Natural Gas – A Game Changer

Water Resources

Environment

Industry

Citizens

A Balance is Needed - Lithuania

Old Issues

New Issues
Presented by:

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B.F. Environmental Consultants Inc.

http://www.bfenvironmental.com

Water Research Center

http://www.water-research.net

This is my Normal Attire.

(photo by: Samantha Oram)
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
- Continuing Education Courses for Engineers, Surveyors, and Water Treatment Professionals
- Water Treatment Process/ Product Development

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Education and Outreach Program funded by B.F. Environmental Consultants Inc.

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

Website: http://www.water-research.net
The **Silurian- Ordovician Shale Play- What is it?**

- ~416 to 480 million years old
- ~7,000 to 12,000 feet deep
- ~500 to 2,500 feet thick
- Formed from organic-rich mud

- Natural gas
- Radioactive (NORM)
- Low permeability

[http://www.kpmginstitutes.com](http://www.kpmginstitutes.com)
Marcellus Shale or Other tight Black Shales
This is why the term – Fairway is being used to describe the play.
3.4 mmcf/day
$ 8,976/day
$ 1800/day (20%)

2.3 to 6.3 mmcf/day
$ 16,600/day
$ 3300/day (20%)

Source: DUG Conference Presentation

Production a function of
Thickness
Organic Content
Porosity
Stability

$2.64 per MMBtu
(2/2012)

1 MMcf = 1000 MMBtu
Baseline Groundwater and Surfacewater Monitoring Related to Natural Gas Development

Site Development (Switching to Closed Loop Drilling)

Frac Job – Hydraulic Fracturing

Production

Processing
Marcellus Shale Drilling Site

Pads can be 5+ acres – but one pad may support drilling multiple horizontal wells. The large pad needed to fit “Hydraulic Fracturing Process”.

Side View

Vertical Approach  Horizontal Drilling

Traditional Vertical Well Spacing: 32 Separate Padsites Needed For 32 Wells. (Method not used by Chesapeake)

Idealized Horizontal Well Spacing: 1 Padsite Yields Up To 32 Wells. (Chesapeake method)
Go To YouTube to See Some Videos - http://youtu.be/lnPqKvE60uI
Getting to The Natural Gas

5000 to 7000 feet

Freshwater Well

Brine / connate Water- Trapped In formation when deposited

5000 to 7000 feet

Potentially Un-Cemented Zone

Rate of Water Movement

Up to a few thousand feet

http://www.propublica.org/special/hydraulic-fracturing
Open Loop Replaced by Closed Loop Drilling

No open pits – no leaky liners – a better approach – testing
Depends on the types of practices that are used. Remember
Pits may not be located on a Deed only a Permit. (Legacy Issues)
Closed Loop Drilling

This replaces the Old Lined Pit
**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.

Could this explain the Bromide Issue??
Catskill Formation

“Bluestone Quarry – West of Dimock”

Note – Preferential Flow Pathways Along Joints and Bedding Planes

Notice these pathways decrease with depth
Drilling Changes/Practices

- Using Water Only for Drilling Through the Freshwater Aquifer, Water/Air or Water Based Muds
- Using – Food Grade Mineral Oil for Drilling the remainder of the borehole.
- Flowback Water Reuse – 100% Treated and Re-used, by blending 80/20 with freshwater.
- More Strings, i.e., cemented casements.
Protective Casing – Do it Right!
Problems with Gas Migration and Cement

Does not Bound
Migration Concepts - Non-Marcellus Shale - While Drilling - Proper Casement Placement

- Private Well
- Water Table
- Confining Layer
- Shallow Gas
- Marcellus Shale
If this much is coming to the surface how much may be being pushed into shallow bedrock units? What happens when this pressure is shut in? http://youtu.be/N4Ibbs7BN_E
Perforating The Well Casing: Shaped Charges

The well liner needs to be perforated so fracturing fluid can flow out of the lined wellbore, and so gas can flow back into it. Perforation is done using shaped charges.

From *Oilfield Review*: Schlumberger
Rarely Seen Video
Hydraulic Fracturing
Get On Site - See and Witness the Process
Hydrofracturing

High Pressure Injection of Water, sand, and a mixture of chemicals in a series of stages to part formation. Note- Drilling Rig is not on the site – all drilling is done.
Fluid being pumped down at 3000 gpm – Total Hole Pressure 4000 psi – bottom hole pressure about 9000 psi.
Hydraulic Fracturing: An Oblique View

Each fracture is roughly elliptical in shape. Height should be thickness of Marcellus layer, length as long as possible.

The length can be 100’s to 1000’s of feet, but probably 500 ft vertical and 1000 horizontal.

Takes a lot of injection fluid to create many such fractures from a single well.

Multiple transverse fractures—probably the best way to tap a reservoir. A drawback is the flow constriction that occurs at the intersection between each fracture plane and the well.
Barriers / Liners – Separate - Containment – Tracking Waste/ Reuse Barriers that Work !
Freshwater Line

Reclaimed Water Line

Water Reuse – In Action
Migration Concepts- Multiple Casements and Recreate Confining Layers – No Uncemented Zones.

The other Problem – Private Water Wells that are Too Deep or Old

Vertical Gas Wells- Storage
We Want This

Not This

Moving Forward
Without Planning

This Takes a Balance – Planning – Strategic Thinking –
It Takes a Community!
Announcements

- New Methane Gas Migration and Methane Gas Mitigation Website
  http://www.water-research.net/methanegas.htm


- New Online Training Courses for Professionals
  - http://www.bfenvironmental.com

- Fact Based Review of Dimock, PA
  http://www.water-research.net/dimockwellwater.htm
Thanks
QUESTIONS
Stop Using the Word – “Frac”

“Frac – was the “four” letter word for the 12 Colonies in Battlestar Galactica.

The process is called Hydraulic Fracturing.

This will make our Jobs a lot easier!
Hydrofracturing