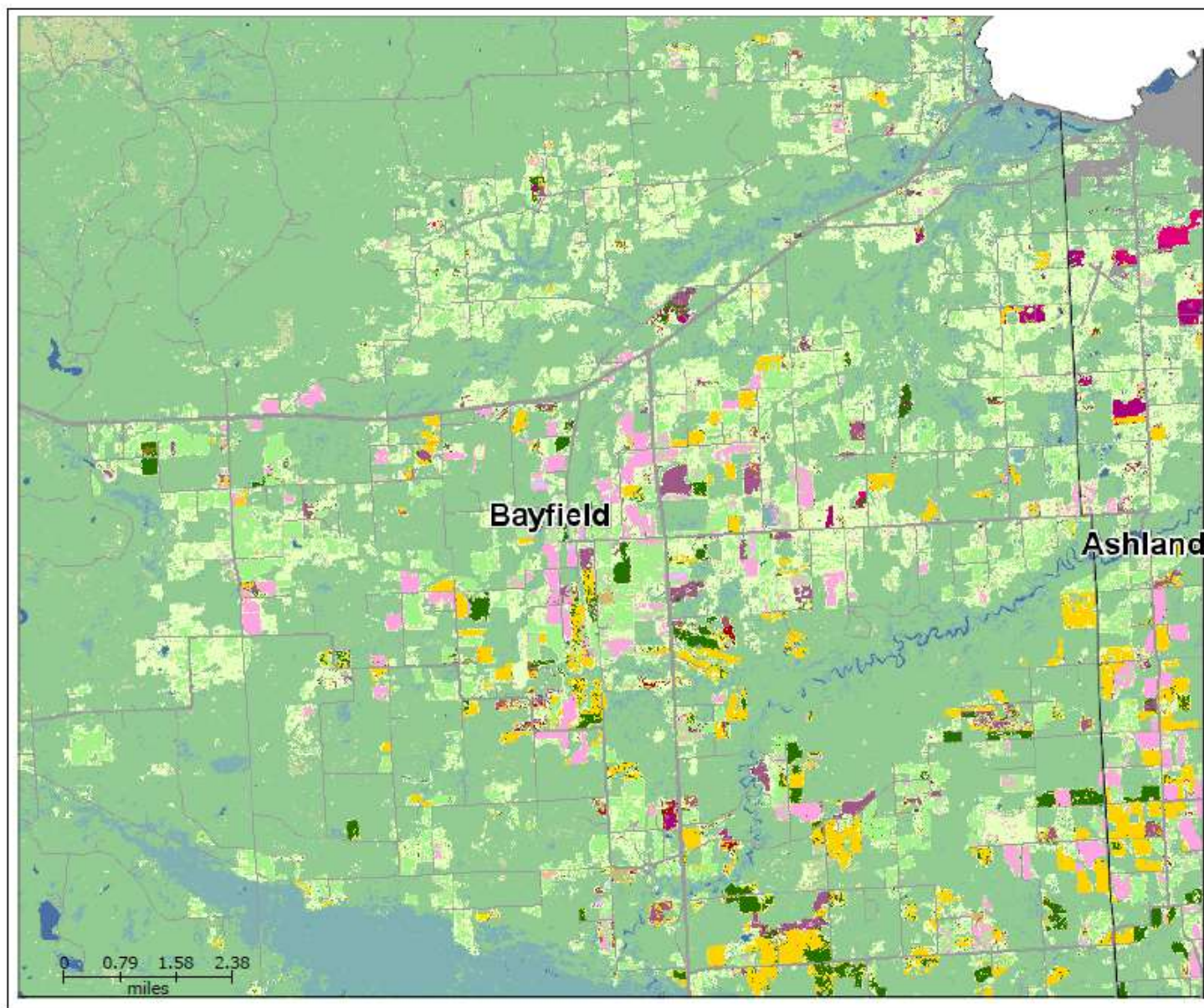
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# 2014 Area of Interest



Land Cover Categories  
(by decreasing acreage)

## AGRICULTURE\*

- Grass/Pasture
- Other Hay/Non Alfalfa
- Corn
- Alfalfa
- Soybeans
- Oats
- Rye
- Barley
- Clover/Wildflowers
- Winter Wheat
- Spring Wheat
- Fallow/Idle Cropland
- Dry Beans
- Sunflowers
- Sorghum
- Triticale

## NON-AGRICULTURE\*\*

- Deciduous Forest
- Mixed Forest
- Woody Wetlands
- Evergreen Forest
- Developed/Open Space
- Shrubland









# 2013 Area of Interest

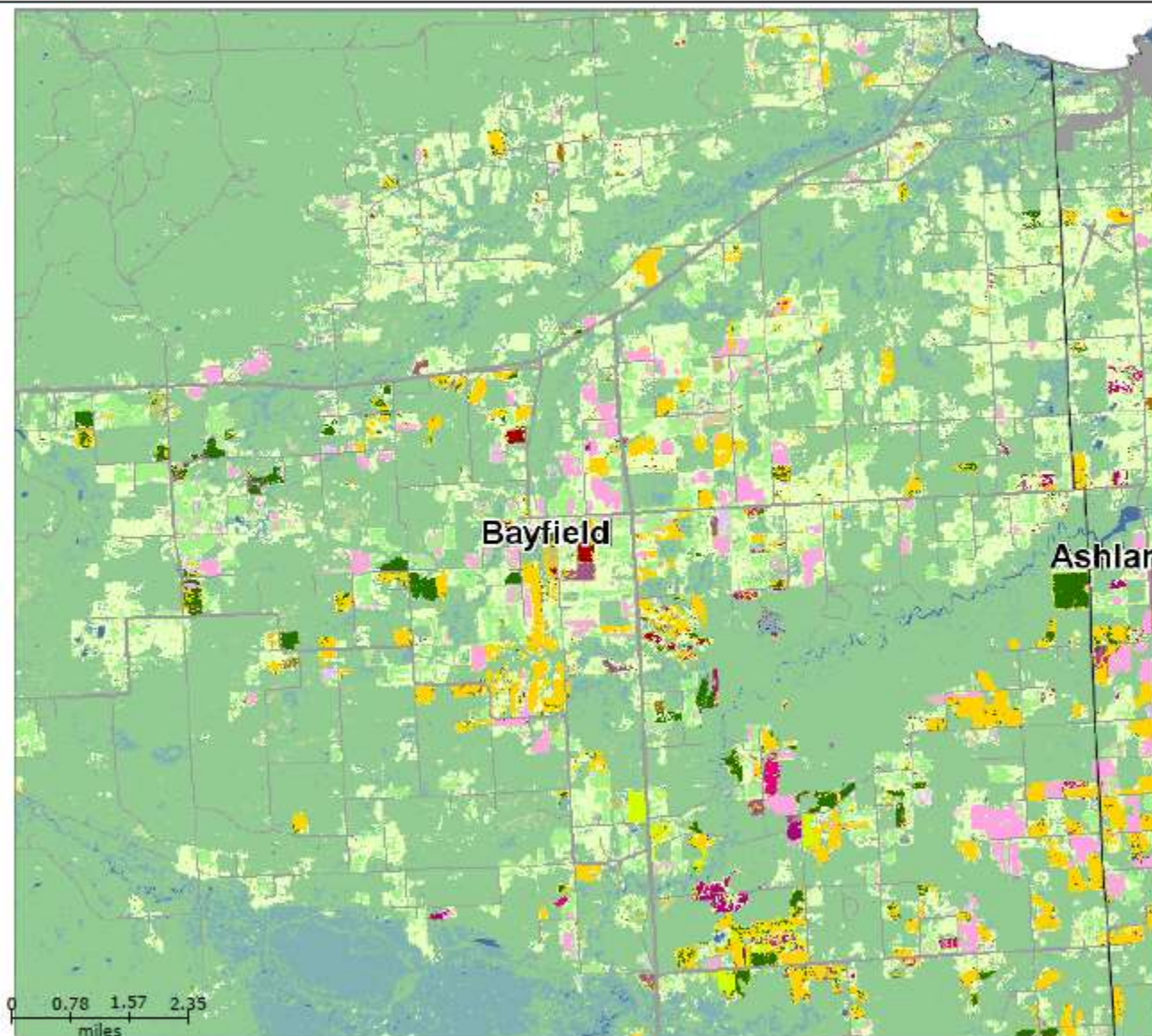
Land Cover Categories  
(by decreasing acreage)

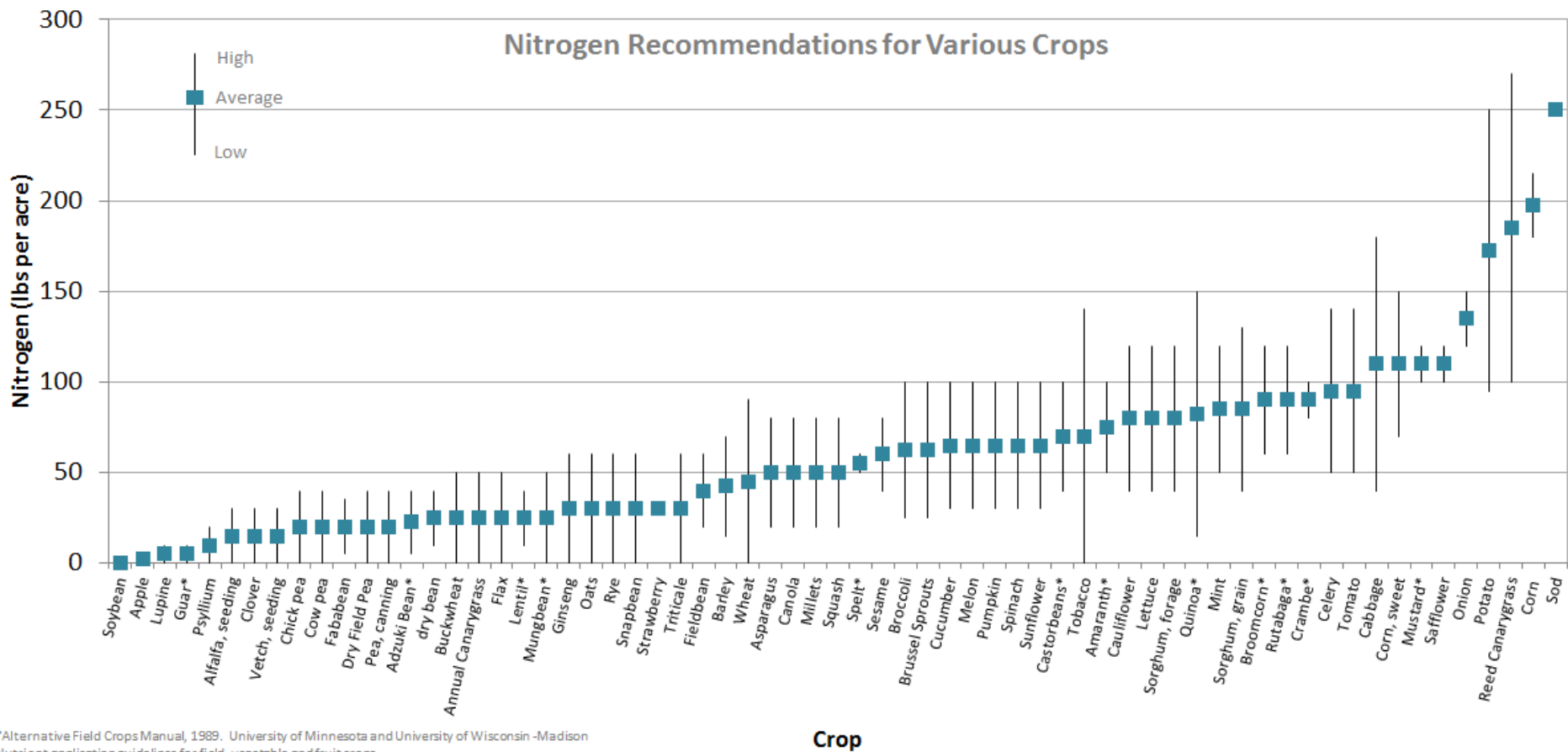
## AGRICULTURE\*

-  Grass/Pasture
-  Other Hay/Non Alfalfa
-  Corn
-  Alfalfa
-  Soybeans
-  Oats
-  Canola
-  Rye
-  Clover/Wildflowers
-  Barley
-  Fallow/Idle Cropland
-  Winter Wheat
-  Dry Beans
-  Spring Wheat
-  Sorghum
-  Triticale

## NON-AGRICULTURE\*\*

-  Deciduous Forest
-  Mixed Forest
-  Woody Wetlands
-  Evergreen Forest
-  Developed/Open Space
-  Shrubland



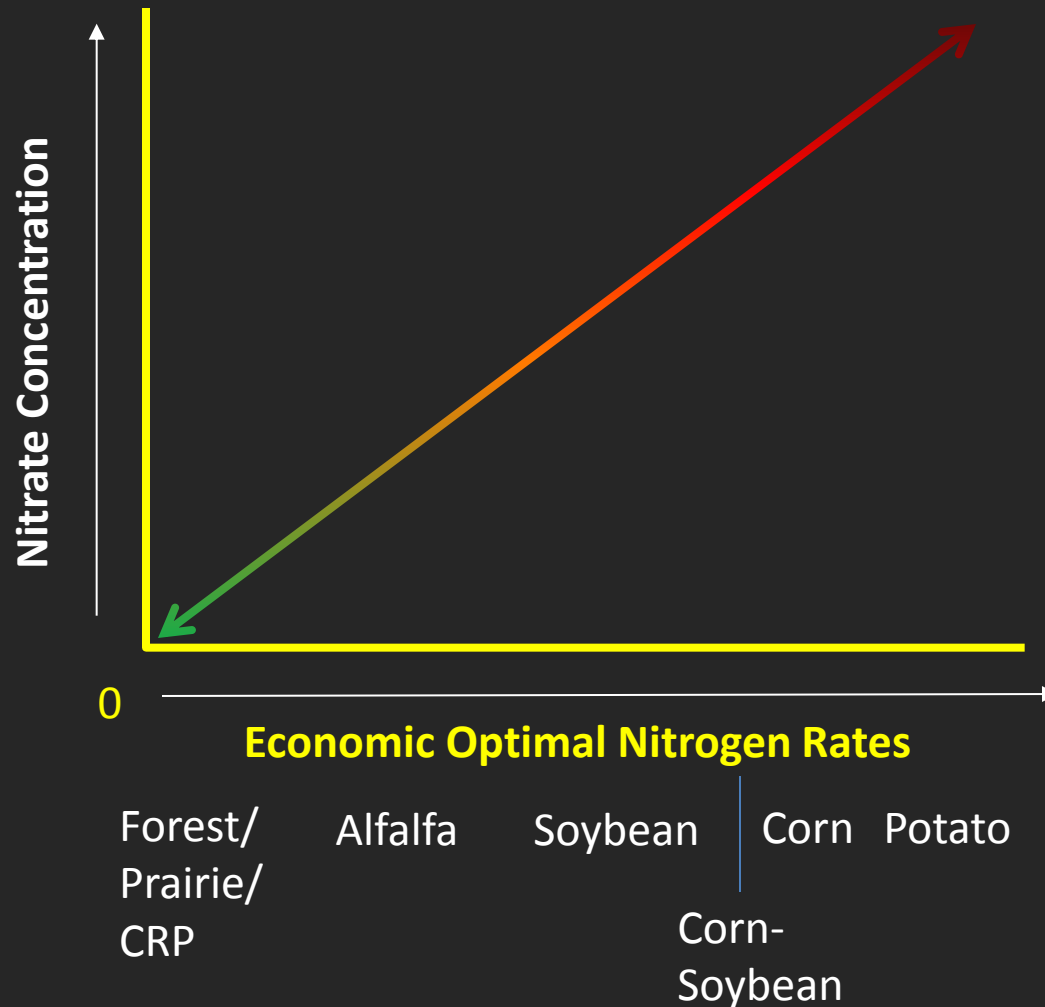


\*Alternative Field Crops Manual, 1989. University of Minnesota and University of Wisconsin-Madison  
 Nutrient application guidelines for field, vegetable and fruit crops

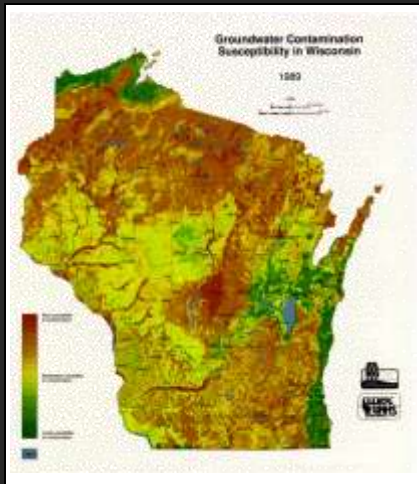
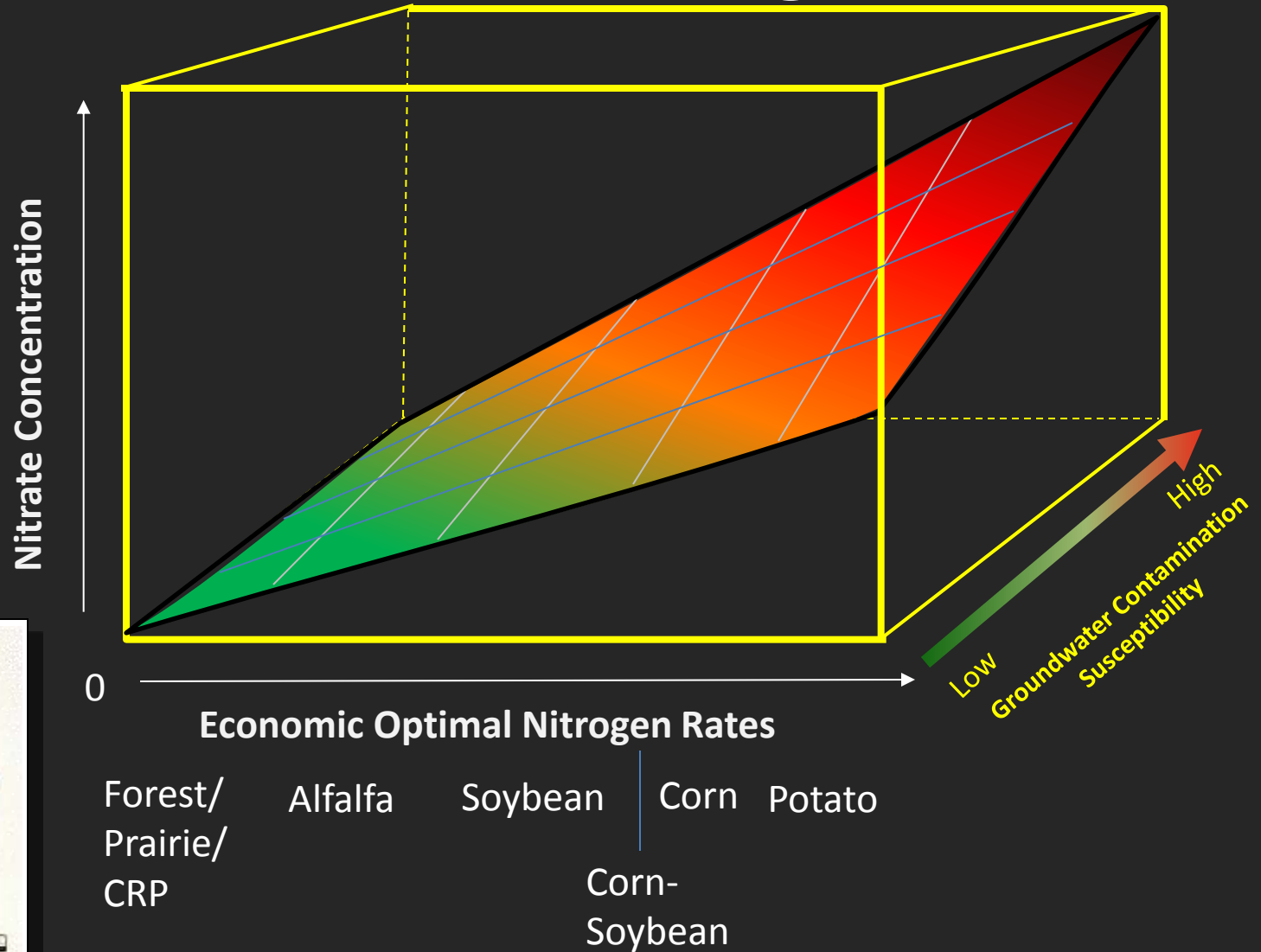




# Generalized Nitrate Leaching Potential

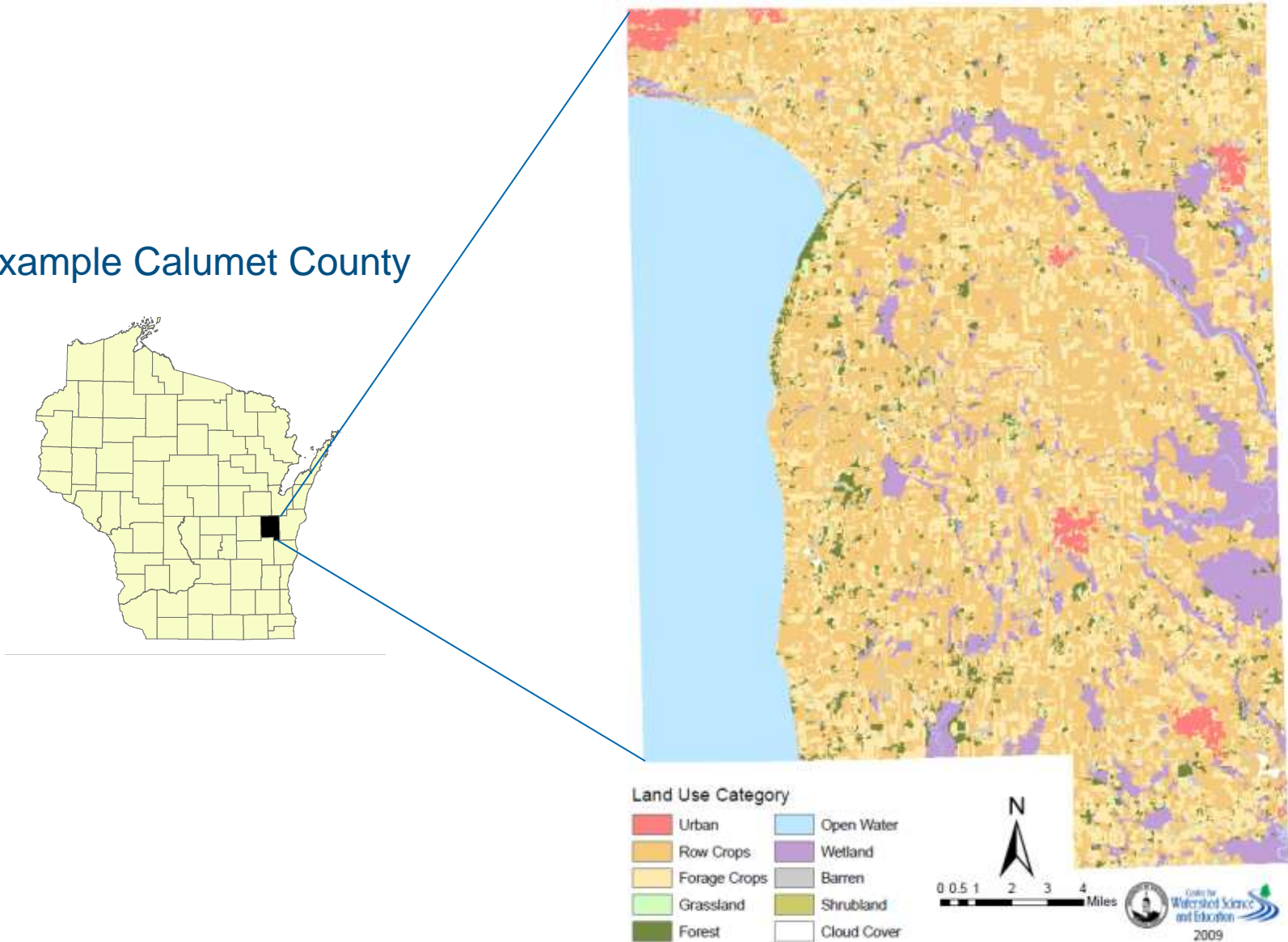


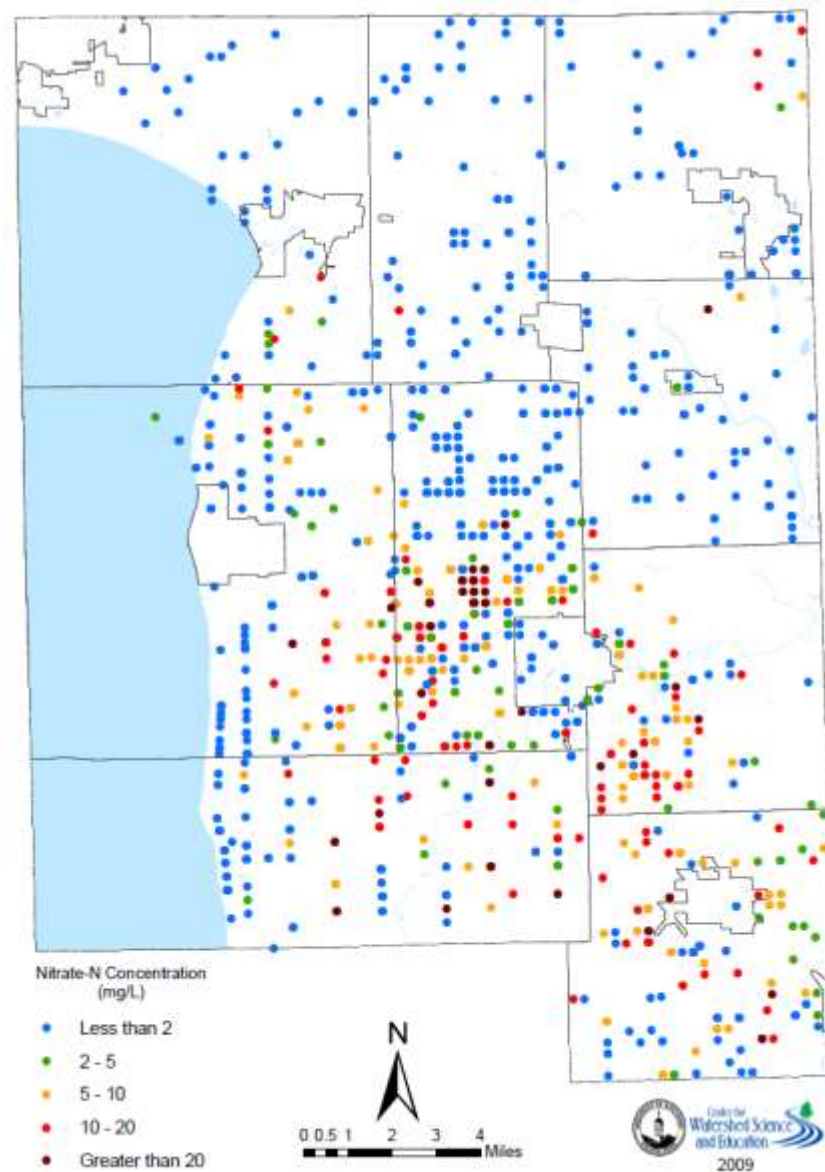
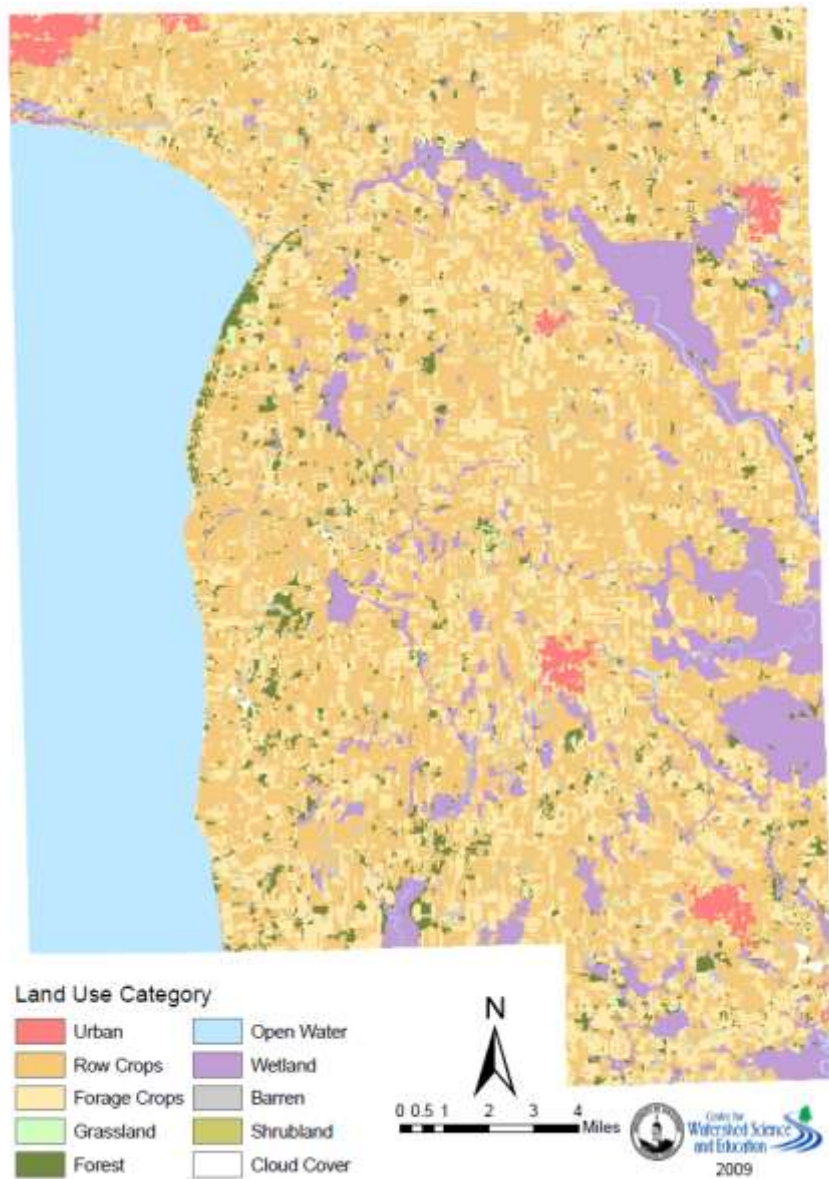
# Generalized Nitrate Leaching Potential



# Interaction of land-use, soils and geology

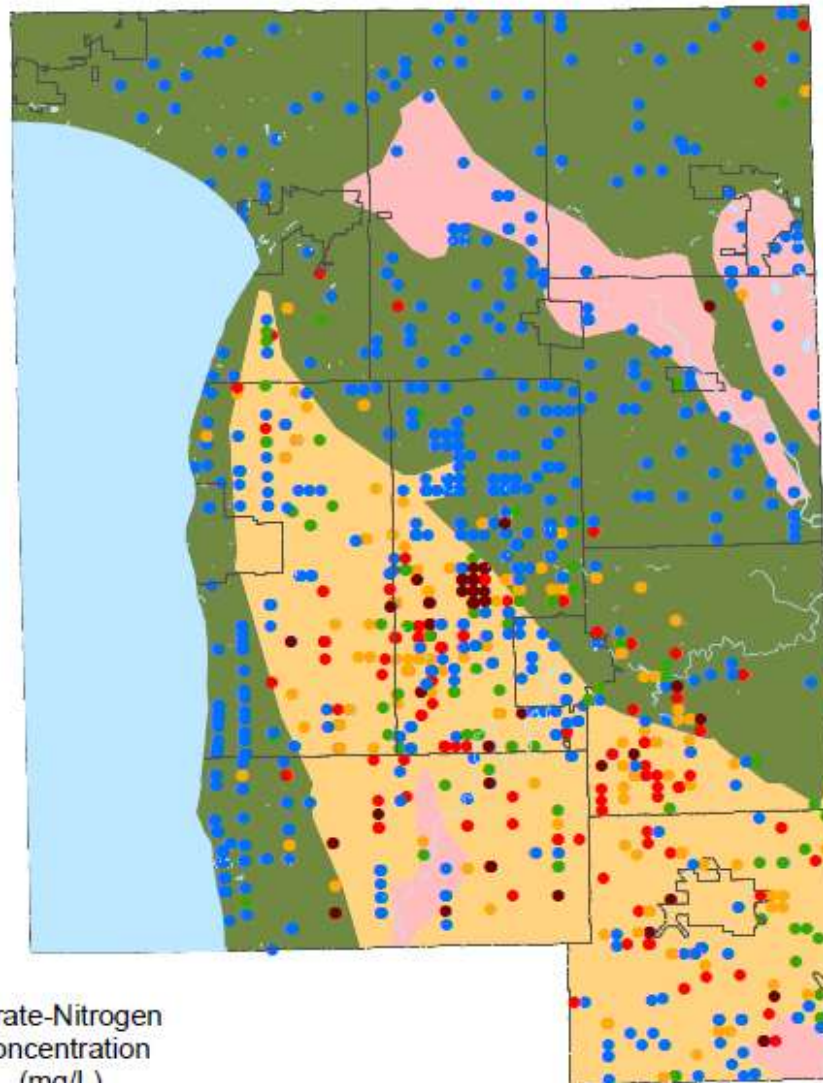
Example Calumet County





Disclaimer: This map represents voluntarily submitted samples in the Center for Watershed Science and Education database. It does not represent all known private wells and does not represent a scientifically conducted study.





Surficial Deposits

- Sand & Gravel
- Sand
- Peat
- Loam
- Clay

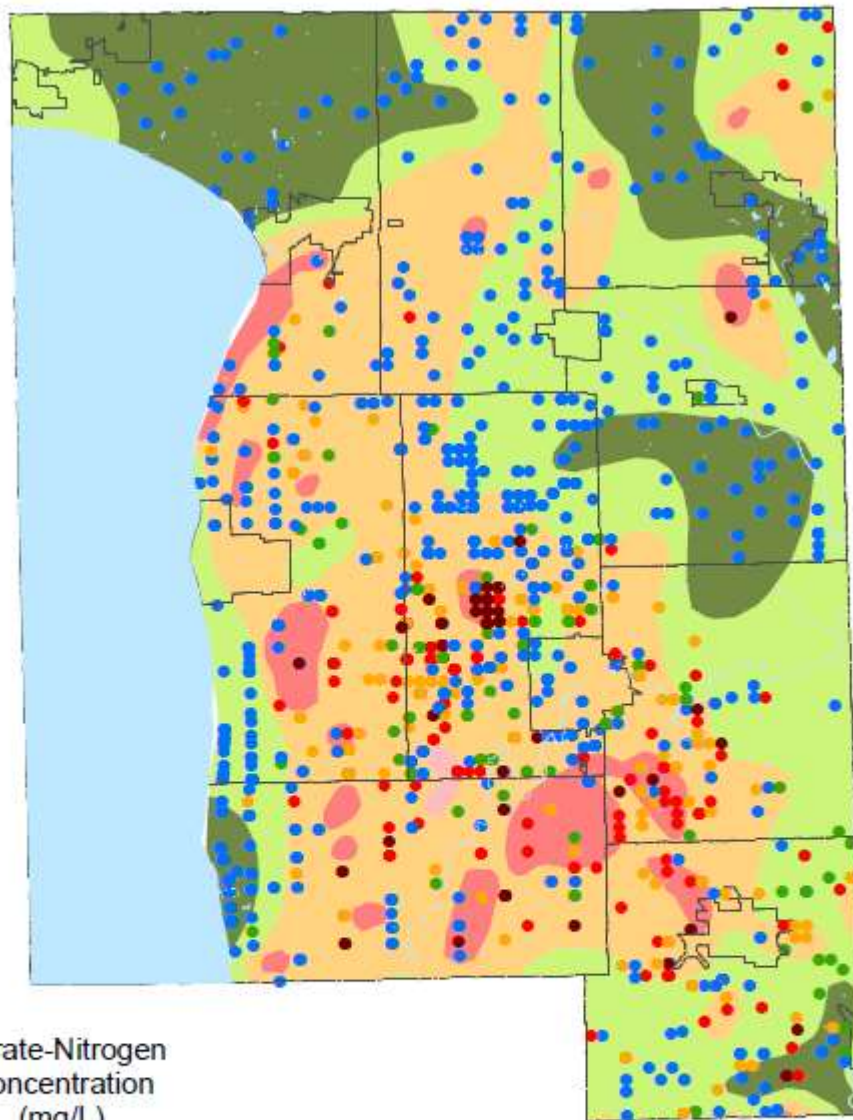
Nitrate-Nitrogen  
Concentration  
(mg/L)

- Less than 2
- 2 - 5
- 5 - 10
- 10 - 20
- Greater than 20



0 0.5 1 2 3 4  
Miles





#### Depth to Bedrock

- Greater than 35% less than 5 ft
- Greater than 70% less than 5 ft
- 5 to 50 ft
- 50 to 100 ft
- Greater than 100 ft

#### Nitrate-Nitrogen Concentration (mg/L)

- Less than 2
- 2 - 5
- 5 - 10
- 10 - 20
- Greater than 20



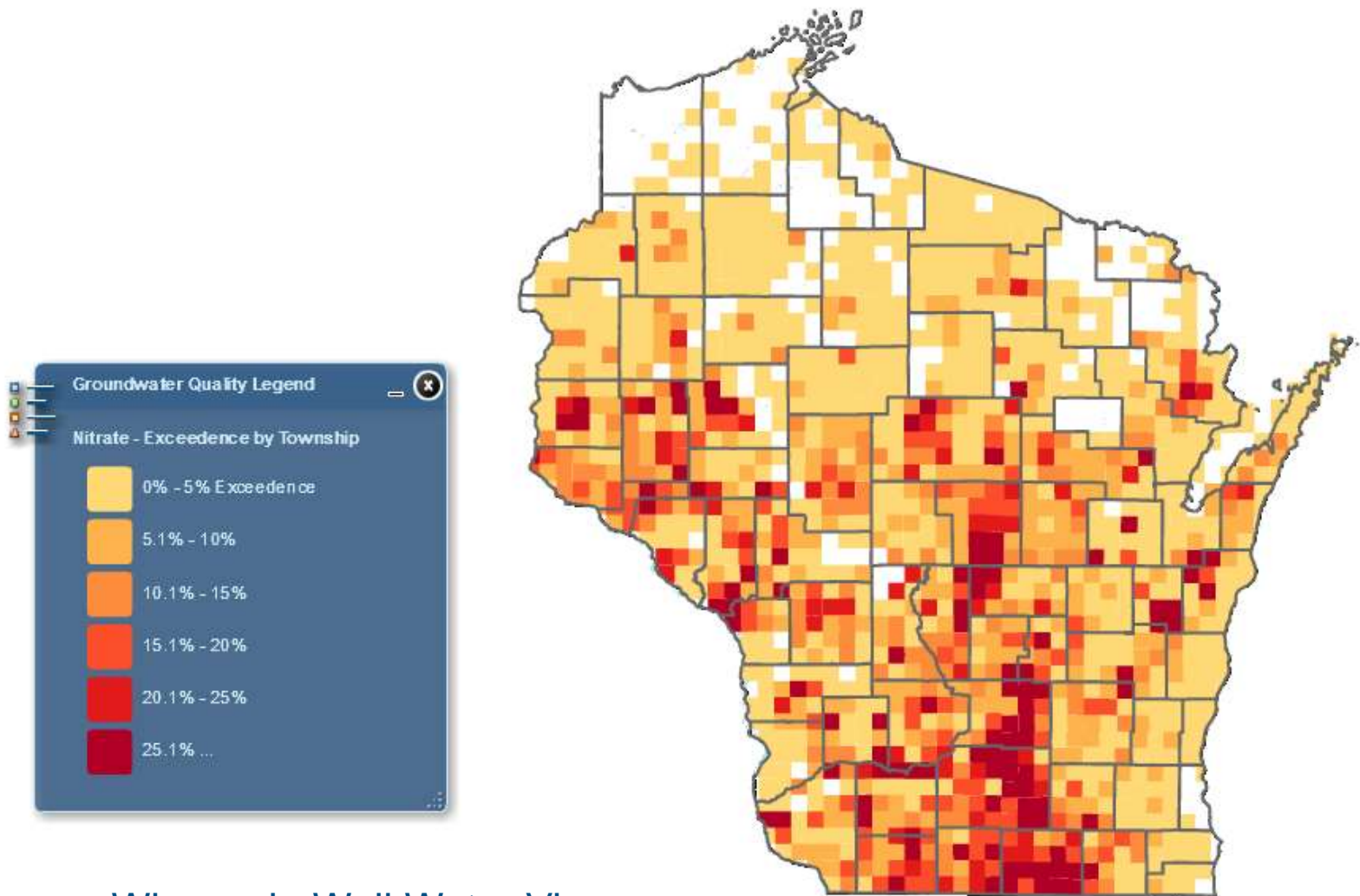
0 0.5 1 2 3 4 Miles



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2011



# Statewide Nitrate

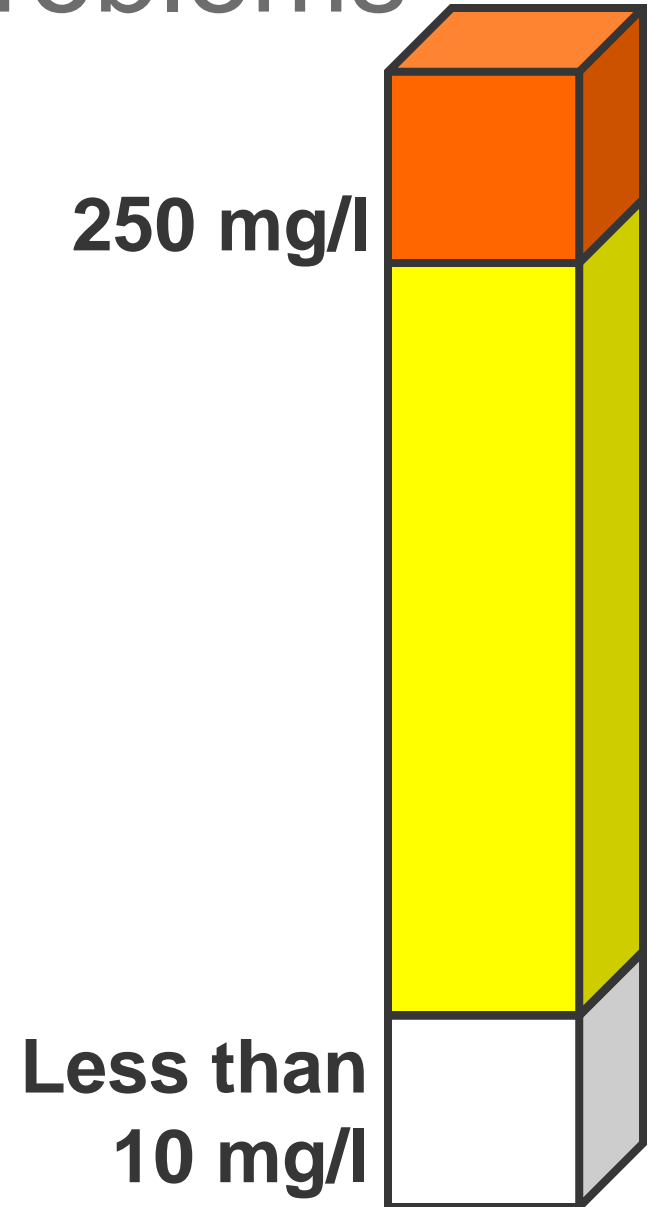


Source: Wisconsin Well Water Viewer

# 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



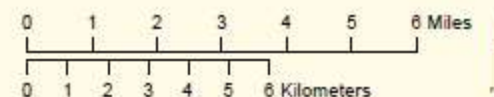
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### CHLORIDE (ppm)

A	None Detected	0	0 %
B	... 10	59	89 %
C	11 - 50	5	8 %
D	51 - 100	2	3 %
E	101 - 200	0	0 %
F	201 ...	0	0 %

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



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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

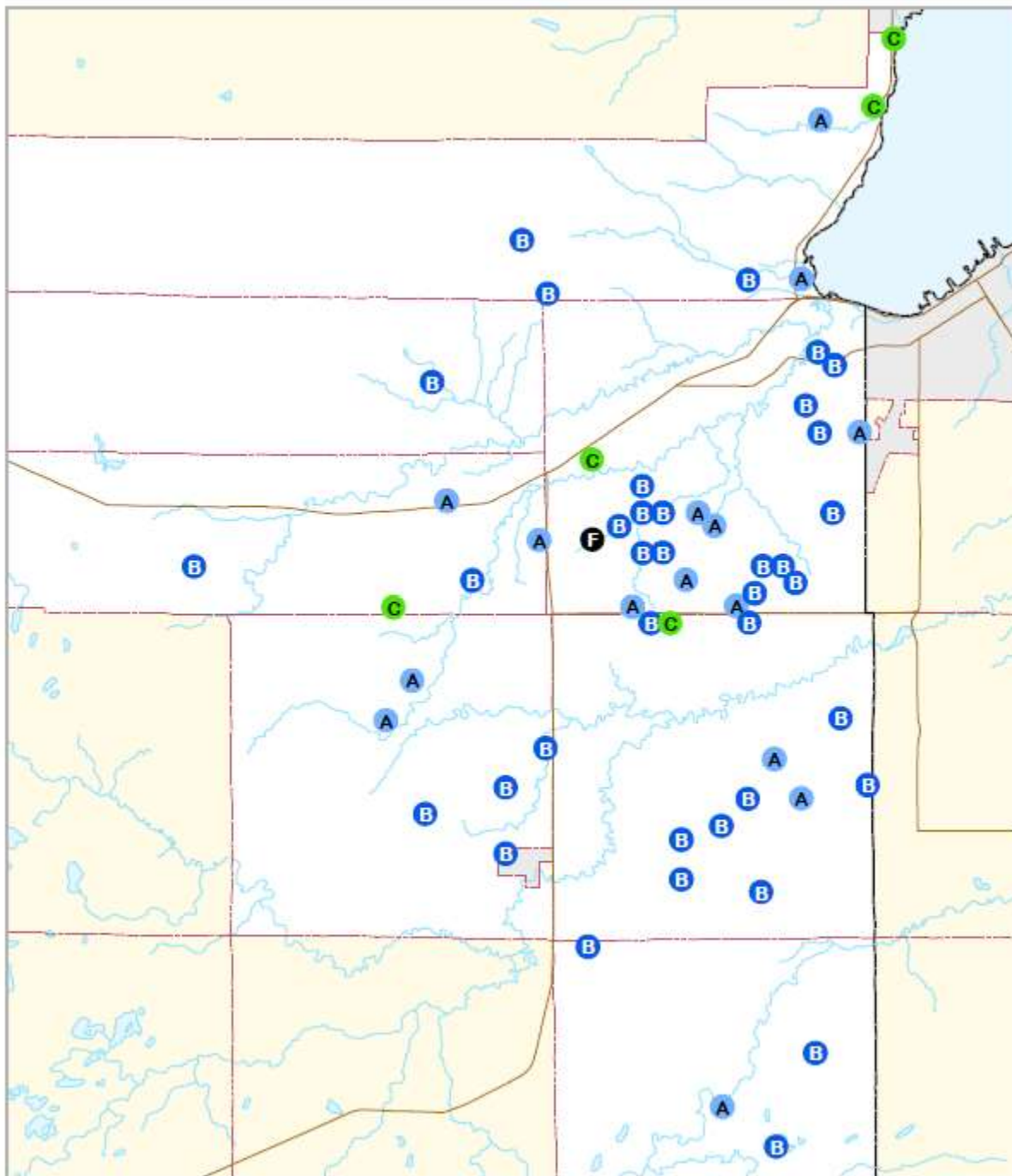


**Greater  
than 0.3  
mg/L**

**Aesthetic  
problems  
likely**

**Less  
than 0.3 mg/L**





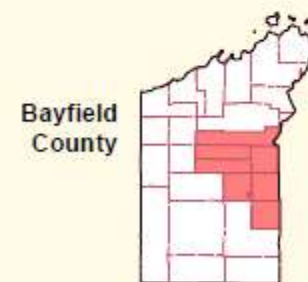
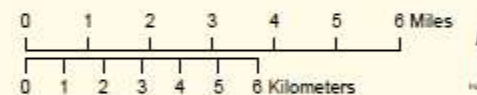
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### IRON (mg/l)

<b>A</b> None Detected	17	26 %
<b>B</b> ... 0.300	42	64 %
<b>C</b> 0.301 - 1.000	6	9 %
<b>D</b> 1.001 - 2.000	0	0 %
<b>E</b> 2.001 - 5.000	0	0 %
<b>F</b> 5.001 ...	1	2 %

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



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# Test Important to Health

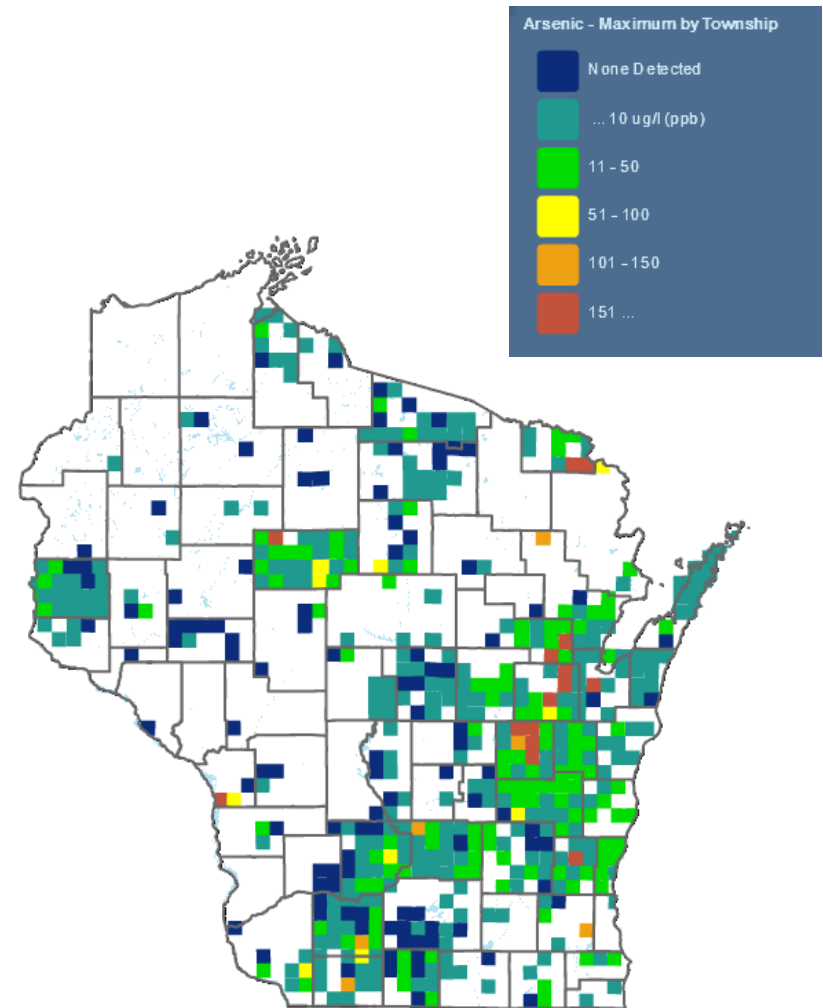
## Arsenic

**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





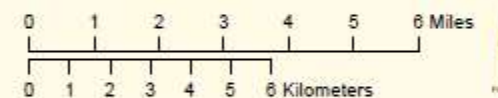
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### ARSENIC (mg/l)

<b>A</b>	<b>None Detected</b>	<b>47</b>	<b>71 %</b>
<b>B</b>	<b>... 0.010</b>	<b>18</b>	<b>27 %</b>
<b>C</b>	<b>0.011 - 0.050</b>	<b>1</b>	<b>2 %</b>
<b>D</b>	<b>0.051 - 0.100</b>	<b>0</b>	<b>0 %</b>
<b>E</b>	<b>0.101 - 0.150</b>	<b>0</b>	<b>0 %</b>
<b>F</b>	<b>0.151 ...</b>	<b>0</b>	<b>0 %</b>

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



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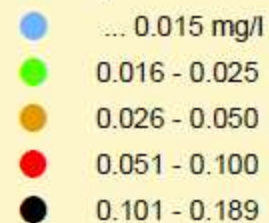


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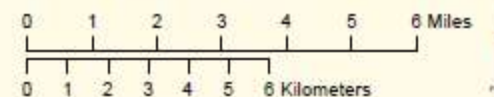
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### Phosphorus



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



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