Community Drinking Water Education Program

Kevin Masarik
Today’s presentation

- Groundwater and water well basics

- What do my individual test results mean?

- General groundwater quality in the Towns of Chester, Springvale and Waupun

- Improving your water quality
- Water converges at discharge locations
- Rivers and streams act like a drain for water to exit a watershed
What happens when we have more rain?
What happens when we have more rain?

- More infiltration
- Groundwater levels rise
- More water in rivers, lakes and streams
What happens when we have less rain?
What happens when we have more rain?

- Less infiltration
- Groundwater levels start to go down
- Less water in rivers, lakes and streams
Fond du Lac County Geology

- Cambrian (sandstone)
- Prairie du Chien (dolomite)
- St. Peter (sandstone)
- Sinnippee (mostly dolomite)
- Maquoketa (shale)
- Silurian (dolomite)

Not to scale
Do deeper wells mean better water?
The role of casing
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.
Why do people test their water?

- Installed a new well
- Change in taste or odor
- Buying or selling their home
- Plumbing issues
- Want to know if it’s safe to drink.
What are the Health Concerns?

- **Acute Effects** – Usually seen within a short time after exposure to a substance.
  (ex. Bacteria or viral contamination which may cause intestinal disease)

- **Chronic Effects** – Results from exposure to a substance over a long period of time.
  (ex. Arsenic or pesticides can increase the chance of developing certain types of cancer)
# Understanding Risk…?

<table>
<thead>
<tr>
<th>Event</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dying from a lightning strike.</td>
<td>0.013 in 1,000 chance.</td>
</tr>
<tr>
<td>0.010 mg/L of arsenic in drinking water.</td>
<td>3 out of 1,000 people likely to develop a form of cancer.</td>
</tr>
<tr>
<td>2 pCi of indoor radon level.</td>
<td>4 out of 1,000 people likely to develop lung cancer.¹</td>
</tr>
<tr>
<td>Dying in a car accident.</td>
<td>4 in 1,000 chance.</td>
</tr>
<tr>
<td>2 pCi of indoor radon combined with smoking.</td>
<td>32 out of 1,000 people likely to develop lung cancer.¹</td>
</tr>
</tbody>
</table>

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

¹[http://www.epa.gov/radon/healthrisks.html](http://www.epa.gov/radon/healthrisks.html)
No one test tells us everything we need to know about the safety and condition of a water supply.
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
# Laboratory Results:

<table>
<thead>
<tr>
<th>Homeowners Package:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacteria-Coliform</td>
</tr>
<tr>
<td>Hardness-Total</td>
</tr>
<tr>
<td>Alkalinity</td>
</tr>
<tr>
<td>Conductivity</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Homeowners Metal Package:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic (VISTA-ICP)</td>
</tr>
<tr>
<td>Calcium</td>
</tr>
<tr>
<td>Copper (VISTA-ICP)</td>
</tr>
<tr>
<td>Iron (VISTA-ICP)</td>
</tr>
<tr>
<td>Lead (VISTA-ICP)</td>
</tr>
</tbody>
</table>

**Pesticides:**

| Triazine Screen              | 0.2 ppb              |

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**Conversions:**

- milligrams per liter (mg/l) = parts per million (ppm)
- 1 mg/l = 1000 parts per billion (ppb)
Coliform bacteria

- Grow in soil, on vegetation, or in the intestines of warm-blooded animals and though it doesn't cause illness can be an indicator of changing water quality and potential contamination of more harmful microorganisms.

- Harmful bacteria and viruses can cause gastrointestinal disease, cholera, hepatitis

- If any is present assume that the water is unsafe

- Sources:
  - Live in soils and on vegetation
  - Human and animal waste
  - Sampling error
E. coli bacteria

- 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.
BACTERIA POSITIVE

Any sample in the 1/4 1/4 section.
Properly fill and seal unused wells

Source: Adapted from DiNovo and Jaffe, 1984.
What should I do if I have bacteria problems?

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
   - Properly fill and seal unused wells
   - Inadequate filtration by soil
4. Disinfect the well
5. Retest to ensure well is bacteria free.

➢ For reoccurring bacteria problems it may be necessary to look into drilling a new well.
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
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 drink softened water and are concerned about sodium levels – use potassium chloride softener salt.
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Chester
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County
Dodge County
November 2008

TOTAL HARDNESS (ppm CaCO3)

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>NONE DETECTED</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>(2 - 25)</td>
<td>0</td>
</tr>
<tr>
<td>C</td>
<td>(25 - 50)</td>
<td>0</td>
</tr>
<tr>
<td>D</td>
<td>(50 - 100)</td>
<td>0</td>
</tr>
<tr>
<td>E</td>
<td>(150 - 200)</td>
<td>0</td>
</tr>
<tr>
<td>F</td>
<td>(200 - 300)</td>
<td>2</td>
</tr>
<tr>
<td>G</td>
<td>(300 - 400)</td>
<td>26</td>
</tr>
<tr>
<td>H</td>
<td>(400 - 500)</td>
<td>49</td>
</tr>
<tr>
<td>I</td>
<td>(500 ...)</td>
<td>9</td>
</tr>
</tbody>
</table>

NOTE: Softened samples not mapped.
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

(-3) (-2) (-1) (0) (+0.5) (+1) (+2) (+3)
Severe Moderate Slight Ideal Slight Moderate Severe

Corrosion occurs

Scaling occurs
Land Use and Water Quality

Well pumping water
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”*

Test Important to Health

Unsafe for infants

“NATURAL”
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
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**NITRATE-NITRITE (ppm N)**

- **NONE DETECTED**: 64 (74%)
- **1.0 - 2.0**: 12 (14%)
- **2 - 5**: 4 (5%)
- **5 - 10**: 6 (7%)
- **10 - 20**: 1 (1%)
- **20 ...**: 0 (0%)
Nitrogen Budget

**Inputs**
- Atmospheric N
- Manure
- Nitrogen Fertilizer

**Outputs**
- Nitrogen Crop Removal
Nitrogen Budget

**Inputs**
- Manure
- Nitrogen Fertilizer
- Atmospheric N

**Outputs**
- Volatilization
- Denitrification
- Nitrogen Crop Removal
- Nitrate to groundwater
Fertilizer Response Curve

Yield or Biomass Accumulation (kg/ha)

Optimal Yield

Fertilizer Added (kg/ha)
Yield or Biomass Accumulation (kg/ha)

Fertilizer Added (kg/ha)

Increasing

100%

Yield Optimum

Economic Optimum
• variable from year to year depending on energy costs, fertilizer costs, price of commodities

Environmental Optimum
• depends on climate, soils, geology, etc.
• also depends on who you are…
What can I do to reduce my nitrate levels?

Ideal 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
  “Natural” in much of WI
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
If your arsenic concentration is:

<table>
<thead>
<tr>
<th>ARSENIC (mg/l)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>NONE DETECTED</td>
<td>35%</td>
</tr>
<tr>
<td>[0.003 - 0.010]</td>
<td>57%</td>
</tr>
<tr>
<td>[0.010 - 0.050]</td>
<td>7%</td>
</tr>
<tr>
<td>[0.050 - 0.100]</td>
<td>2%</td>
</tr>
<tr>
<td>[0.100 ...]</td>
<td>0%</td>
</tr>
</tbody>
</table>

Maximum value for the 1/4 1/4 section.

- **0 mg/L**: Water okay to drink. No further action needed.
- **0.003 mg/L**: Water okay to drink. Consider testing again in a year to see if levels have changed.
- **0.010 mg/L**: Recommend not using water for drinking.
Tests for Aesthetic Problems

Iron

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

0.3 mg/L

0
Copper

- Sources: Copper water pipes
- Standard: 1.3 mg/L

Health Effects:
- Some copper is needed for good health
- Too much may cause problems:
  - Stomach cramps, diarrhea, vomiting, nausea
  - Formula intolerance in infants
Sources: Lead solder joining copper pipes (pre-1985)

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:

- Run water until cold before drinking.
- Use a treatment device.
Insecticides, herbicides, fungicides and other substances used to control pests.

Health standards usually only account for parent compound.

Parent compounds breakdown over time.

May be additional effects from combination of chemicals to consider.

Most frequently detected pesticides in WI:
- 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.

* WI public health groundwater standard for breakdown component Alachlor ESA.
** WI public health groundwater standard is for the total chlorinated atrazine residue.
Tests Important to Health

**DACT Screen**

- Measures a particular breakdown component of triazine type pesticides (mainly atrazine used on corn crops, also simazine, propazine, cyanazine, etc)

- Specific to diaminochlorotriazine (DACT) underestimates the amount of total atrazine

- Groundwater Enforcement Standard: 3 ppb for total atrazine residue
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DACT (ug/l)

- NONE DETECTED
- [0.1 - 0.3]
- [0.3 - 1.0]
- [1.0 - 2.0]
- [2.0 - 3.0]
- [3.0 ...]

Maximum value for the 1/4 1/4 section.
A word about water treatment...

- Test water at a certified lab
- Know the types and amounts of contaminants you need to remove
- Choose a device approved by the Wisconsin Department of Commerce for the problems found in your water
- Maintenance and testing necessary to ensure proper treatment.
Next Steps

- Test well annually for bacteria, or if water changes color or clarity.
- If levels are elevated, test again in 15 months for nitrate.
- If arsenic was detected, consider testing again in a year to see if levels have changed.
Next Steps

Test for known or potential contaminants in your neighborhood

- Gasoline?
- Pesticides?
- Solvents?

Check for known contamination sites in Fond du Lac County at:
http://dnr.wi.gov/org/aw/rr/gis/index.htm
Thanks to the following for helping sponsor this program:

- Rising Sun Grange
- Town of Chester
- Town of Springvale
- Town of Waupun
- Fond du Lac County UW-Extension
- Dodge County UW-Extension
- Center for Watershed Science and Education

Questions?

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