Getting the Waters Tested – The Marcellus Shale Factor Working as a Community

Water Resource

Old Issues

Environment

Actions for Young Adults

New Issues

Presented by:

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

B.F. Environmental Consultants Inc.
http://www.bfenvironmental.com
And
Water Research Center- Free Information on Water Quality
http://www.water-research.net

B.F. Environmental Consultants Inc.

- Professional Consulting Services in the areas of water quality, soils, stormwater, geology, aquifer analysis, and land-development.
- Baseline – Chain-of-Custody
- Expert Testimony
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Water-Research Center

Education and Outreach Program funded by
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Outreach Programs

- Environmental and Professional Education and Training for Citizens and Local Municipalities
- Water Quality Help Guides – Information Library
- Community and Business Outreach Programs
- Low Cost – Informational Water Testing Program with National Laboratory
- Citizen Monitoring Programs- Developing Low Cost Water Quality Sensors

Website: http://www.water-research.net

Current Work

- Citizens Groundwater / Surfacewater Database – Certified Data Only!
  http://www.bfenvironmental.com
- Radon Levels in Private Well – Goal is to Sample approximately 200 wells in Northeastern PA.
  Private Well Owner / Watershed Group Survey
  Take the Survey:
  http://www.surveymonkey.com/s/NMG6RQ3

Announcements

- New Methane Gas Migration and Mitigation Website
  http://www.water-research.net/methanegas.htm
- New Information Guide for Private Well Owners will be available in April 2012.
  http://www.bfenvironmental.com

What is the Marcellus Shale Factor?

- We have been educating private wellowners 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 be 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**

WATER QUALITY DATABASE CONSENT & INFORMATION

Our Drinking Water

Marcellus Shale

The Match Of the Century – Pick a Side and Lets See Who Wins.

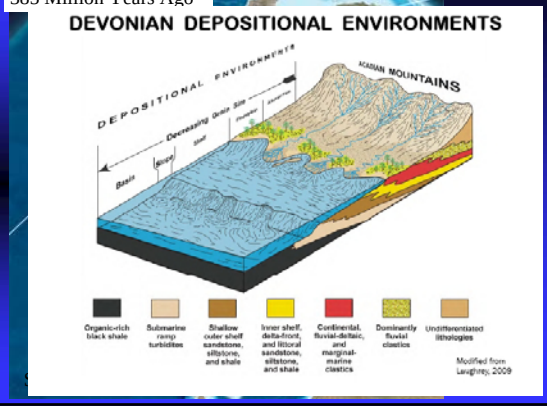
No – We don't want this situation - This mindset is Causing all the Concern?

Geological Sequence – Northeast PA

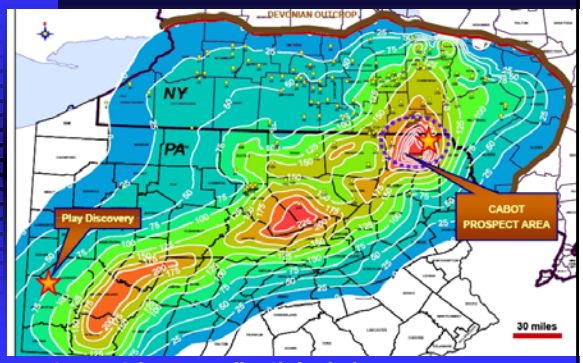
OLDER

Time	Period	Deposit or Rock Type
0 to 1.8 million years	Quaternary – Glaciation	sand, silt, clay, and gravel
1.8 to 290 million	Tertiary to Permian	**Not present (eroded and weathered)**
290 – 320 million	Pennsylvanian	**Llewellyn (coal) and Pottsville (minor coal)**
320 – 354 million	Mississippian	**Mauch Chunk Pocono and Spechty Kopf**
354 - 417 million	Devonian	Catskill Formation **Trimmers Rock Formation Mahantango Formation Marcellus Formation (Black Shale)- Target**
417 – 443 million	Silurian	**Onondaga Formation (calcareous sandy shale)**

385 Million Years Ago



This is why the term – Fairway is being used to describe the play.



Source- Cabot – Marcellus Shale Thickness Map

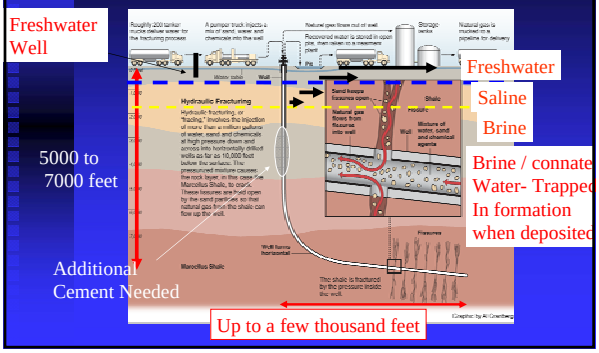
Concerns Related to Marcellus Shale

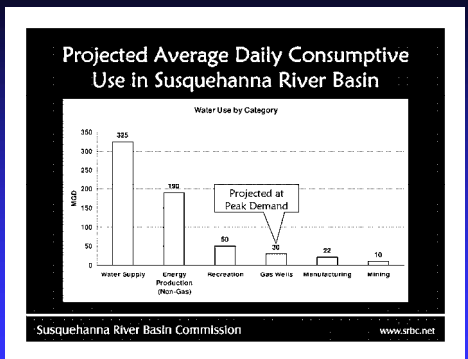
- In general, the concerns are related to the following:
  - Surface Spills and Releases Near Surface
  - Methane Gas Migration
  - Pushes and Slugs associated with Improper Cementing and not Properly Sealing the Existing Confining Layers Improper Disposal of Brines
  - Freshwater Aquifer Contamination by brine water and drilling fluids/ muds.
  - Drilling fluids may contain environmental contaminations (metals and organics).

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.

Getting to The Natural Gas

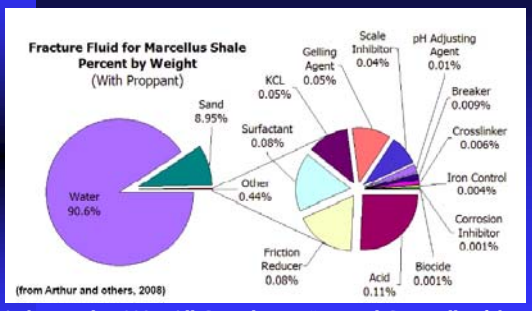




At Full Build Out – This water usage by the Industry is equivalent to the daily water usage of 1 – Nuclear Plant

Using Degraded Waters

- Partially Treated Wastewater
- Recycling Flowback and Production Water
- Using Stormwater
- Using Mine Drainage
- Potential Beneficial Use of Some of the Well Cuttings

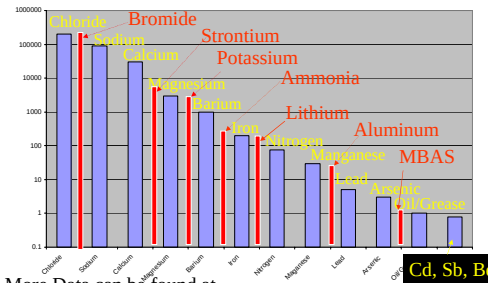


Arthur et. al., 2008 – All Consulting – " Natural Gas Wells of the Marcellus Shale", Presented at Groundwater Protection Council 2008 Annual Forum.

Frac Water Chemical Disclosures

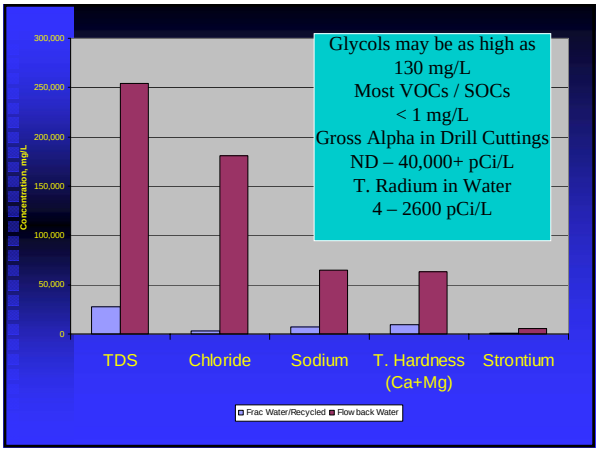
- FracFocus"- **http://fracfocus.org/**. - the hydraulic fracturing chemical registry website.
- This website is a joint project of the Ground Water Protection Council Interstate Oil and Gas Compact

Approximate Flowback Water - Wastewater Chemistry
Concentration - mg/L (Source: PSU and Marcellus Shale Coalition



More Data can be found at
http://www.bfenvironmental.com

Cd, Sb, Be, Cr
Ni, Ag, Tl and
other trace
metals



Misconception 1: Past Water Quality Issues are Not Being Communicated

100 % Pure Water – No Problems

The Real Facts on Drinking Water

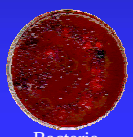
50%

Other 50%

Iron / Manganese

Sediment / Gases

Corrosion



Bacteria

Therefore – 3% of Private Wells may have a Saline water fingerprint.

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%.

Methane Migration (Natural, Induced, Facilitated)

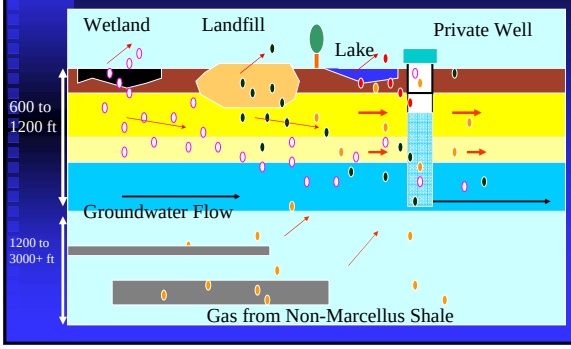
Smell is Odorless, Colorless, and Looks Like This:

Add Ignition Source And Oxygen

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

Methane Gas Migration- Not Related to Marcellus Shale



Rock Sample from Quarry – West of Dimock

Sandstone Unit – Containing Plant Materials, Organic Muds – Possible Shallow Methane Source

Methane (a little more)

- The Coal regions and northern portion of NEPA, and areas associated with the Mahantango / Marcellus Shale may have elevated levels of methane.
- No drinking water limit, but Office of Surface Mines recommends monitoring for concentrations from 10 to < 28 mg/L and immediate action for concentrations > 28 mg/L
- My Recommendations (Oram, 2009):
  - < 2 mg/L – Monitor annually with passive venting, annual testing
  - > 2 to 7 mg/L – Monitoring with active venting- Twice a Year for One Year (During Times Out-gassing is Severe).
  - > 7 mg/L to < 10 mg/L – active venting, pump shroud, isotophic analysis. Quarterly Testing for one year.
  - > 10 mg/L – Treatment , active venting with more aggressive management, isotophic analysis , and possible well rehabilitation- Monthly testing for up to one year.

Methane Gas

Video from Salt Springs State Park – Fall 2010, by Brian Oram

http://www.friendsofsaltspringspark.org

"At the base of the gorge is a bubbling salt spring, traces of an 1850s woolen mill, and mid-19th century farmhouses and barns."

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.

Does this Look Familiar?

Part of the Reason for the Discolored Water May be Iron Bacteria
Iron Related Bacteria is a common problem in NEPA –About 50% of Wells with an Iron Problem or Coliform Problem have IRB.

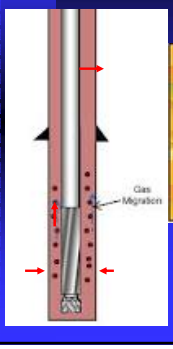
I am not saying there is no methane gas in the water.

Oram, 2011
Susquehanna County, PA

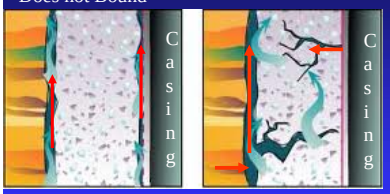
Example of Nuisance Bacteria
Iron Related Bacteria Count - > 140,000 colonies per ml
Aluminum – 0.511 mg/L, Iron 1.87 mg/L, Manganese – 5.4 mg/L, Lead 0.029 mg/L, **Methane - < 0.001 mg/L**

Protective Casing – Do it Right !

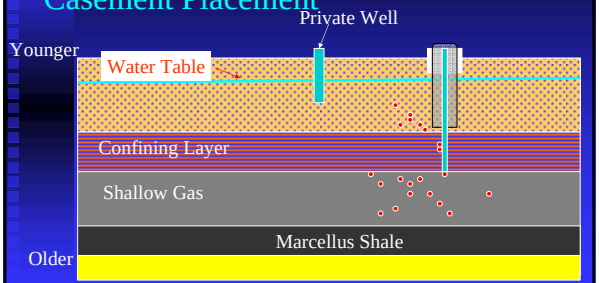
Problems with Gas Migration and Cement



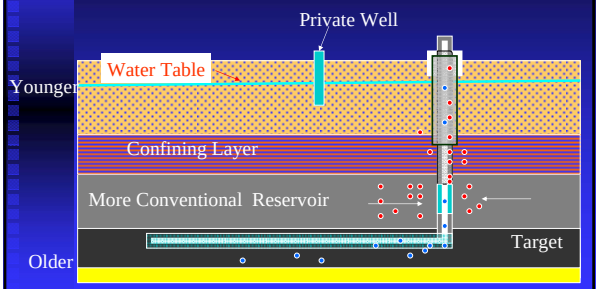
Does not Bound



Migration Concepts- Non-Marcellus Shale - While Drilling- Proper Casement Placement



Migration Concepts- Multiple Casements and Recreate Confining Layers- Need Good Cement Bonds- Cement up to Deepest Casement or Surface



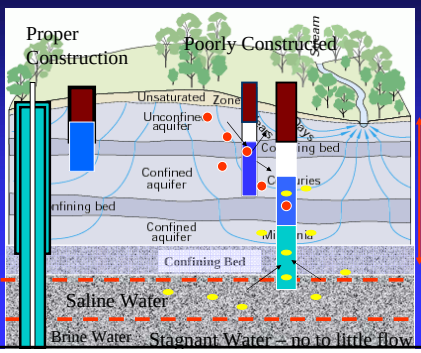
Migration

Methane Gas Migration – At Wellhead – Prior to Regulation Change

Protective Casing and Cement– Do it Right !

Ok – I get the outgassing – by why is it brown?

Properly Constructed Wells and Poorly Constructed Wells

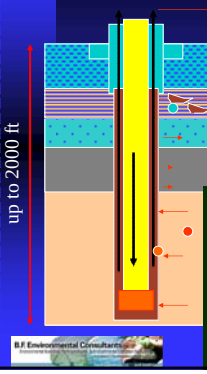


600 to 1200 ft

Fresh Water

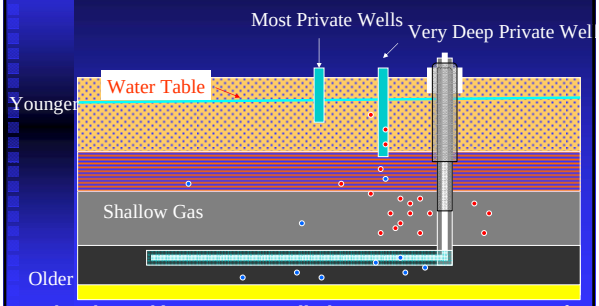
Sea Level

PSU Study -Migration and Disturbance During Drilling-losing circulation



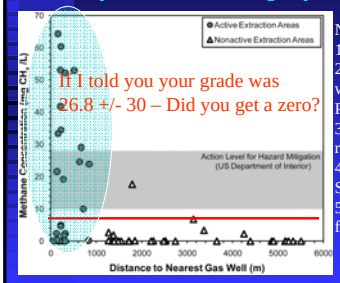
Key Points
1. Proper Casing and Cement of Marcellus Shale Wells
2. Knowing How Private Wells Are Constructed
3. Isolation Distances will not Solve This Problem.
4. Fixing Private Wells has to be part of the Solution.
5. This may account for the data on bromide from PSU.
6. The issue may not be well radial distance, but construction and drilling issue.
7. Recommend closed loop drilling with water within freshwater aquifer (no muds) or water-based muds.

Migration Concepts- Multiple Casements and Recreate Confining Layers – No Uncemented Zones.



The other Problem – Private Wells that are Two Deep – I aware of some private wells that are over 900 feet deep.

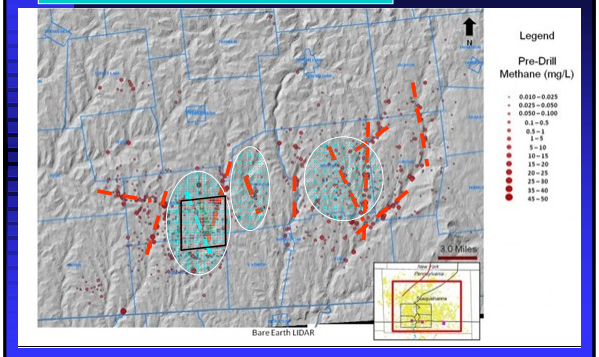
Duke Study- "Gas Well Drilling and Hydraulic Fracturing" by Osborn



Note:
1. Action Level is 7 mg/L
2. Study done in an area with "suspected" gas migration Problems- Not Considered.
3. Data suggest a simple 2-D relationship.
4. Many samples well above Saturation- Influenced by Pump Depth.
5. Contains No Pre-Drill Data- for the shaded area.

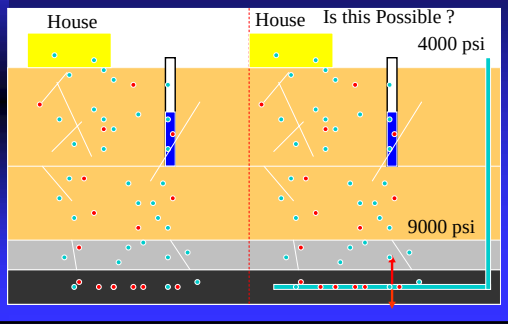
Title is spin.

Cabot – Quick Look



It looks like background methane levels may follow a linear/ curvilinear trend.

Could Radon Gas be a Good Surrogate for Methane Migration? It cost less to test for Radon than Methane- Not Suggesting we Eliminate Methane- add Radon



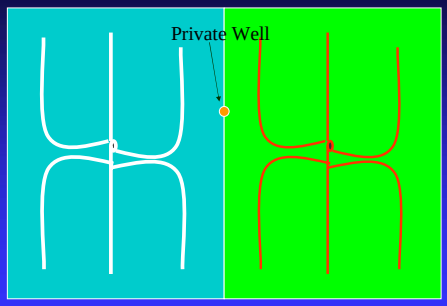
Note

- Again – I am not saying anything migrated from the Marcellus Shale into the Catskill Formation or directly into a private well.
- I am suggesting a Push- Like a “domino effect” or like in Shooting Pool with a possible lag because of permeability- just vertical.

Action as a Student

- Learn about How Your Family Use Energy
- Implement Energy Conservation – Switch Bulbs, Close the Door – Turn the Lights Out- Unplug Your Charger
- Put a Coat On, Put on Some Soaks, Where a Sweater – Anything But Turning Up the Heat or the AC on.
- Help to Educate the Community.
- Be an example - Conserve Energy, Recycle, Reuse.
- Get a Good Education and Make a Difference in Your Community

My Primary Concern with Respect to Radius and Assumed Liable is "Who is Responsible"



Changes in the Regulations

- Require Lined Sites with Containment.
- Require Cement Bond Logging.
- Require Cementing to Surface for all strings and production casing.
- Require Monitoring Private Wells During Drilling Process – Field Screening Only
- Increase Baseline Testing Zone , but not a Circle.
- Require Closed Loop Drilling
- Require Disclosure Using Frac Focus
- More Cased Zones – Multiple Cement Casing
  - New Strings – Placed Based on Local Geology and Well Survey
    - Shallow Freshwater
    - Deeper Freshwater
    - Saline Zone Casing

New Community Resource Helping To Take Action

Download a Free Copy (pdf) or Link to a copy email – bfenviro@ptd.net

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

WATER QUALITY DATABASE CONSENT & INFORMATION

Recent Site Tour- Towanda, PA

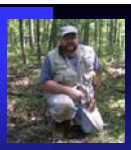
I took both photos – First Time on the Drilling Platform

Certificate of Completion

Training Event
Getting the Waters Tested – The Marcellus Shale Factor
Working as a Community – Actions for Young Adults
3/27/2012
2 – hour PDH or 0.2 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

iCONSERVE PENNSYLVANIA



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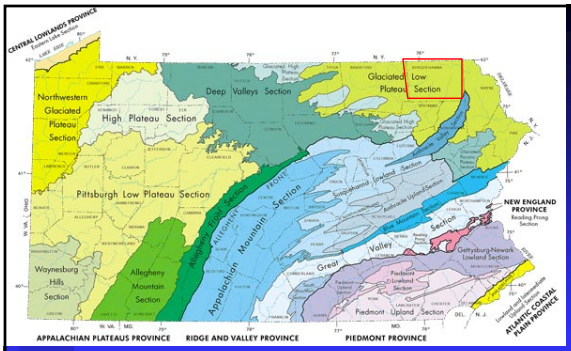
Most Contamination appears to be associated with Total Coliform Bacteria

- 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.



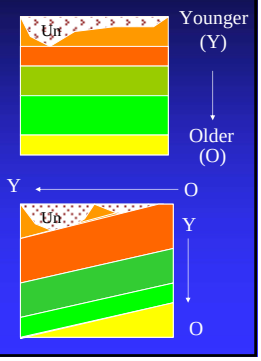
Susquehanna County was glaciated and it is located within are within the Appalachian Plateau

Source: DCNR - http://www.dcnr.state.pa.us/topogeo/map13/map13.aspx

Appalachian Plateau Province

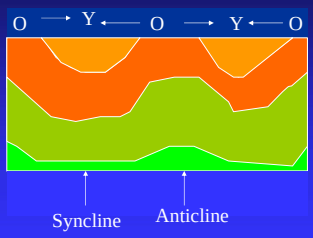
- Broad to Narrow Valleys
- Rounded Hills and Valleys Associated with Glaciation
- Valleys filled by glacial fluvial material

Unconsolidated Material (Un)



Ridge and Valley Province

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



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

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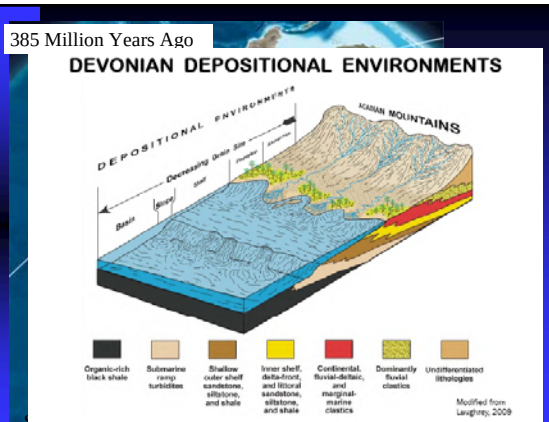

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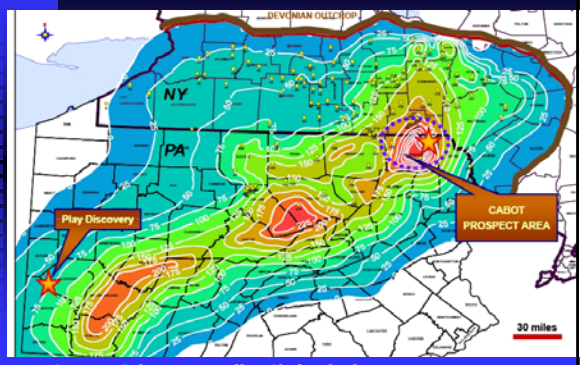

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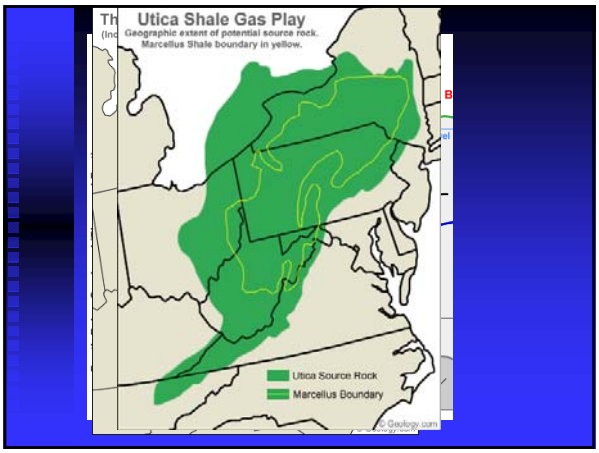


Active Marcellus Production Site – Frac Fluid Chemistry

Typically Frac Water is comprised of clean water with a low probably 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.

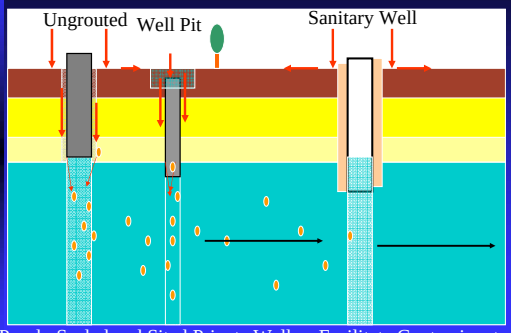
Biocides- control growth or regrowth of microorganisms.

Scale Inhibitor – phosphate based chemicals to inhibit precipitate formation and scale formation.

Private Wells Not Regulated

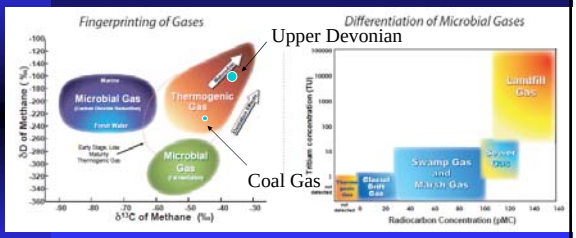
- Private Wells Are Not Regulated under Safe Drinking Water Act
  - EPA – NO
  - PADEP – NO
  - County – Very Few Counties in PA
  - Townships – some have basic ordinance on placement- some have comprehensive requirements

How Contaminants Can Get In to the Aquifer (Surface)



Poorly Sealed and Sited Private Wells – Facilitate Contaminant Migration

Gas Fingerprinting



Test Well Water for Methane, Ethane, and Propane- expensive and may need large volumes of samples and reference samples.

Private Wells/ Springs/ Water Systems in Pennsylvania

What ?