Getting The Waters Tested
The Marcellus Shale Factor

Water Resources

Old Issues

Environment

New Issues

Presented by:

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http://www.wilkes.edu/water

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Center for Environmental Quality

Non-profit/equal opportunity employer, is operated and managed within the Department of Environmental Engineering and Earth Sciences at Wilkes University

Outreach Programs

- Environmental and Professional Education and Training
- Applied Research: Product Development
- Community and Business Outreach Programs

Website: http://www.wilkes.edu/water
B.F. Environmental Consultants Inc.

- Professional Consulting Services in the areas of water quality, soils, stormwater, geology, aquifer analysis, and land-development.
- Water Treatment Process/ Product Development
- http://www.bfenvironmental.com
- http://www.water-research.net

FREE TECHNICAL ASSISTANCE FOR WATERSHEDS!!!

C-SAW
(Consortium for Scientific Assistance to Watersheds)

Funding provided by Growing Greener and the kind support of the partners

Goals
- Local and Regional Geology
- Existing Problems in Region
- The Citizen Groundwater Database
- Baseline Testing – What Parameters?
- Educating the Community
What is the Marcellus Shale Factor?

- We have been educating private well owners for 20 years, but it was difficult to get citizens to test their well water. It looks clear – I am not sick – It is fine.
- The Marcellus Shale Factor – Baseline Testing for Natural Gas Development is conducting testing and citizens are being told they have a problem NOW.
- Based on Private Well Construction and Placement - Some Private Wells may be the pathways for contamination.
- We need to protect our source water - not just from Marcellus Shale Development, but from US and our past.
- How do we track an unregulated activity – such as Private Wells and Identify Zones or Areas that are Vulnerable to Contamination.
- This lead to the idea for creating the Citizen Groundwater / Surfacewater Database

Background

- Geology/Hydrology

Marcellus Shale

This is Causing all the Concern?
Marcellus Shale – present in Appalachian and Ridge and Valley, but likely productive only in the Appalachian Plateau.

Appalachian Plateau Province
- Broad to Narrow Valleys
- Rounded Hills and Valleys Associated with Glaciation
- Valleys filled by glacial fluvial material
  - Unconsolidated Material (Un)
  - Younger (Y)
  - Older (O)
Ridge and Valley Province

- Bedrock has been folded into a series of anticline and synclinal structures.

Geological Sequence – Northeast PA

<table>
<thead>
<tr>
<th>Time</th>
<th>Period</th>
<th>Deposit or Rock Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 1.8 million years</td>
<td>Quaternary – Glaciation</td>
<td>sand, silt, clay, and gravel</td>
</tr>
<tr>
<td>1.8 to 250 million years</td>
<td>Tertiary to Permian</td>
<td>salt, sand, and mudstone</td>
</tr>
<tr>
<td>290 – 320 million years</td>
<td>Pennsylvanian</td>
<td>Llewellyn (coal) and Pocono (coal)</td>
</tr>
<tr>
<td>320 – 354 million years</td>
<td>Mississippian</td>
<td>Mahantango Formation</td>
</tr>
<tr>
<td>354 – 417 million years</td>
<td>Devonian</td>
<td>Catskill Formation</td>
</tr>
<tr>
<td>417 – 443 million years</td>
<td>Silurian</td>
<td>Trimmers Rock Formation</td>
</tr>
</tbody>
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Surfacewater & Groundwater

- They Are Related and Connected!
Bedrock Fractures and Fractured Zones

Within Consolidated Rock or Bedrock Water Moves Along Bedding Planes, Joints, Fractures, and Faults.

Edge Ridge and Valley Province – Rt 309- Dallas, PA

Bedding Planes with Seepage

Private Wells/ Springs/ Water Systems in Pennsylvania

What?
Private Wells Not Regulated

- Private Wells Are Not Regulated under Safe Drinking Water Act
  - EPA – NO
  - PADEP – NO
  - County – Very Few Counties in PA
  - Townships – some have basic ordinance on placement- some have comprehensive requirements

Groundwater Northeast Pennsylvania

Based on the geology of Northeast PA, the common water quality problems are as follows:

- Corrosive Water
- Low pH
- Soft Water (low hardness) to Moderate Hardness
- Iron and Manganese
- Discolored Water – Reddish in Brown Tints
- Total Coliform Bacteria
- Sulfur Odors and Elevated Sulfates
- Methane – Yes Baseline Levels can be High – Predrilling

Air Quality Issues – Radon In Air!

Before Marcellus Shale Development

What was the Quality of Private Well Water?

Personal Observations

- Impacts from Road Salt, Old Landfills, Gas Stations, Saline Water (1981 – 1985)
- Bacterial Contamination and Well Construction Issues (1985)
- Methane Gas Present in Wells in Northern Tier of PA and in parts of Columbia and Luzerne County, PA (Oram, 1989).

Testing Conducted by Wilkes University in throughout the United States indicates that 30 to over 50% may be contaminated – Mostly by Total Coliform Bacteria (1989 – 2011). Locally – it tends to be about 40 to 50%.
Most Contamination appears to be associated with Total Coliform Bacteria

- Insects, Larvae and Nests / Egg Masses
- Mouse Colonies
- Snakes
- Beehives
- Mud - when casing to close to ground

Therefore – In some cases - the Private Wells are Facilitating Groundwater Contamination.
Three Step Process

- Baseline Testing – Documenting Conditions
- Citizen Database- Track Change
- Making Improvements – The Real Work!

Step 1: Baseline Testing—Education and Need Good Data

- Baseline Testing
  - Proper Well Purging, Field Monitoring, and Sampling
  - Documenting Existing Conditions and Well or Water Source Information
  - Chain-of-Custody Protocols
  - Using a Certified Lab / Using Certified Methods
  - Picking Water Quality Parameters
  - Educating Private Well Owners and Explaining Results

Education

- Conducted Free Workshops and Fairs
- Updated Website
  http://www.wilkes.edu/water
- Created a New Free Community Resource
- Added Informational Water Testing – Saline Water Screening Program

Schedule a Free Training Session – Go to Our Website
Chain-of-Custody

- Sampling Procedures
- Sampling Operations
  - Short-Term
  - Long-Term
- Sample Transport
- Receipt, Storage, Transport
- Sample Analysis
- Procedures for Data

Chain of Custody is Not Just a Third Party Sampler – Much More – Begins at the Lab

Step 2: Citizen Database

- Provide a Central Location to Store Baseline Pre-Drilling and/or Post-Drilling Water Quality Data for the Region – Provided by Citizens.
- Document Quality by Geological Formation – Conduct Vulnerability Analysis
- Identify Existing Regional Issues or Concerns (Pre-drilling)
- Provide an Un-Biased Community Resource
- Provide a Mechanism to Track Temporal, Spatial, and other Geospatial Variation in Water Quality.
- Aid in Conducting Vulnerability Analysis
- Supplement the Database with Other Data Sources – Currently I am adding all the data from the Dimock PADEP Investigation.
Citizen Database at Wilkes University -
Guidelines for Submission

II. Guidelines for Data Submission

1. Third Party Samplers following chain-of-custody to certified laboratory.
2. Submit detailed reports from certified laboratory with a GPS position for
   the well – either from the citizen or direct from laboratory.
3. The water sample must be collected ahead of any water treatment system.
4. Other conditions – Learn More at the Wilkes University Website.

Learn More –
http://www.wilkes.edu/water

Recent Baseline Testing in Luzerne County, PA
320 Private Wells
Study Area

Tested Conducted by Certified Laboratories
Third Party Samplers Not Wilkes University

Image Source: Luzerencounty.org

Preliminary – Screenshots – Add Hydrology, Roads, other GIS Layers
Connate water is water that was trapped in formation when material was deposited.

Methane in Water
- Methane has been a hidden issue in NEPA.
- The gas is colorless, tasteless, and odorless and there are no known health effects.
- Potential concerns relate to flammability/explosiveness of gas.
- Background – appears to range from non-detect to over 20+ mg/L (highly variable) in Northeast Pennsylvania
- Highest in the database – Now – about 7 mg/L – I am in the process of adding baseline data that is approaching 20 mg/L (predrilling)

Problems with Iron, Manganese, and Sulfur – May be Bacterially Related
In Northeastern PA: “Nuisance Bacteria may be associated with an Odor, Iron, Manganese, or Sulfur problem. Up to 50% of the time.
Make sure to test for total coliform, standard plate count, and Nuisance Bacteria.
What are Phthalates?
- Used as Plasticizers - is a substance which when added to a material, usually a plastic, makes it flexible and easier to handle.
- Bis(2-ethylhexylphthalate) (DEHP) – DW Standard – 6 ppb – GI problems, possible endocrine disruptor and carcinogen.
- Recent Testing – Highest Value was 60 ppb.
- How did this get in the aquifer?
  - Possibly the Black Coil Pipe used in wells and delivery lines for private homes.

What Parameters
- Baseline Testing

Suggested Baseline - For Citizens from PADEP (11/2010)
- Alkalinity, Chloride, Conductivity,
- Hardness, Oil and Grease, pH, Sulfate,
- Total Dissolved Solids, Total Suspended Solids, Total Solids
- Barium, Calcium, Iron, Magnesium, Manganese, Potassium, Sodium, Strontium
- Ethane/Methane
- Total Coliform / E. coli

Other Recommendations at: http://www.wilkes.edu/water (Fact Sheet - Recommended Baseline)
Baseline Testing – Oram’s Recommendations for Citizens

- Where are you located?
- What is your surrounding land-use?
- Do you have any water quality problems—such as discolored water, odors, or staining?
- Do you have a water treatment system?
- What is the source of your water?
  - Well, Spring, Cistern, etc

Same Baseline Parameters?

Quarry

Salt Spring, Susquehanna County
(You can light the gas- Back to 1800s)

Mixed Hazards

In general – I could see a radius from 3000 ft to 1 mile

- Mud/ Methane Migration (up to 1000 ft)
- Methane Pushes (2500 feet)
- Area Above Lateral
- 1000 ft Buffer

This is More Opinion/ Judgment- not fact.

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Suggested Baseline- For Citizens

- Testing Package # 1 Recommendations
  - Total Coliform with e. coli confirmation, chloride, sodium, bromide, barium, pH, total dissolved solids, MBAS, iron, manganese, and methane/ethane.

- Testing Package # 2 Recommendations
  - Package # 1 plus Total Hardness, Magnesium, Selenium, Strontium, Conductivity, Calcium, Zinc, Alkalinity, Arsenic, Nitrates, Total Suspended Solids, Sulfate, Od & Grease, and 21-VOCs/MTBE.

- Testing Package # 3 Recommendations
  - Package #1 and # 2 - plus Potassium, Sulfide, Ammonia, Acidity, Nickel, Gross, Alpha/Beta, Lead, and Uranium.

It may be advisable to add Glycols and other organics and inorganics depending on surrounding land-use, use of geothermal wells, and past history.

http://www.wilkes.edu/water (Fact Sheet - Recommended Baseline)

Step 3: New Community Resource
Helping To Take Action

Download a Free Copy (pdf) or Link to a copy at http://www.wilkes.edu/water

Also:
1. We are Working on a Regional Citizen Water Quality Database.
2. We provide informational water testing - not certified test - screening testing post drilling

Add Your Data to the Citizen Database

Other Projects

- Developing Low Cost Water Monitoring Equipment with Remote Reading Capacity for Citizen Scientists.
- Assisting with the Development of Stream and Watershed Based Monitoring Programs.
- Developing and Training Citizen Scientists
- Working on Sourcewater Protection Projects
- Educating Private Well Owners
Step 4: New Program to Help Private Well Owners (Fixing Problem Wells)

- Pocono Northeast RC&D Council – Private Well Assistance Program
  - Education
  - Outreach/Training
  - Funding Need Repairs – via a 1% loan program- terms up to 20 yrs.
  - http://www.pnesolutions.org

Working as a Community

Recent Site Tour - Towanda, PA

It is Critical to Get in the Field - Keep Your Eyes Open

Certificate of Completion

Training Event
Getting The Waters Tasted: The Marcellus Shale Factor
3/12/2011

1 - hour PDH or 0.1 CEUS
Presented by
Mr. Brian Oram, PG

B.F. Environmental Consultants Inc
15 Hillcrest Drive
Dallas, PA 18612
More Online Training @
http://www.bfenvironmental.com
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Mine Water Treatment System

Production Water Treatment-Modified POW Process for Brines
### Injection Wells – Class II

Class II wells inject fluids associated with oil and natural gas production. Most of the injected fluid is salt water (brine), which is brought to the surface in the process of producing (extracting) oil and gas.

**Regulated by:**

- EPA - [http://www.epa.gov/safewater/uic/wells_class2.html](http://www.epa.gov/safewater/uic/wells_class2.html)

**Does the UIC Program regulate hydraulic fracturing?**

Sometimes. The UIC Program regulates the following activities:

- Well injection of fluids into a formation to enhance oil and gas production (Class II wells).
- Fracturing used in connection with Class II and Class V injection wells to “stimulate” (open pore space in a formation).
- Hydraulic fracturing to produce methane from coal beds in Alabama.
- Hydraulic fracturing that uses diesel in the mixture.

Note: Class V wells are shallow wells that inject water into or above a freshwater aquifer. [http://www.epa.gov/ogwdw000/uic/](http://www.epa.gov/ogwdw000/uic/)