

Groundwater and Well Water Education Program

Waushara County - Eastern Towns
Part of a study of Nitrate and
Chloride in Waushara County



Through the University of Wisconsin-Extension, all Wisconsin people can access University resources and engage in lifelong learning, wherever they live and work.

Today's presentation

- Groundwater Basics: Where does my water come from
- Well Construction
- What did we test for and why?
- Nitrate and chloride results in Waushara County
- Improving your water quality



Groundwater Basics: Where does my water come from?
How does your water quality compare? Look for data in your area
Learn about well construction
Interpret my water test results
How to improve my water quality
Who to contact if I need additional assistance

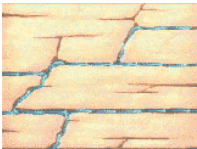
UW Extension
Center for Watershed Science and Education

What is Groundwater?
Watersheds of Wisconsin
Aquifers: Our groundwater storage units
Factors that affect groundwater quality
Better Homes and Groundwater

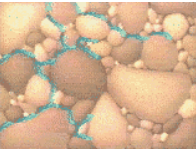
Aquifers: Our groundwater storage units

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.



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.

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.

Sand and gravel
Sandstones and dolomite
Crystalline bedrock

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

Eastern Dolomite
Youngest
Oldest

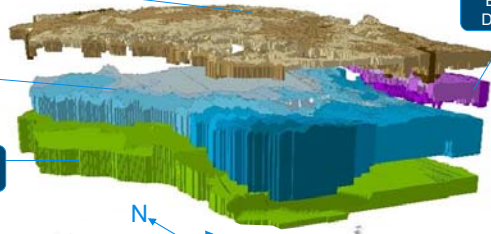
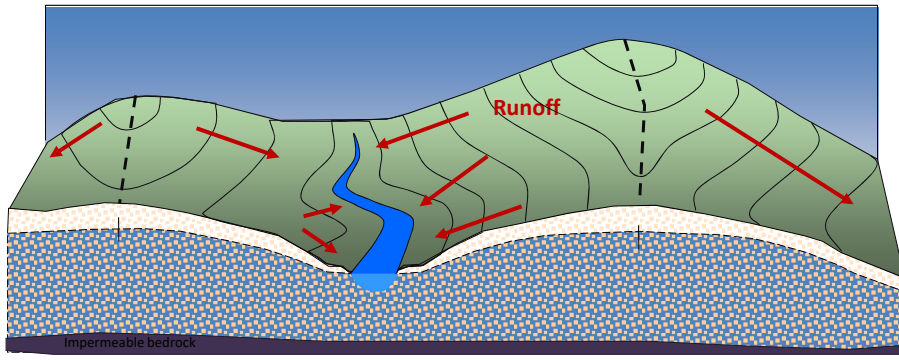


Diagram courtesy of WGNHS

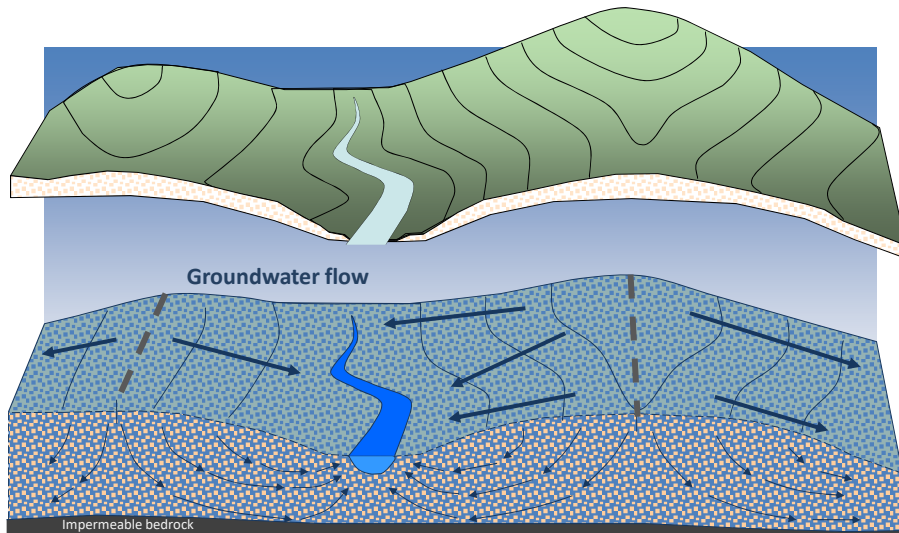
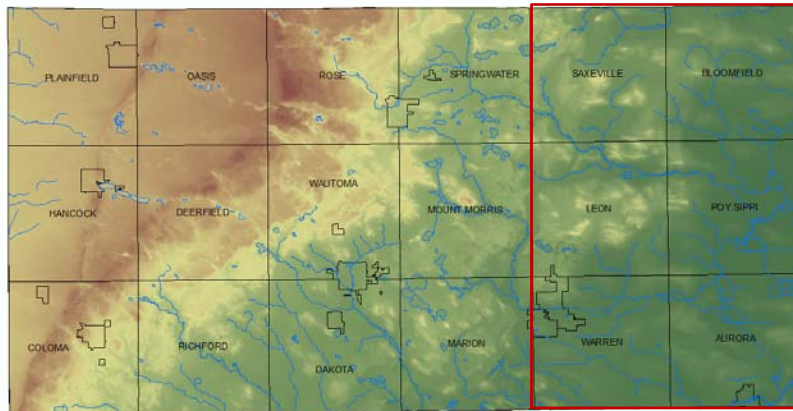
Watershed – the land area where water originates for lakes, rivers or streams. Water flows from high elevation to low elevation.



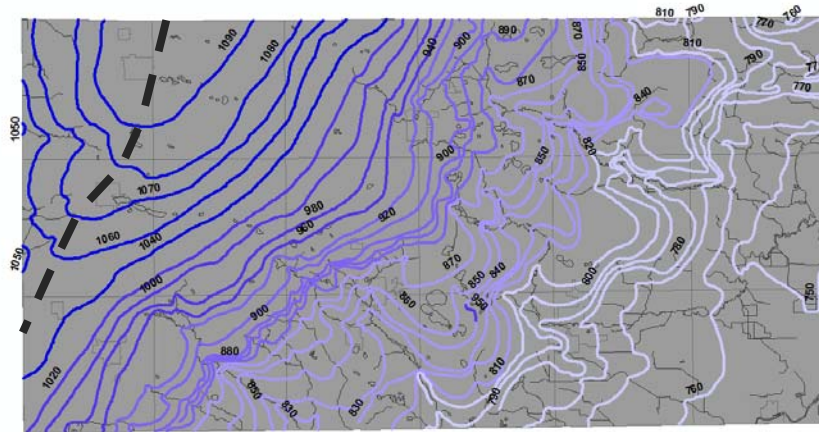
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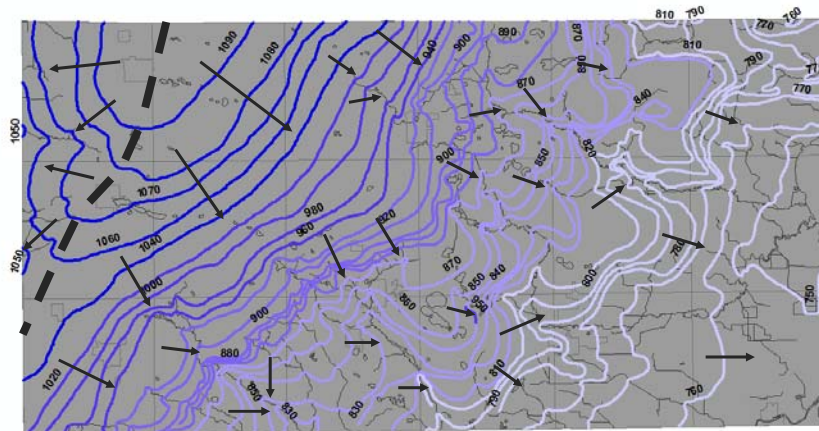
Waushara County



Water Table Elevation

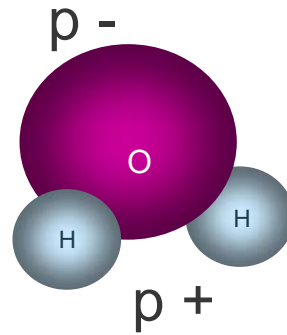


Water table elevation with generalized groundwater flow



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.
- Treatment sometimes used to take impurities 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:

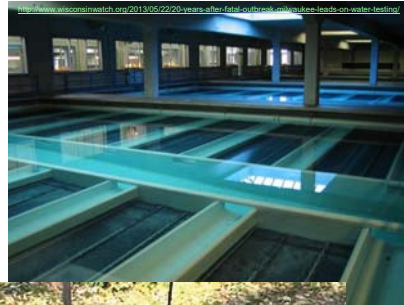
- Saturation Index
- Alkalinity
- Conductivity
- Potassium

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

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.



Well and Casing Depth

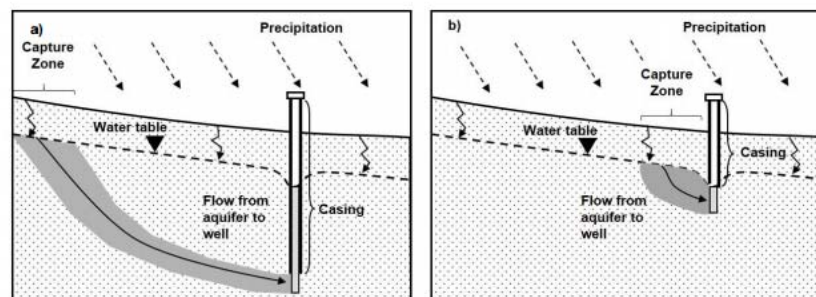
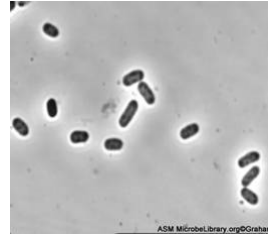


Figure 7. Diagrams illustrating how well and casing depth influence the capture zone of a well. Wells in which the casing extends below the water table will tend to have capture zones that are located further away from the well (a) than one in which the casing does not extend as far or may not extend past the water table (b).

- Typical well construction in area have wells screened between 15-30 feet below the water table
- Capture zone ~ $\frac{1}{4}$ to $\frac{1}{2}$ mile upgradient of well

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



Greater than or equal to 1

Present = Unsafe

Zero bacteria

Absent = Safe

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

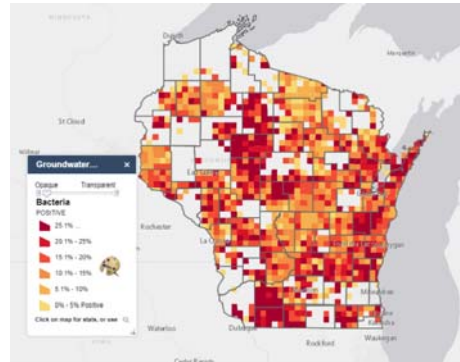
- Confirmation that bacteria originated from a human or animal fecal source.
- E. coli are often present with harmful bacteria, viruses and parasites that can cause serious gastrointestinal illnesses.
- Any detectable level of E.coli means your water is unsafe to drink.

Information Source: United States Department of Health and Human Services - Centers for Disease Control and Prevention www.cdc.gov and United States Environmental Protection Agency www.epa.gov

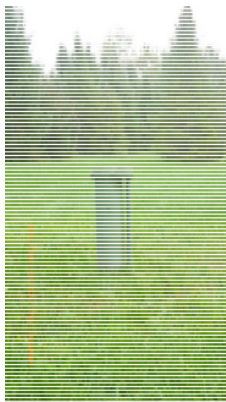
Contaminants	Sources	Symptoms
BACTERIA		
<i>Escherichia coli</i> form (E. coli) <i>Salmonella</i> <i>Campylobacter</i> <i>E. coli</i> 0157 (Requires a special water test for detection. Causes similar, but more serious illness than other E.coli strains. Requires medical treatment.)	<ul style="list-style-type: none"> Infected human and animal feces Manure Septic systems Sewage 	<ul style="list-style-type: none"> Gastrointestinal illness Low-grade fever Begins 12 hrs - 7 days after exposure
<i>Leptosporidia</i>	<ul style="list-style-type: none"> Urine of livestock, dogs and wildlife Manure 	<ul style="list-style-type: none"> High fever, severe headache and red eyes Gastrointestinal illness Begins 2-28 days after exposure
MICROSCOPIC PARASITES		
<i>Cryptosporidia</i> <i>Giardia</i>	<ul style="list-style-type: none"> Infected human and animal feces Manure Septic systems Sewage 	<ul style="list-style-type: none"> Gastrointestinal illness Begins 2-14 days after exposure
VIRUSES		
Norovirus	<ul style="list-style-type: none"> Infected human feces and vomit Septic systems Sewage 	<ul style="list-style-type: none"> Gastrointestinal illness Low-grade fever & headache Begins 12-48 hrs after exposure
CHEMICALS		
Nitrate	<ul style="list-style-type: none"> Fertilizers Manure Bio-solids Septic systems 	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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.

Coliform Bacteria in Wells

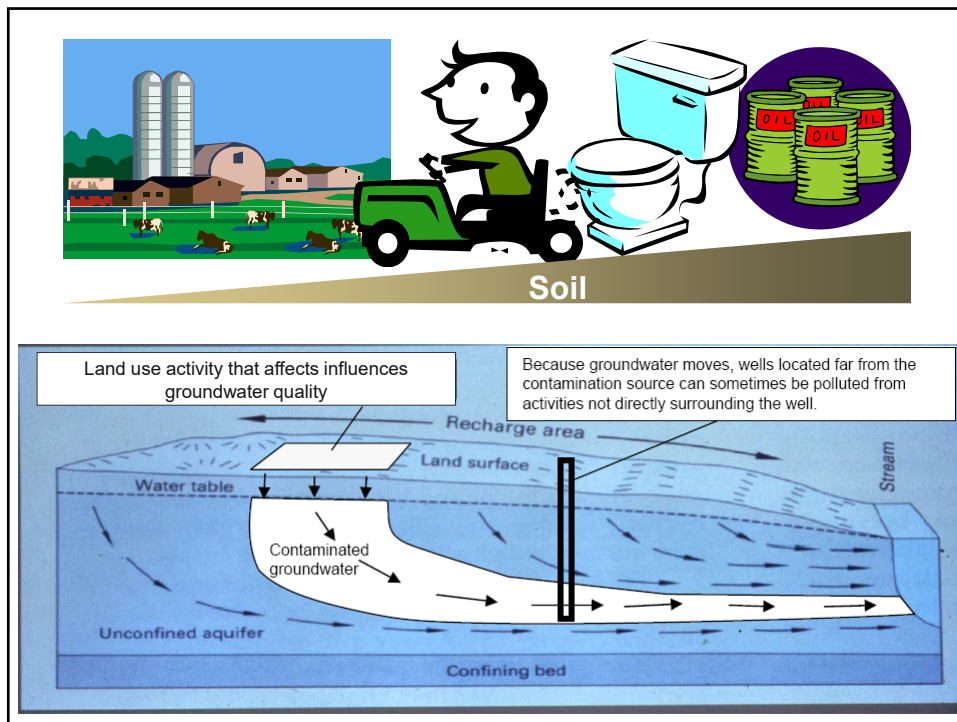
- Statewide, estimate that 15-25% of wells are likely to test positive for coliform bacteria



Well Construction



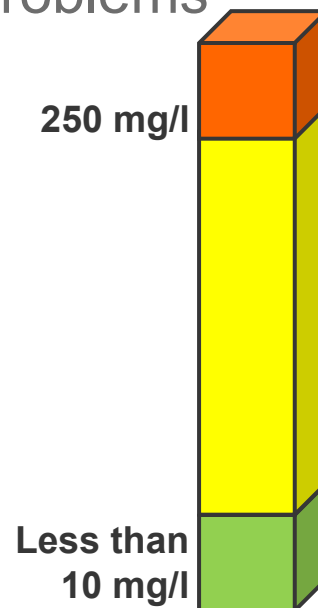
Photos courtesy of: Matt Zoschke



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 indicates likely land-use impacts
- Less than 10 mg/l considered "natural" in much of WI
- **Sources:** Fertilizers (potash), Septic Systems and Road Salt



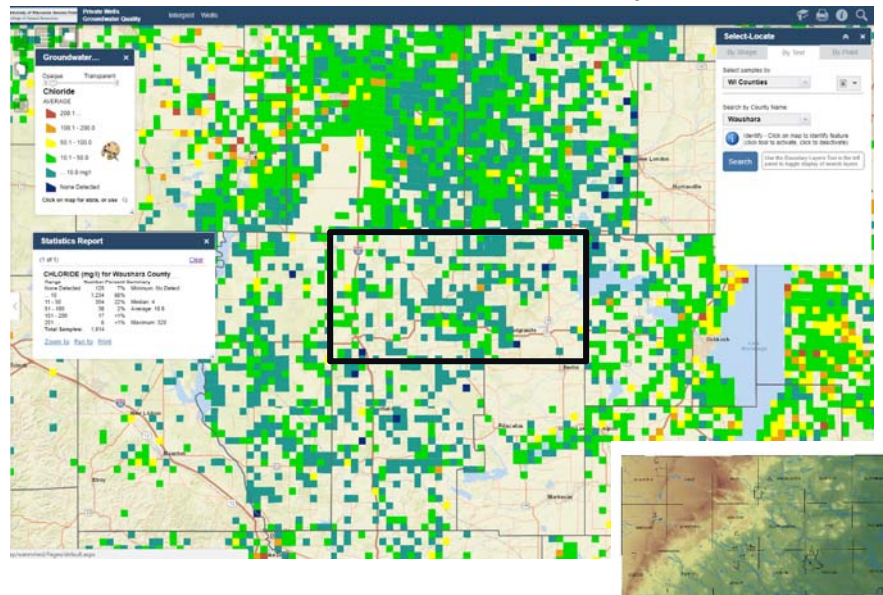
Chloride Summary by Town

Town	n	Chloride (mg/L)			
		Average	Median	Max	Min
Aurora	16	10.4	2.4	55.0	0.9
Bloomfield	21	5.3	3.3	32.1	0.7
Leon	33	5.0	1.9	39.7	0.7
Poy Sippi	13	22.7	4.3	228.0	0.7
Saxeville	18	4.8	3.4	16.7	0.7
Warren	13	2.3	1.3	12.1	0.9
Total	114	7.5	2.1		

Waushara Co. Chloride by Town

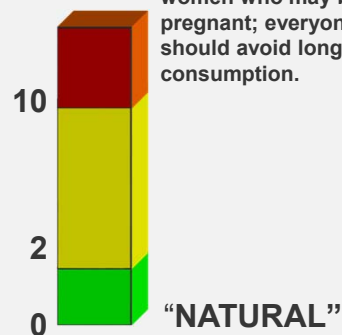


Waushara Co. Chloride by Section



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"



UNSAFE - for infants and pregnant women or women who may become pregnant; everyone should avoid long term consumption.

Sources: Agricultural fertilizer, lawn fertilizer, septic systems, animal wastes or other bio-solid applications

*Indicator of other potential contaminants

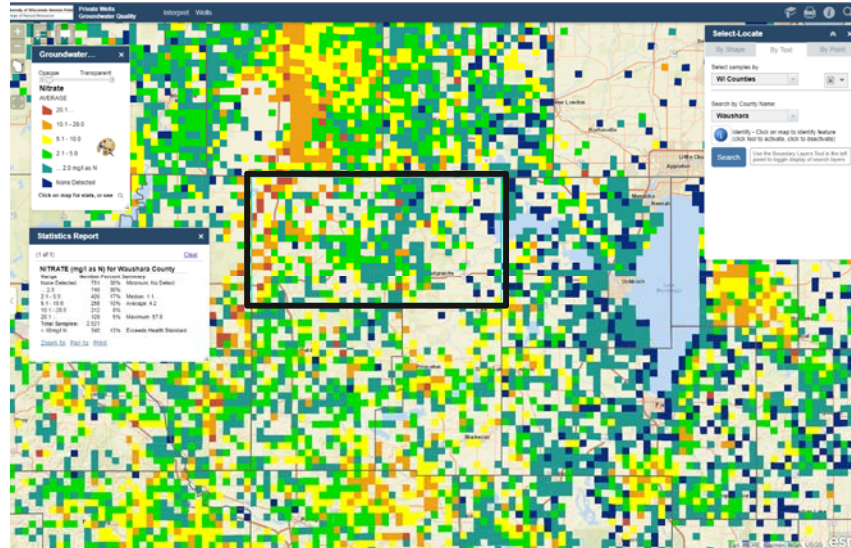
Nitrate Summary by Town

Town	n	Nitrate-N (mg/L)				
		Average	Median	Max	Min	% >10 mg/L
Aurora	16	5.7	<0.1	66.4	<0.1	12.5
Bloomfield	21	2.2	<0.1	25.2	<0.1	4.8
Leon	33	4.4	1.2	29.0	<0.1	15.2
Poy Sippi	13	1.7	<0.1	11.3	<0.1	7.7
Saxeville	18	2.9	0.9	14.9	<0.1	5.6
Warren	13	0.7	<0.1	3.7	<0.1	0
Total	114	3.2	<0.1			8.8

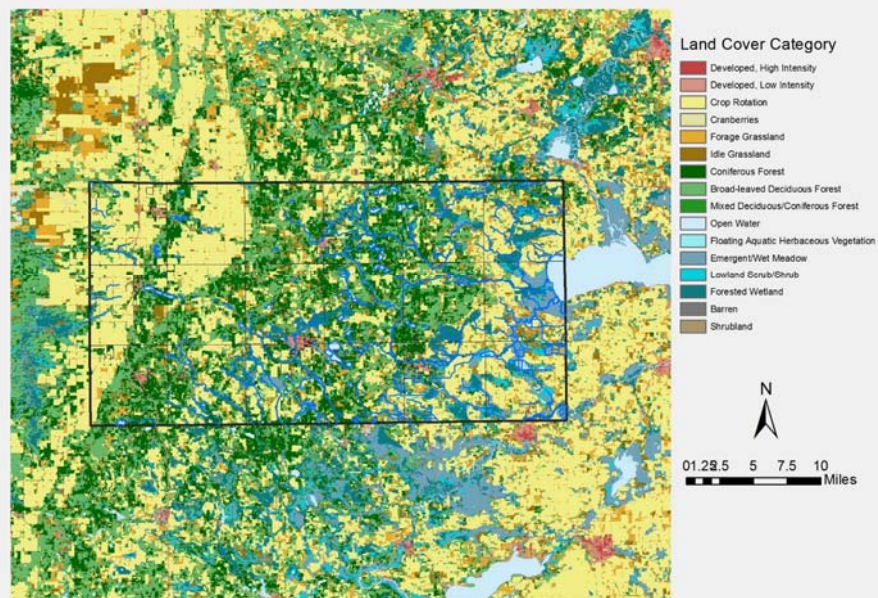
Waushara Co. Nitrate by Town

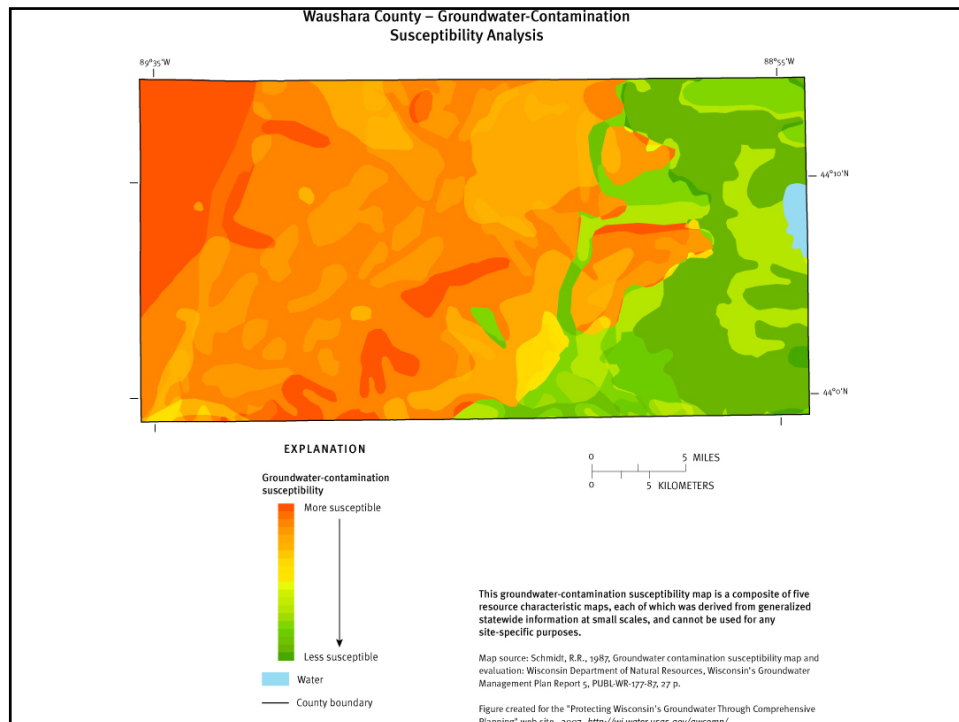


Waushara Co. Nitrate by Section



Waushara County Land Cover





What can be done to reduce nitrate levels?

Long term look at working to reduce nitrate loss to groundwater at the source:

- Have to implement the right tools
- Could take years to notice a response in wells

Short term look at providing safe water:

Private Wells ([Lewandowski et. al. 2008](#))

- ☐ New well (not guaranteed, deeper adds to expense) - \$7,200
- ☐ Bottled water - \$190/person/year
- ☐ Water treatment devices \$800 + 100/yr
 - ☐ Reverse osmosis (also removes most pesticides)
 - ☐ Distillation (removes some pesticides)
 - ☐ Anion exchange (nitrate only, wouldn't have any effect on pesticides)

Additional testing recommendations:

- If nitrate levels above 10 mg/L:
 - DO NOT give water to infants, women who are or may become pregnant
 - All persons should avoid long-term consumption of water greater than 10 mg/L
 - If relying on treatment:
 - Test treated water periodically to ensure its providing safe water
- If nitrate levels less than 10 mg/L:
 - Test annually to ensure levels remain below 10 mg/L
 - If greater than 5 mg/L may consider testing quarterly for a year to understand variability



Waushara County

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