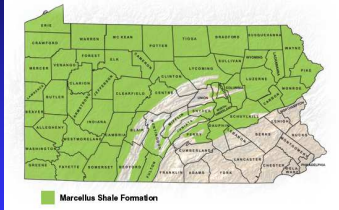


## Marcellus Shale Factor Getting the Waters Tested !



EWQA Fall Conference  
and Trade Show!  
November 16, 17-18, 2010  
Eden Resort, Lancaster, PA

---

---

---

---

---

---

---

---



### Presented by:

Mr. Brian Oram, Professional Geologist (PG),  
Soil Scientist, Licensed Well Driller, IGSHPA  
Accredited Geothermal Installer

Laboratory Director, Center for Environmental Quality  
Wilkes University

<http://www.wilkes.edu/water>

And

B.F. Environmental Consultants Inc.

<http://www.bfenvironmental.com>

<http://www.water-research.net>



---

---

---

---

---

---

---

---

### 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
- Community and Business Outreach Programs

Website: <http://www.wilkes.edu/water>

---

---

---

---

---

---

---

---

## Before Marcellus Shale Development What was the Quality of Private Well Water?

A USGS survey found that 70% of private wells were contaminated. This contamination could result in acute or chronic health concerns (1996).

Testing Conducted by Wilkes University in through out the United States indicates that 30 to over 50% may be contaminated – Mostly by Total Coliform Bacteria (1989 – 2010).

PSU – Master Well Owner Network suggests that 33 to 50 % of Private Well Owners in PA may have some Form of contamination.

---

---

---

---

---

---

---

---

## 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 are the Private Wells are Facilitating Groundwater Contamination.

---

---

---

---

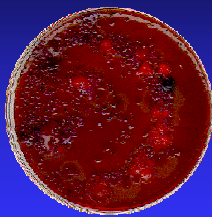
---

---

---

---

## Based on the geology of the NEPA, 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 to Brown Tints
- Total Coliform Bacteria
- Sulfur Odors and Methane- Biogenic Gas

Contamination by VOCs, SOCs, Glycols, and Radionuclides are NOT COMMON!

---

---

---

---

---

---

---

---

# Marcellus Shale

---

---

---

---

---

---

---

---




---

---

---

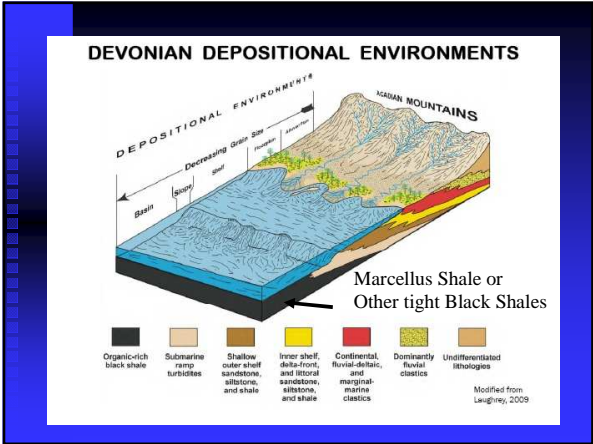
---

---

---

---

---




---

---

---

---

---

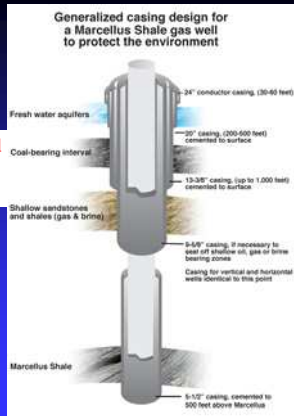
---

---

---



Multiple Grouted Casing Used in Drilling Process




---

---

---

---

---

---

---

---

---

---

Types of Fluids - Associated with Marcellus Shale

- Top hole fluids – typically the water from the freshwater aquifer. This water from the first 600 to 1200 feet.
- Bottom hole fluids – brine or connate water.
- Stimulation Fluids – fluid used to improve recovery (frac process)- includes biocides and other chemicals.
- Production Fluids – water produced along the natural gas release – similar to bottom hole fluid.

---

---

---

---

---

---

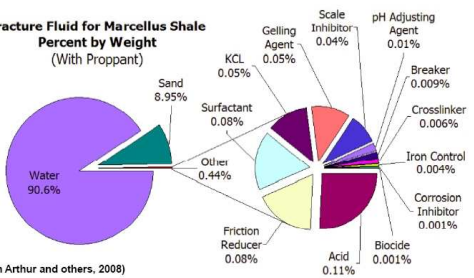
---

---

---

---

Fracture Fluid for Marcellus Shale  
Percent by Weight  
(With Proppant)



(from Arthur and others, 2008)  
Arthur et. al., 2008 – All Consulting – “ Natural Gas Wells of the Marcellus Shale”, Presented at Groundwater Protection Council 2008 Annual Forum.

---

---

---

---

---

---

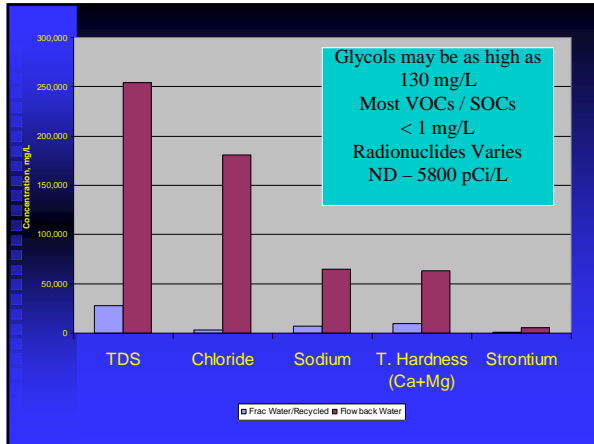
---

---

---

---






---

---

---

---

---

---

---

---

---

---

---

---

### Active Marcellus Production Site – Frac Fluid Chemistry

Typically Frac Water is comprised of clean water with a low probability for scale formation, but treated effluents and other sources being evaluated. The components include:

- Friction Reducer – anionic polymer high molecular weight (hold frac sand and other particles)
- Wetting Agent- nonionic surfactant – reduce surface tension and improve frac water flowback.
- Biocides- control growth or regrowth of microorganisms.
- Scale Inhibitor – phosphate based chemicals to inhibit precipitate formation and scale formation.

---

---

---

---

---

---

---

---

---

---

---

---

### The Marcellus Shale Factor

- In 1996 – we knew 50% of Private Wells in PA were contaminated – But What Did We DO?
- The Marcellus Shale Factor or the Development of this resource is NOW bringing this problem to the surface.
- Baseline Testing is being conducted and more problems with groundwater quality are being identified.
- What to do now?

---

---

---

---

---

---

---

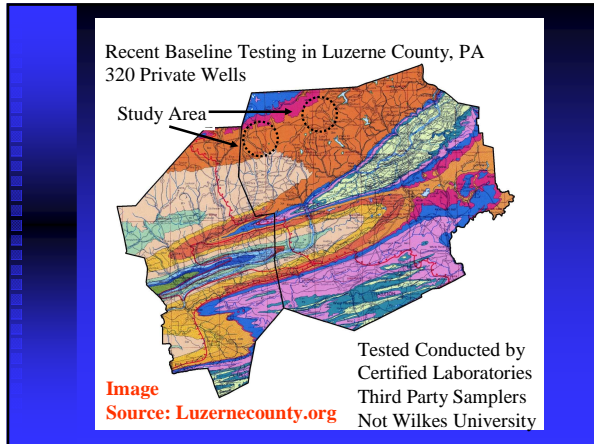
---

---

---

---

---




---

---

---

---

---

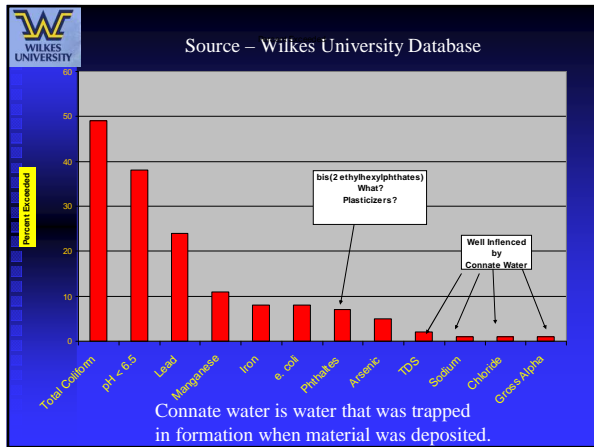
---

---

---

---

---




---

---

---

---

---

---

---

---

---

---

### 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(2thylhexylphthalte) (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?

---

---

---

---

---

---

---

---

---

---

## How ? Not Sure – Here are Some Ideas

- Private Wells Not Regulated and there are no plumbing codes.
- Sources – PVC plastic piping used in the home.
- Sources – Drop Pipe and Delivery Piping used in the well.

This is only a hypothesis.

---

---

---

---

---

---

---

---

## Arsenic (5 % above Limit)

- The drinking water MCL is 0.010 mg/L.
- Arsenic can result in the formation of malignant tumors on skin and lungs and may cause nervous system disorders.
- For this particular parameter within Northeastern Pennsylvania (NEPA), it would be advisable to retest the water for dissolved and total arsenic.
- In many cases, the arsenic has been leached from a colloid or particle that could be more cost effectively removed by standard filtration. It is also typically bound to iron oxide complexes.

---

---

---

---

---

---

---

---

## Suggested Baseline- For Citizens

- Testing Package # 1  
Total Coliform with e. coli confirmation, chloride, sodium, bromide, barium, pH, total dissolved solids, MBAS, iron, manganese, and methane/ethane.
- Testing Package # 2  
Package # 1- plus T. Hardness, Magnesium, Selenium, Strontium, Conductivity, Calcium, Zinc, Alkalinity, Arsenic, Nitrate, Total Suspended Solids, Sulfate, Oil & Grease, and 21-VOCs/MTBE.
- Testing Package # 3  
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)

---

---

---

---

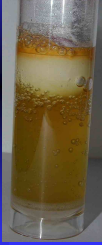
---

---

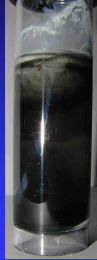
---

---

## 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.



---

---

---

---

---

---

---

---



## 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.
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>



---

---

---

---

---

---

---

---

## Suggested Action

- Baseline Testing should identify and document current water quality and quantity and be specific to the wellowner.
- Baseline testing information should be used to correct, improve, or abandon wells that can not be remediated. This may not just mean installing treatment – we may also need to improve the well.
- Establish Statewide Standards for Private Well Placement and Construction.
- Establish specific plumbing codes for drinking water piping for private wells.
- Establish more detailed standards and guidelines for geothermal well placement and construction.

**WORK as a Community – Participate in the Citizen Database**

---

---

---

---

---

---

---

---

## New Community Resource



WATER QUALITY  
DATABASE  
CONSENT &  
INFORMATION

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

Add Your Data to the Citizen Database

---

---

---

---

---

---

---

---

## Presented by:

Mr. Brian Oram, Professional Geologist (PG),  
Soil Scientist, Licensed Well Driller

Laboratory Director, Center for Environmental Quality Wilkes University  
<http://www.wilkes.edu/water>

And

B.F. Environmental Consultants Inc.  
<http://www.bfenvironmental.com>  
<http://www.water-research.net>



---

---

---

---

---

---

---

---