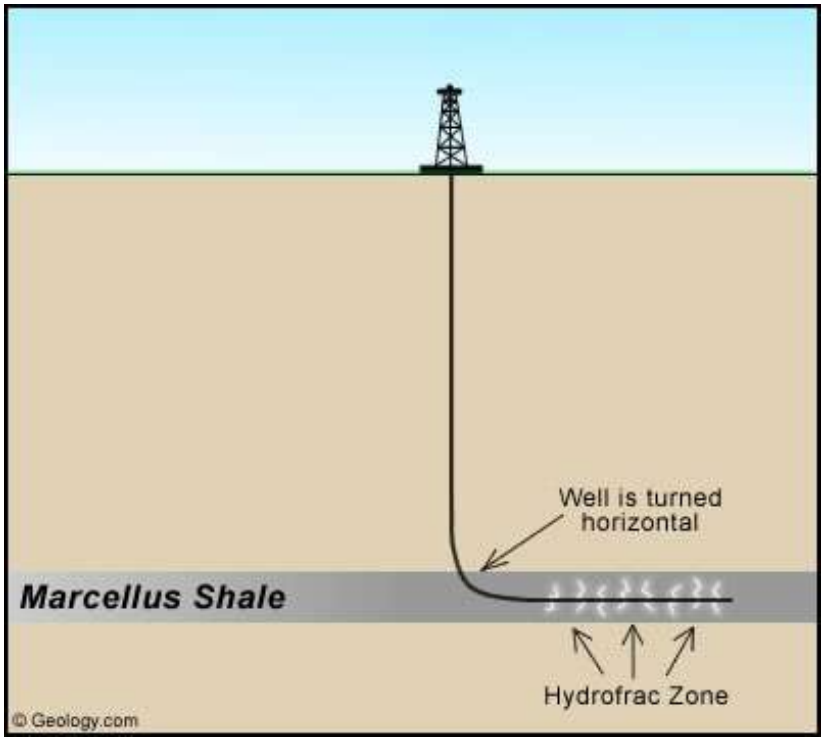
Shale Gas Plays in New York: Information for An Informed Citizenry



Prof. Tony Ingraffea
Unatego, NY
October 6, 2010

Outline of Presentation

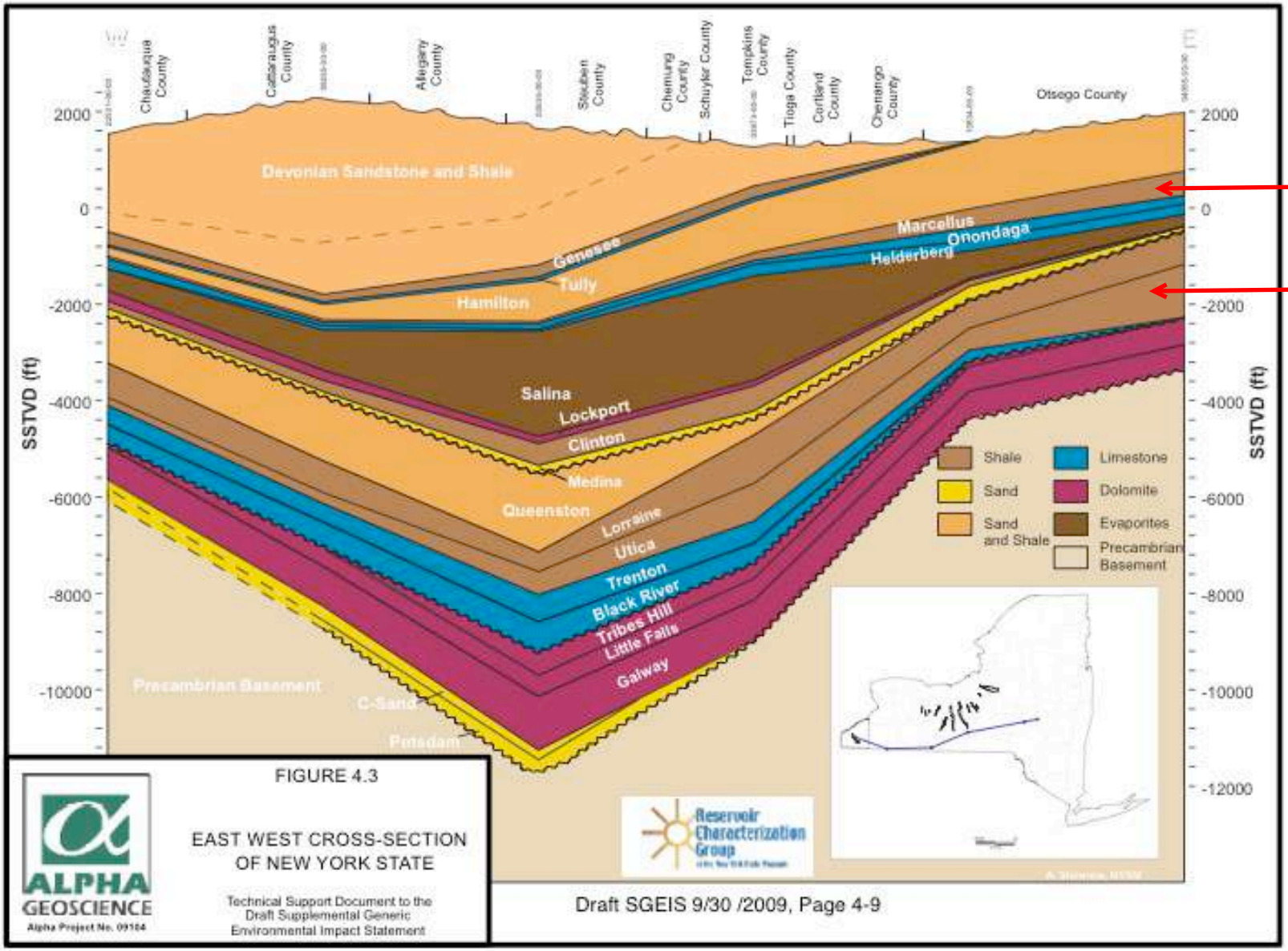
- Where and Why Shale Gas: Why Us?
- The Potential Scale of the Play in NY: Be Prepared for Big Numbers

Bottom Line: We will know what we are talking about, and can better evaluate "information" in the media and from the gas industries

- Fracturing Fluid: Where Does It Go and What Goes with It?
- Is It All Worth It? My Opinions, You Decide

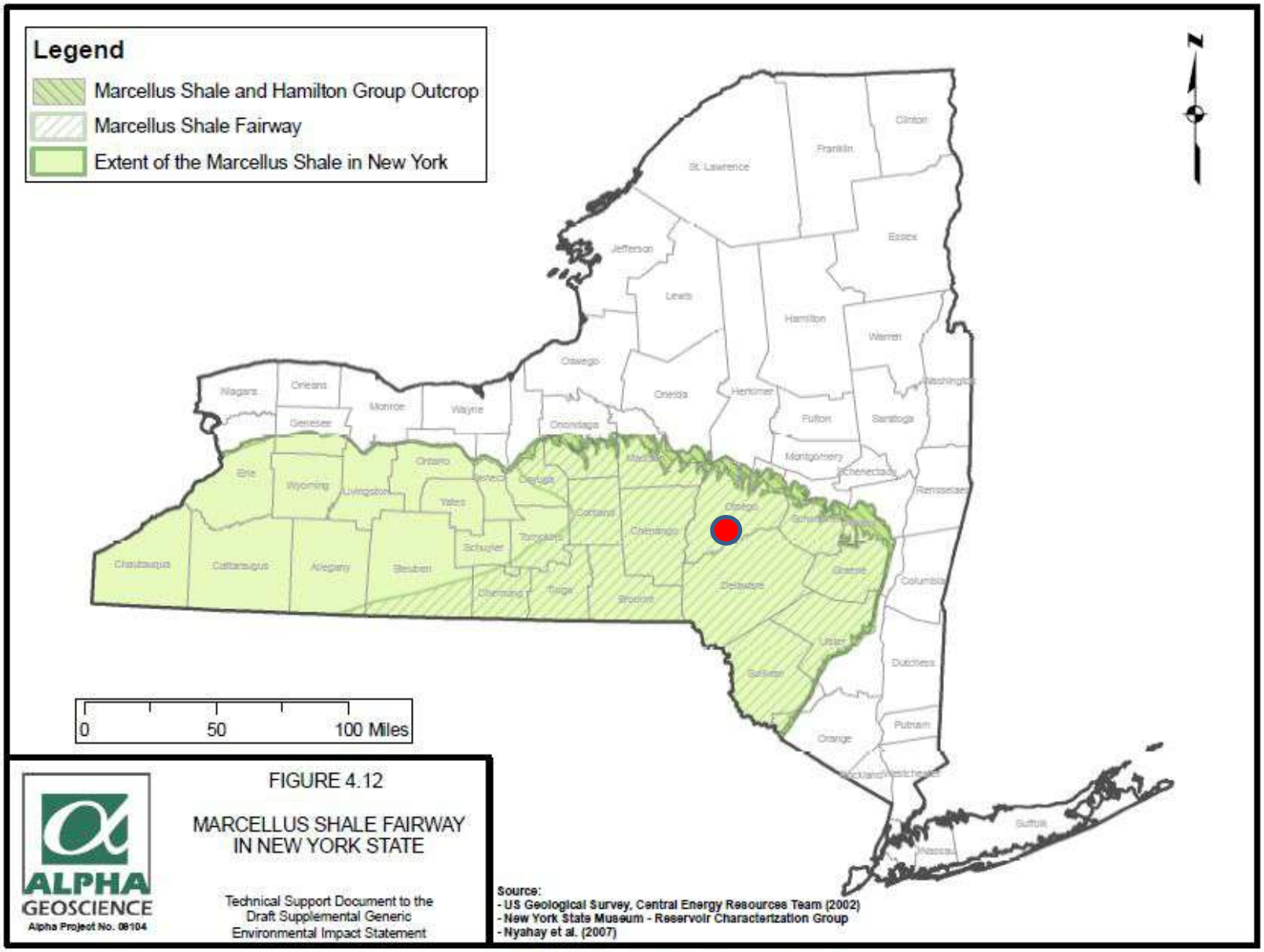
But the MAIN MESSAGE Today Is That Industry Plans for Development of Shale Gas in NY Are

NYS Stratigraphy: The Underall Picture



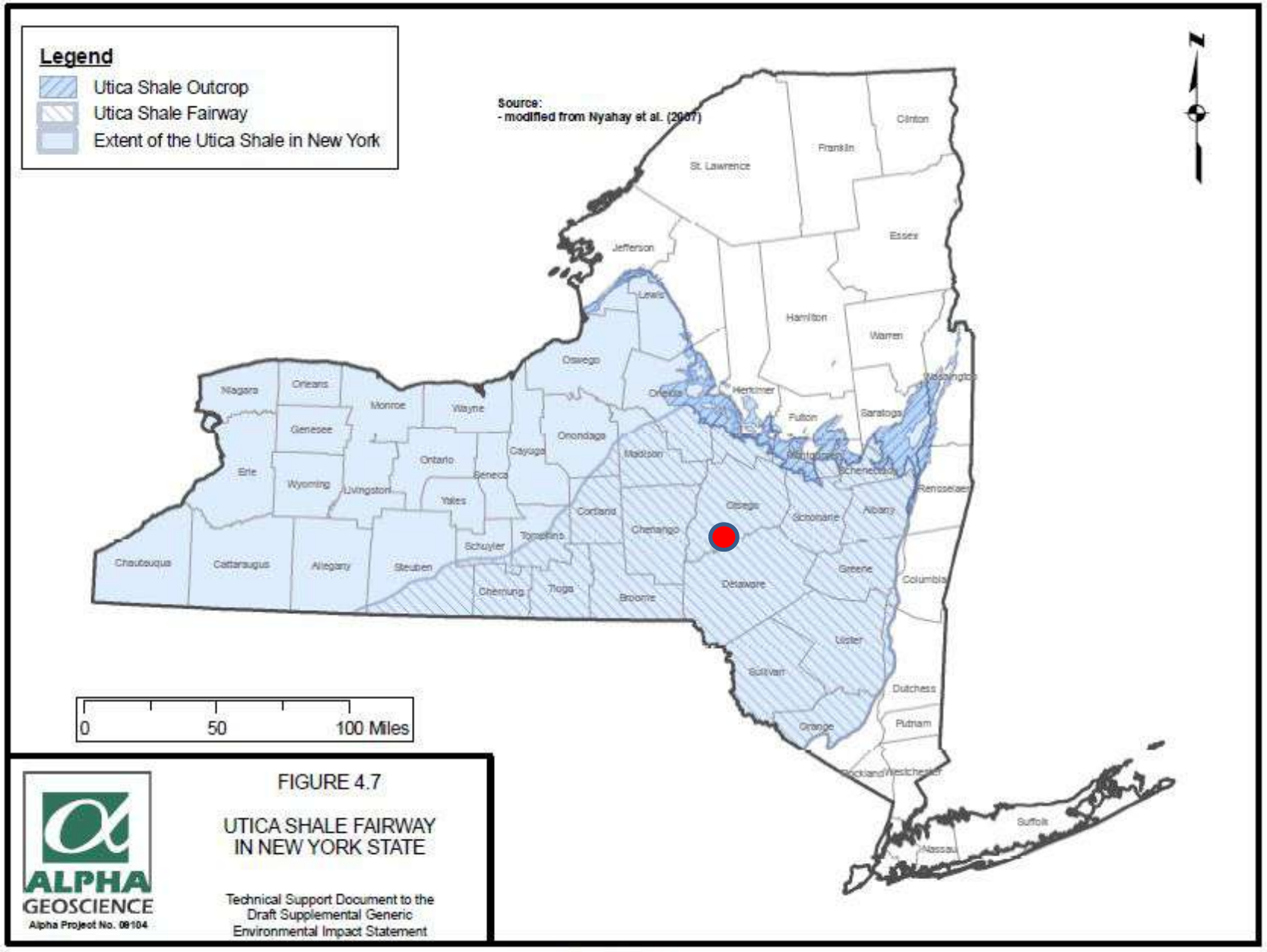
From NYS SGEIS

Marcellus Shale and Its Fairway in NYS



Draft SGEIS 9/30 /2009, Page 4-23

Utica Shale and Its Fairway in NYS



Draft SGEIS 9/30 /2009, Page 4-16

So How Much Can Marcellus Gas Help U.S. Supplies???

Natural Gas Consumption by End Use

(Million Cubic Feet)

Area: U.S. **Period:** Annual

Download Series History | Definitions, Sources & Notes

Show Data By: Data Series / Area	2004	2005	2006	2007	2008	2009
Total Consumption	22,388,975	22,010,596	21,684,641	23,097,140	23,226,612	22,816,303
Lease and Plant Fuel	1,097,904	1,111,517	1,141,977	1,226,386	1,223,786	1,261,440

- That's 23 TRILLION cubic feet.
- That's about 25% of TOTAL U.S. energy consumption.
- To impact these numbers, *what spatial and temporal intensity is needed?*

http://tonto.eia.doe.gov/dnav/ng/ng_cons_sum_dcu_nus_m.htm

Marcellus

By Terry Engelder, Ph.D., Professor of Geosciences, The Pennsylvania State University

Terry Engelder

Range Resources' (RRC) fourth quarter 2007 call announcing initial production rates (IP = 24 hour production tests) from five wells in Washington County, Pa., kicked off the Marcellus gas shale's breakout year. At the time, the "official" sources, including the U.S. Geological Survey (USGS) and the Energy Information Administration (EIA) gave no indication of the potential for gas production from the Marcellus. Thirty-year-old U.S. Department of Energy estimates for technically recoverable gas from Appalachian Basin black shales had mysteriously dropped out of sight. At a Petroleum Technology Transfer Council (PTTC) workshop in early January 2008, Gary Lash, Ph.D., and I pointed out that the Marcellus would become one of the world's top super giant gas fields, according to volumetric calculations. Dr. Lash is a professor in the Department of Geosciences at State University College in Fredonia, N.Y. The press got wind of this news and set off a land rush in the Appalachian Basin. More than a year later, enough Marcellus production data have leaked

Terry Engelder, Ph.D., is a professor of geosciences in the Department of Geosciences at The Pennsylvania State University in University Park, Penn. He is a leading authority on the recent Marcellus gas shale play, holds degrees from Penn State B.S. ('68), Yale M.S. ('72) and Texas A&M, Ph.D. ('73). He has previously served on the staffs of the U.S. Geological Survey, Texaco and Columbia University. Academic distinctions include a Fulbright Senior Fellowship in Australia, Penn State's Wilson Distinguished Teaching Award, membership in a U.S. earth science delegation to visit the Soviet Union immediately following Nixon-Brezhnev détente, and helping Walter Alvarez collect the samples that led to the famous theory for dinosaur extinction by large meteorite impact. Engelder has written 150 research papers, many focused on Appalachia, and a book, the research monograph "Stress Regimes in the Lithosphere." In the international arena, he has worked on exploration and production problems with companies including Saudi Aramco, Royal Dutch Shell, Total, Agip and Petrobras. Engelder may be contacted at engelder@geosc.psu.edu.

The Article That Caught The Attention of Many

FORT WORTH Basin
Oil&Gas Magazine
August 2009

Key Data from Engelder Article: Part 1

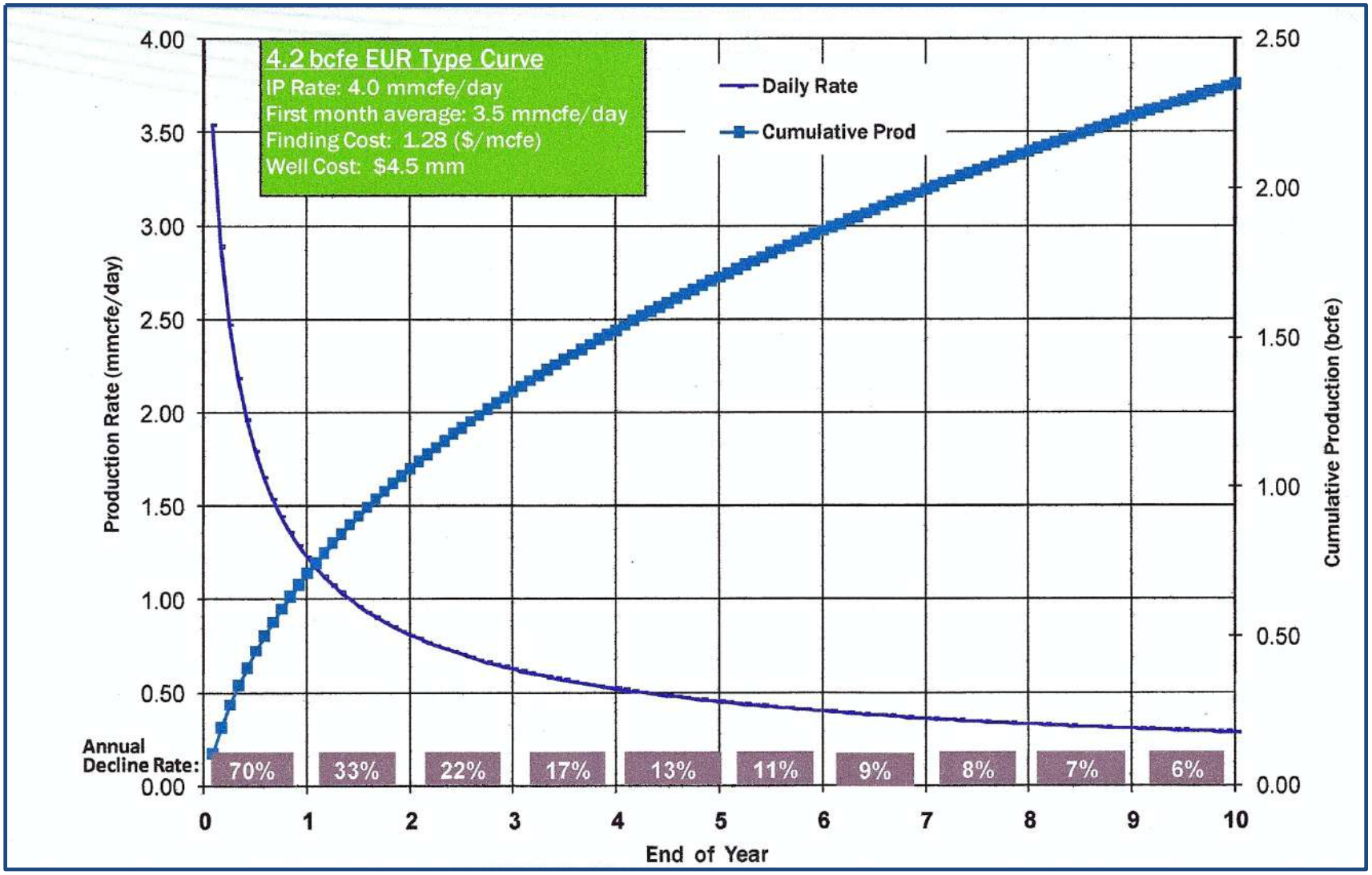
Marcellus production counties and their production potential by state

Table 1

Counties ranked by tier based on both geology and gas production data from the Marcellus through May 15, 2009. *Tier 1 counties are those counties with proven horizontal wells producing with a P50 IP > 4 MMcfe/d or less than 10 miles from such wells. The other 109 counties are not adequately tested by production and thus graded downward between Tier two and Tier six depending on geological conditions.*

	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5	Tier 6	Total
Maryland			1				1
New York			3	4	4	6	17
Pennsylvania	5	6	8	6	6	11	42
Ohio		1	1	2	6	8	18
West Virginia	3	3	2	4	7	20	39

Key Data for Estimation of Well Productivity and Economics: PA



From: Chesapeake Energy (CHK) published *pro forma* data

Key Data from Engelder Article: Part 2

5-year production probabilities, by state, from core counties

Table 3

Five-year production from core area of Marcellus

Power-law model assuming that 70% of the sections in each county produce with an 80-acre well spacing.

These predictions require a minimum of
8 wells per square mile on 70% of each county.

			P90	P50	P10
			Bcf	Bcf	Bcf
Maryland	1	656	1,061	2,371	3,993
New York	7	6,417	7,110	16,842	29,989
Pennsylvania	25	20,801	40,228	87,888	158,345
Ohio	4	1,804	2,679	6,077	10,749
West Virginia	12	3,430	6,436	14,222	25,512
Totals	**49**	**33,108**	**57,514**	**127,400**	**228,587**

Key Data from Engelder Article: Part 3

50-year production probabilities, by state, from all counties

Table 2

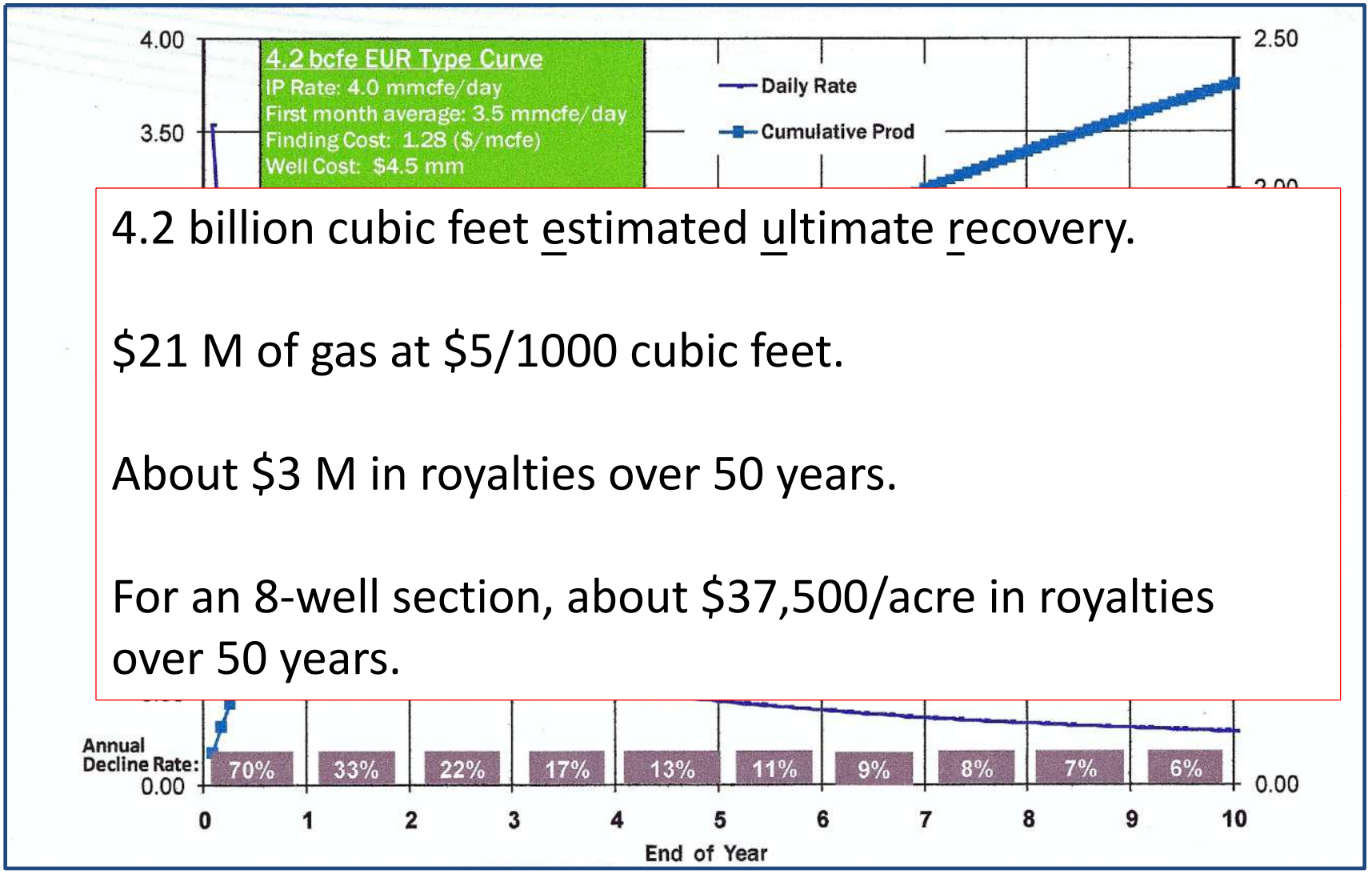
Estimated Ultimate Recovery from Marcellus after a 50-year decline.
Power-law model assuming that 70% of the sections in each county are accessible and a well

For the NYS Marcellus play to have even a minor impact on national energy picture, spatially and temporally INTENSE development will be required.

			P90	P50	P10
			Bcf	Bcf	Bcf
Maryland	1	656	3,123	6,980	11,756
New York	17	13,906	30,955	71,859	126,176
Totals	117	73,333	220,701	489,241	867,162

And such intense development might not be possible: leasing and capital control.

Key Data for Estimation of Well Productivity and Economics: PA



4.2 billion cubic feet estimated ultimate recovery.

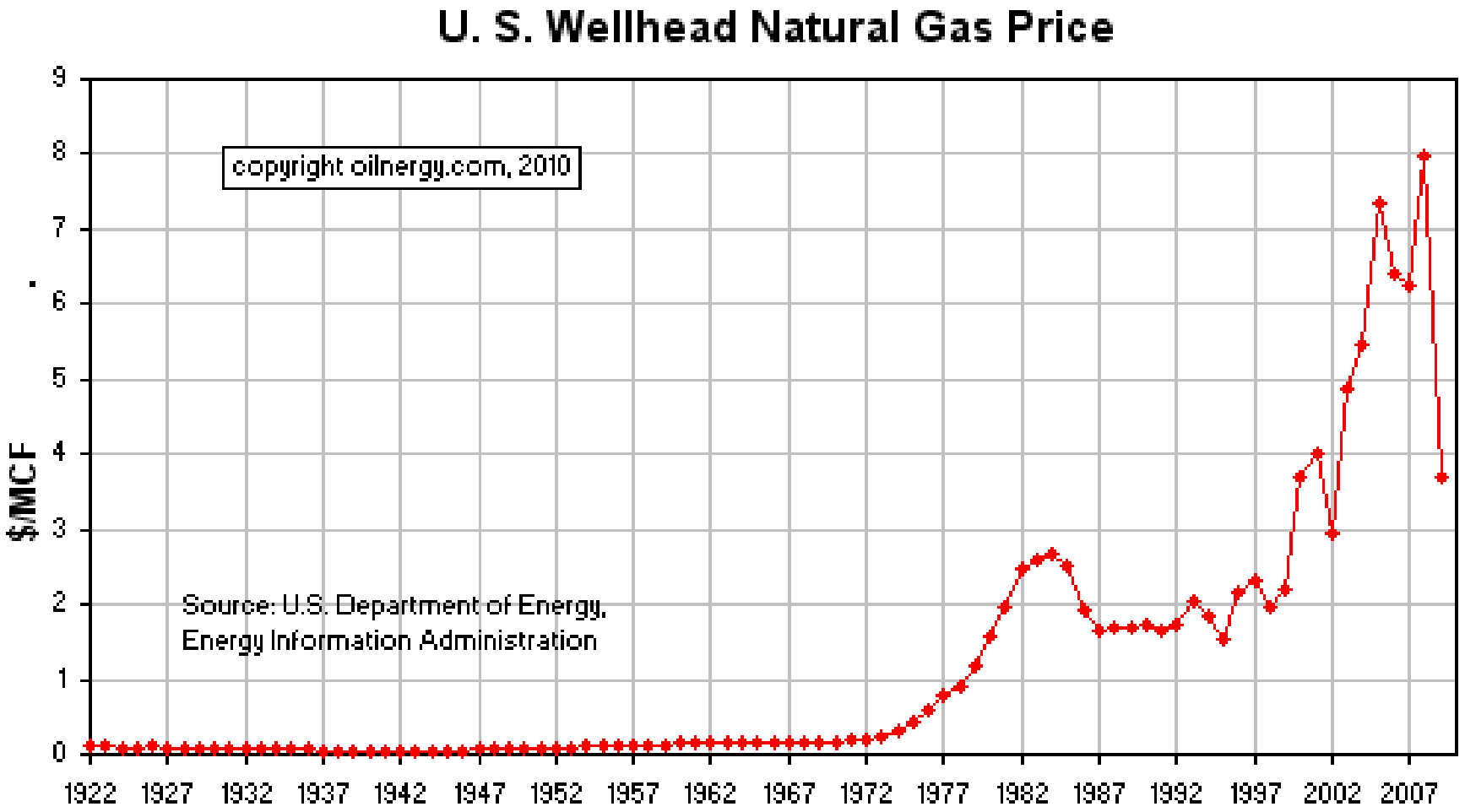
$21 M of gas at $5/1000 cubic feet.

About $3 M in royalties over 50 years.

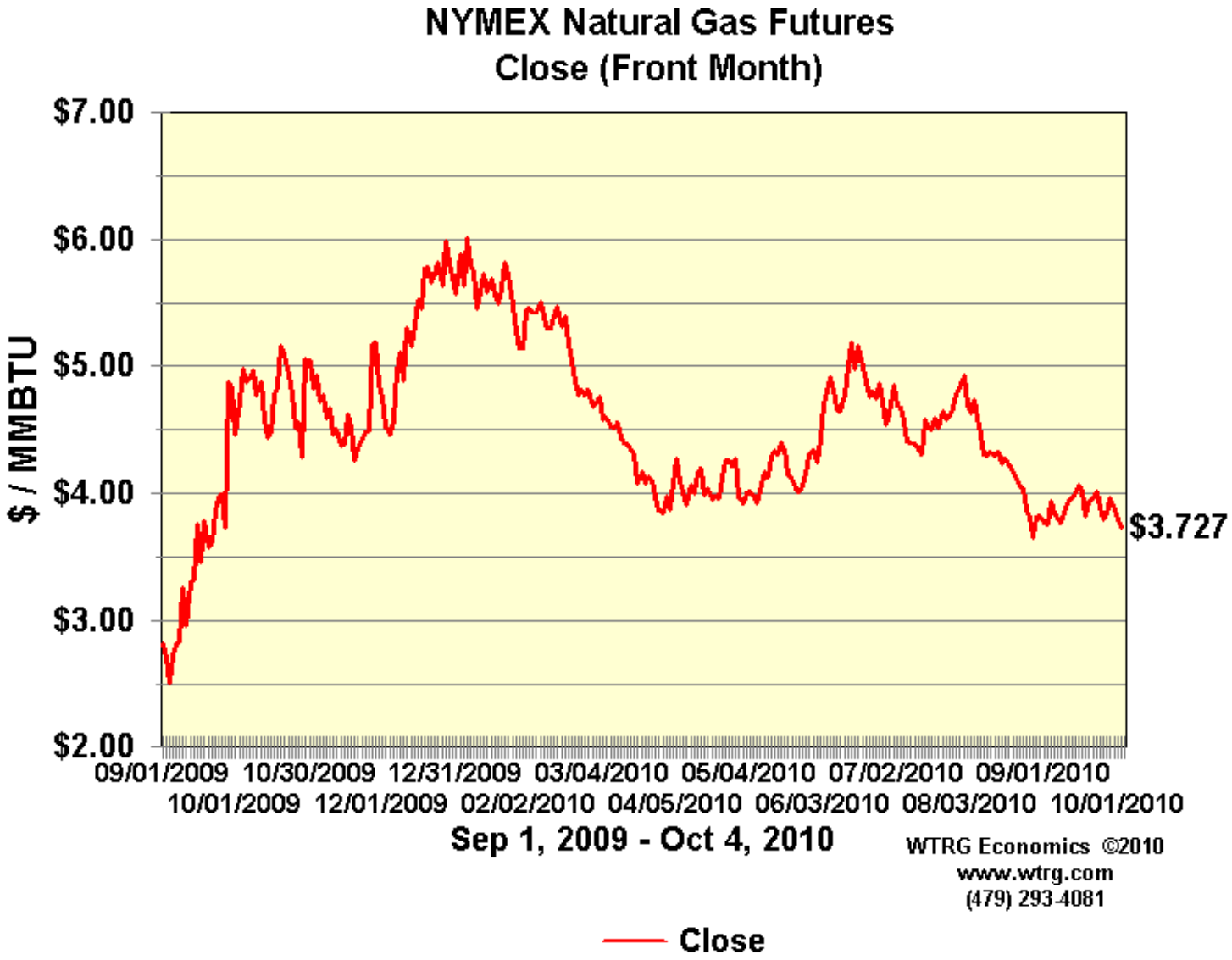
For an 8-well section, about $37,500/acre in royalties over 50 years.

From: Chesapeake Energy (CHK) published *pro forma* data

How Much Is Your Gas Worth?



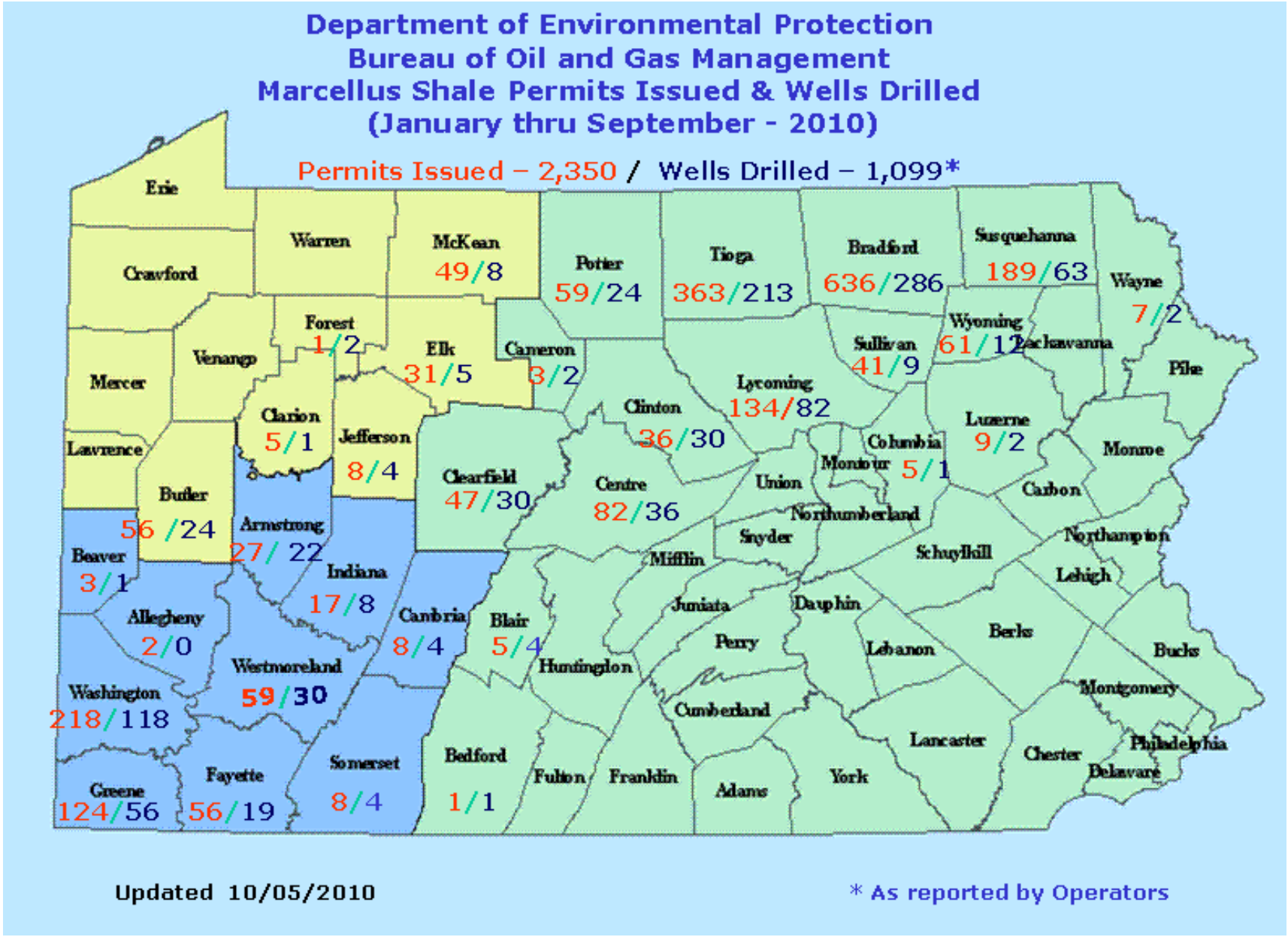
How Much Is Your Gas Worth?



Development in PA Will Control Rate of Development in NY

- 120 big rigs in PA by end of 2010: not many more available now—capital?
- Gathering lines just now under construction in PA
- 5,000 wells/year plan for PA; 1400 this year.
- If/when permitting starts in NY, few will be receiving royalties for years to come—capital for rigs, lines, compressors; DEC review staffing
- Don’t get your hopes up for big checks soon, even if permitting were to start today

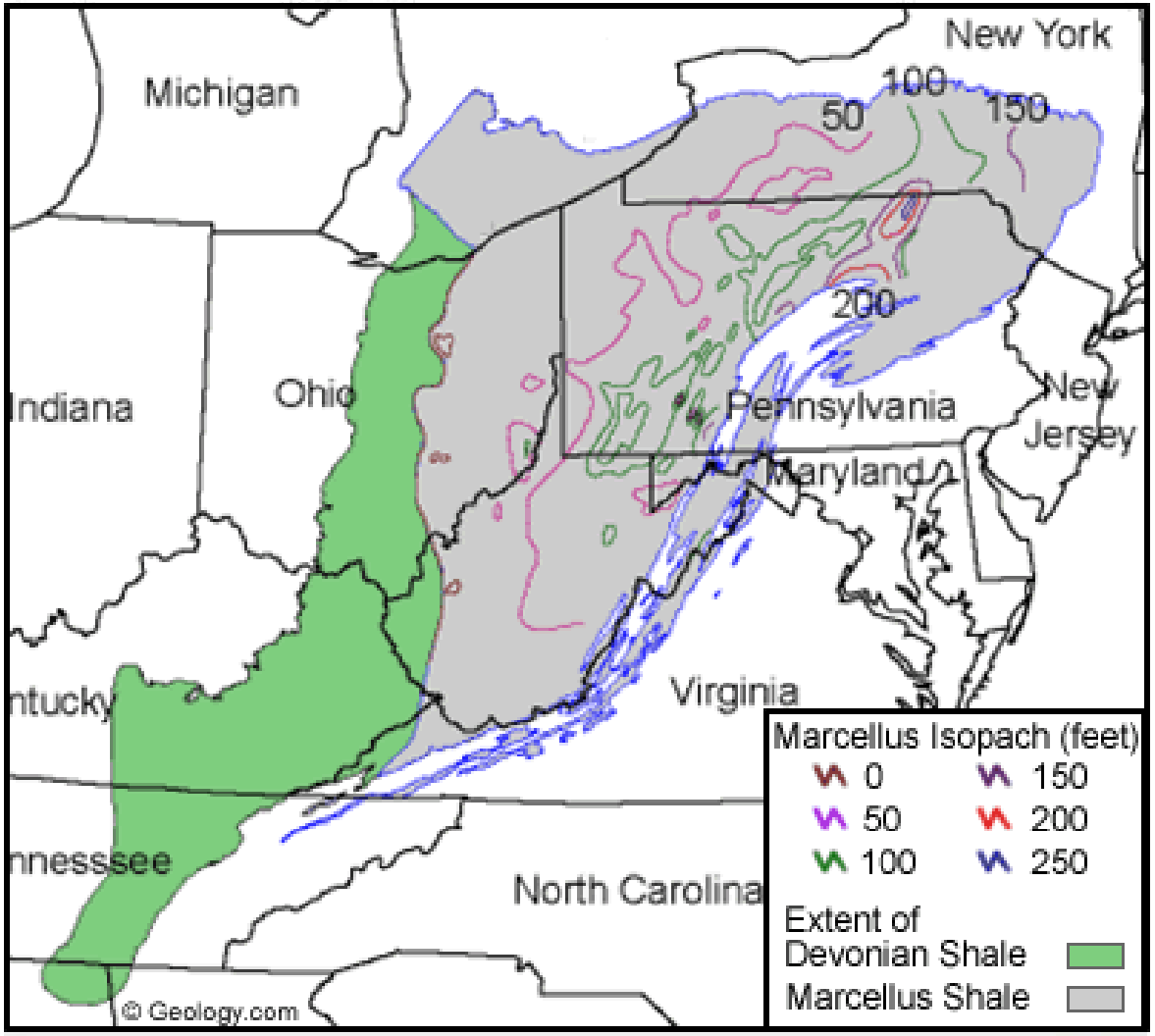
Marcellus Shale Action in PA



Outline of Presentation

- Where and Why Marcellus Shale Gas: Why Us?
- The Potential Scale of the Play in NY: Be Prepared for Big Numbers
- The Technique of Drilling and Fracturing: "Fracking": The MOVIE
- Water: How Much, From Where
- Fracturing Fluid: What Is It and Why
- Fracturing Fluid: Where Does It Go and What Goes with It?
- Is It All Worth It? My Opinions, You Decide

Why Horizontal Drilling and Hydraulic Fracturing?



http://geology.com/articles/marcellus-shale.shtml

The Marcellus Shale Formation:

- Large Area
- Shallow Depth
- Lotsa Gas

But:

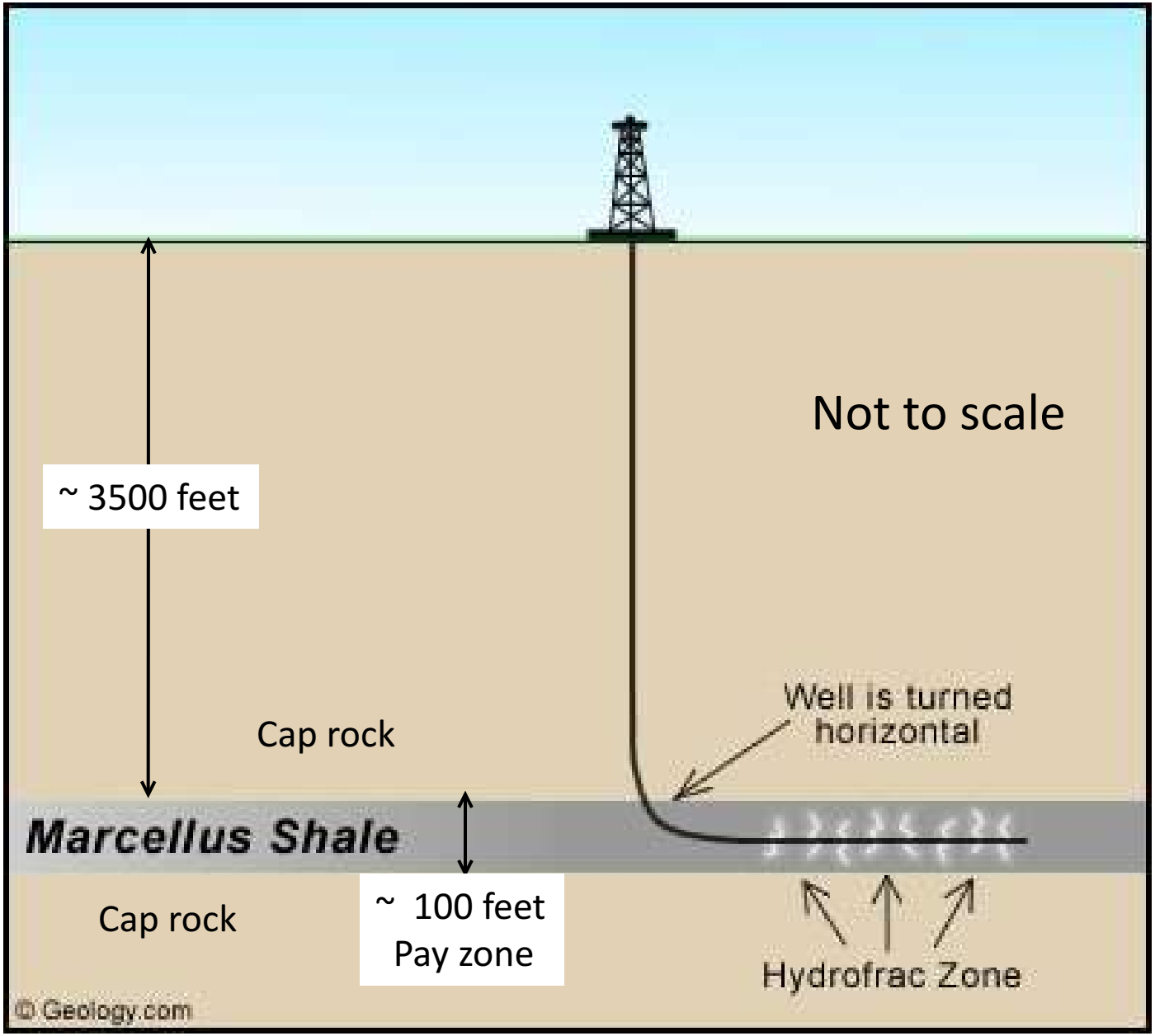
- Thin formation
- Tight Rock
- Jointed formation

Thin Formation, Tight Rock

- Need to drill DOWN 3000 to 5000 feet in NY, but the Marcellus layer is only about 100 to 150 feet thick. Therefore, start vertical, then go "HORIZONTAL"!
- Marcellus shale is "tight", meaning not many small cracks between joints, so the gas trapped in the rock needs to find a way out. Therefore, fracture it artificially and ***open the joints*** using "hydraulic fracturing".

How do these technologies work?

“Horizontal” Drilling and Fracturing: The Concept



A Typical Drilling Pad

To see all the jargon, go to http://www.glossary.oilfield.slb.com/

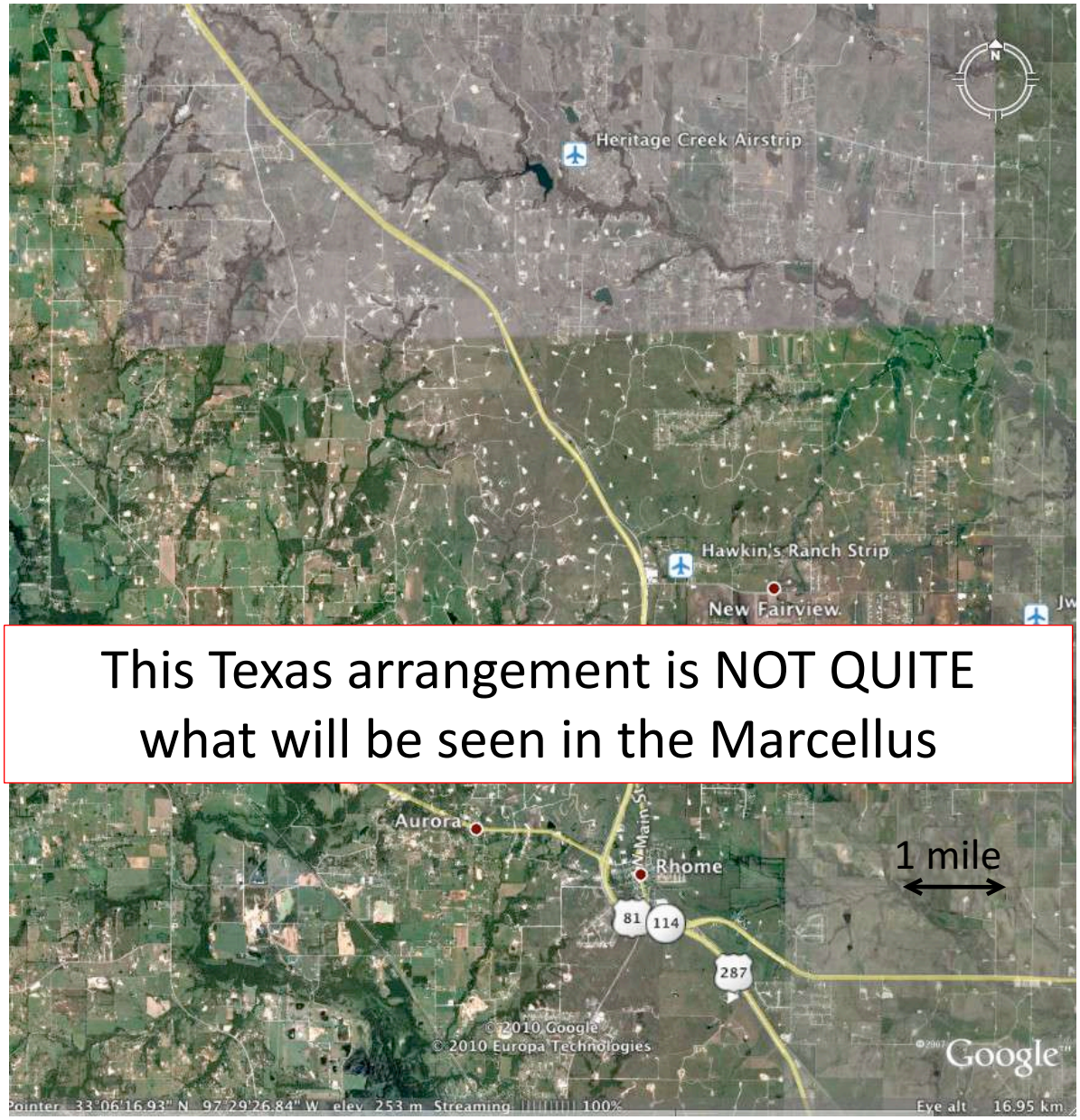
A Close-Up View of Perforations and Hydraulic Fractures

Wyoming Field at “40 Acre” Pad Spacing

This Wyoming arrangement is NOT what will be seen in PA/NY

http://www.skytruth.org/

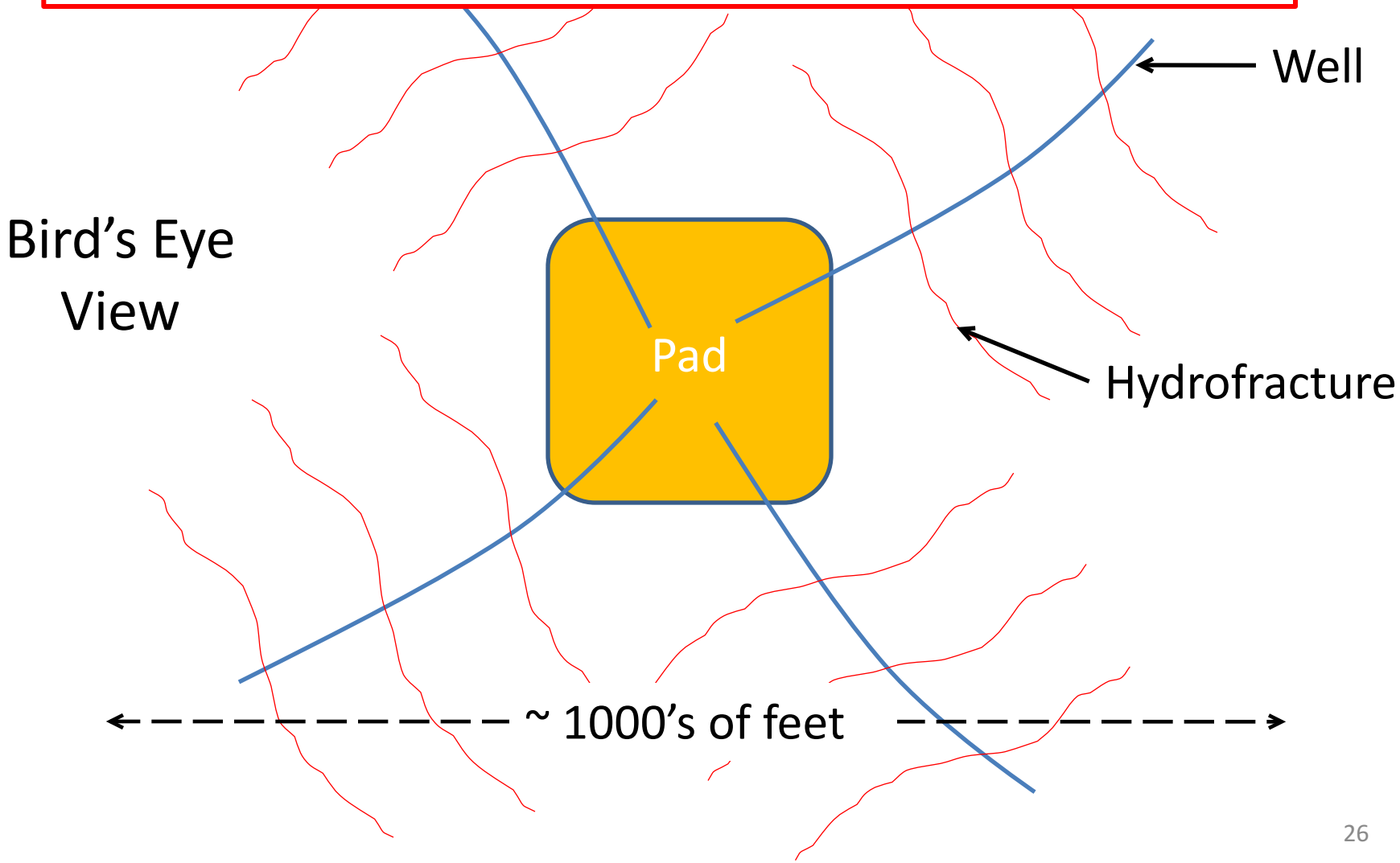
The Barnett Texas Shale Gas Play: 40 to 80 Acre Pad Spacing



This Texas arrangement is NOT QUITE what will be seen in the Marcellus

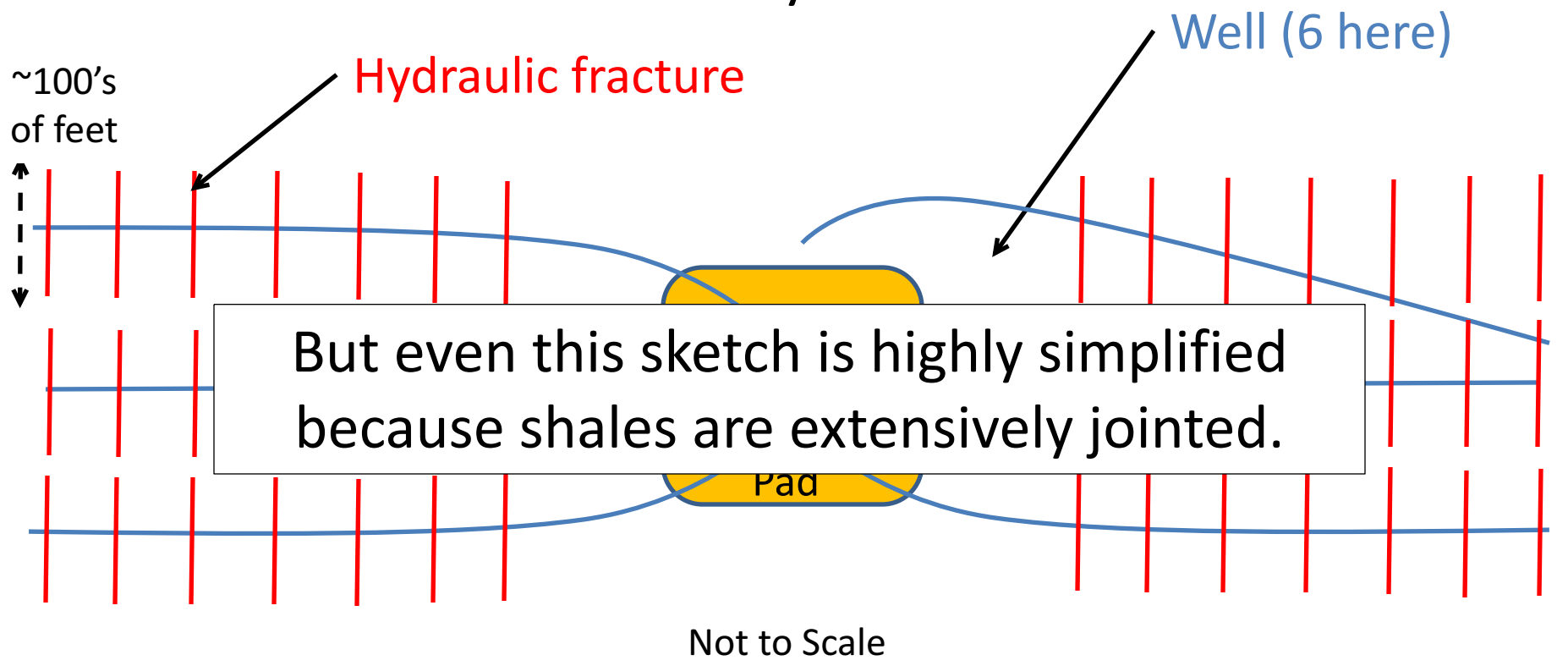
Can Have More Than One Well per Pad

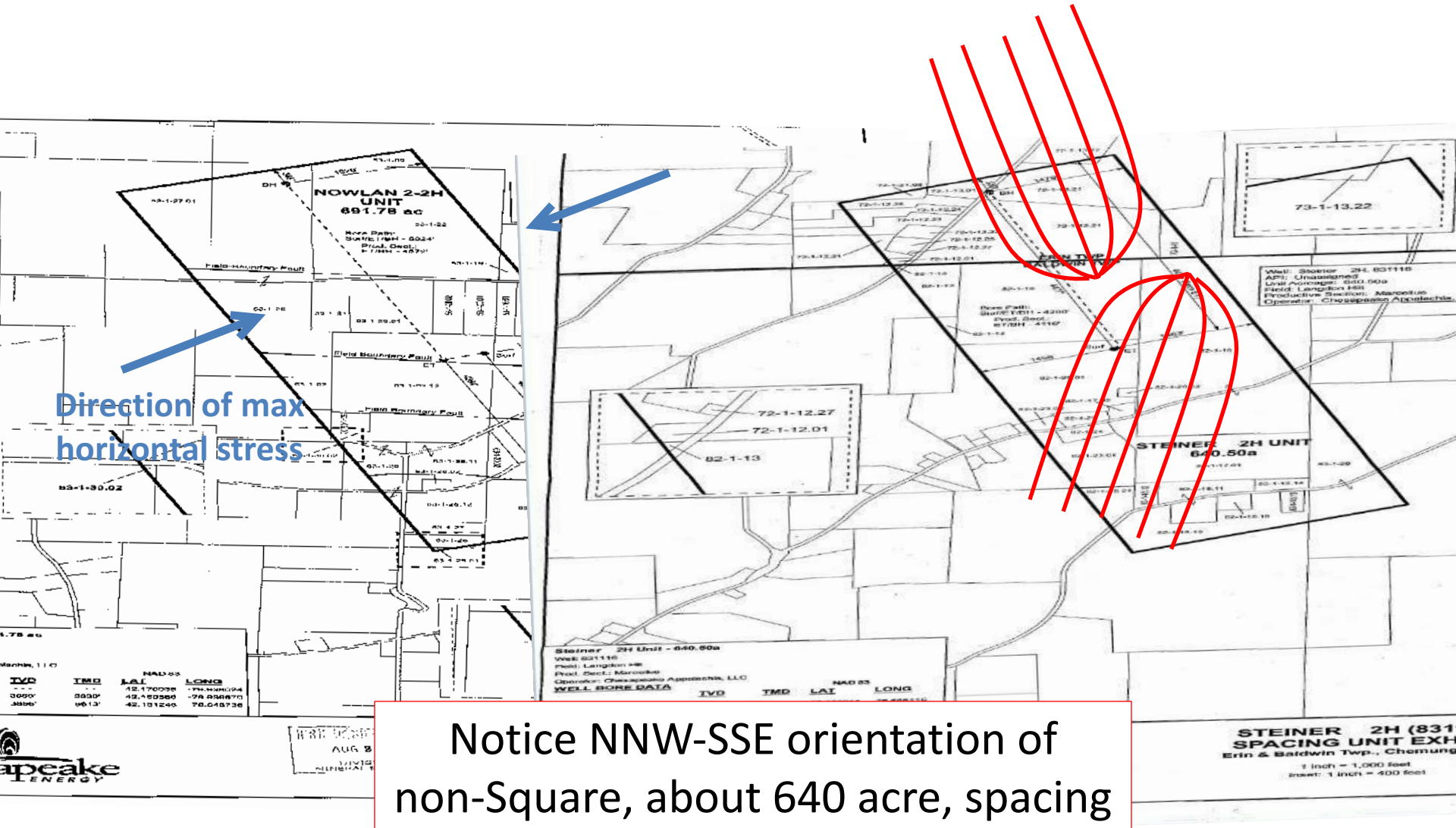
This arrangement is **physically impossible**: wells radiating like ”spokes on a wheel” from a single central pad is **nonsense**.



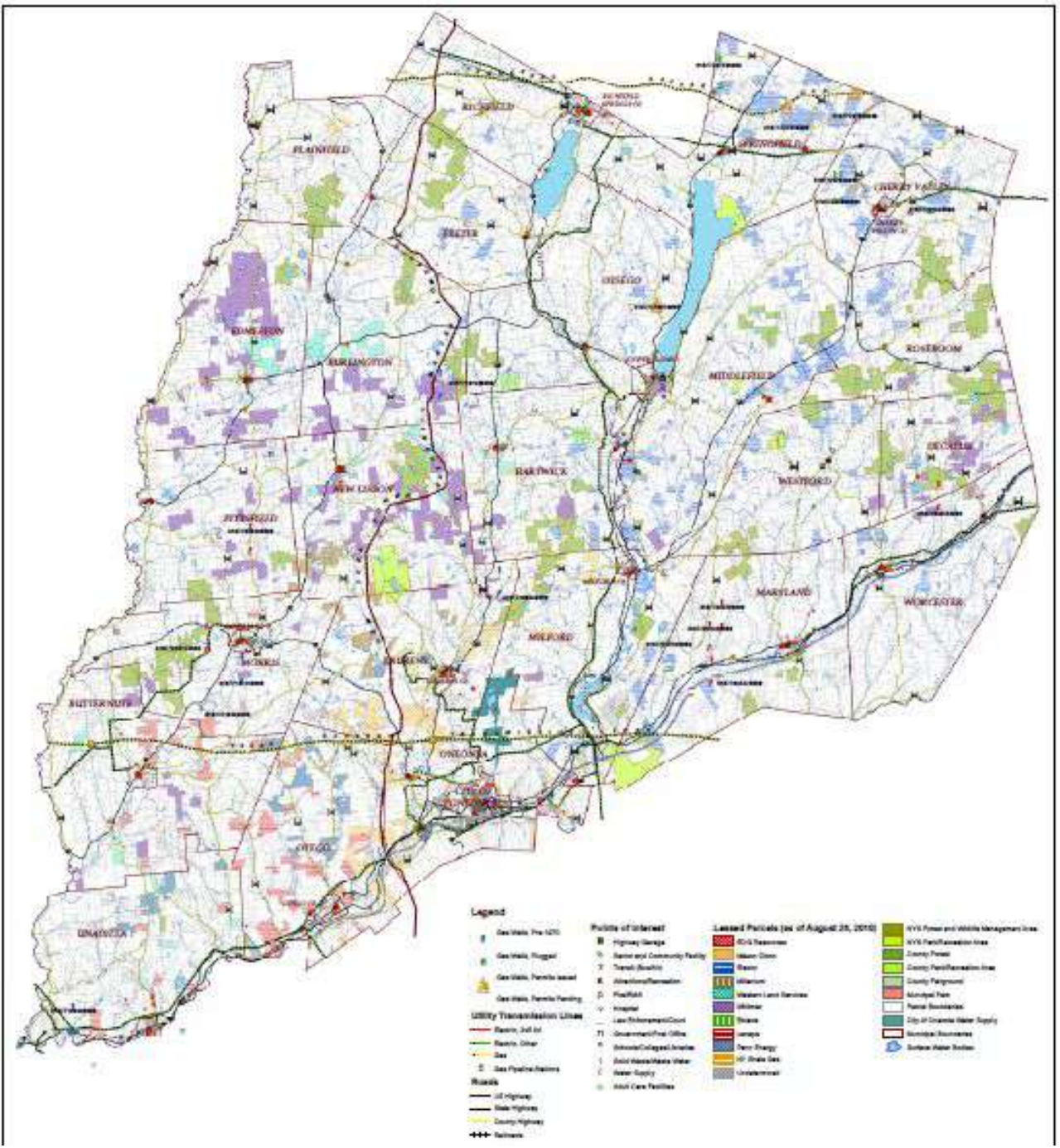
Will Have More Than One Well per Pad

Actual Arrangement
Bird's Eye View



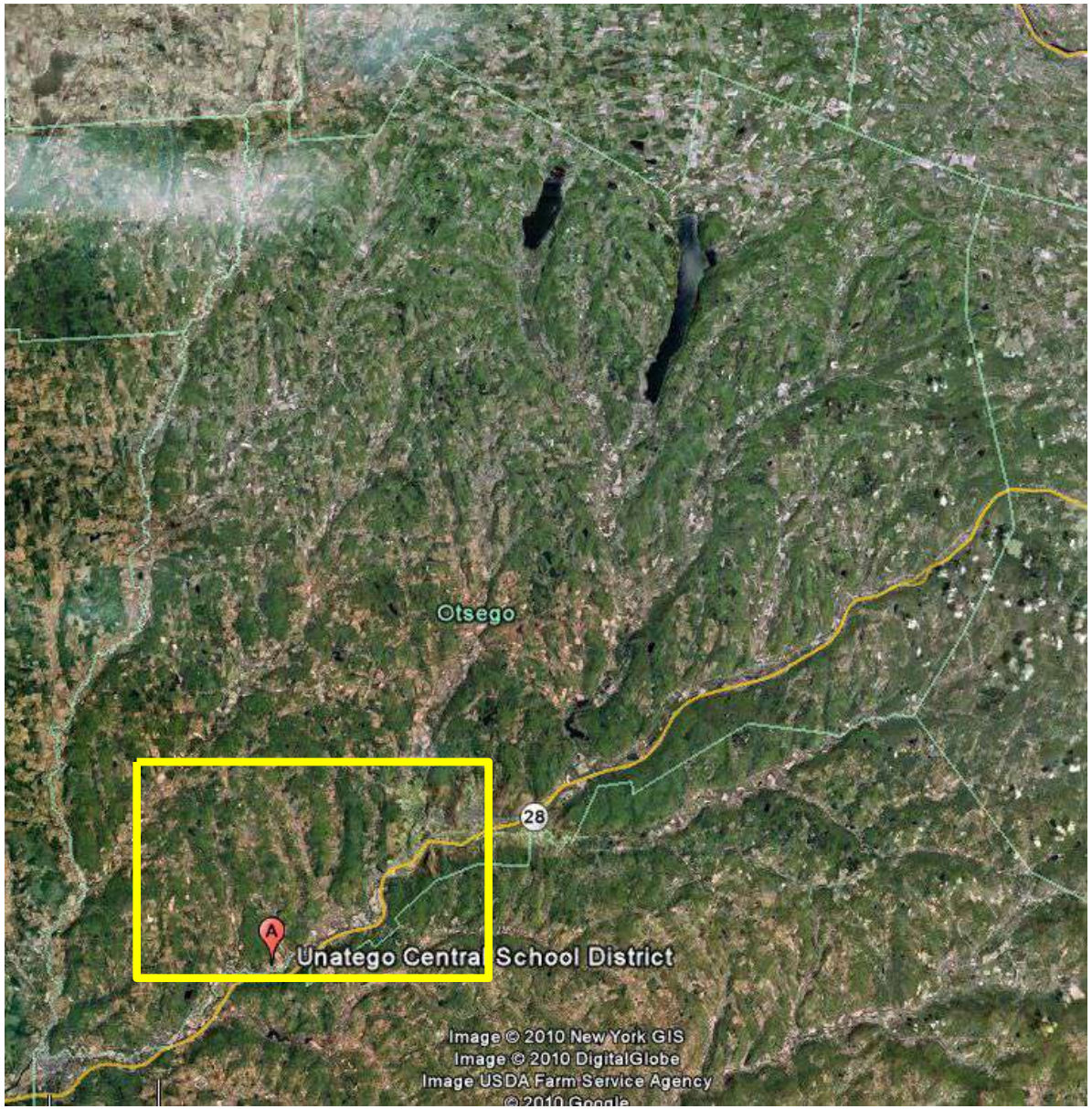


Notice NNW-SSE orientation of non-Square, about 640 acre, spacing unit. Geology and leasing control.

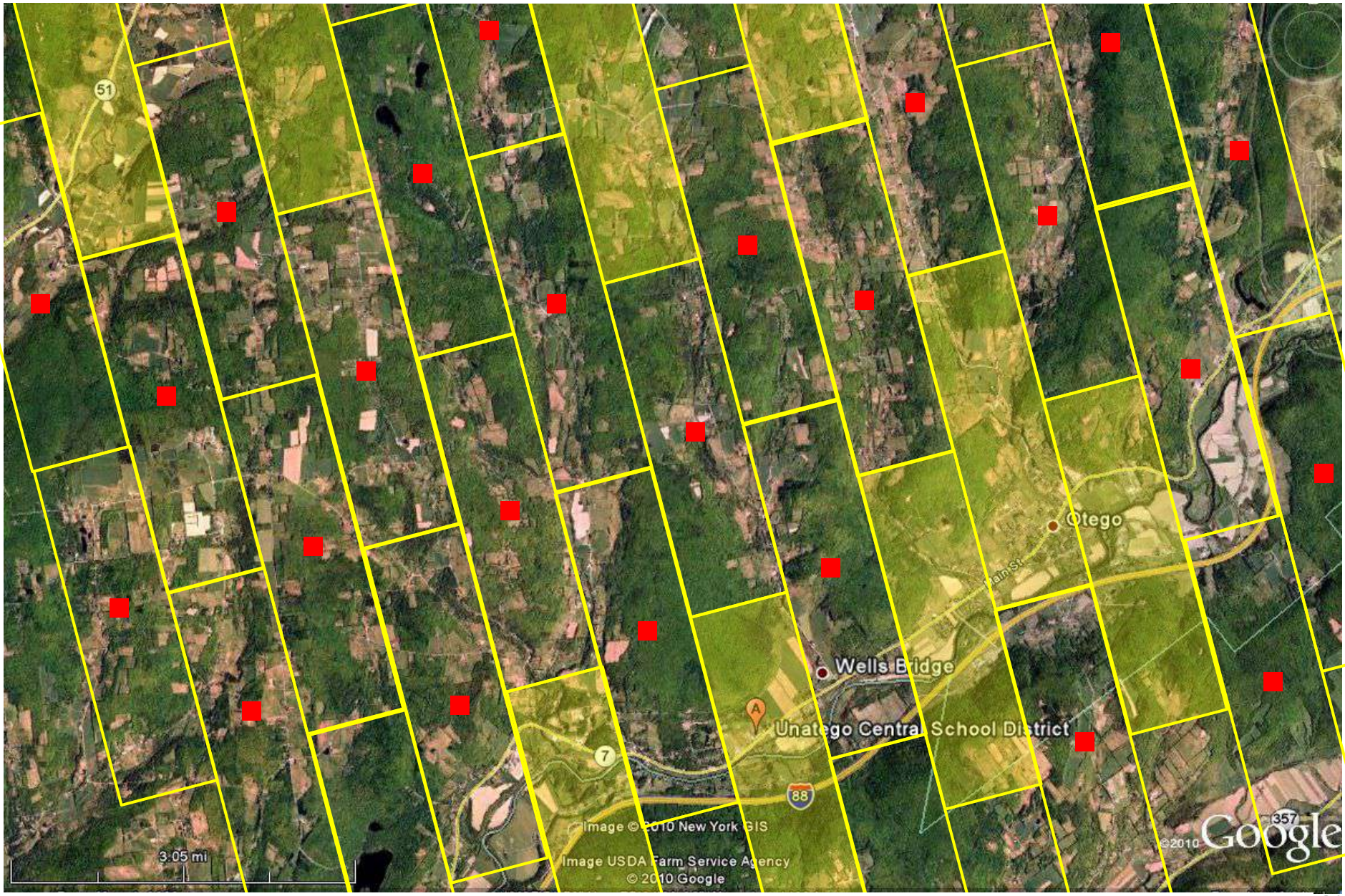


Leases in Otsego County

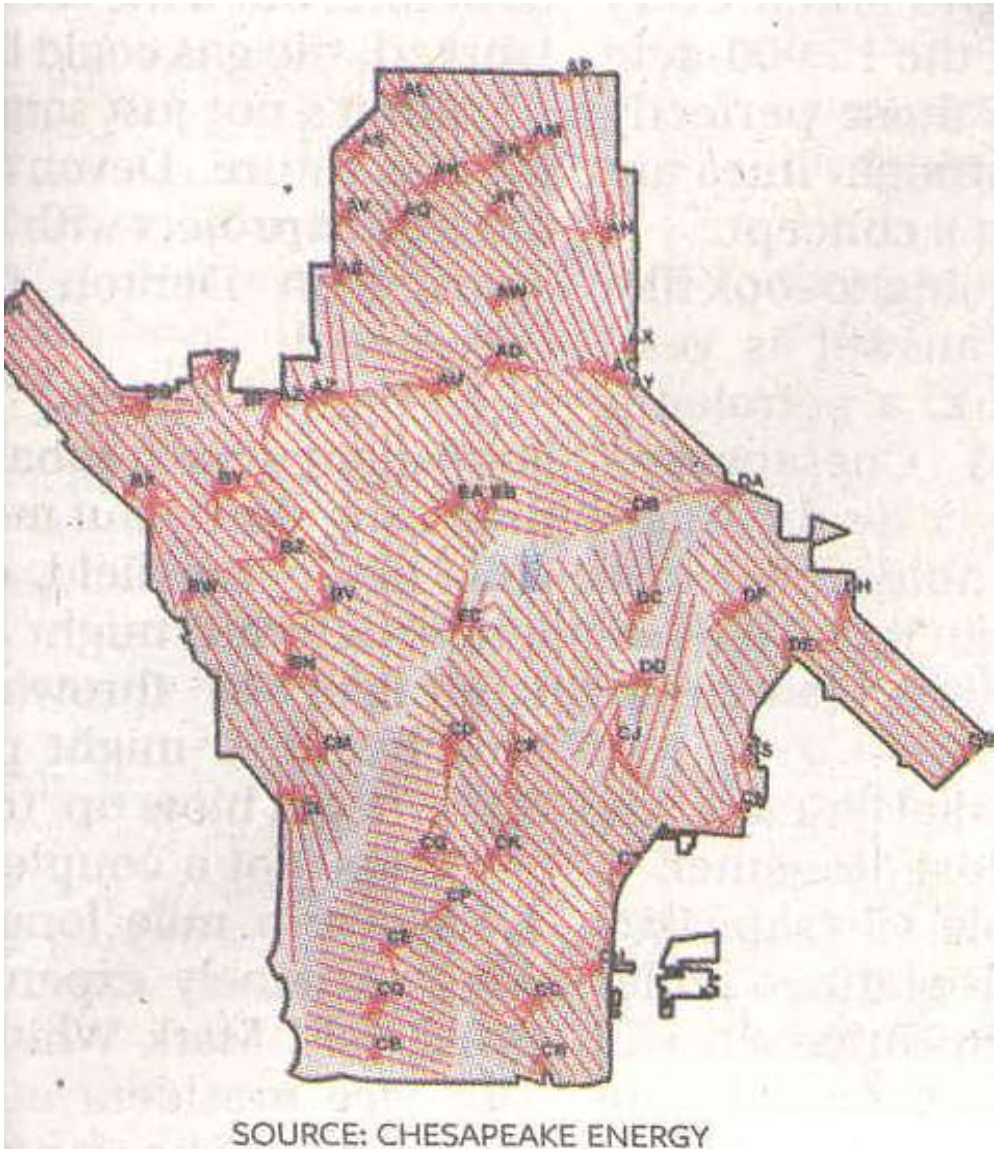
To Maximize Gas Recovery:
Minimum 1 Pad on 70% of Every Square Mile



Ideal Arrangement of Spacing Units



Example: Dallas/Fort Worth Airport Property, Barnett Shale Play

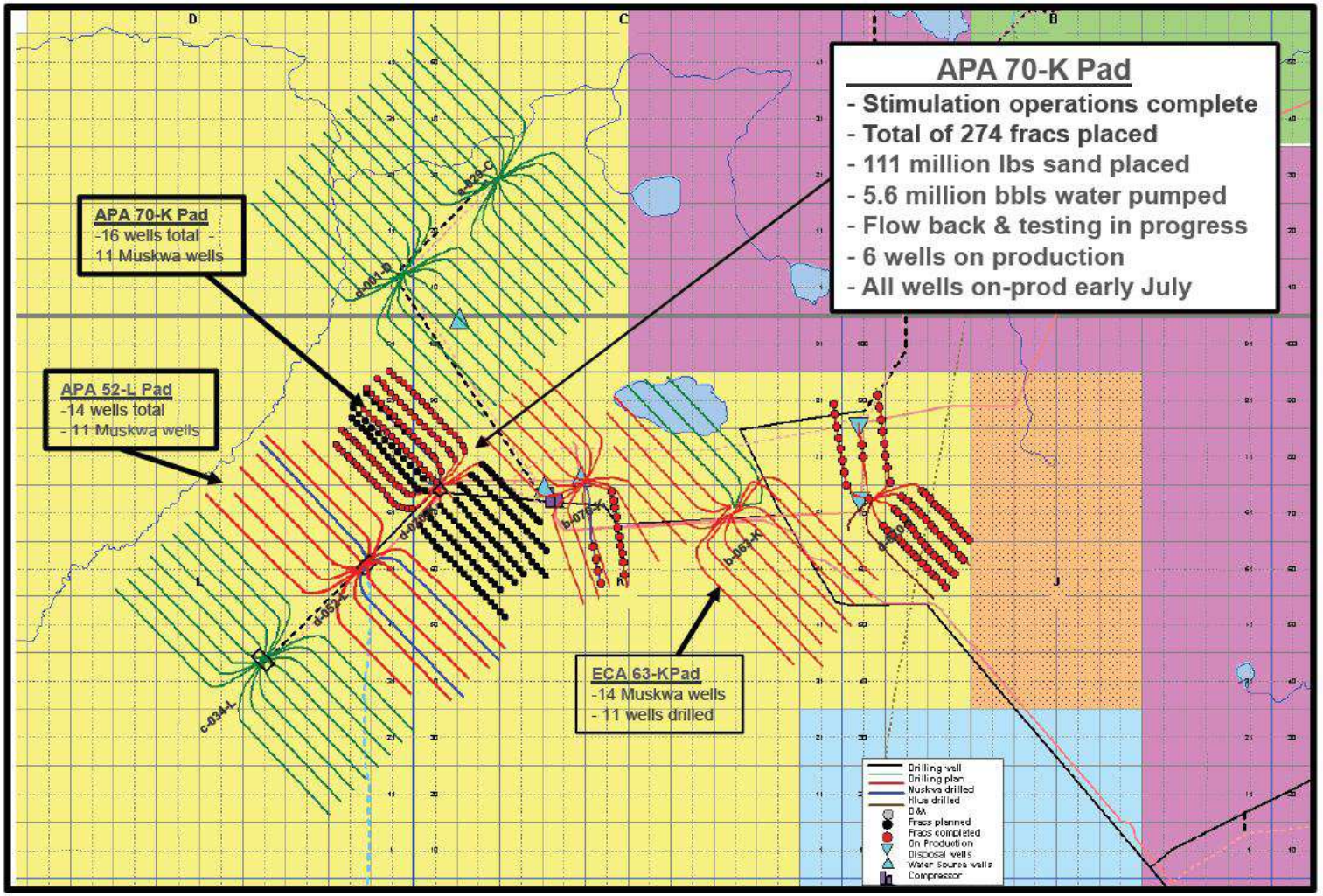


SOURCE: CHESAPEAKE ENERGY

- 53 pads on 18,076 acres
- Almost complete coverage
- Patchwork, mostly ideal units
- One developer

Horn River Area, NE British Columbia

Two Island Lake Operations Status



World's Largest Frac Job

Apache CORPORATION

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How Much Water For Each Well?

- Depends on number and size of hydraulic fracture treatments in that well
- Typically, much more than 1 million gallons
- There…
- That's
- That's at least 1,000 seconds, 15 minutes, of flow in your favorite stream which flows at 100 CFS.
- Need large river flow rates, or lake supply to meet this demand

Chesapeake is averaging 5.5 million gallons/well in PA Marcellus play.

http://hydraulicfracturing.aitrk.com/Pages/information.aspx

What Else Goes Down The Well With All That Water?

Proppant: Particles, like sand, transported into the fractures to keep them open a

Gelling Agents: Increa

Biocides: Kill bacteria

Breakers: Decrease v
fracturing process

Fluid-Loss Additives:
rock.

Anti-Corrosives: Prot

Friction Reducers: Allow high pressures and flow rates.

Acid : Clean out perfs, well, fractures

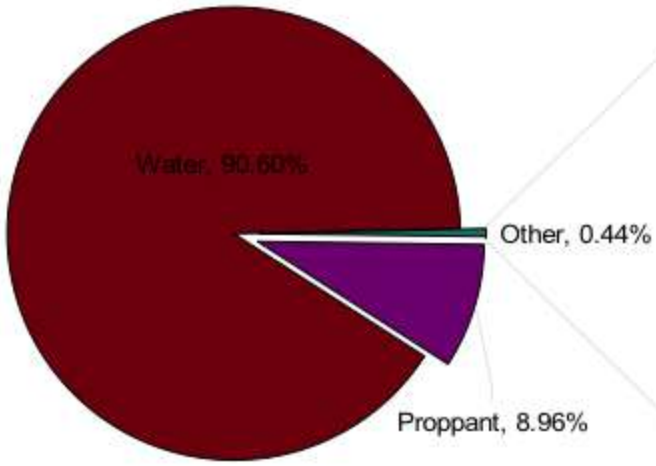
A Cocktail of Non-People-Friendly Fluids

http://www.epa.gov/OGWDW/uic/pdfs/cbmstudy_attach_uic_ch04_hyd_frac_fluids.pdf

http://www.earthworksaction.org/hydfracking.cfm

Breakdown of Additives to Fracturing Fluid

Remember: 0.5% of 5 million gallons is 25,000 gallons



Acid, 0.11%

Breaker, 0.01%

Bactericide/Biocide, 0.001%

Clay Stabilizer/Controler, 0.05%

Corrosion Inhibitor, 0.001%

Crosslinker, 0.01%

Friction Reducer, 0.08%

Gelling Agent, 0.05%

Iron Control, 0.004%

Scale Inhibitor, 0.04%

Surfactant, 0.08%

pH Adjusting Agent, 0.01%

From NYS DEC's SGEIS, 2009

What Comes Back Up?
Called FLOWBACK Fluid and Produced Water

- When the fracturing process is completed, the pressure is released, and much of the fracturing fluid backflows to the wellhead*.

- The backflow will:

➢ be highly saline;

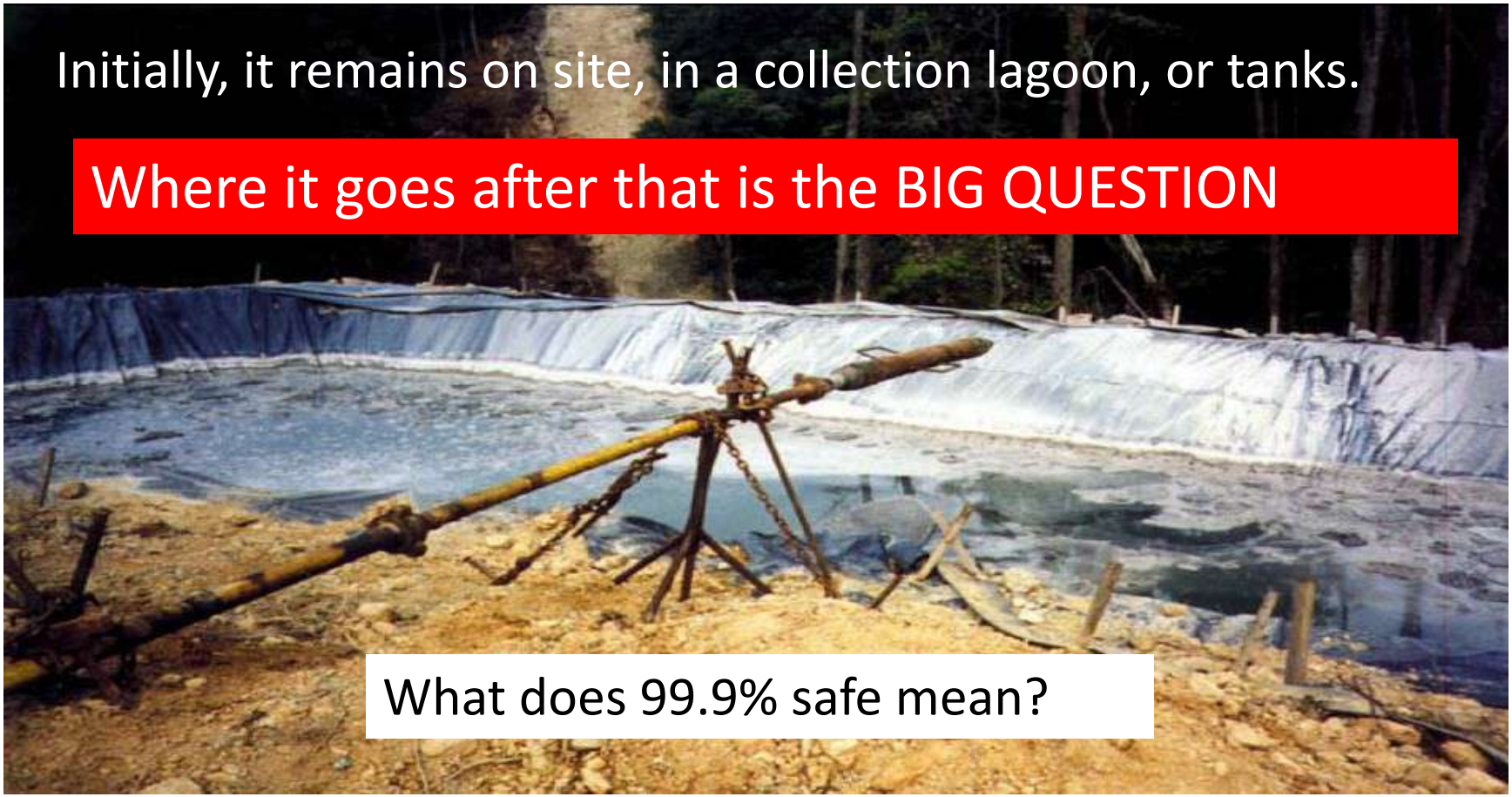
➢ contain some heavy metals (e.g. barium, strontium);

➢ contain non-people friendly fluid additives;

➢ contain a level of NORM.

*Industry spokespeople say 10-50% of injected fluid flows back. Of course they will low-ball that estimate, but the volume varies from well to well and over the measurement time.

Where Does The FLOWBACK Go When It Comes Back UP?



http://www.epa.gov/OGWDW/uic/pdfs/cbmstudy_attach_uic_ch04_hyd_frac_fluids.pdf

Centralized Flowback Storage Facility Under Construction in PA

http://www.donnan.com/Marcellus-Gas_Hickory.htm

How many Pads, Wells?
How Much Water, Flowback?

To extract a significant percentage of the gas, ***at least*** one pad per square mile will be required, each with multiple wells. Ultimately, ***more pads per square mile*** might be needed. Let's look at just a sample 6 county area.

Here are some **target** estimates to remember:

County	Area (sq. mi)	Pads @ 1/sq. mi.	Wells @ 8/Pad

Recall that Engelder's predictions require a minimum of 8 wells/sq mile, with 70% coverage: **31,000 wells**

31,000 wells @ 5 million gallons/well = **155 billion gallons of water**
31,000 wells @ 1.5 million gallons/well = **46 billion gallons of flowback**

155 billion gallons of water **drains Onondaga, Otisco, Hemlock, Conesus, Hemlock and Canadice Lakes**.
46 billion gallons of flowback **fills Onondaga lake with 10 billion gallons extra.**

“Recycling” of Waste Fluids

- 400,000 wells in the Marcellus alone: billions of gallons of waste fluids.
- Traditional O/G waste fluid disposal technique is EPA-regulated Class II deep injection well.
- Not available in PA/NY: unreceptive geology, few existing licensed Class II wells.
- Therefore, “recycling” and/or “reuse” key to reduction in environmental and health impact.

“Recycling” of Waste Fluids: Confusion in Terminology

“Recycling“ might mean **“reusing”:** dilute flowback fluid with fresh water and reinject. CHK has pioneered this approach. Many companies refuse to use this technique for various technical and economic reasons.

“Recycling" might mean **"special processing"** of the flowback fluid, using methods like distillation and a number of other techniques, onsite, or offsite.

The Industry Is Still in the R&D Stage of "Recycling" Technologies

"With fortunes, water quality and cheap energy hanging in the balance, exploration companies, scientists and entrepreneurs are scrambling for an economical way to recycle the wastewater.

"Everybody and his brother is trying to come up with the 11 herbs and spices," said Nicholas DeMarco, executive director of the ***West Virginia Oil and Natural Gas Association.*** "

AP Sunday, February 7, 2010

From Halliburton:

"...The industry is also trying to find ways to recycle the water used in fracturing in order to reduce the effect on local water supplies.

"We're still in the infancy of trying to figure out how to recycle the water," said Ron Hyden, the manager for Halliburton's production enhancement business. "We're trying to be good corporate citizens on that front.""

HOUSTON CHRONICLE, Fri 12/11/2009

The Industry Is Still in the R&D Stage of "Recycling" Technologies

From Chesapeake:

Recycling Technology
Why can't the water generated from natural gas production be recycled?

Most of the water generated from natural gas production contains too many naturally occurring minerals, such as salt, to be recycled effectively. ***There has been some success in recycling the first 5% of produced water during flowback operations.*** However, by the end of the first few days after fracing (and in some cases a few hours), salt content of the produced water can reach as high as 70,000 parts per million (ppm), more than twice the salinity of seawater (30,000 ppm). ***The majority (95%) of the produced water returned from the well, with its high salt content, is too saturated to make recycling currently economically viable.*** Chesapeake and others in the industry are constantly evaluating opportunities to treat produced water, so that less of it will need to be injected into saltwater disposal wells.

http://www.askchesapeake.com/MarcellusShale/NY/Water/Pages/SaltwaterDisposalWells.aspx

American Ingenuity Starting to Address The Problem

Integrated Water TECHNOLOGIES

Environmental and Cost Effective Water Remediation

Our Company | Industries | FracPure™ Process | Environmental Benefits | Customer & Vendor Proposals | News & Media | Experience | Events | Employment | Contact Us

FracPure
Produced Water Remediation

The World's Only Complete Water Management Solution for the Natural Gas Industry.

- Natural Gas Opportunity
- Hydraulic Fracturing Problem
- Environmental & Economic Benefits
- Manufacturing
- Permits

pennsylvania
DEP Demo

FracPure™ 3 Stage Solution

Stage One
The Supply of Water

Stage Two
On-Site Water Treatment

Stage Three
Crystallization/Desalinization

A "Cradle to Grave" Solution

Integrated Water Technologies was founded to create water remediation technologies to help develop natural gas as a clean and abundant green energy source for the future. We developed FracPure™ specifically for the natural gas industry, providing a proven solution to the industry's largest obstacle: Hydraulic Fracturing or Frac Water Management.

The natural gas drilling process hydraulic fracturing or fraccing creates 2 major water management challenges.

- Supplying 4-6 million gallons of fresh water for each well. This water is currently being drawn from local rivers, lakes and streams, negatively impacting water resources.
- The disposal and handling of over 1 million gallons of produced contaminated water for each well, within the first two weeks of drilling.

Our patent pending process, FracPure™ is a revolutionary "cradle to grave" solution which environmentally and cost effectively solves both of these problems, while yielding beneficial salt products and distilled water. FracPure™ water distillate is safe to return to the environment and exceeds all EPA and State environmental regulatory agency drinking water standards.

FracPure™ also drastically reduces trucking costs for natural gas companies both on incoming freshwater supplies and outgoing disposal.

FracPure™ Solution

FracPure™ is the World's only complete water management solution for the natural gas

Watch our full length video demonstrating the FracPure™ Process

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

FracPure™ is the world's only 100% frac water remediation, which was proven in a demonstration to the Pennsylvania Department of Environmental Protection.

American Ingenuity Starting to Address The Problem

AQUA PURE

Wastewater Solutions | In-House Capabilities | Investor Center | Downloads | Contacts

Industrial Wastewater SOLUTIONS

Municipal Wastewater SOLUTIONS

Wastewater Solutions

- Industrial Solutions
- Case Studies
  - Mobile Wastewater Recycling - NOMAD 2000
  - Frac Flowback Recycling
  - SAGD Produced Water Recycling
  - LPG Storage Cavern – Brine Pond Concentrator
- Municipal Solutions

Wastewater Solutions

Frac Flowback Water Recycling

Natural gas wells often require large volumes of fresh water to frac or stimulate production. While underground, the water dissolves a range of contaminants and a number of chemical additives making the flowback water unsuitable for environmental discharge. Producers currently pay a great deal of money to purchase fresh water, haul the fresh water to site, haul contaminated water to a disposal well, and pay for disposal. Installing an Aqua-Pure evaporator in areas where high levels of well fraccing take place reduces fresh water supply volumes, water hauling volume and produced water disposal by up to 90%. This drastically reduces the cost of natural gas production, especially in areas where fresh water is scarce and/or disposal costs are high.

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Recent Article
Mobile Evaporators - Clean Water To Go In Texas.

Cost Comparison


Wegmans
Wastefluid Recycling Facility
Carpenter St
Center Pl
W 3rd St
2nd St
W Church St
220
Via Bella St
Hepburn St
Image PA Department of Conservation and Natural Resources-PAMAP/USGS
©2010 Google
814 ft
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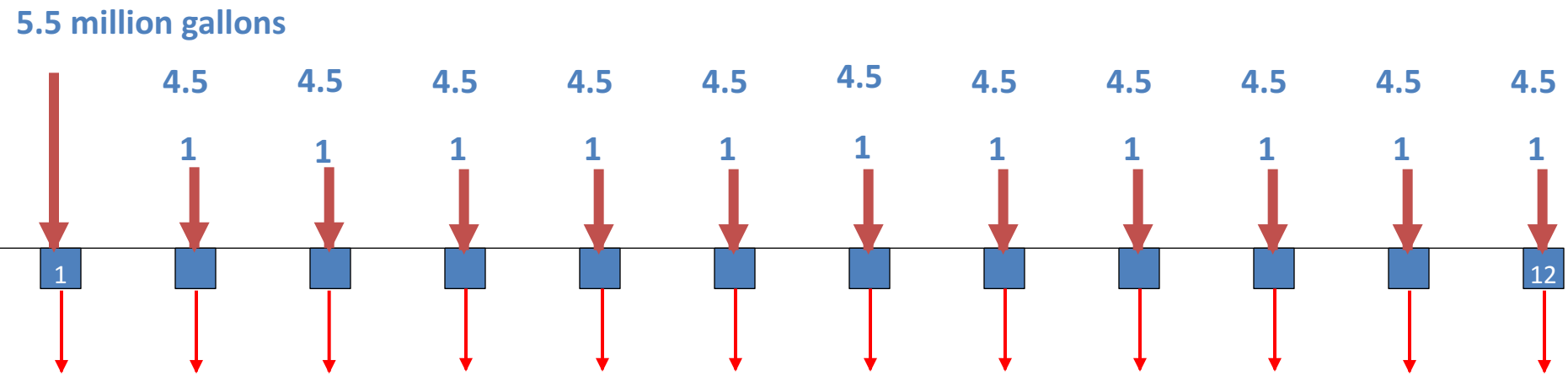
Schematic Flowchart of "Ideal" Recycling Capability

For a 12-well pad, assuming CHK PA average 5.5 mmgallons/well injection, 27% short-term flowback fluids, and 66% recycling recovery from flowback fluids:



KEY:

Blue = "Fresh" Water

Red = Flowback Fluids

Total Fresh Water to Pad:

With recycling: 5.5 + 11*4.5 = 55 million gallons

Without recycling: 5.5*12 = 66 million gallons

Total Flowback Fluids from Pad:

With recycling: 0.5*11 + 1.5 = 7 million gallons

Without recycling: 1.5*12 = 18 million gallons

American Ingenuity Starting to Address The Problem

DOE funds nine shale gas, CBM technology efforts

WASHINGTON, DC, Aug. 19 -- The US Department of Energy's National Energy Technology Laboratory is supporting nine projects targeting environmental tools and technology for shale gas and coalbed methane production, DOE's Fossil Energy Office announced.

ALL Consulting of Tulsa will receive $776,574 to go with $334,496 it is providing for a 36-month project to help operators and regulators plan all aspects of water management associated with shale gas development, the DOE office said.

It said General Electrical Co. of Niskayuna, NY, will receive $799,897 to use with $199,976 of its money for an 18-month project to develop a low-cost mobile process to treat total dissolved solids in hydraulic fracturing operations' flowback water.

A 32-month project at the University of West Virginia in Morgantown, which includes development of a pretreatment filter and associated elements for handling frac water returns from Marcellus shale wells is scheduled to receive $609,619 from DOE to go with the $390,381 it has already, according to

DOE funds nine shale gas, coal bed methane recycling technology efforts

The Ground Water Protection Research Foundation in Oklahoma City is due to receive $845,923 to go with $211,474 which it has budgeted to develop a new hydraulic fracturing module as an add-on for regulators and operators to use with GWPRF's risk-based data management system, the DOE office continued.

The Fossil Energy Office said that Altela Inc. of Albuquerque is scheduled to receive $886,025 for use with $912,316 of its own money for an 18-month demonstration of its AltelaRain technology to treat Marcellus shale produced and flowback water under state and federal regulations.

It said that it will provide $794,225 for the University of Pittsburgh to use with $269,011 of the school's money for a 36-month evaluation of the potential for combining and treating two waste streams (flowback water and acid mine drainage) for reuse as a fracturing fluid. Some of the money also will be used to develop novel viscosity modifiers for water high in total dissolved solids, the DOE office said.

It said the ninth project it is supporting will be a 24-month effort at the Texas Engineering Experiment Station at College Station to identify an efficient and cost-effective pretreatment method of treating and re-using field-produced brine and fracture flowback waters. DOE said that its share of the cost will be $844,216 while the recipient will provide $450,000

Outline of Presentation

- Where and Why Marcellus Shale Gas: Why Us?
- The Potential Scale of the Play in NY: Be Prepared for Big Numbers
- The Technique of Drilling and Fracturing: "Fracking"-The Movie
- Water: How Much, From Where
- Fracturing Fluid: What Is It and Why
- Fracturing Fluid: Where Does It Go and What Goes with It?
- Is It All Worth It? My Opinions, You Decide

The Letter I Wish Had Been Written

July 1, 2007

To: The Citizens of States Over the Marcellus
From: The Natural Gas Industry

We are writing to ask your permission to develop shale gas in your states using high-volume, slickwater, hydraulic fracturing from long horizontal well legs (HVSHF).

Although you have allowed us to produce oil and gas from thousands of wells over many years, we recognize that we are now asking you to allow us to do much more intense development than ever before, using a technology never before used in your area. We acknowledge our development plan for your states might eventually involve over 400,000 Marcellus wells alone, with thousands more in other shales, and be valued in the trillions of dollars, over decades to come.

We have seen how such intense development with this technology has caused problems where we are using it already in gas shales. We have listened closely to your concerns about these problems, and others on the horizon, so we are writing you now to make a compact with you. We understand that you are granting us a privilege, that, collectively, all of you have to give us the right to develop your gas, because, quite honestly, our plans will significantly affect all of you, not just landowners with whom we might have a business relationship.

Therefore, if you give us the permission we seek, here are our promises to you:

1.Since we will not be developing in your area for another 2-3 years, we have time to help you prepare for our arrival:

*** We will immediately fund appropriate training programs in your community colleges to produce homegrown workers for our industry. We will subsidize tuition for the students who commit to work in our industry. Those workers will get right-of-first-refusal on our job openings.**

*** We will immediately fund appropriate training programs for your emergency response teams--fire, police, medical, and spill hazards--and we will equip them at our expense.**

*** We recognize that our heavy equipment will damage many of your roads and bridges. We will start now to pay to upgrade these so that they all remain usable not just by our equipment, but by you, too, throughout the development process. This will be a "stimulus" to help your unemployment situation now. When development is complete in an area, we will pay for final repairs necessary to leave all impacted roads and bridges in state-of-the-art condition. This will be a legacy gift to you from our industry.**

*** We will fund the construction or upgrading of regional industrial waste treatment and disposal facilities with adequate capacity to process safely all of the solid and liquid wastes we produce. We will not truck your wastes to other states.**

2. We will be transparent about our entire plan for development:

*** We will tell you as soon as practicable, but no later than 1 year before start of activity, where and when we will drill, and what pipelines and compressor stations will be needed where and by when.**

*** We will publish gas and waste production figures from every well, accurately, and on-time.**

*** We will tell you where your gas is going to market. We will not sell your gas to a foreign market.**

*** We will disclose, completely, all chemicals and other substances we use.**

3. We will accept, without debate, all new regulations that might be proposed by your regulatory agencies: your existing regulations are inadequate to cover the new technologies and cumulative impact of HVSHF. We will offer your agencies suggestions for continuous evolution of the regulations as a result of lessons we are learning.

4. With respect to your natural environment legacy:

*** For every tree we uproot, we will plant at least 1 replacement.**
We will reforest all access roads as quickly as we can, and minimize the width of all forest cuts.

*** We will pay a fair price for the water we extract from your lakes and rivers, which will average several million gallons per gas well.**

*** Whatever we break, despoil, or pollute, we will repair, replace, or remediate, at our expense.**

5. We will safely dispose of all liquid and solid wastes from our development:

*** We will never store any flowback fluids or produced water in open pits. All such fluids will be recycled to the highest extent possible by existing technologies, regardless of increase in cost to us.**

*** All liquid and solid wastes remaining from recycling will be treated at the above-mentioned industrial waste treatment plants.**

*** We will provide radiation monitoring equipment on every well pad: any materials, including drill cuttings, leaving a well pad that trigger an alarm will be sent to a licensed radioactive waste disposal facility.**

6. We will not cause an increase in any tax levy on your citizens.

*** We will agree to a substantial increase in permit fees to reflect the expected 4-fold increase in person-time we expect you to spend on review of permits for HVSHF.**

*** We will agree to a state severance tax, the level of which will be floating, according to an accurate accounting of all costs to the state and municipalities.**

7. We will practice what we preach about clean fuels and emissions:

*** Every truck, every generator, every pump, every compressor will run on natural gas--no diesel, no gasoline engines.**

*** We will not allow uncaptured gaseous emissions from any of our processes: no evaporation from open pits, no pressure releases from compressor stations or condensate tanks.**

8. We will be sensitive to noise and light pollution, even if a community does not have zoning restrictions in place to regulate such:

*** All of our pads and compressor stations will have sound/light suppression measures in place before startup.**

*** Site drill pads, compressor stations, and pipelines in collaboration with the community.**

9. We will not unduly stress any of your communities:

*** We will never experiment with drilling many wells in a small area over a brief period of time.**

*** We will abide by all area and time restrictions on permitting.**

*** We will never contest loss of well water use by any citizen. If a well is lost, we will replace it with whatever type of supply is requested by its owner at our expense.**

*** We will never require a citizen harmed by our development to promise silence in return for remediation.**

Finally, and humbly, we note that even our best plans and efforts will come up short, sometime, someplace, somehow. ***Therefore, in addition to all the contributions noted above, we also pledge to establish an escrow account which will receive 1% of the value of all gas produced from shale gas wells using HVSHF each year. This account will be administered by an independent 3rd party, advised by an independent panel you select, and will be used as an emergency fund to compensate those financially or physically harmed by our development in your state.***

Thank you for your attention to our request.

What is Acceptable Level of Risk for A Communal Industry?

A ***communal industry*** is one in which large segments of society participate, or are forced to participate

Voluntary Participation: Bridge industry

The steel bridge design specification is calibrated to achieve a 75-year probability of system failure of about 2 in 100,000,000.

That is a reliability of 99.999999 %

Forced Participation: Marcellus Gas Shale Play

In PA in last 3 years, 30 serious environmental accidents from 1900 Marcellus wells (Engelder, 2010). That is a reliability rate of about 98.5%. Acceptable?

0.001 system failures, **total**

My List of Good Reasons for Prohibiting ***Immediate***, ***Intense*** Exploitation of Marcellus Gas Shale in New York

It will benefit a few for a short time, and cost many more for much longer.

Those who will benefit will sell themselves short.

Technologies for waste disposal immature; risks from spills, blowouts too high.

It will cause loss of life, loss of habitat, loss of infrastructure, loss of income and the "fingerlakes quality of life" for many: without any current source of compensation for these losses.

It prolongs the inevitable shift to renewable energy sources, while providing negligible impact on national energy supply: PA and WV have already committed, NYS supply is relatively small and should be banked.
Save it for the grandkids.

It will continue to supply CH_4 and CO_2 to an already burdened earth atmosphere.

The Letter I Hope Will Be Written

July 1, 2011

To: The Natural Gas Industry
From: The Citizens of States Over the Marcellus

We have observed, calculated, thought, done the science, and **we have concluded that even "doing it right" is still wrong.**

No thanks. For now.

Thank you for your time.

Think.

Act.

Please, I'd like constructive feedback:

What did I miss?

What did I miss-speak?

Send to: ari1@cornell.edu