

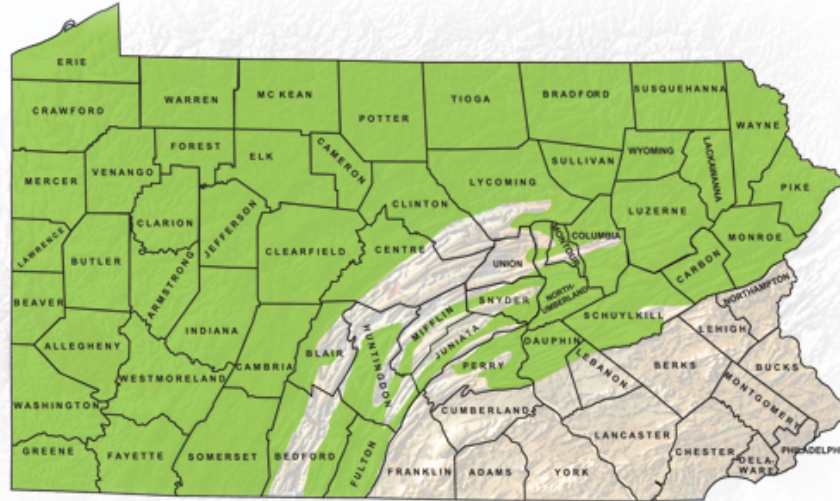
Getting the Waters Tested – The Marcellus Shale Factor Working as a Community



Water Resource



Environment



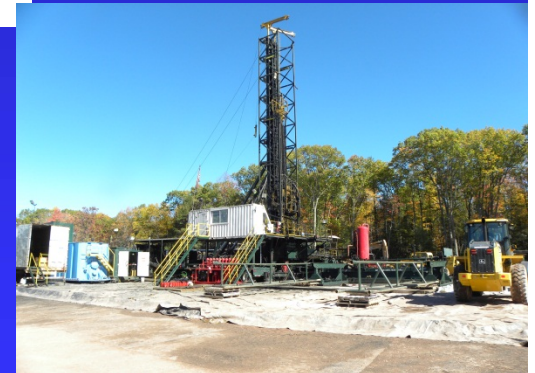
Marcellus Shale Formation



Actions for Young Adults



Old Issues



New Issues



Presented by:

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

B.F. Environmental Consultants Inc.

<http://www.bfenvironmental.com>

And

Water Research Center- Free Information
on Water Quality

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



Carbon County Groundwater Guardians

- The Carbon County Groundwater Guardians (CCGG) is a 501(c)(3) non-profit, volunteer, environmental education organization which provides homeowners with information on private wells, water quality and quantity, and septic systems.
- <http://carbonwaters.org/>



Pocono Northeast RC&D Council



- The Pocono Northeast Resource Conservation & Development Council is a community resource providing expertise in resource management and development throughout a ten county area of Northeastern Pennsylvania.
- <http://www.pnercd.org>





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
- Water Treatment Process/ Product Development
- <http://www.bfenvironmental.com>

B.F. Environmental Consultants Inc.

Environmental Scientists, Hydrogeologists, & Environmental Education Specialists
Located in Northeastern Pennsylvania

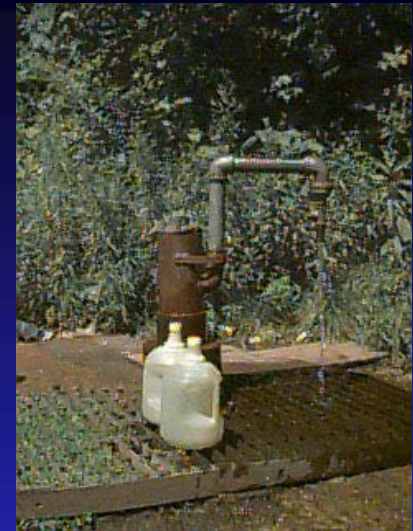
water reuse

hydrogeology

soil testing

Water-Research Center

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- 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>
- Well by Well Review for Dimock
Blog- <http://www.bfenvironmental.com/links.php>

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 May 2012.

<http://www.bfenvironmental.com>



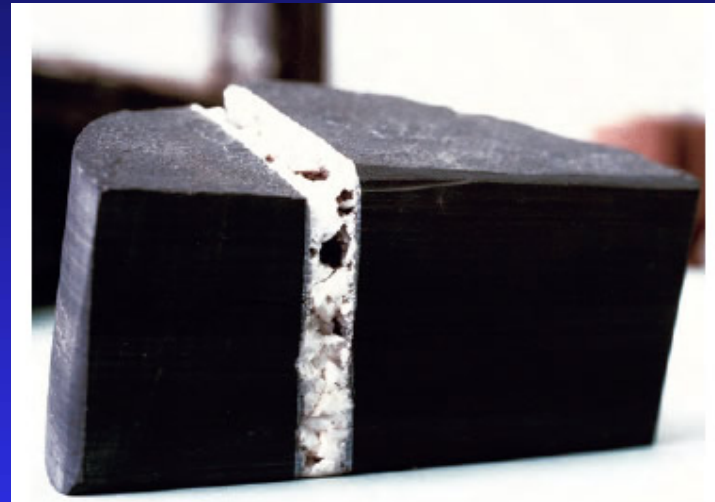
What is the Marcellus Shale Factor?

- 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**

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?

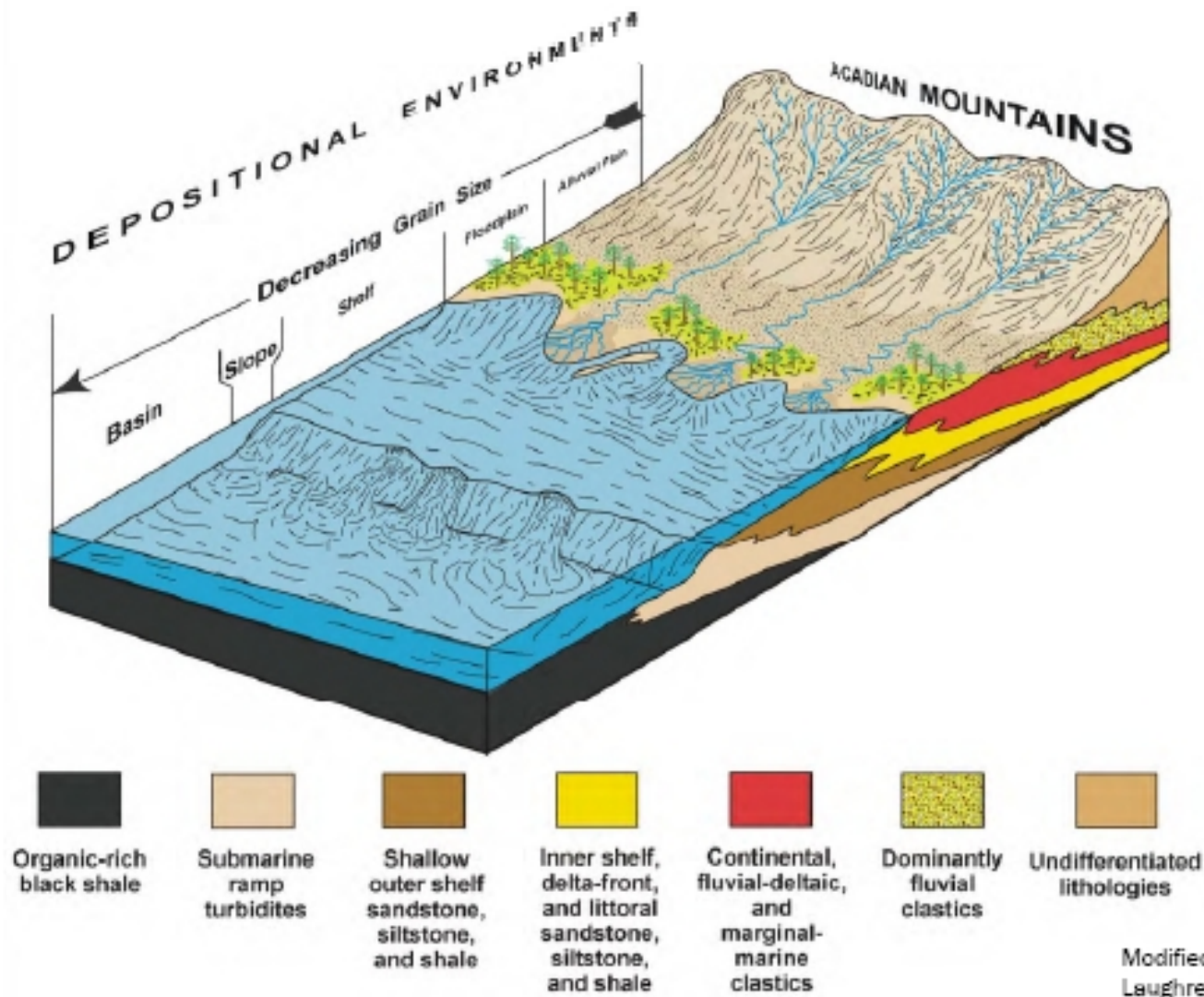
Geological Sequence – Northeast PA

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 Onondaga Formation
417 – 443 million	Silurian	(calcareous sandy shale)

OLDER
↓

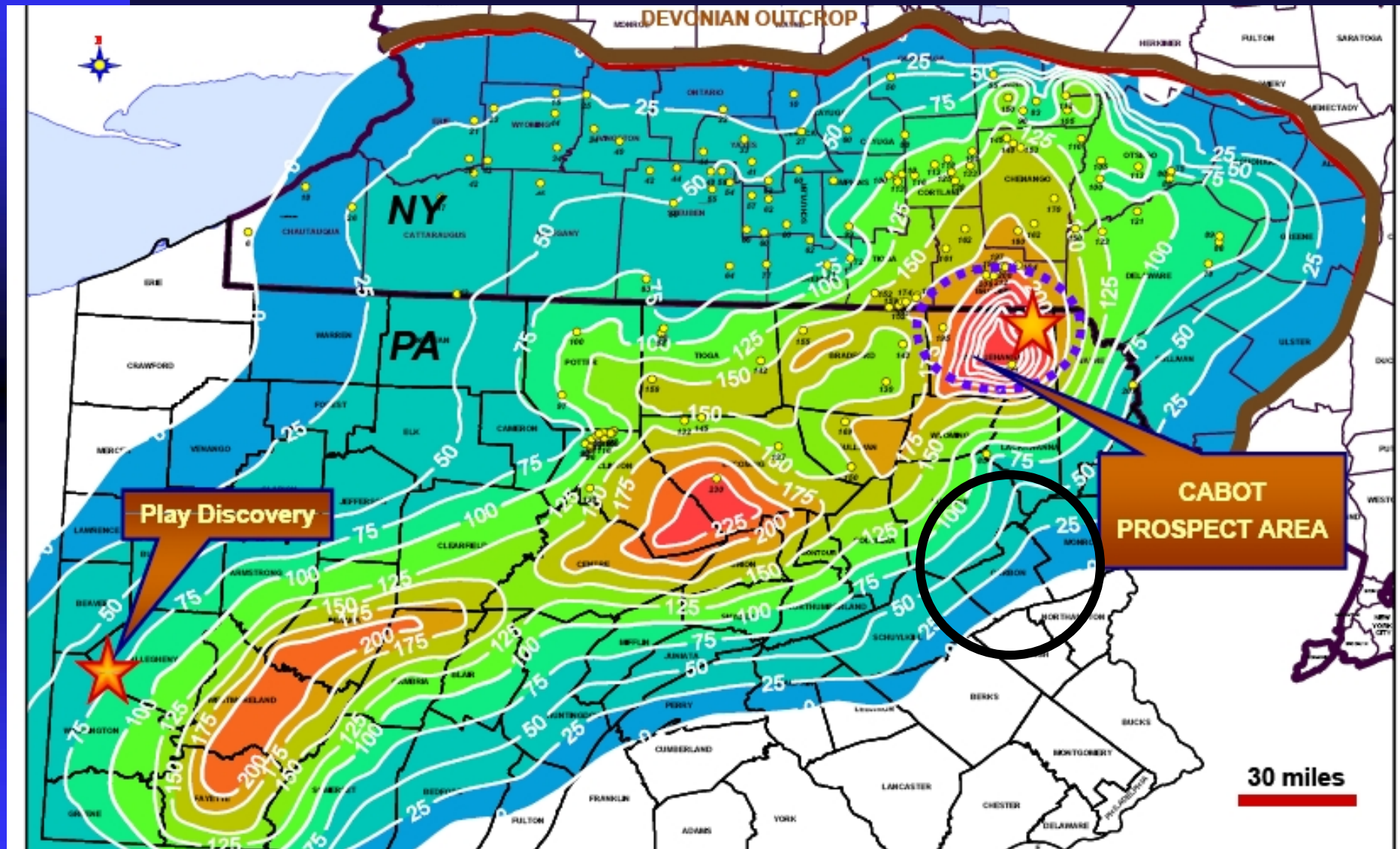
385 Million Years Ago

DEVONIAN DEPOSITIONAL ENVIRONMENTS



Modified from
Laughrey, 2009

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

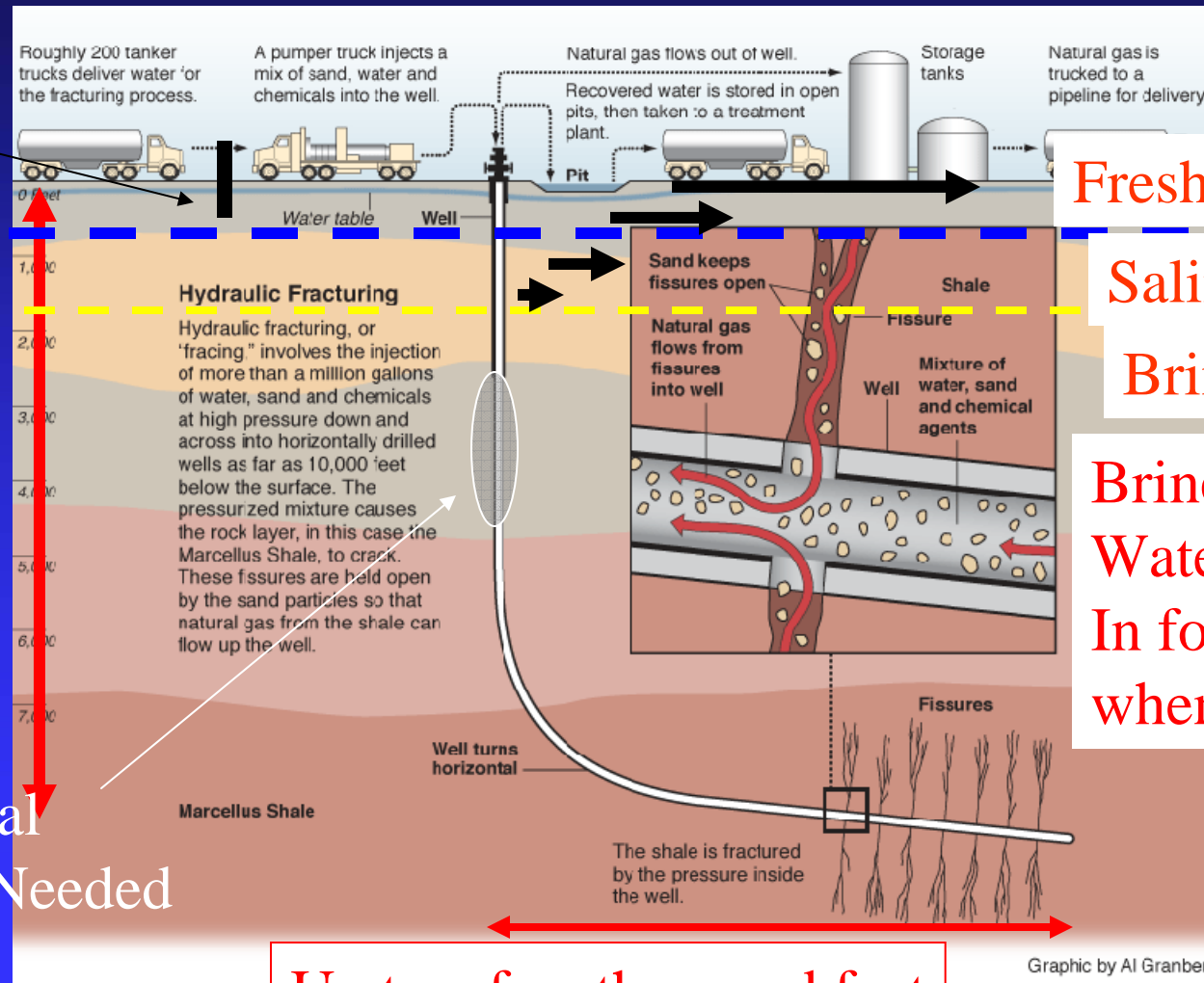
- Top hole fluids – typically the water from the freshwater aquifer. This water from the first 600 to 1200 feet.
- Bottom hole fluids – brine or connate water.
- Stimulation Fluids – fluid used to improve recovery (frac process)- includes biocides and other chemicals.
- Production Fluids – water produced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

Getting to The Natural Gas

Freshwater
Well

5000 to
7000 feet

Additional
Cement Needed



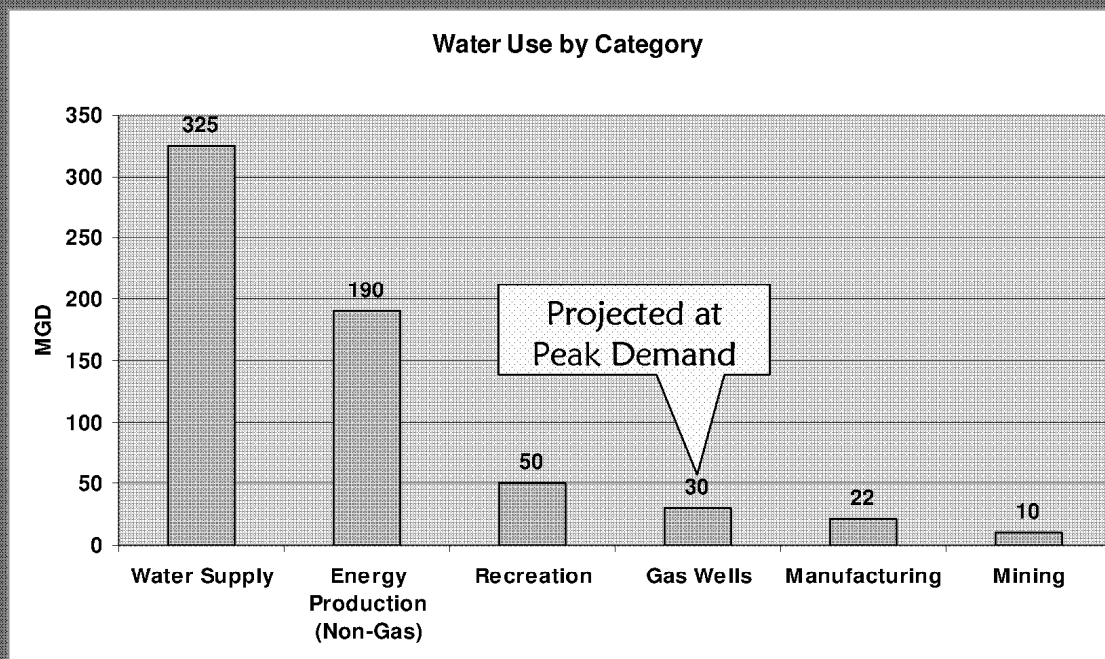
Freshwater

Saline
Brine

Brine / connate
Water- Trapped
In formation
when deposited

Up to a few thousand feet

Projected Average Daily Consumptive Use in Susquehanna River Basin



Susquehanna River Basin Commission

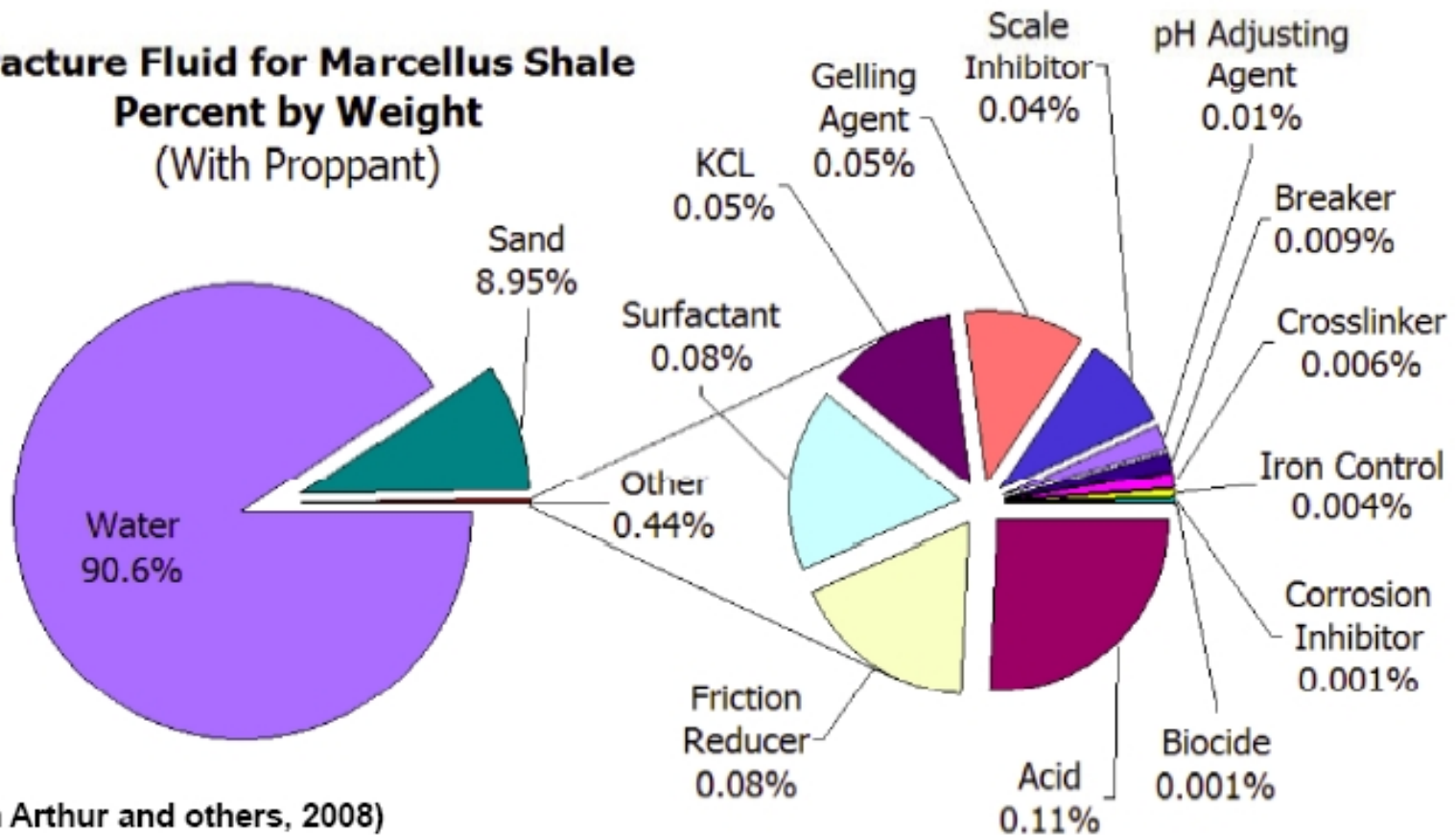
www.srbc.net

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

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



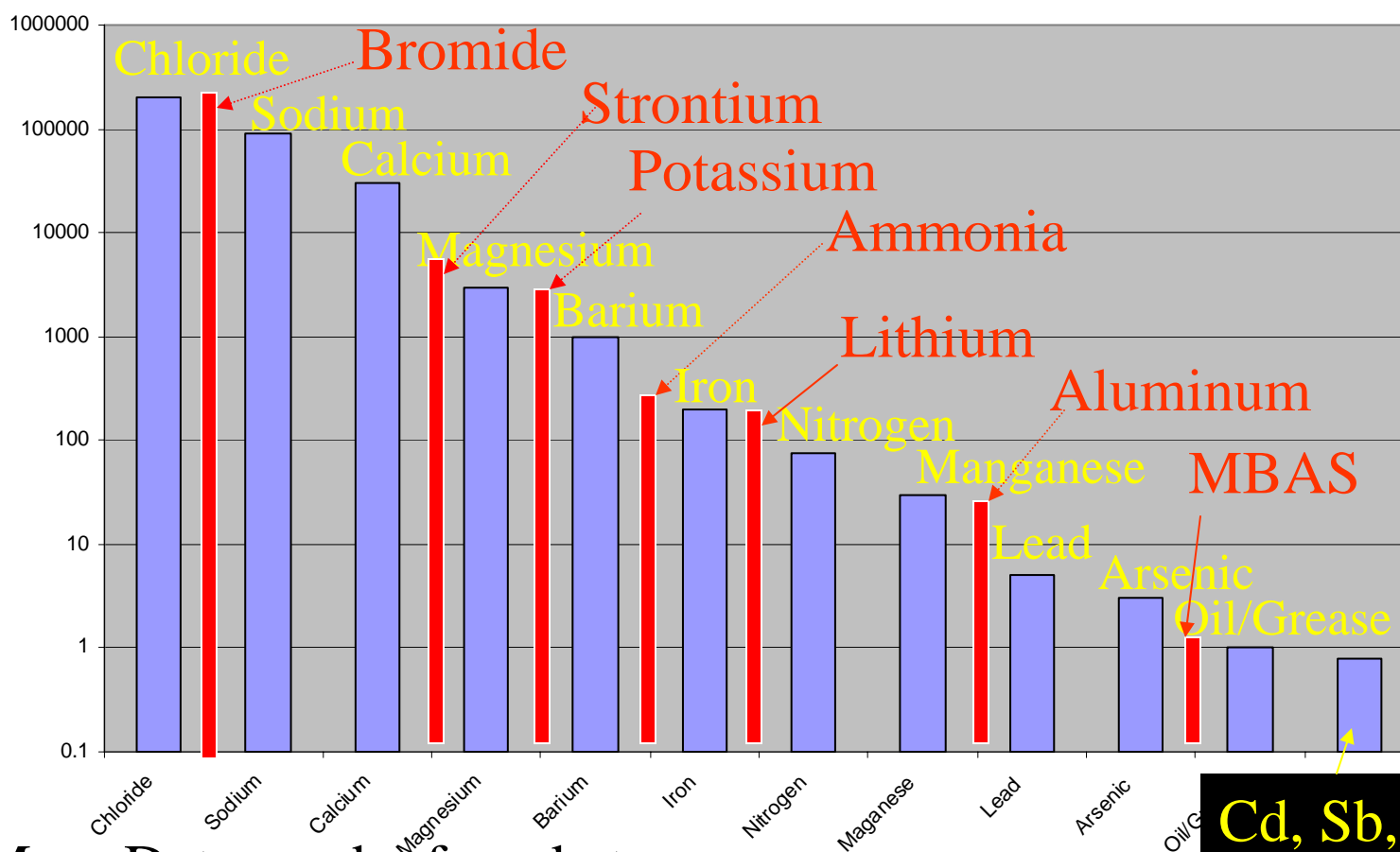
(from Arthur and others, 2008)

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

Frac Water Chemical Disclosures

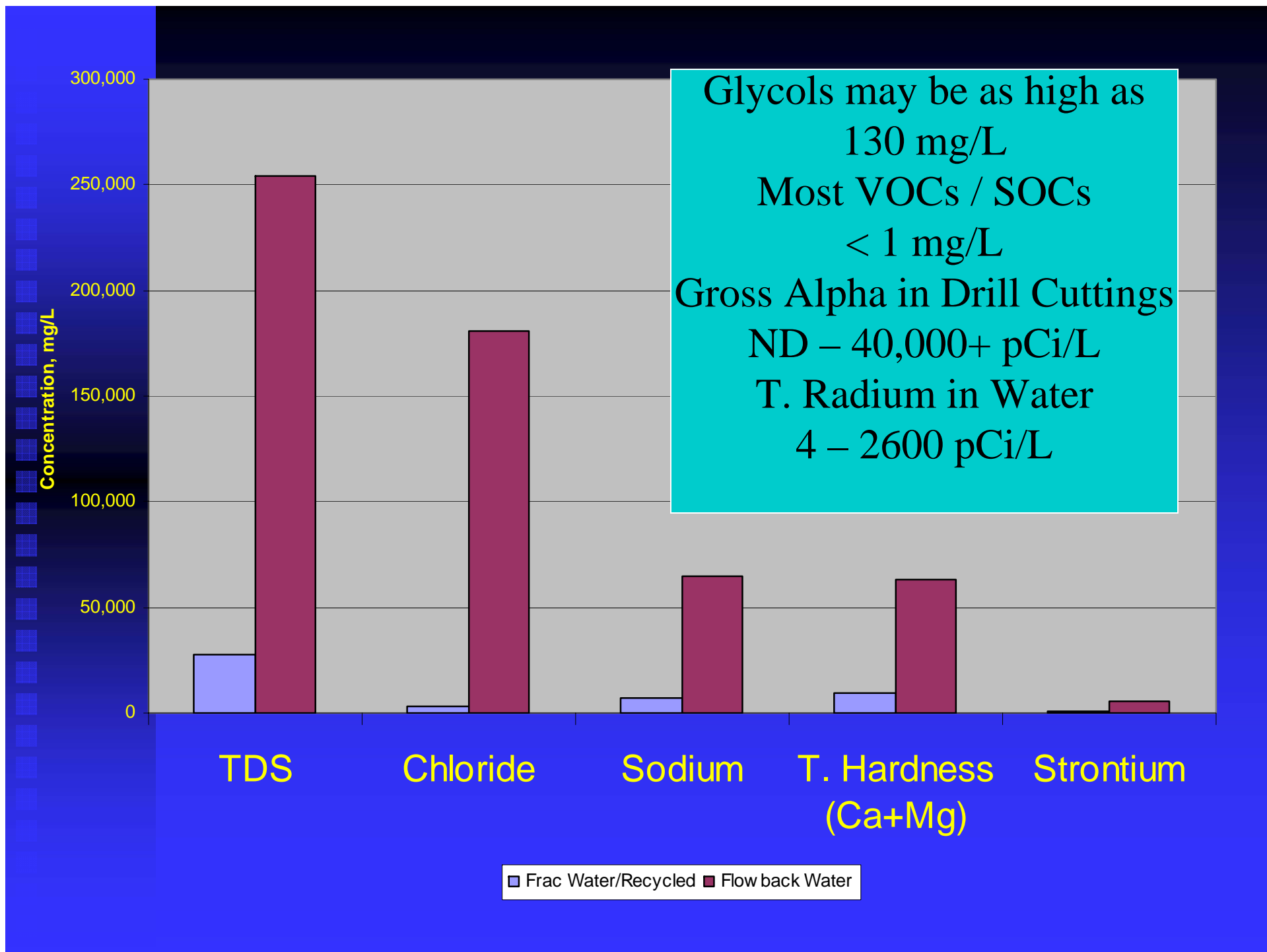
- FracFocus''- <http://fracfocus.org/>. - the hydraulic fracturing chemical registry website.
- This website is a joint project of the Ground Water Protection Council Interstate Oil and Gas Compact

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%

Corrosion



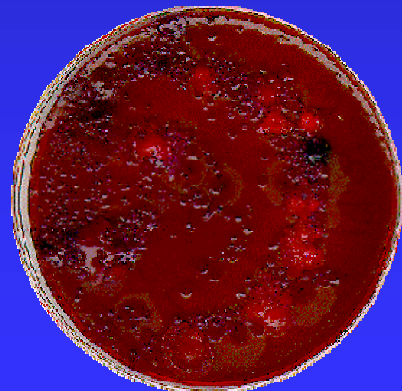
Iron / Manganese



Sediment / Gases



Bacteria

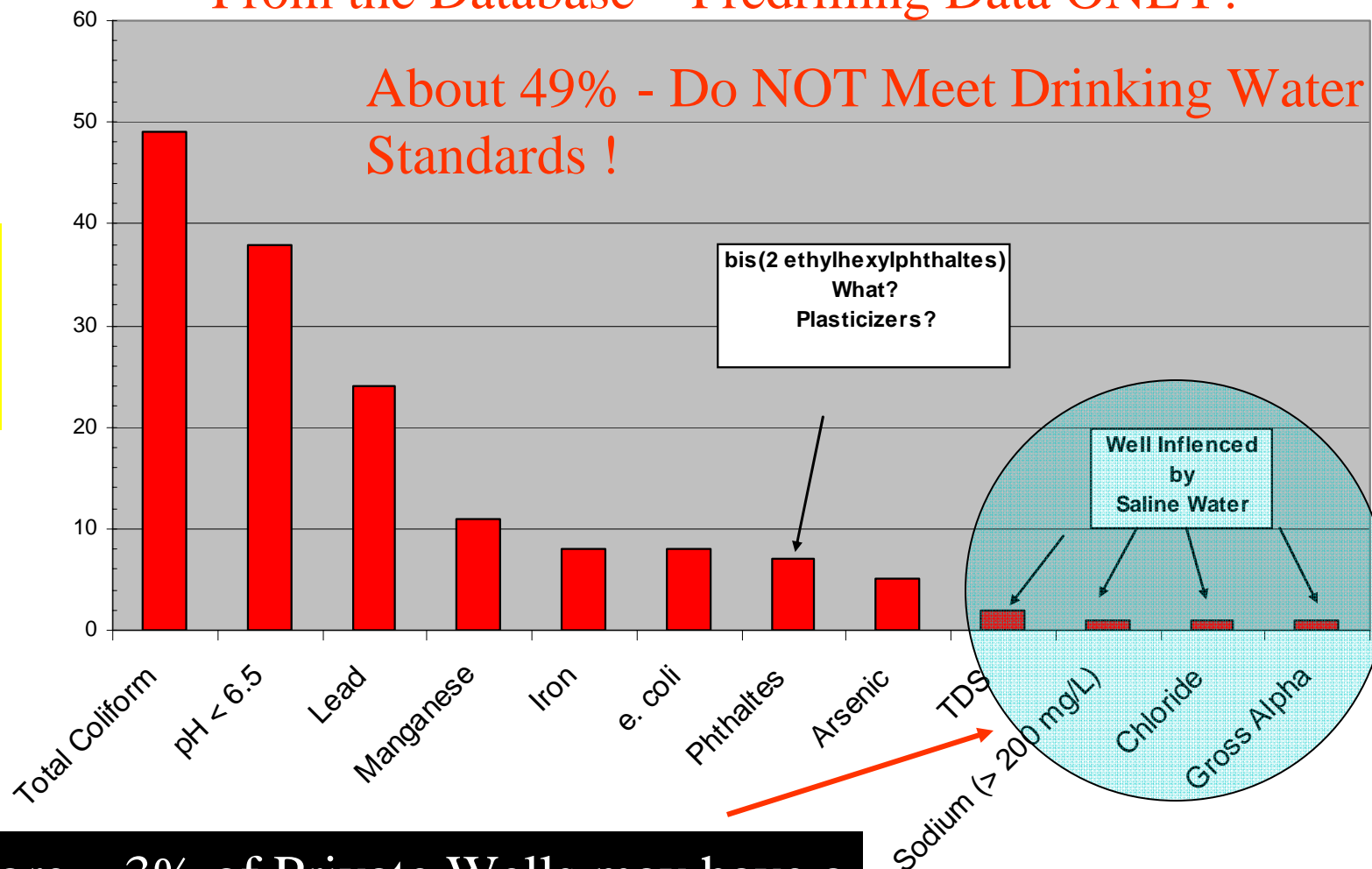


Percent Exceeded

From the Database – Predrilling Data ONLY!

About 49% - Do NOT Meet Drinking Water Standards !

Percent Exceeded



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

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.

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:



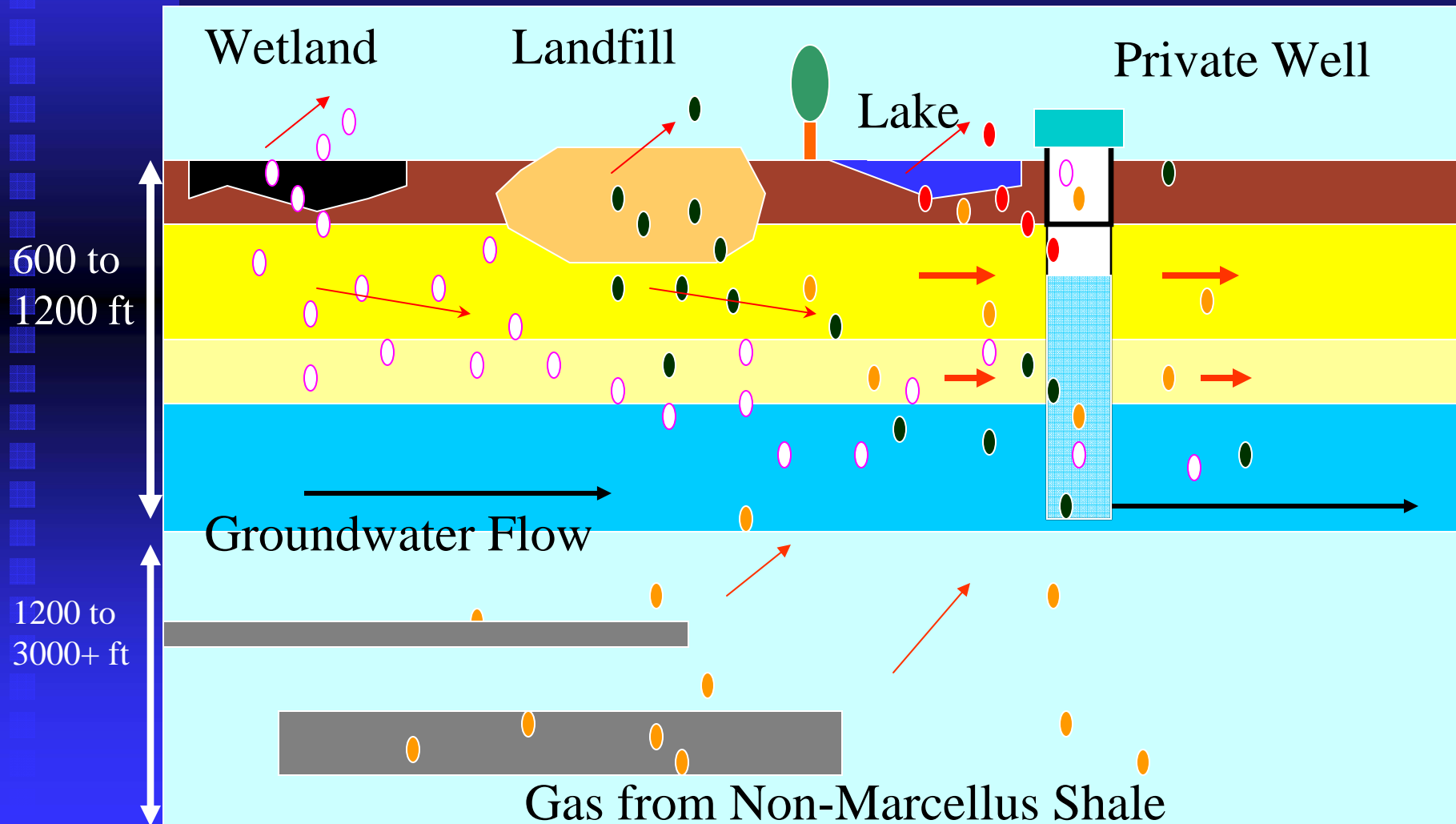
Add Ignition Source
And Oxygen



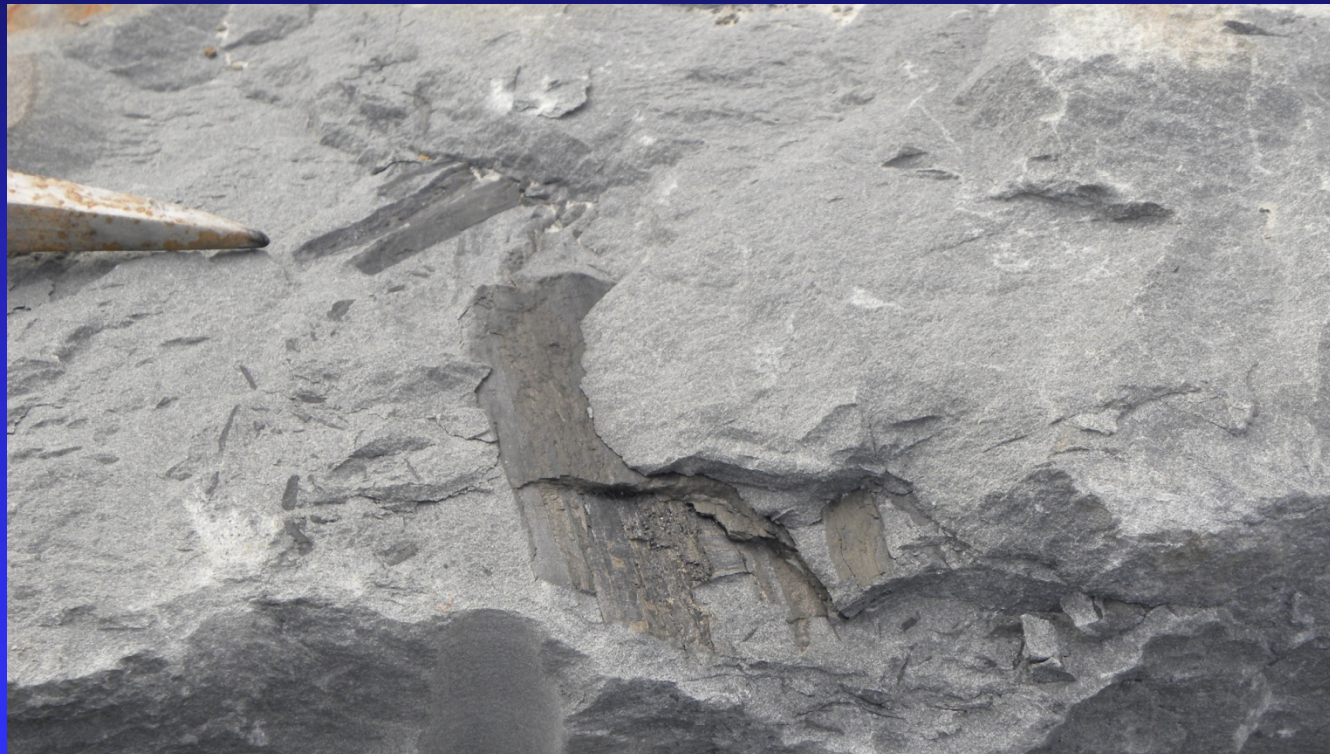
Methane in Water

- 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, isotopic analysis. Quarterly Testing for one year.
 - ◆ > 10 mg/L – Treatment , active venting with more aggressive management, isotopic 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.”

Water has a
Purple Hue !



Oram, 2011
Susquehanna County, PA

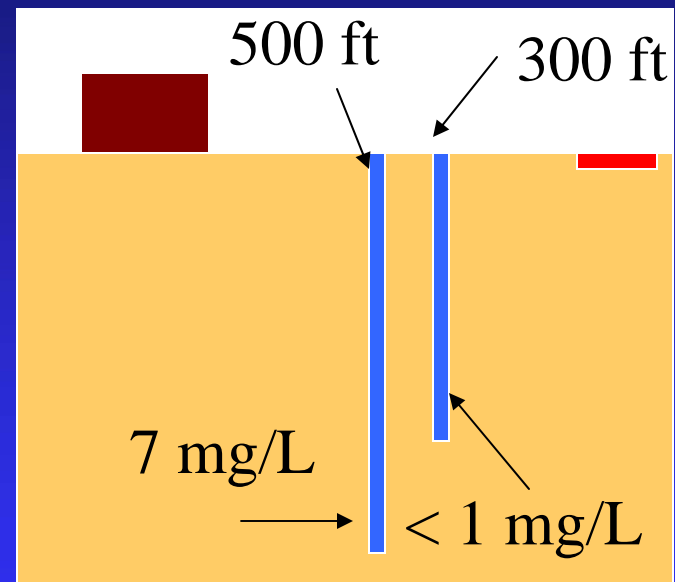
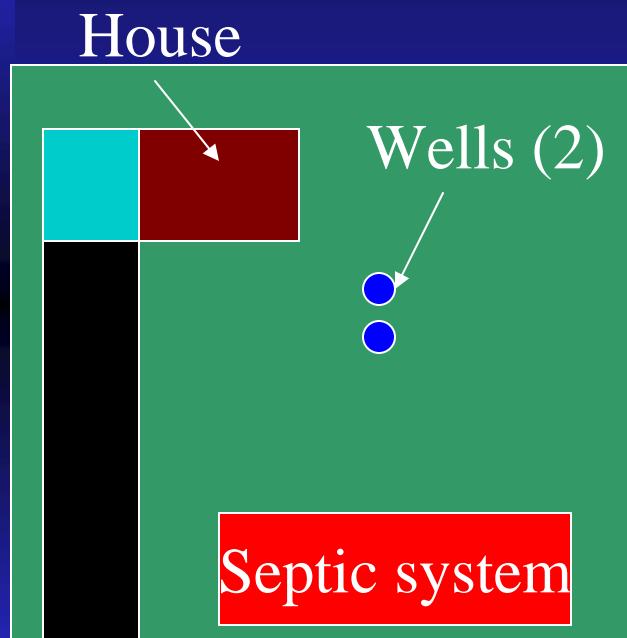
Example of Nuisance Bacteria

Iron Related Bacteria Count - > 140,000 colonies per ml

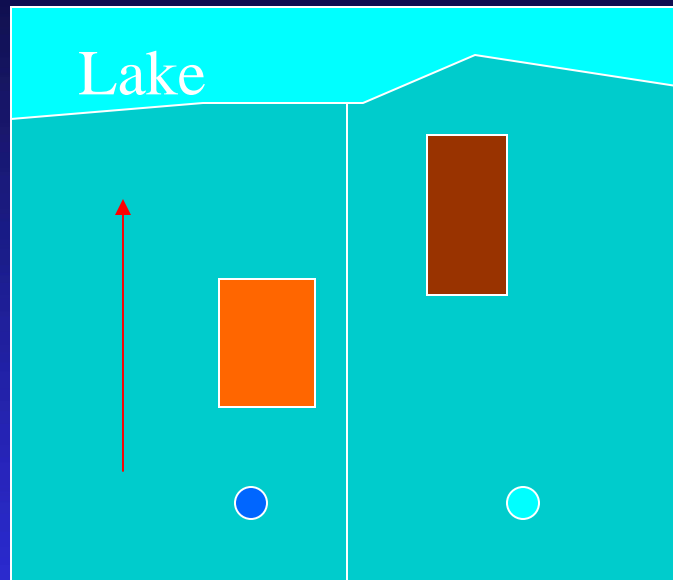
Aluminum – 0.511 mg/L, Iron 1.87 mg/L, Manganese – 5.4 mg/L,

Lead 0.029 mg/L, **Methane - < 0.001 mg/L**

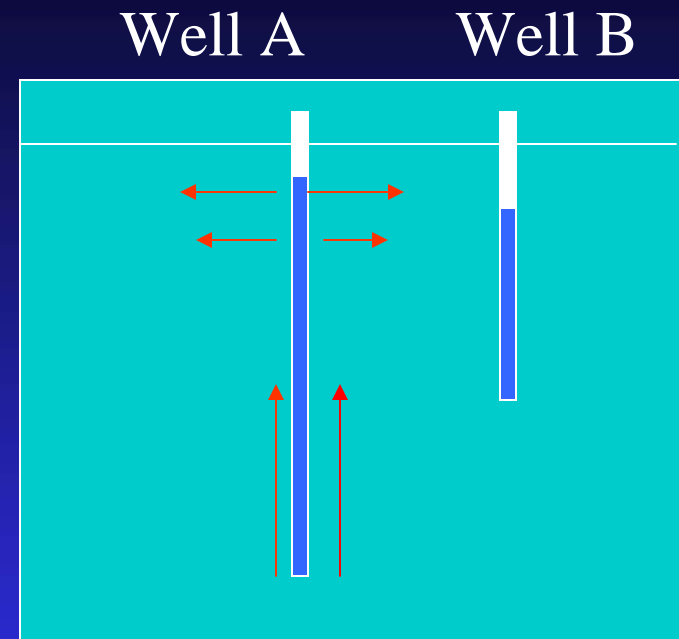
Methane Variability- Actual Examples- Depth Well Depths



Impact Where There is NO Drilling – Baseline Testing



Groundwater Flow Towards
The Lake



Direction of Groundwater
Flow - UP

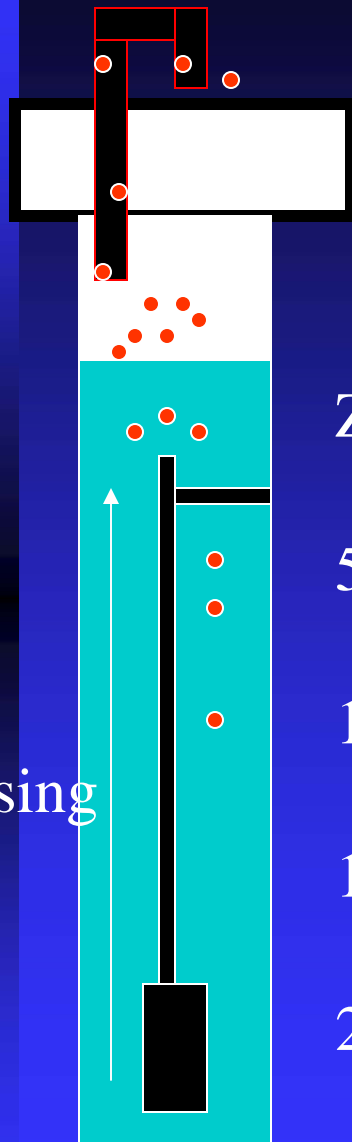
Well A- 300 feet

Methane – 10 to 15 mg/L – the real problem, Barium 4 mg/L, Radon 577 pCi/L, Chloride 250 + mg/L, Bromide 1.5 mg/L, Strontium 5.57 mg/L, Iron – 3.2 mg/L

Well B – 200 feet

Methane – 6 mg/L, Chloride 30 mg/L, Barium 1.13 mg/L, Strontium 2.15 mg/L, Radon < 60 pCi/L, Iron – 1.39 mg/L

Well A may be Impacting Well B



Methane Solubility

Zero Head	28 mg/L
50 feet Head	69 mg/L
100 feet Head	110 mg/L
150 feet Head	151 mg/L
200 feet Head	192 mg/L

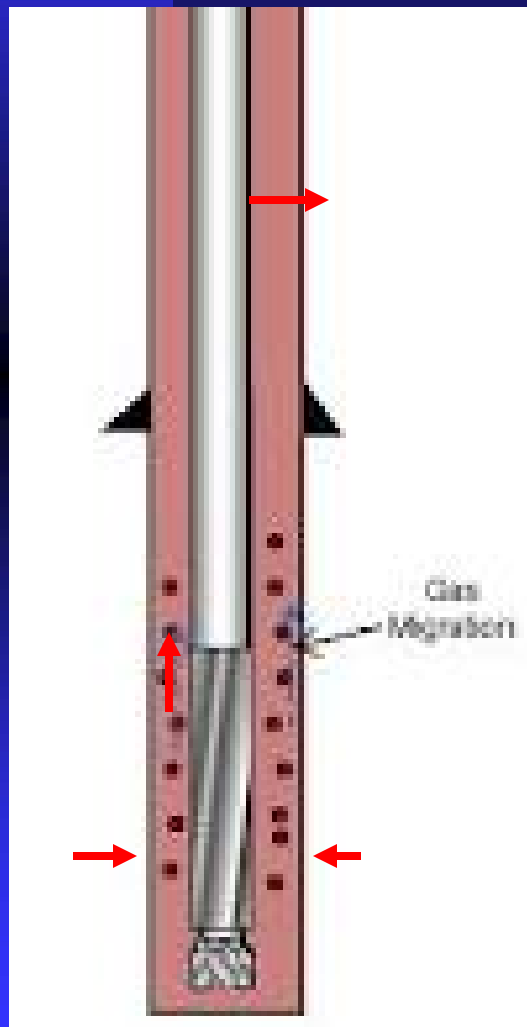
Therefore, Water Well methane levels can exceed 28 mg/L if water is not in equilibrium with the atmosphere.

Freshwater – Solubility as a function of pressure.

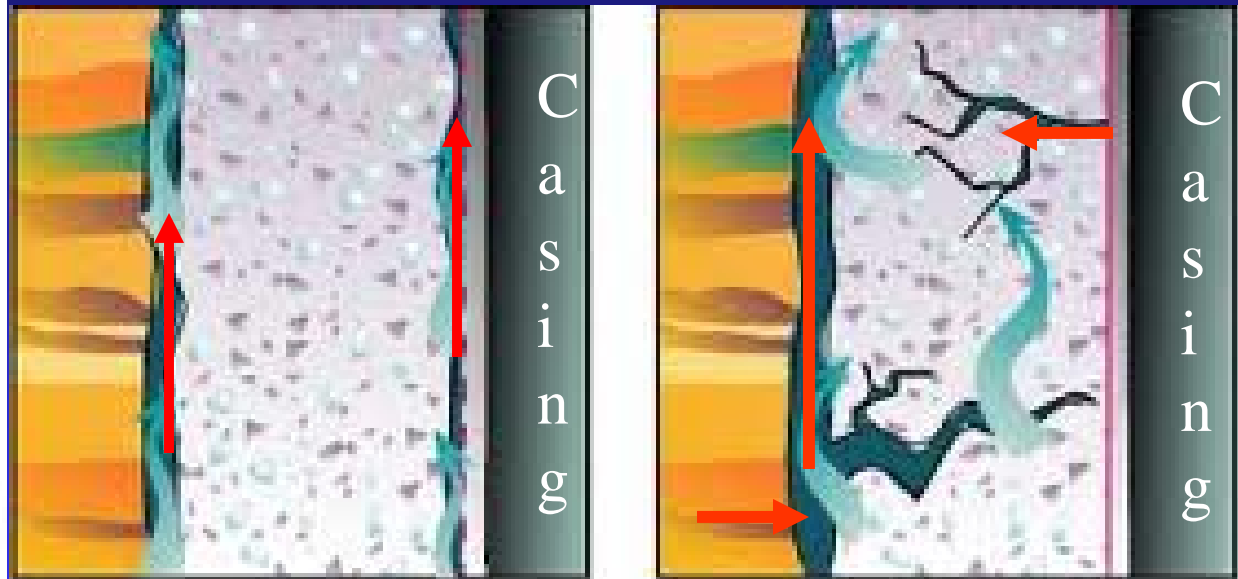
Protective Casing – Do it Right !



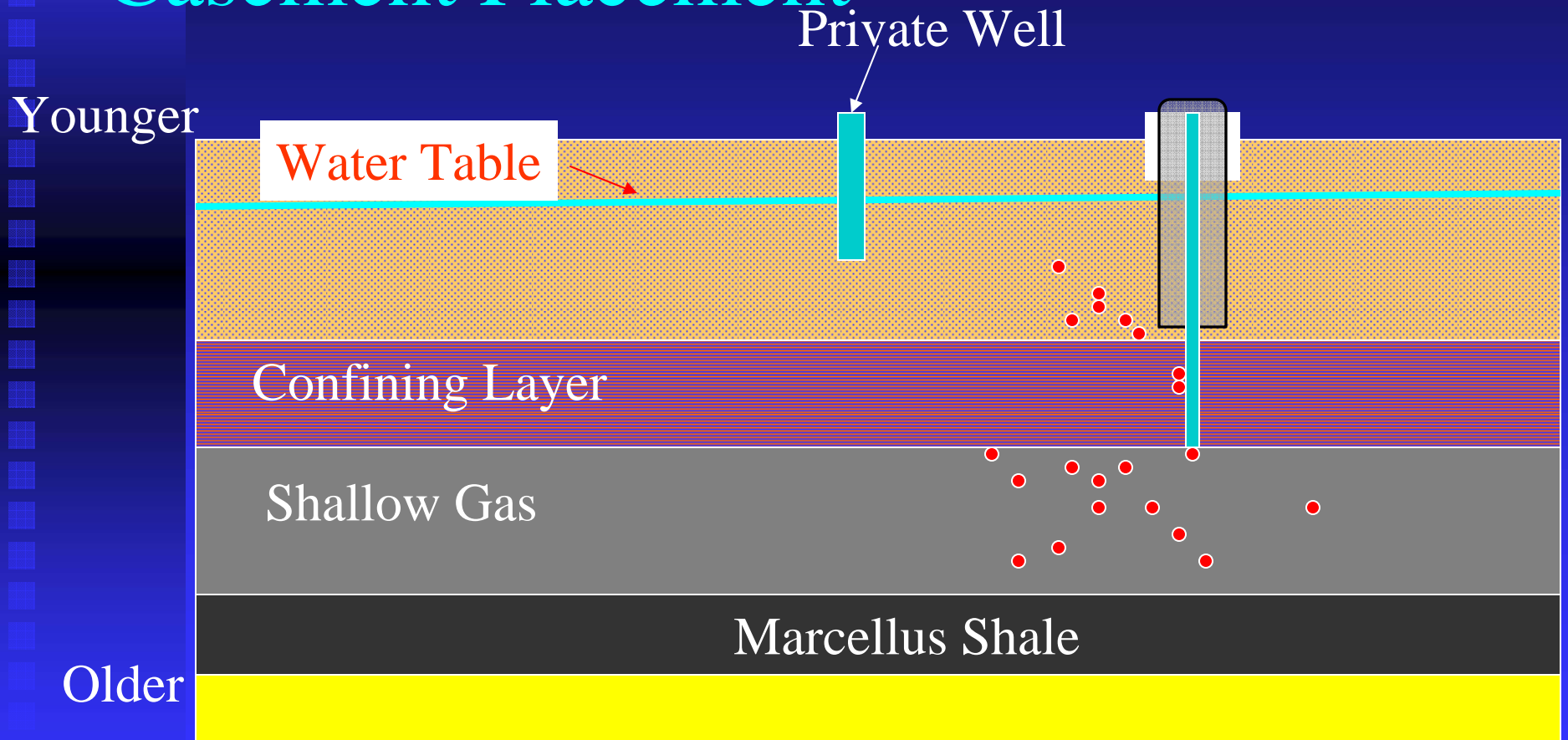
Problems with Gas Migration and Cement



Does not Bound



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



Younger



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?

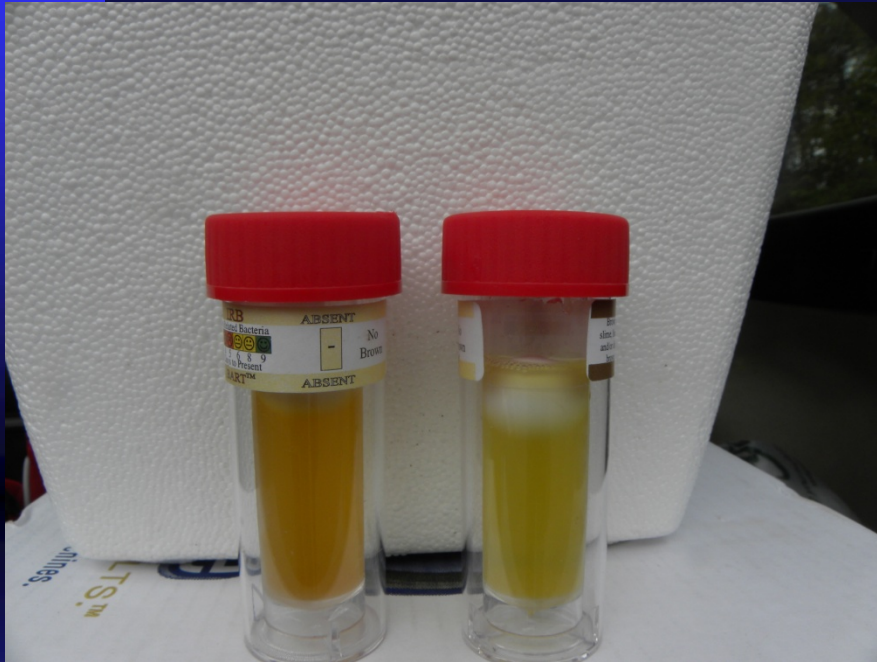
Problems with Iron, Manganese, and Sulfur – May be Bacterially Related



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.



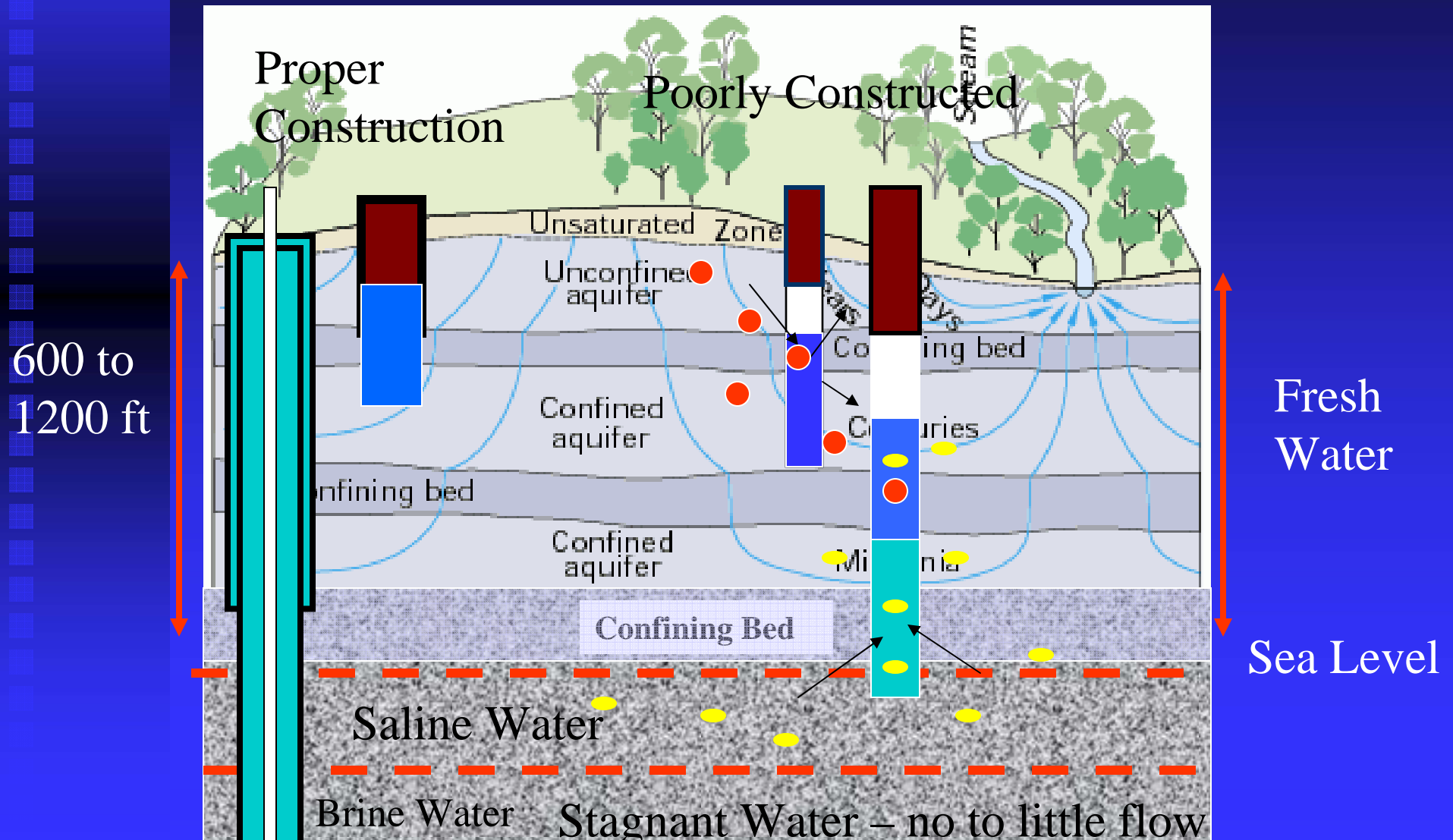


Does this Look Familiar?

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.

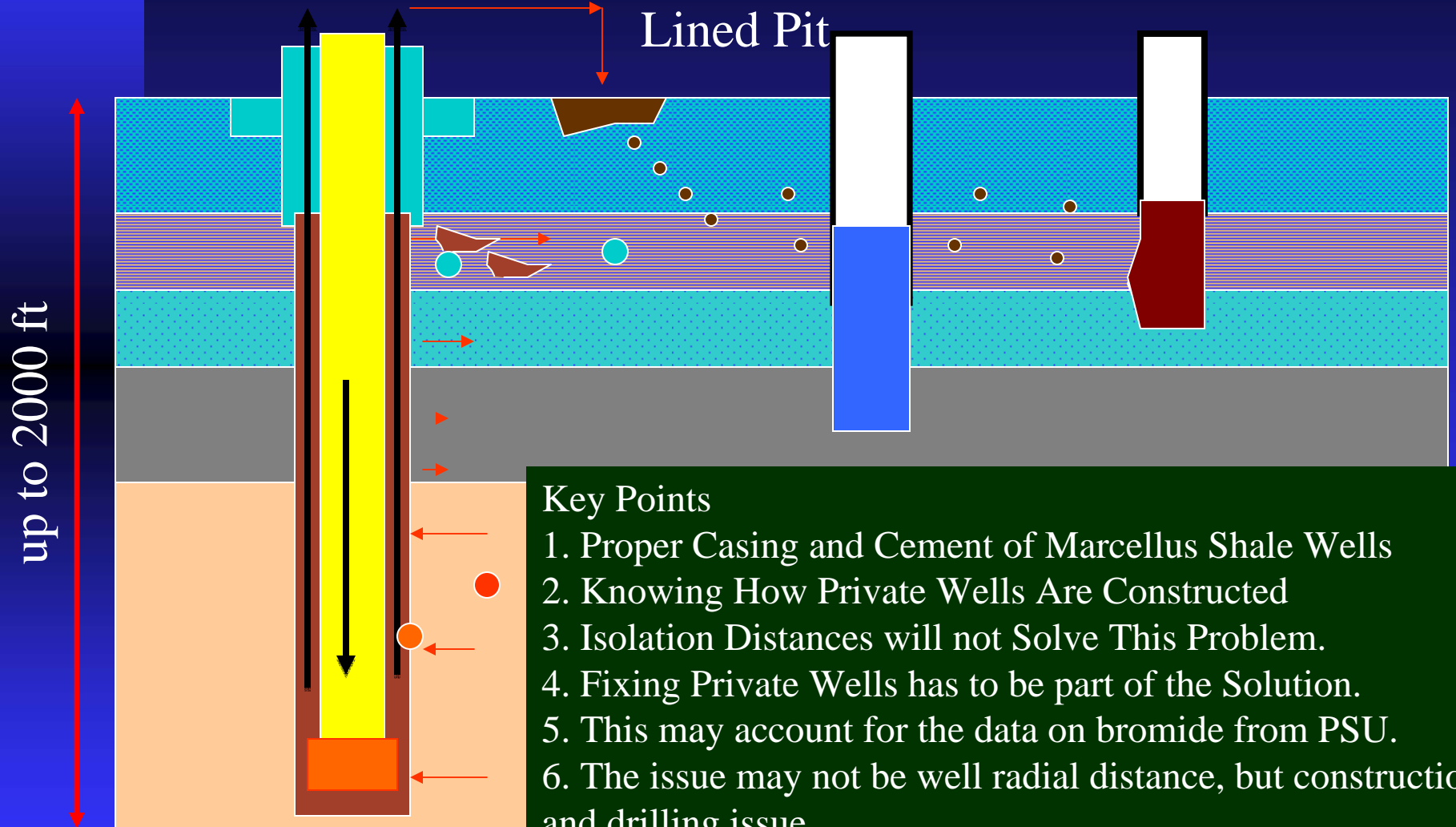
I am not saying there is no methane gas in the water.

Properly Constructed Wells and Poorly Constructed Wells



PSU Study -Migration and Disturbance During Drilling-losing circulation

Proper Construction Poor Construction
Lined Pit



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.

Most Private Wells

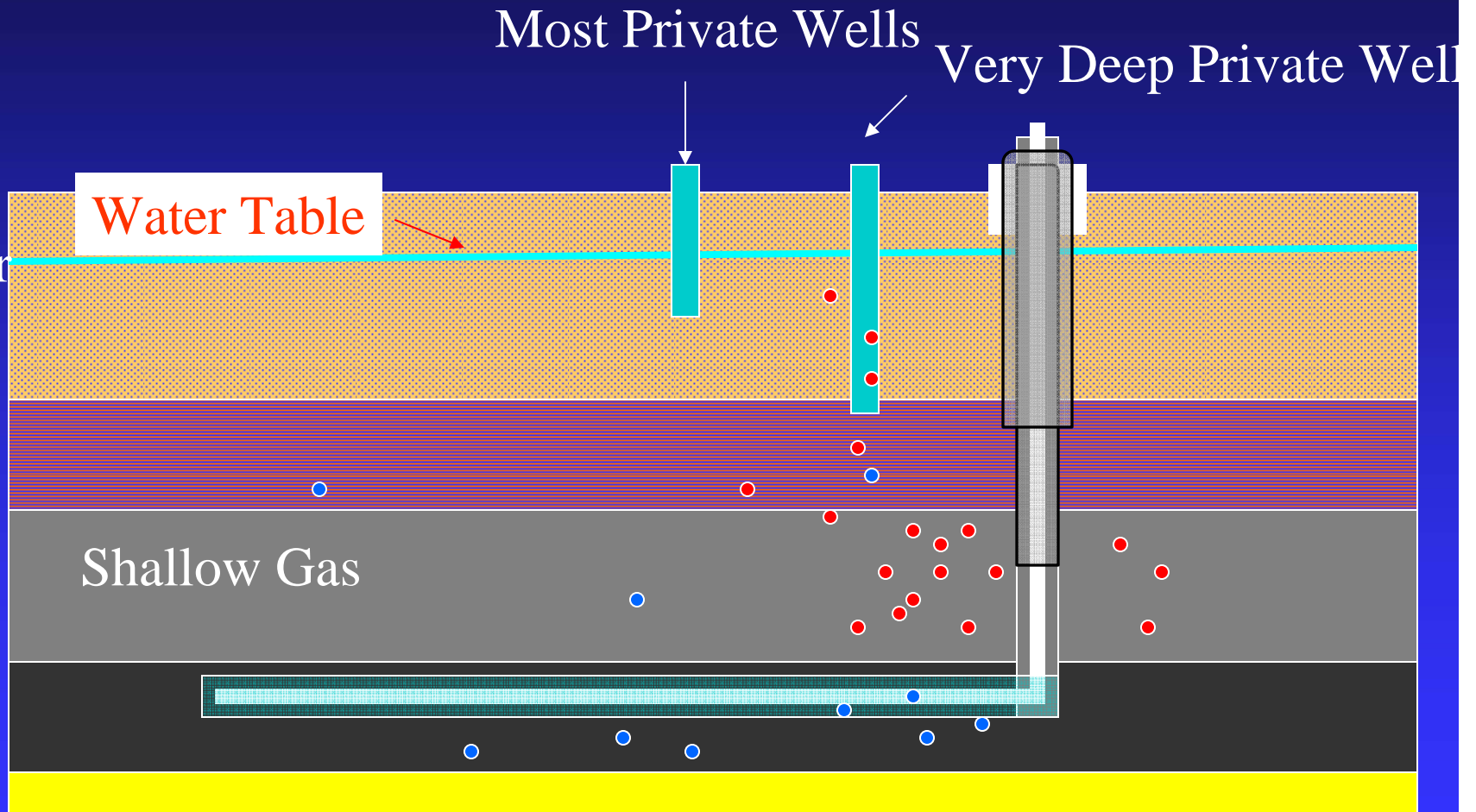
Very Deep Private Well

Water Table

Younger

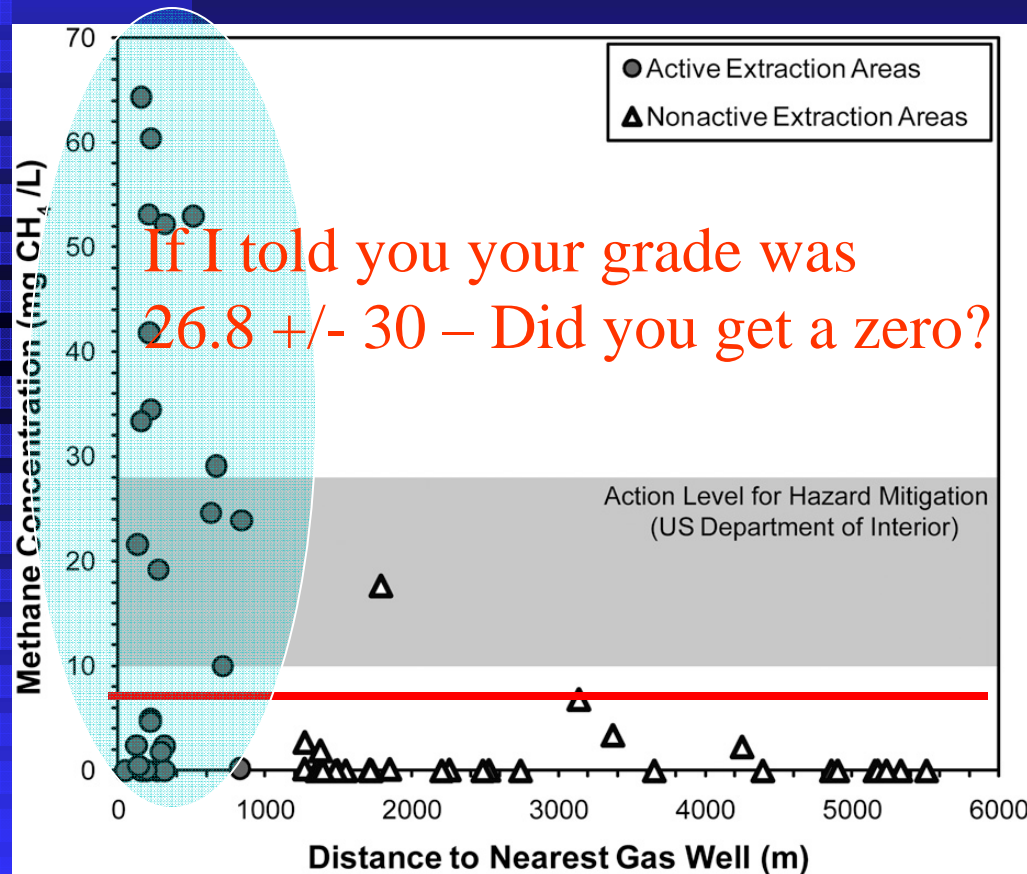
Shallow Gas

Older



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

Duke Study- “Gas Well Drilling and Hydraulic Fracturing” by Osborn

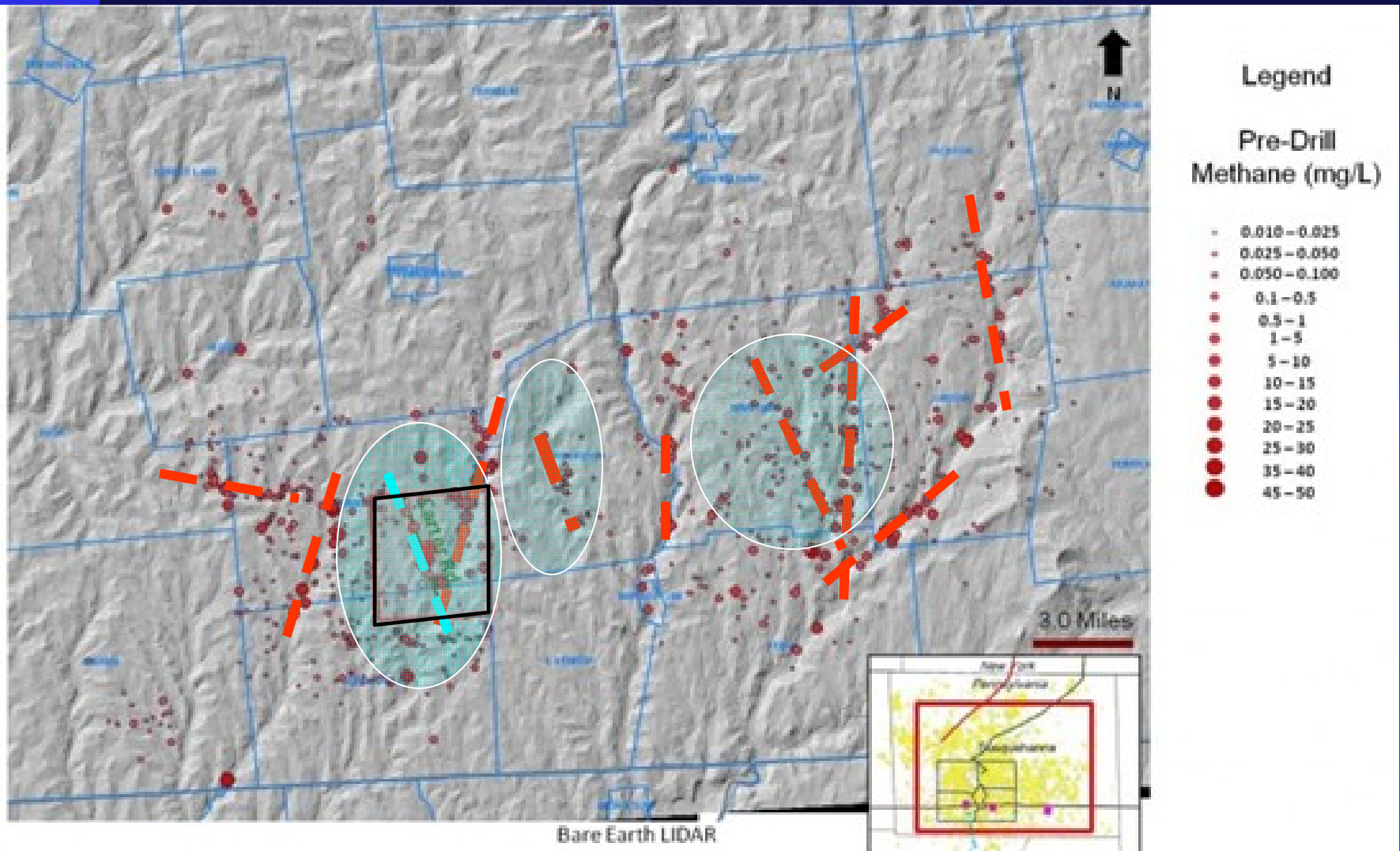


Note:

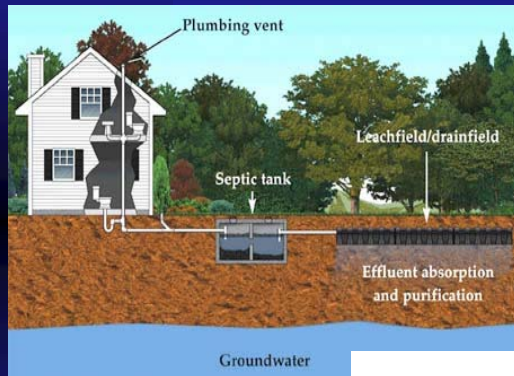
1. Action Level is 7 mg/L
2. Study done in an area with “suspected” gas migration Problems- Not Considered.
3. Data suggest a simple 2-D relationship.
4. Many samples well above Saturation- Influenced by Pump Depth.
5. Contains No Pre-Drill Data- for the shaded area.

Title is spin.

Cabot – Quick Look



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



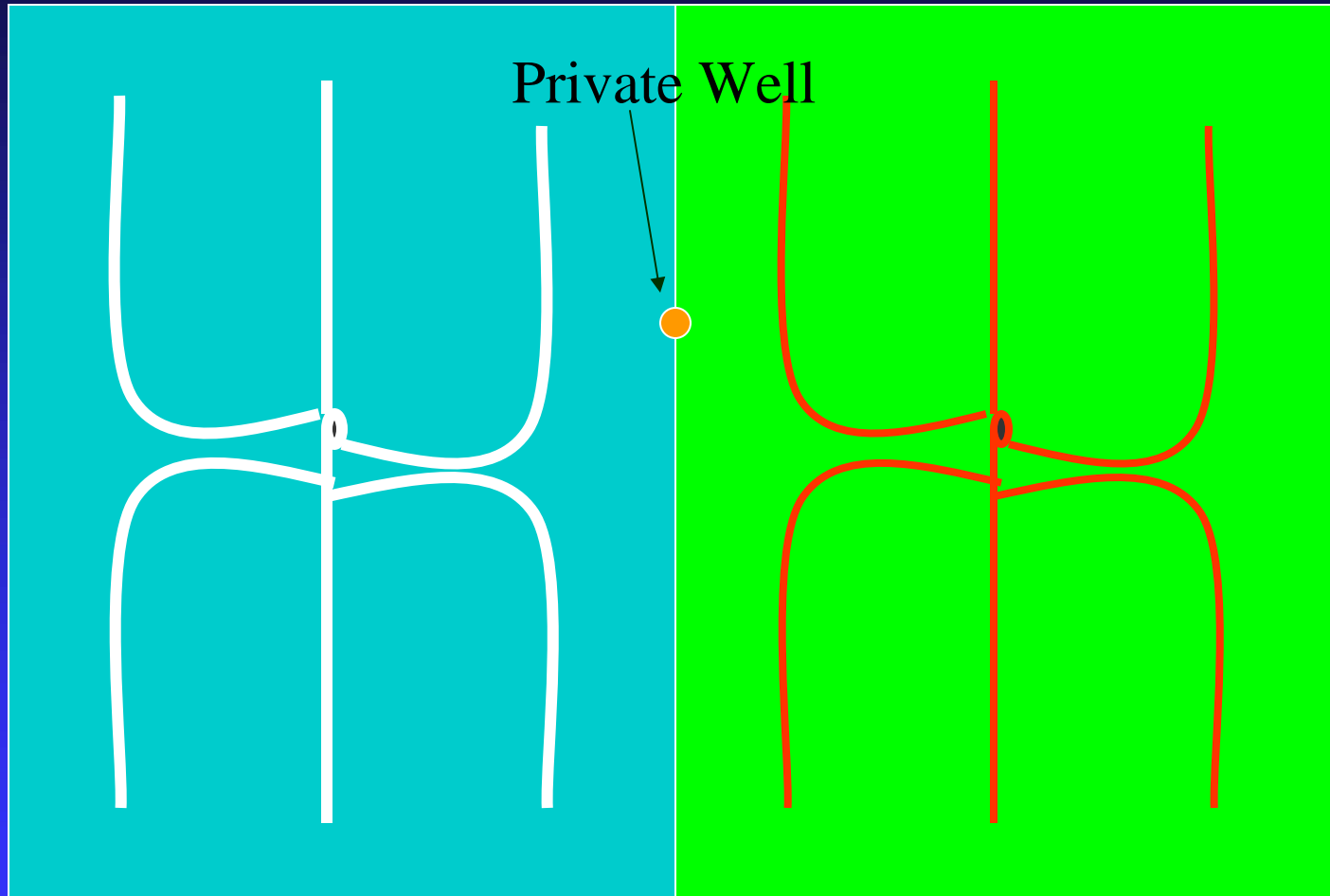
Not Just a Marcellus
Shale Issue and in some cases
other Private Wells are Part of the Problem



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 Liabile is “Who is Responsible”



Company A

Company B

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

The Facebook logo, consisting of the word "facebook" in a white, lowercase, sans-serif font, is centered within a dark blue rectangular box.

Please look for us on Facebook

B.F. Environmental Consultants Inc.
Carbon County Groundwater Guardians
Pennsylvania – Private Well Owner Forum
Pocono Northeast RC&D Council
Water Research Center

Can Not Find Us – email bfenviro@ptd.net



Certificate of Completion

Training Event

Getting the Waters Tested – The Marcellus Shale Factor
Working as a Community – Actions for Young Adults

4/25/2012

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>





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>

