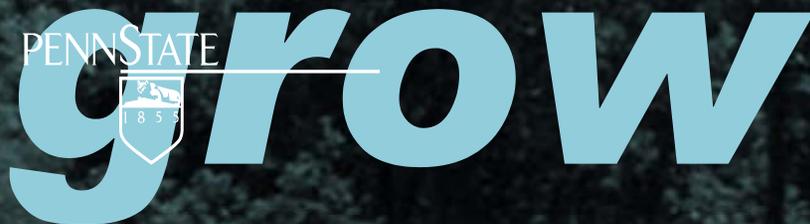


MARCELLUS SHALE PLAY and surface issues

an overview for forest landowners

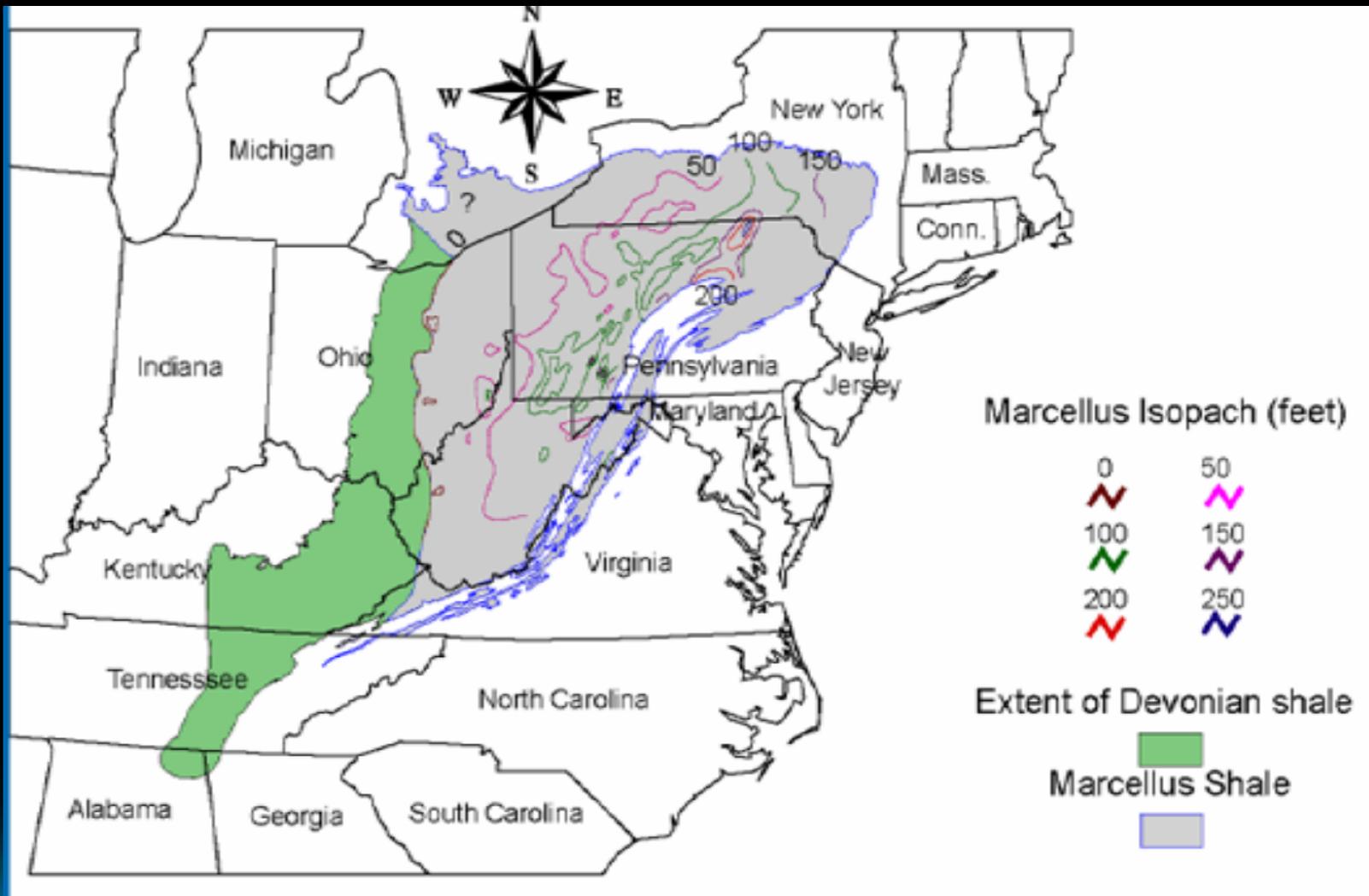
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Penn State EXTENSION

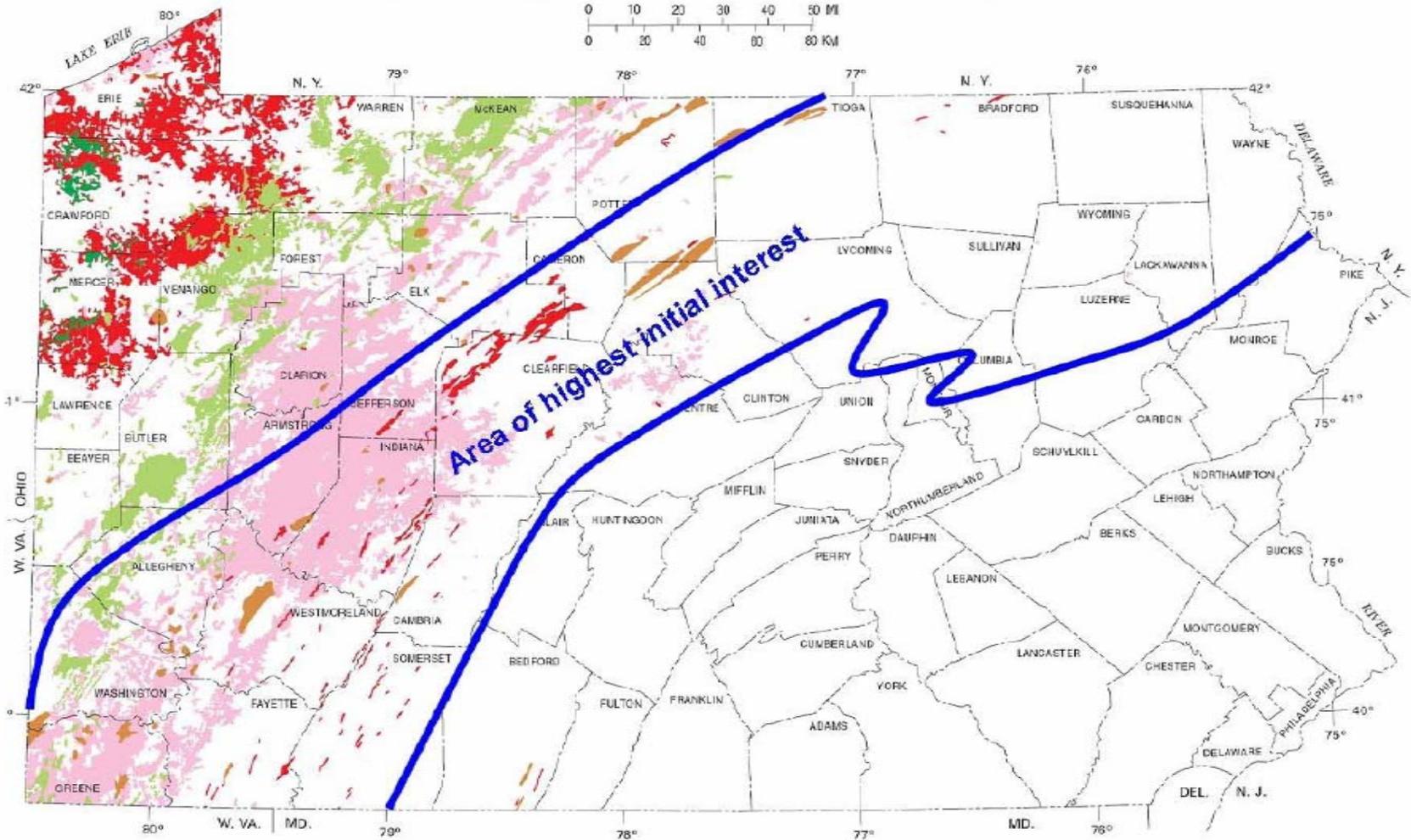
AGRICULTURE | COMMUNITY & FAMILY | ENVIRONMENT

MARCELLUS SHALE



Map of Pennsylvania Oil and Gas Fields

Showing area of highest interest for Marcellus Shale exploration



EXPLANATION

- | | | | | |
|---|---|--|---|---|
|  |  |  |  |  |
| Shallow oil field | Deep oil field | Shallow gas field | Deep gas field | Gas storage area |

Permits

To drill a gas well in Pennsylvania the operator needs...

- A drilling permit
- An Erosion and Sedimentation Control Plan

Permits

Additional permits may be needed

- Chapter 105 encroachment permit
- Stormwater management permit for projects affecting more than five acres

DRILLING THE WELL



Conductor 9 5/8"

Approx. 40'



Fresh
Ground
Water



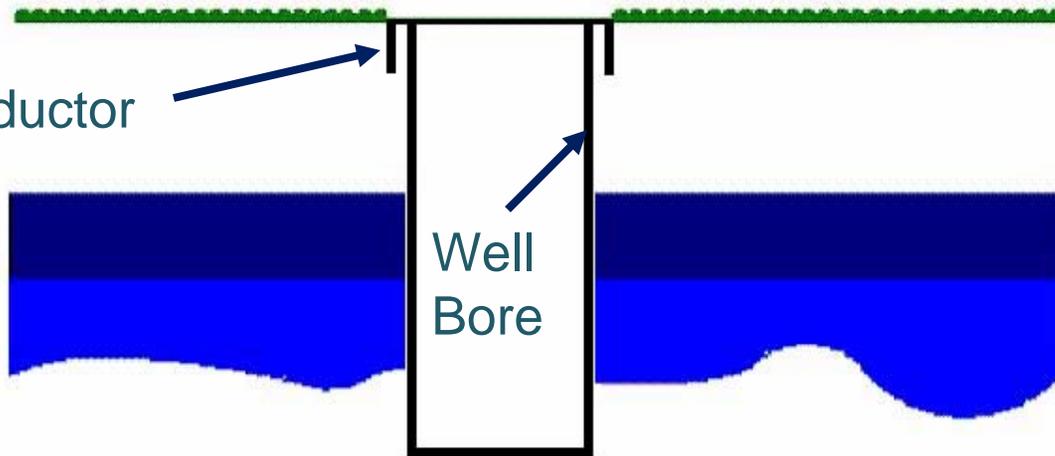
Gas/Oil



Formations



Conductor

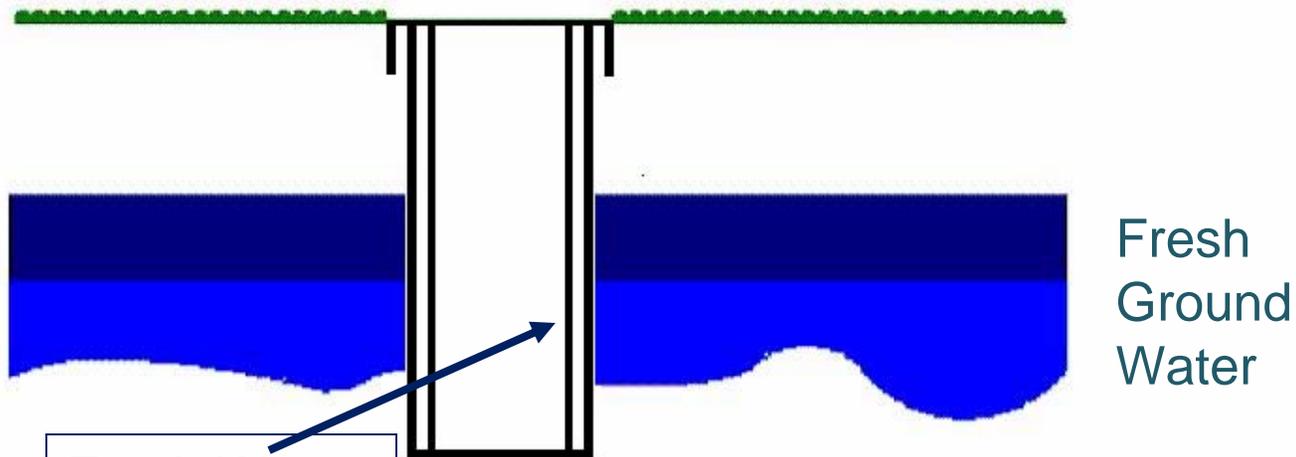


Well
Bore

Fresh
Ground
Water

Gas/Oil

Formations

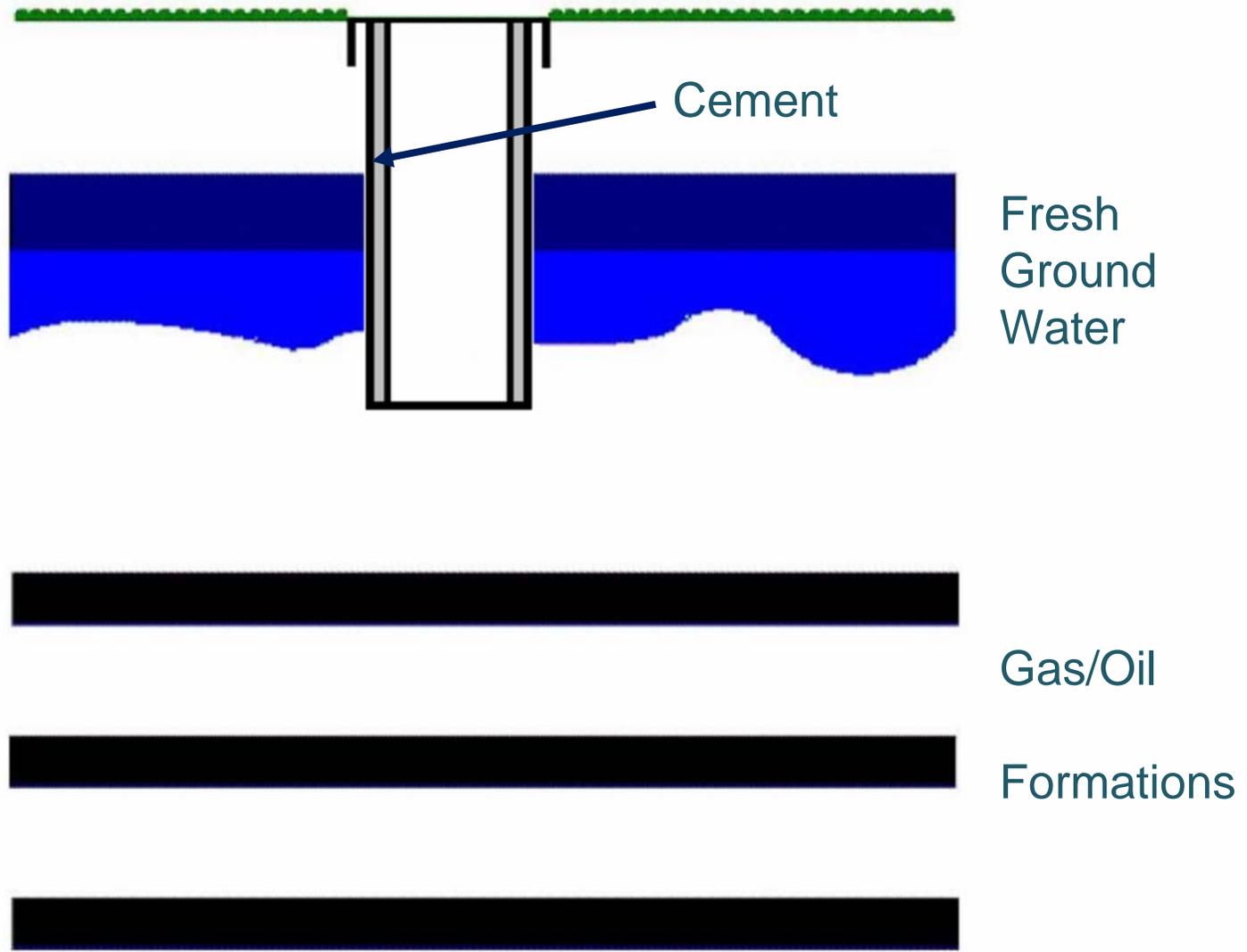


Fresh
Ground
Water

Fresh Water
Casing 7"
800'-1200'

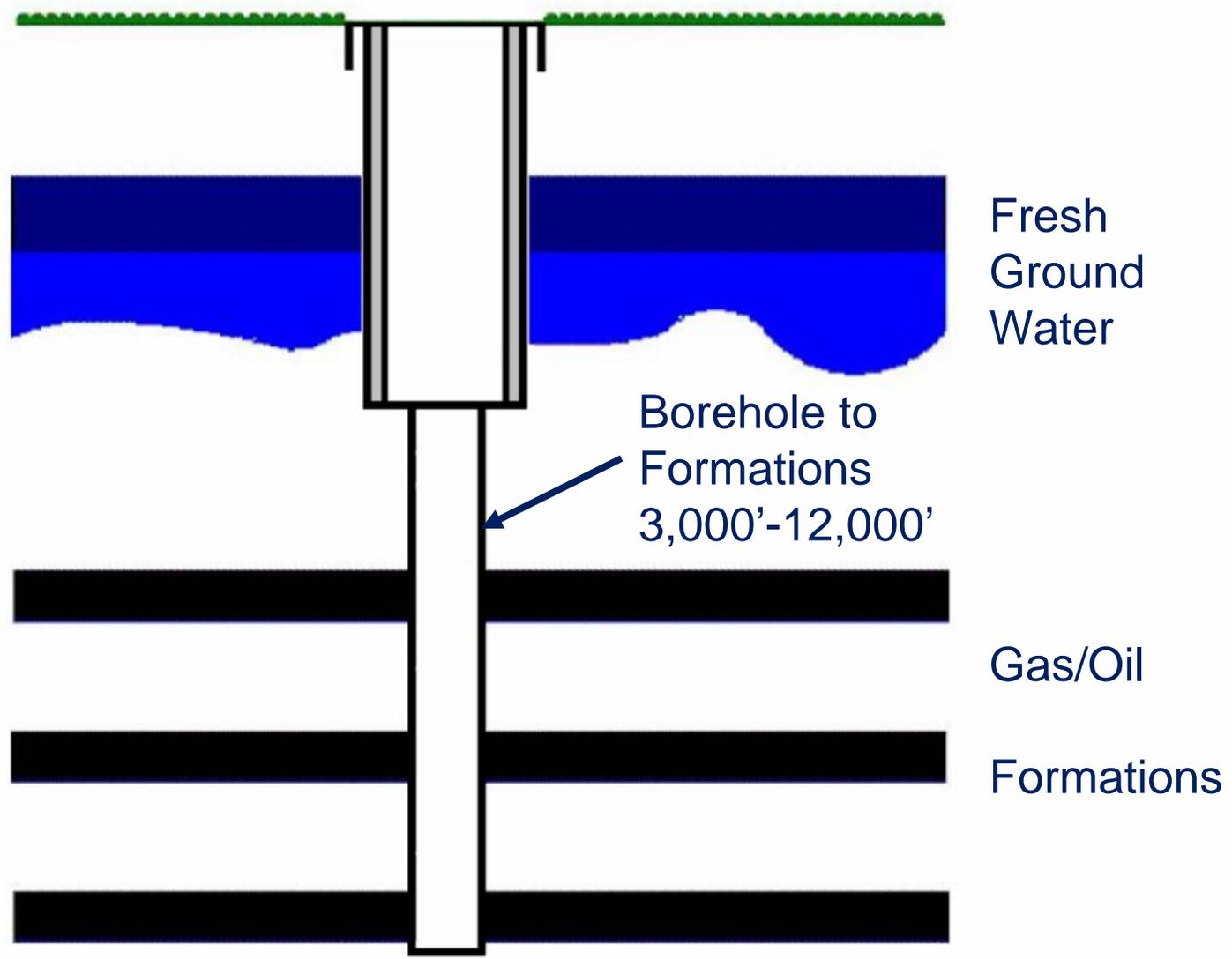
Gas/Oil

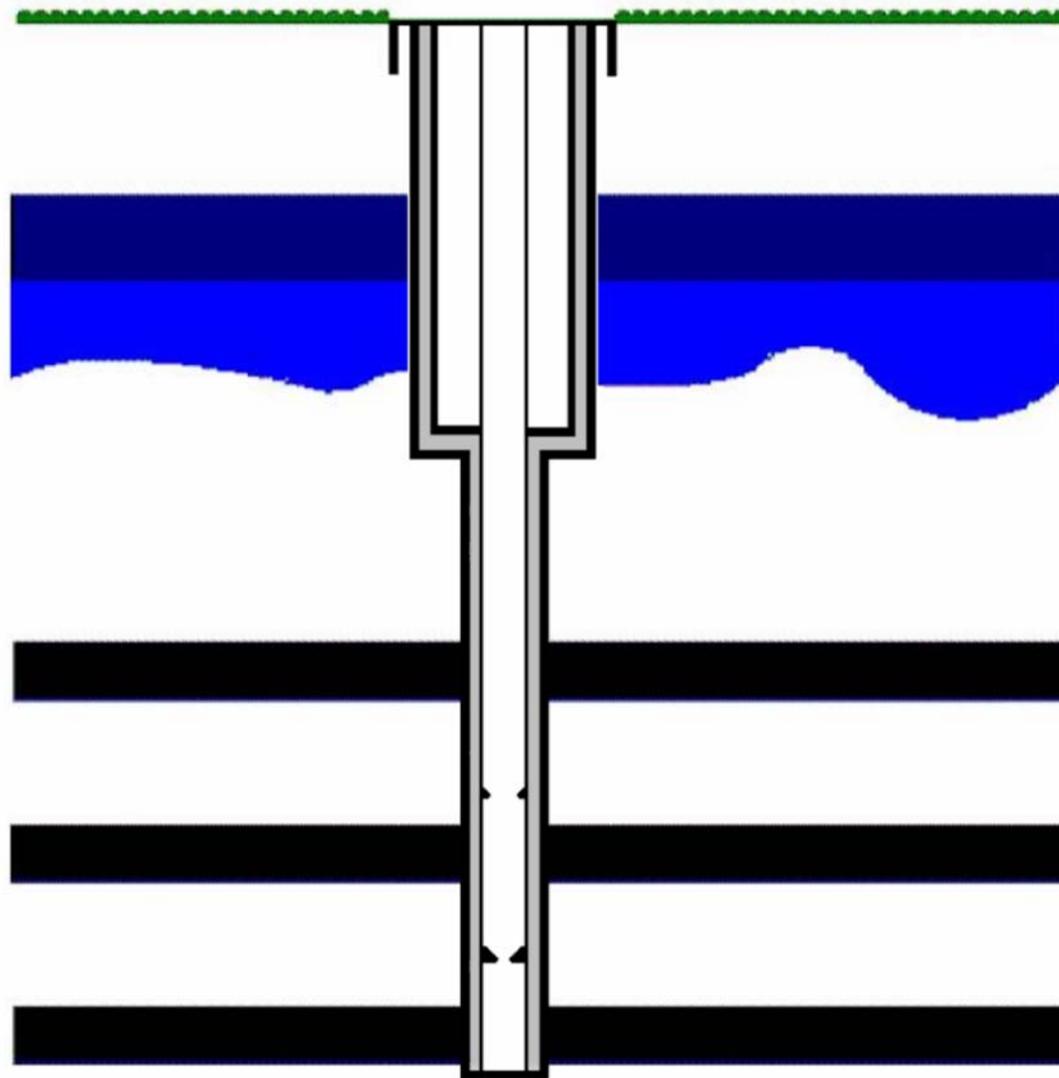
Formations



Cement Returns from the Annular Space







Fresh
Ground
Water

Gas/Oil

Formations

Fracing the Well



What is Fracing?

Hydraulic fracturing is the process in which fluid is pumped down a well and into a formation under pressure high enough to cause the formation to crack, or fracture, forming passages through which gas can flow into the well bore.

Upon completion of the frac this fluid is pumped from the formation into a lined sump and trucked to a permitted treatment facility.

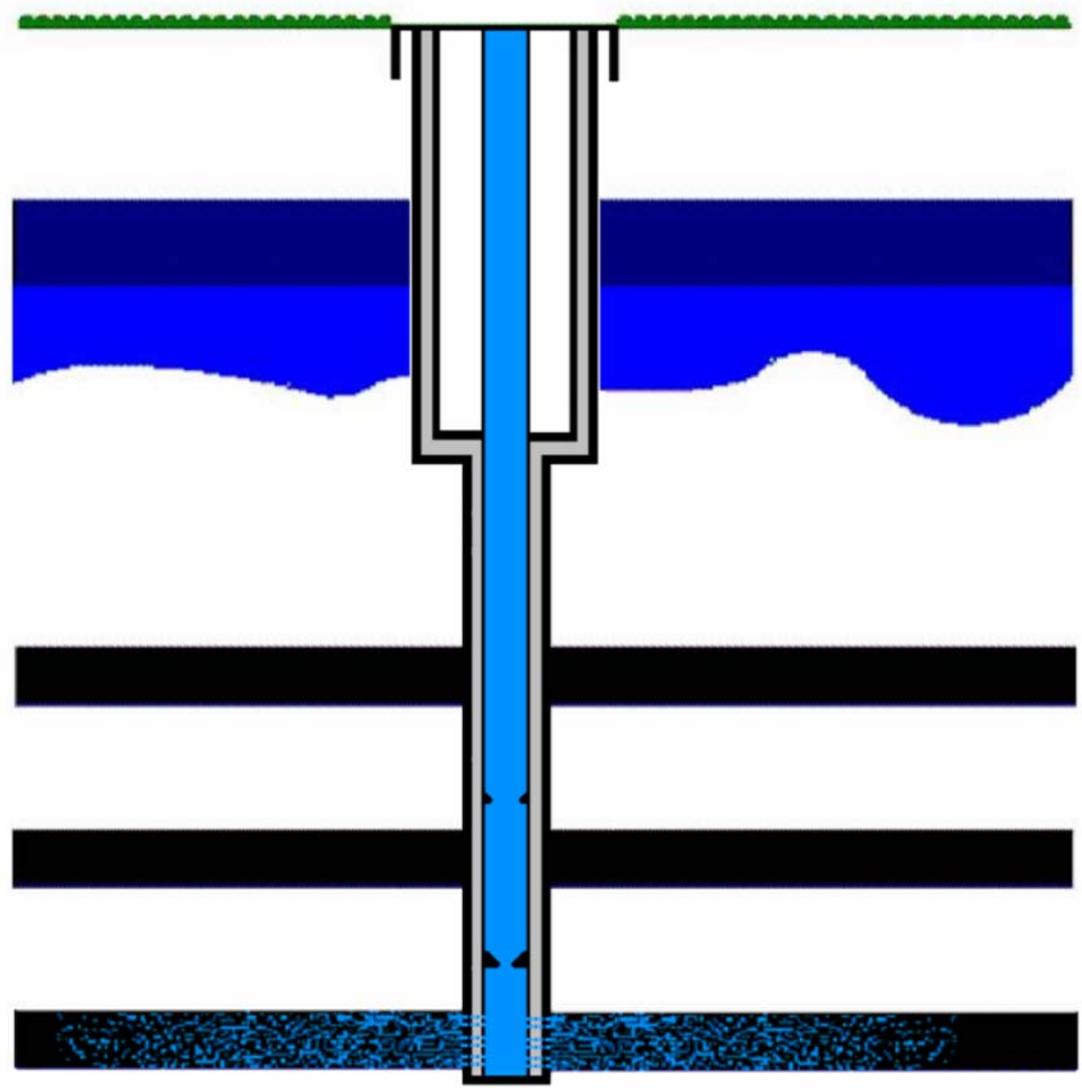
What is Fracing?

A major ingredient in hydraulic fracing fluid is water



Lots of water...

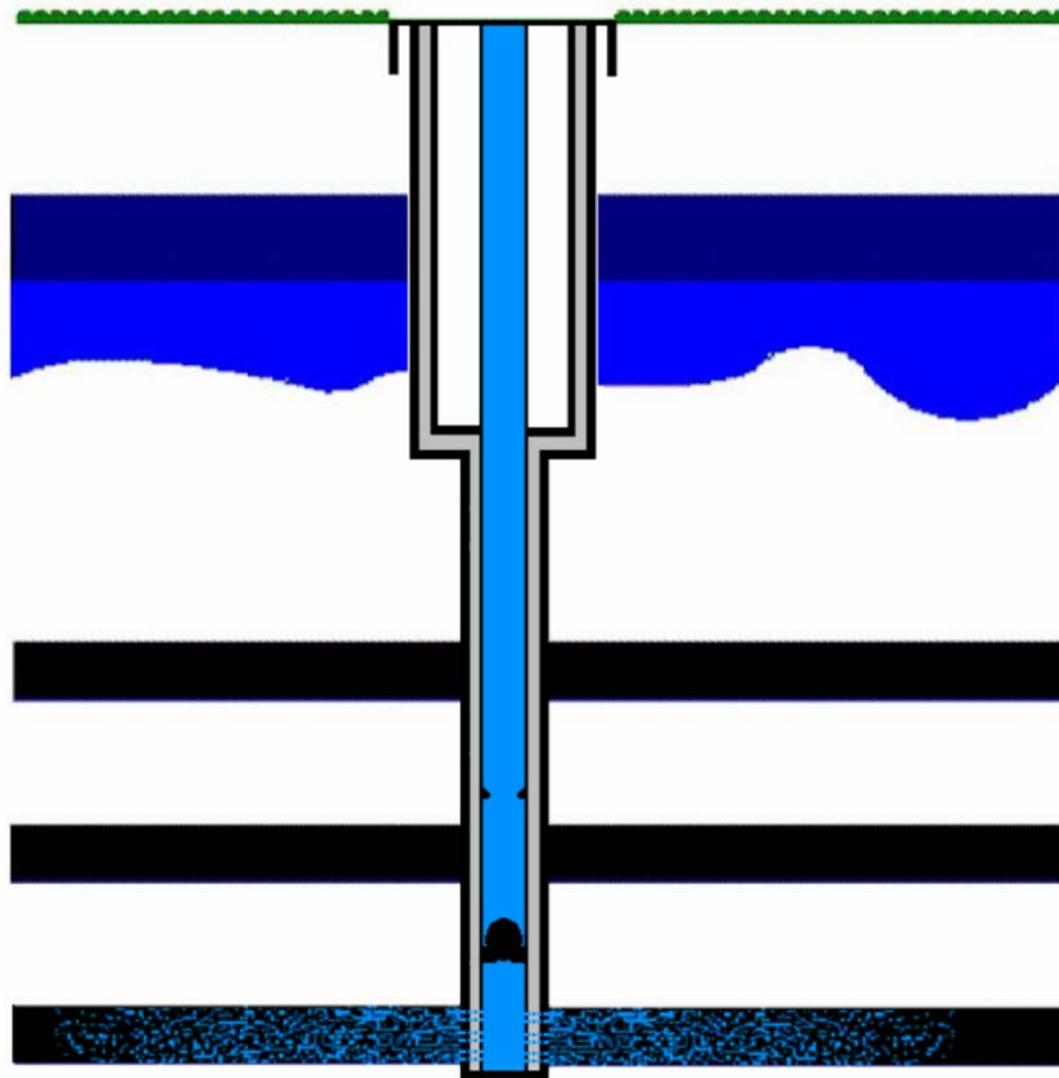
**ONE
MILLION
GALLONS OR
MORE PER WELL**



Fresh
Ground
Water

Gas/Oil

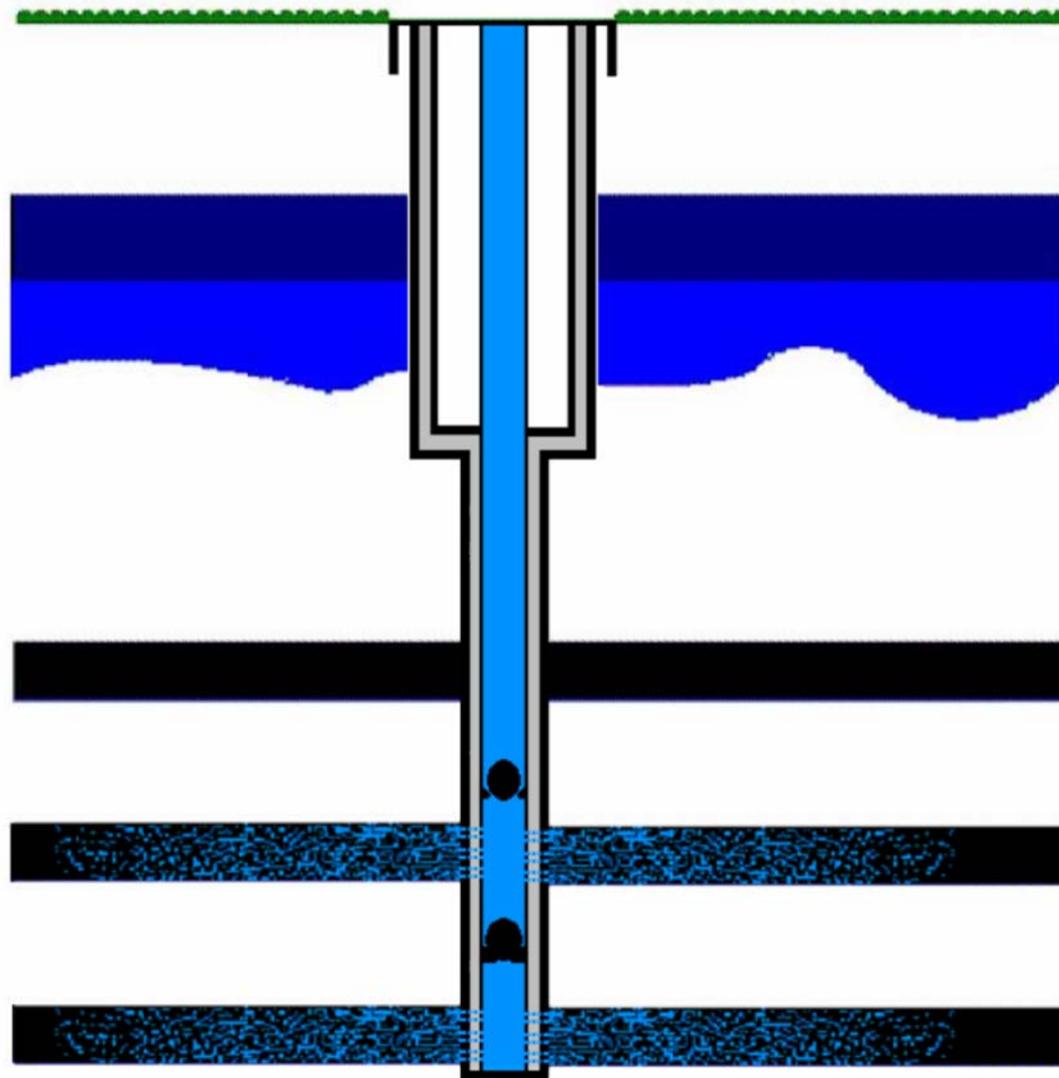
Formations



Fresh
Ground
Water

Gas/Oil

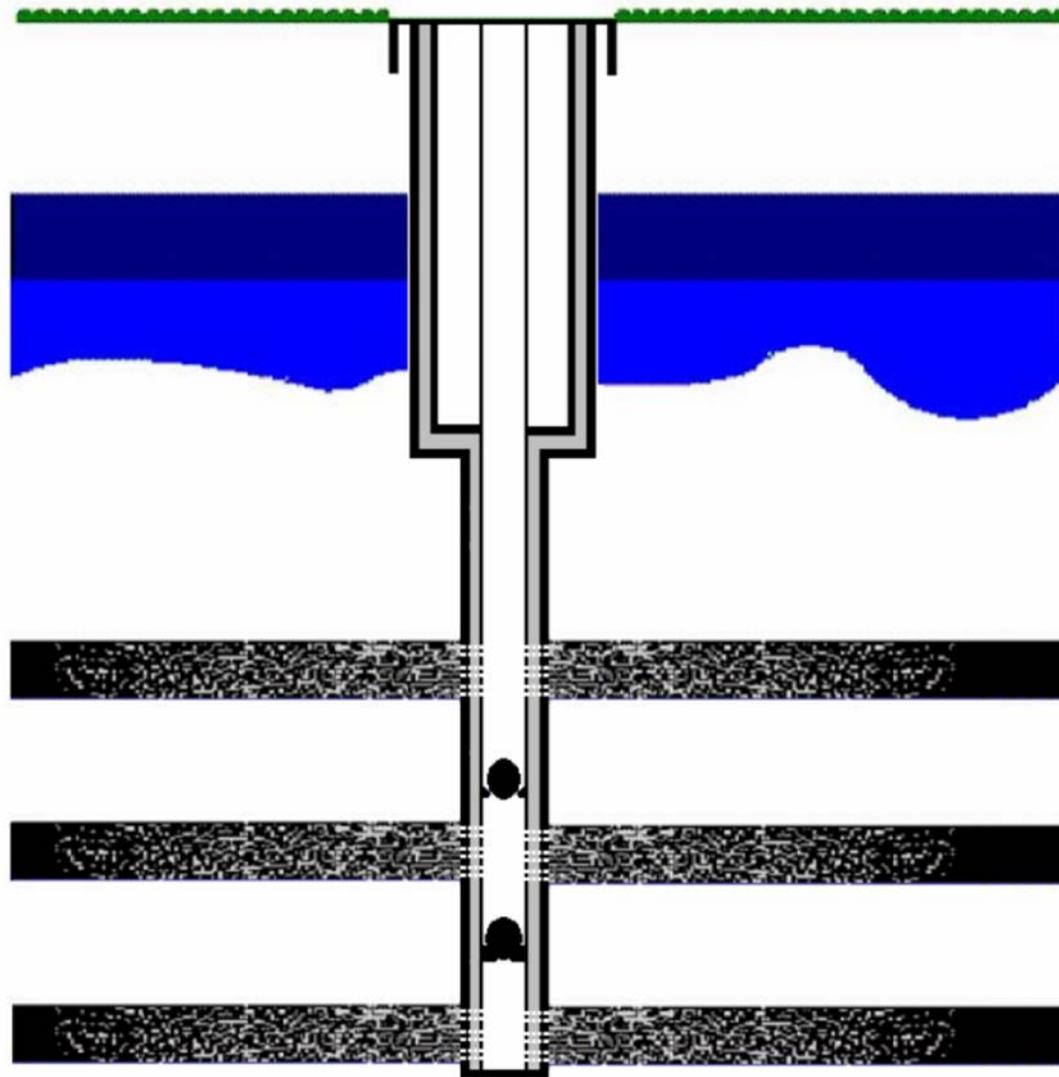
Formations



Fresh
Ground
Water

Gas/Oil

Formations



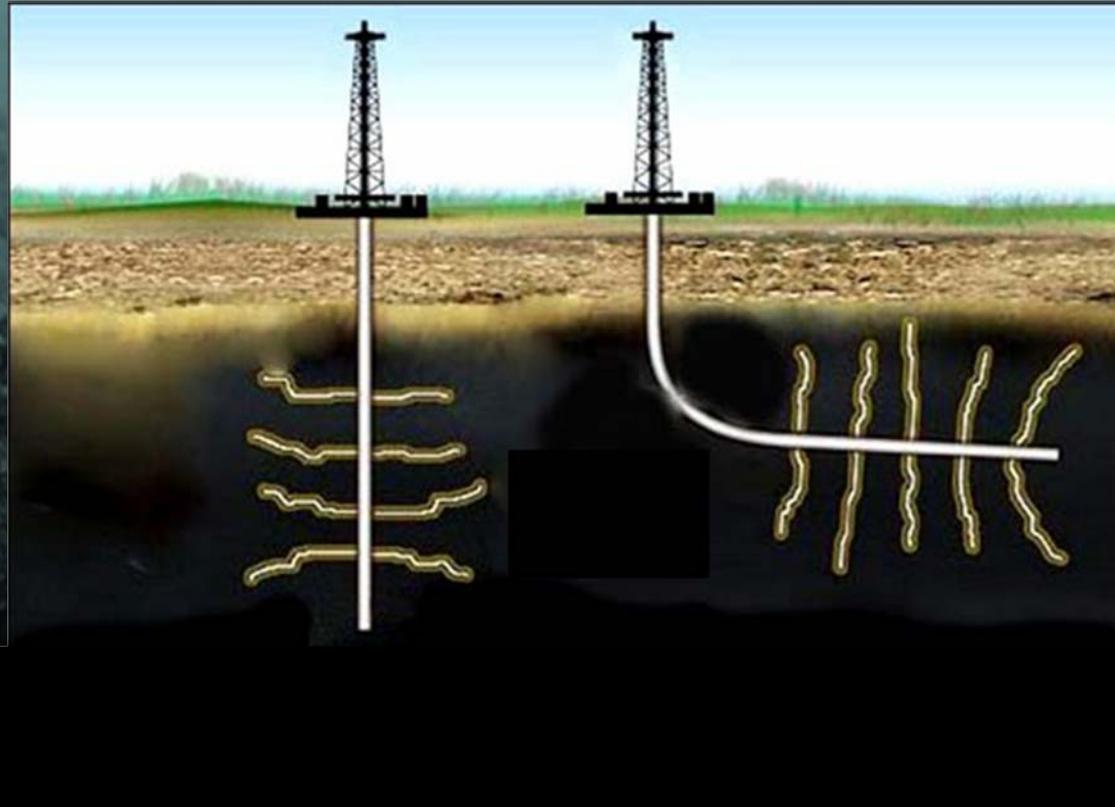
Fresh
Ground
Water

Gas/Oil

Formations

MARCELLUS SHALE PLAY

vertical and horizontal drilling



Vertical and Horizontal

- **Either type of drilling can be done**
- **One reason for horizontal is the opportunity to retrieve vast amount of gas (makes the drilling economically viable)**
- **Vertical is used for test drilling and production, but has much less gas retrieval than horizontal**
- **More vertical drills within an area needed to achieve results similar to horizontal drilling**

Vertical and Horizontal

- The general premise or selling point for exploration in Pennsylvania has been that horizontal drilling has less surface impact, and in reality, it does.
- The question remains how much of it will be done versus vertical drilling, which could lead to much more disturb surface area.

MARCELLUS SHALE PLAY

what about the water?



Two Issues on Water

1. Large amounts of water are needed for fracing

- *Where will it come from?*

2. Once the water is used in fracing it is returned to the surface

- *Returned frac fluids contain both manufactured and naturally occurring compounds that can be hazardous or contaminated*

Two issues on water

1. Where will it come from?

- Tap surface sources including rivers streams, lakes, private ponds
- Wells – existing or newly drilled
- Bought through contractual arrangements with municipalities

2. Who is in charge?

- DEP, and Susquehanna and Delaware River Basin Commissions

Two issues on water

How is water protected through regulations ?

Protection

- 200 ft from an existing building or water well without written consent of the owner.
- Drinking water - an operator is responsible for any degradation of the water quality within 1000 ft of the gas well and occurs within six months of the completion of drilling, unless the operator can prove otherwise

Two issues on water

Protection of surface water – distance restrictions

- 100 ft. from stream, spring or body of water
- 100 ft. must be maintained from any wetland greater than one acre in size.
- The DEP may grant a waiver to these distance restrictions
- Amount of water used is monitored by DEP, Susquehanna and Delaware River Basin Commissions

Two issues on water

Used frac fluid needs to be treated

All fluids used in the drilling and fracing of a gas well are collected in lined sumps or above ground tanks



Two Issues on Water

- Fracing fluid is typically hauled to a permitted treatment facility
- Other technologies being investigated to treat water including portable recycling and/or crystallization

MARCELLUS SHALE PLAY

land impacts



Land Disturbance Issues

- **There are many ways surface disturbances can occur in natural gas exploration and production**
- **Impacts are often similar in nature, but there can be differences between them**

Land Disturbance

- **Impacts could include:**

- seismic lines

- well sites

- roads

- pipelines

- upgrading facilities

**WHAT YOU SEE
IS WHAT YOU GET**

**A photo essay of
surface impacts**



24/7



Well Site Prep and Drilling



Erosion & Sediment Controls



Well Site BMPs



Brush Barrier & Sediment Trap



Road Culverts



Stream Crossing



Frac Tanks at Well Site



Well Site in Fracing Process



Pipeline Trenching



Pipeline Stream Crossing



Pipeline Right-of-Way



Well Site in Production



Fortuna Energy

Compressor Station



Fortuna Energy

Stabilized Road Surface



MARCELLUS SHALE PLAY

the balancing act for forest landowners



The Balancing Act

- **When it comes to natural gas exploration and production, the forest landowner can be faced with many issues**
- **Many landowners are conflicted with personal values on stewardship, heritage, forest management and economic viability versus monetary windfalls from natural gas coupled with its inevitable environmental impacts**

The Balancing Act

First, if you are considering leasing your ground, then build a team of players to consult

- **A forester**
- **County conservation district technician**
- **An attorney**
- **Gas company representative**

Others to consider

- **DEP, Bureau of Oil and Gas Management**
- **NRCS**
- **Your neighbors**

The Balancing Act

- **Together with group establish the goals to minimize impacts and maximize economic benefits**
- **Look for ways to multiuse or combine any clearings to reduce fragmentation**
- **Layout property to avoid disturbing productive stands or sensitive areas; think long term**

The Balancing Act

- **There could be long-term maintenance issues wellhead sites, roads, and pipelines etc.**
- **Do not assume anything; get everything in writing for example:**
 - set timber prices, gates for pipelines and roads, location of pipelines and well sites, and reclamation in the lease agreement, details, details, details**
- **When you feel you have everything covered then work with your attorney to add addendums to the company contract**

The Balancing Act

- **Finally, remember it is your ground, and it has value, and everything is negotiable**
- **When negotiating, do so in good faith and keep in mind your the goals and objectives for your forestland**

MARCELLUS SHALE PLAY

comments on the moment



December 9, 2008

- **What a difference a few months make. This summer land prices for gas leases were at historical highs. The gas industry was flush with money. The boom, the big gas rush was on. Now, the heady days of summer seem a distance memory. The industry went into the economic abyss with the rest of the country. Some companies' futures are in question. Others are fine and playing it conservatively.**
- **It will come back steadily and surely. For now we can take a breath and plan before the next big move arrives.**

Further Sources and Readings:

www.naturalgas.psu.edu

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http://www.beg.utexas.edu/energyecon/thinkcorner/Forest_Fragmentation_Alberta.pdf

Pennsylvania Forests Magazine, 2008, *Forest Landowners Face Unique Issues with Gas Wells*, Ken Balliet

Pennsylvania Game Commission - State Wildlife Management Agency, Wildlife Notes

<http://www.pgc.state.pa.us/pgc/cwp/view.asp?a=458&q=150440&pp=12&n=1>

**Special Thanks to
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