

Natural Gas Well Drilling – Issues and Impacts in the Delaware River Basin

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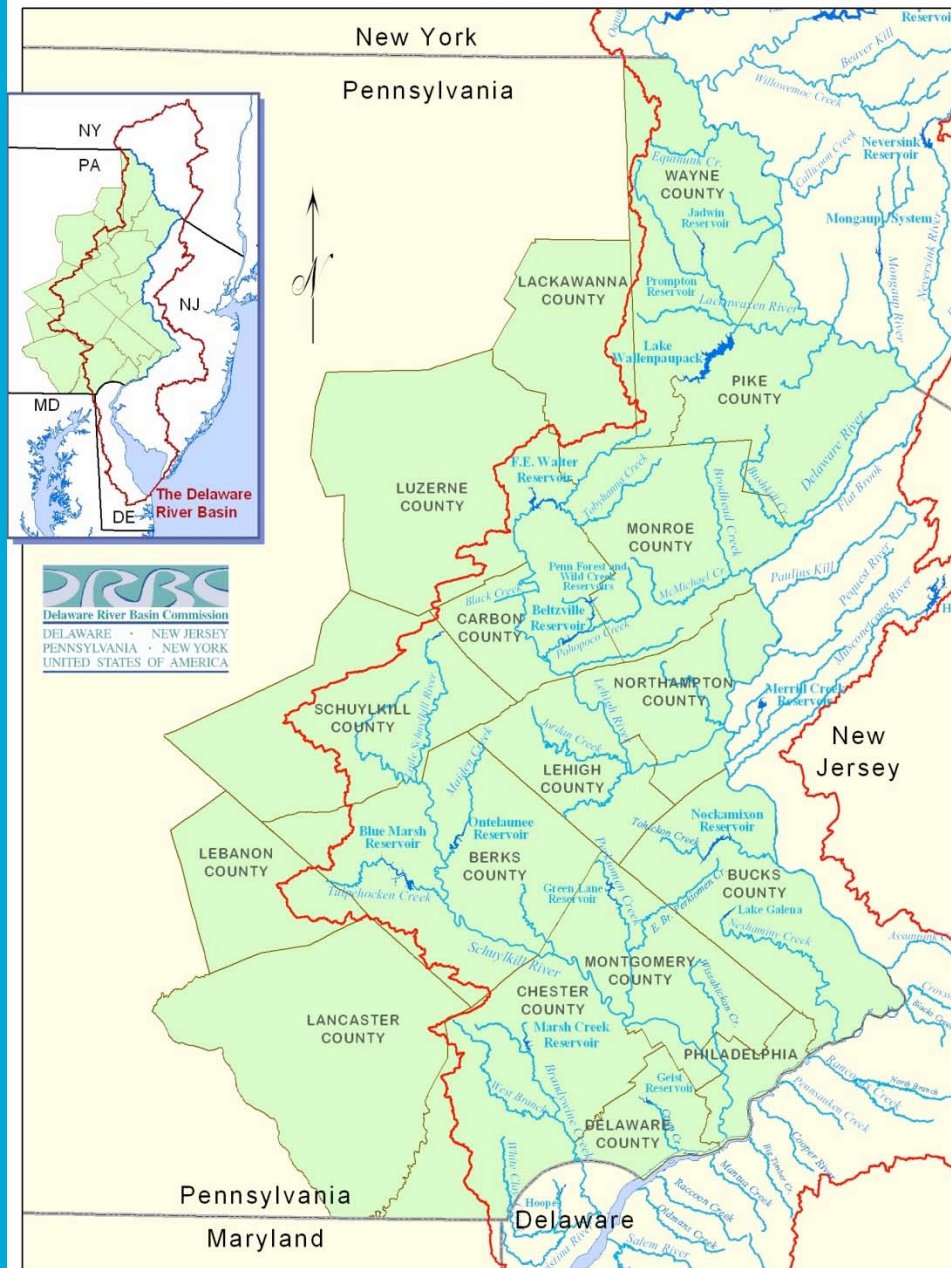


Delaware River Watershed Facts

- ❑ Over 15 million people (about 5% of the U.S. population) rely on the waters of the basin
- ❑ Drains 13,539 mi² , or 0.4 of 1% of the continental U.S. land area



PENNSYLVANIA COUNTIES IN THE DELAWARE RIVER BASIN

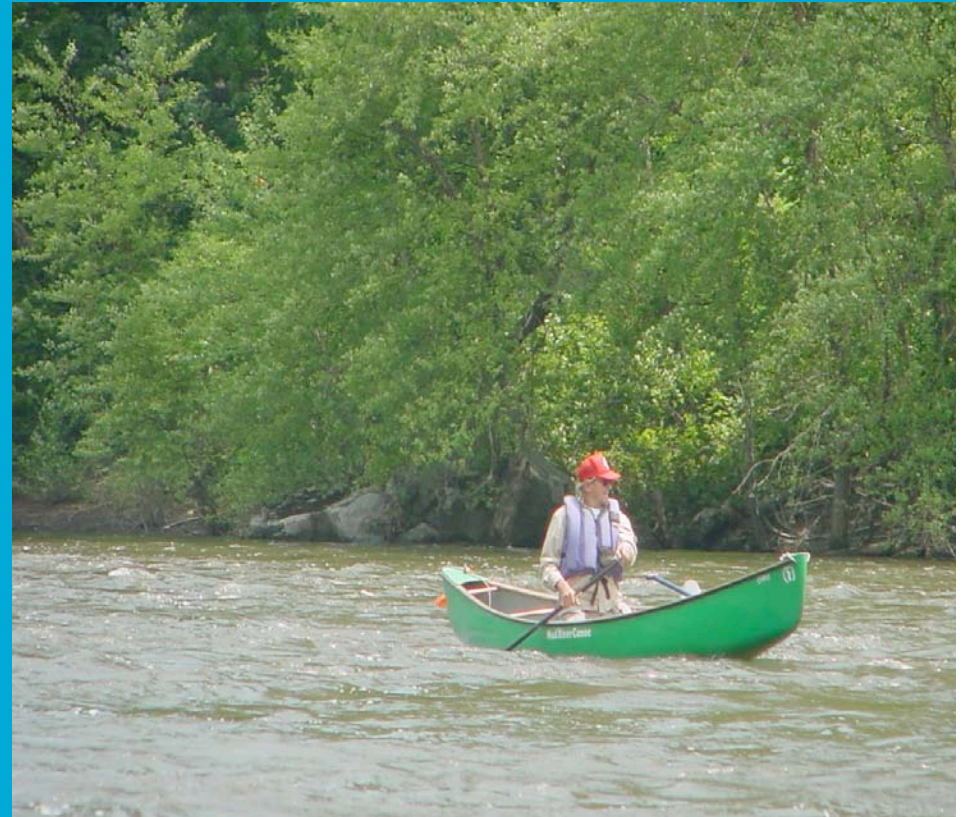


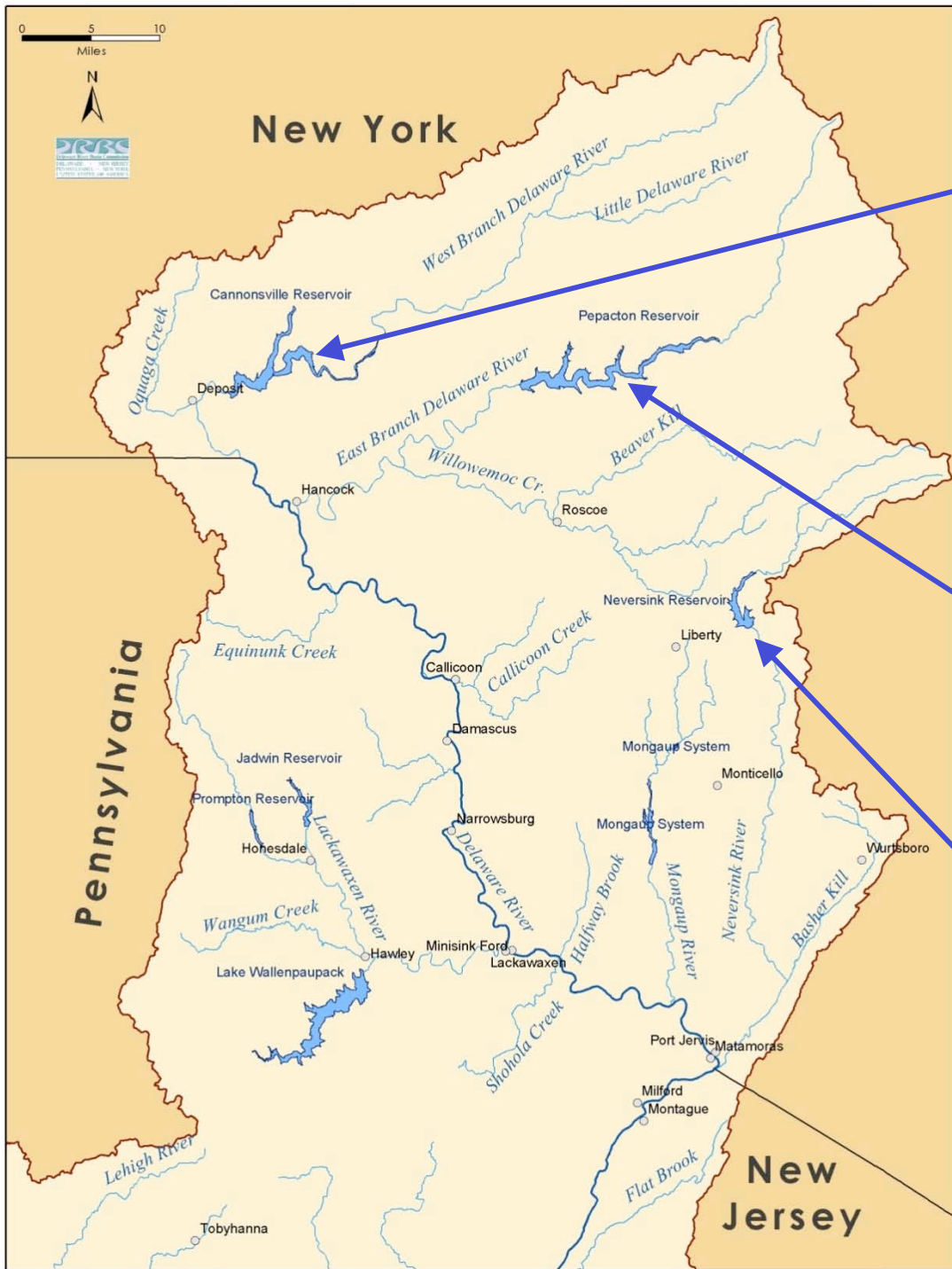
Approximately 5.2 million Pennsylvanians (42% of the state's population) live in the basin, which drains 14.4% (6,456 square miles) of Pennsylvania's total land area.

Delaware River

**Longest Undammed River
East of the Mississippi**

330 miles

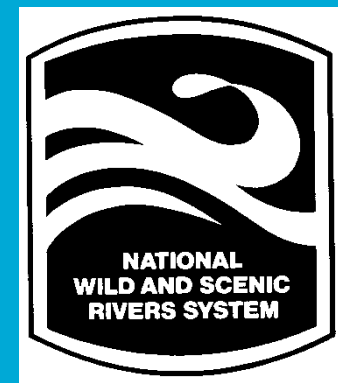




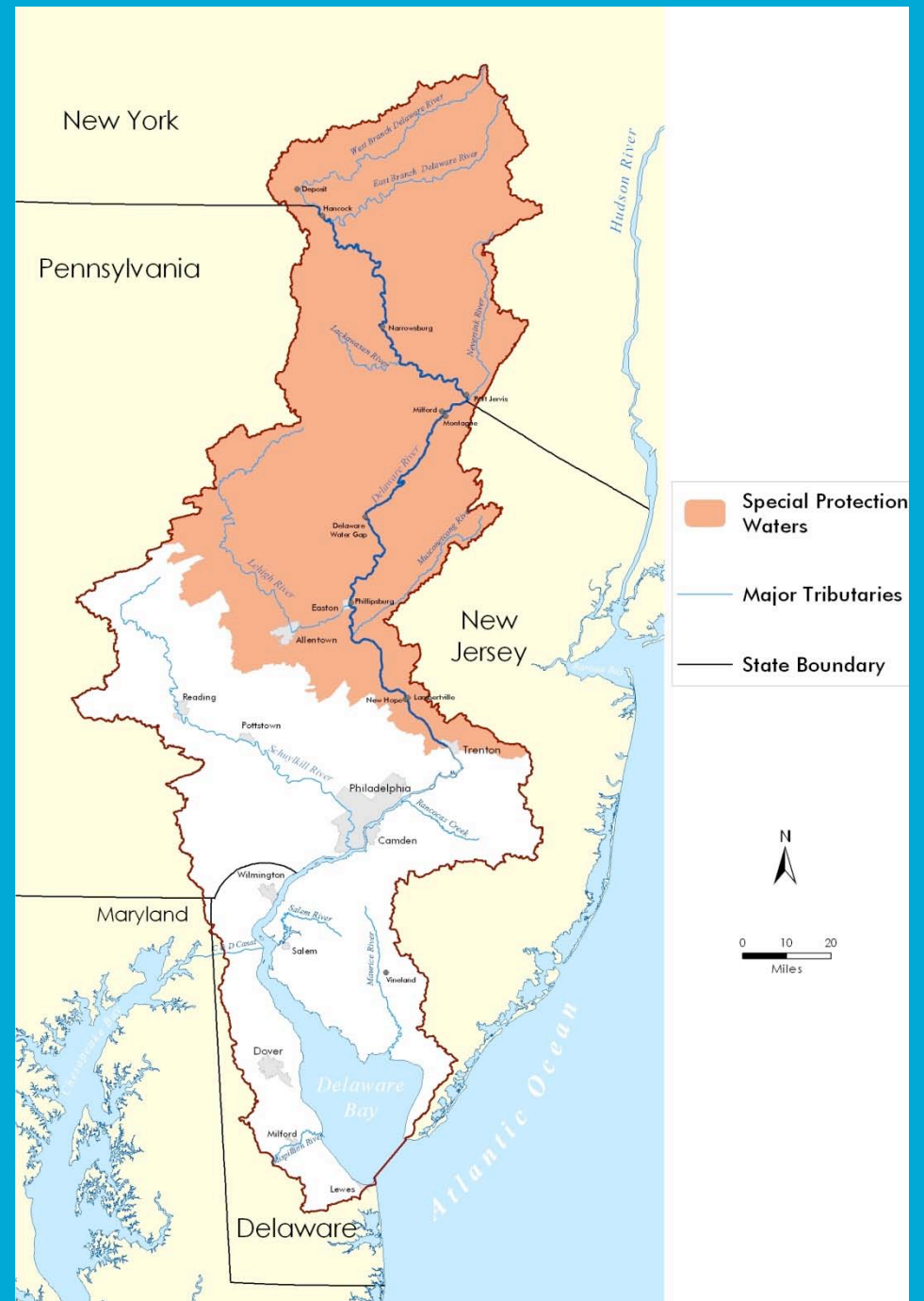
Photos Courtesy NYC DEP



- The U.S. has 3.5 million miles of rivers. The National Wild and Scenic Rivers System includes 11,303 miles of this total, or just over one-quarter of one percent.
- Three quarters of the Non-Tidal Delaware is designated in the Wild and Scenic Program



Special Protection Waters (SPW)

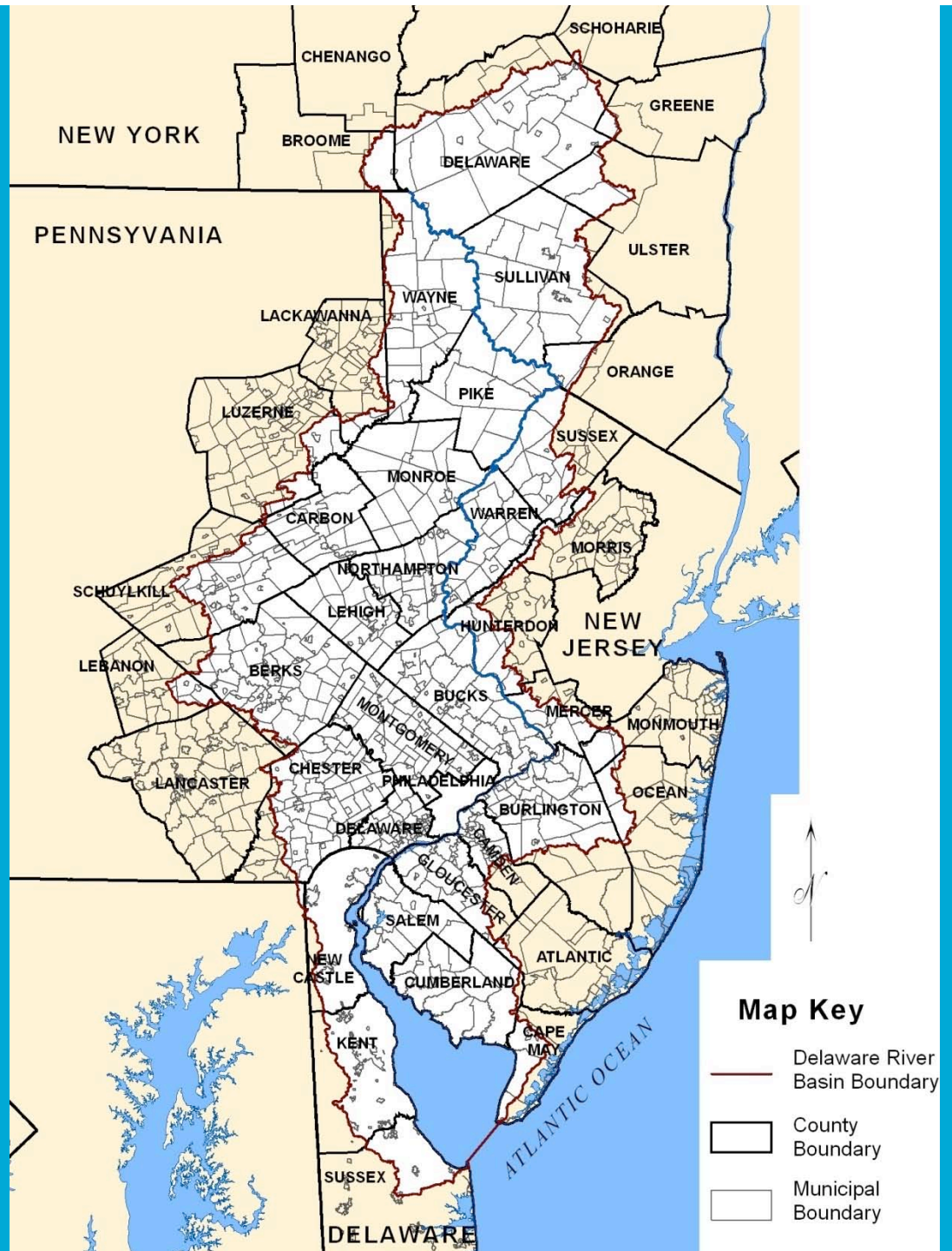


Delaware River Port Complex – Largest Fresh Water Port



The Need for Basin-Scale Planning

- 4 States
- 25 Congressional Districts
- 42 Counties
- 838 Municipalities



Delaware River Basin Commission



WHAT DOES DRBC DO?

- ✓ **Manages Resources on a Watershed Basis**
- ✓ **Regulates Water Quality & Quantity**
- ✓ **Directs a Fair Distribution of Water**
- ✓ **Plans for Best Use of Water Resources**
- ✓ **Coordinates / Facilitates**
- ✓ **Educates about Water Resources**
- ✓ **Is a Forum for Adaptive Management**



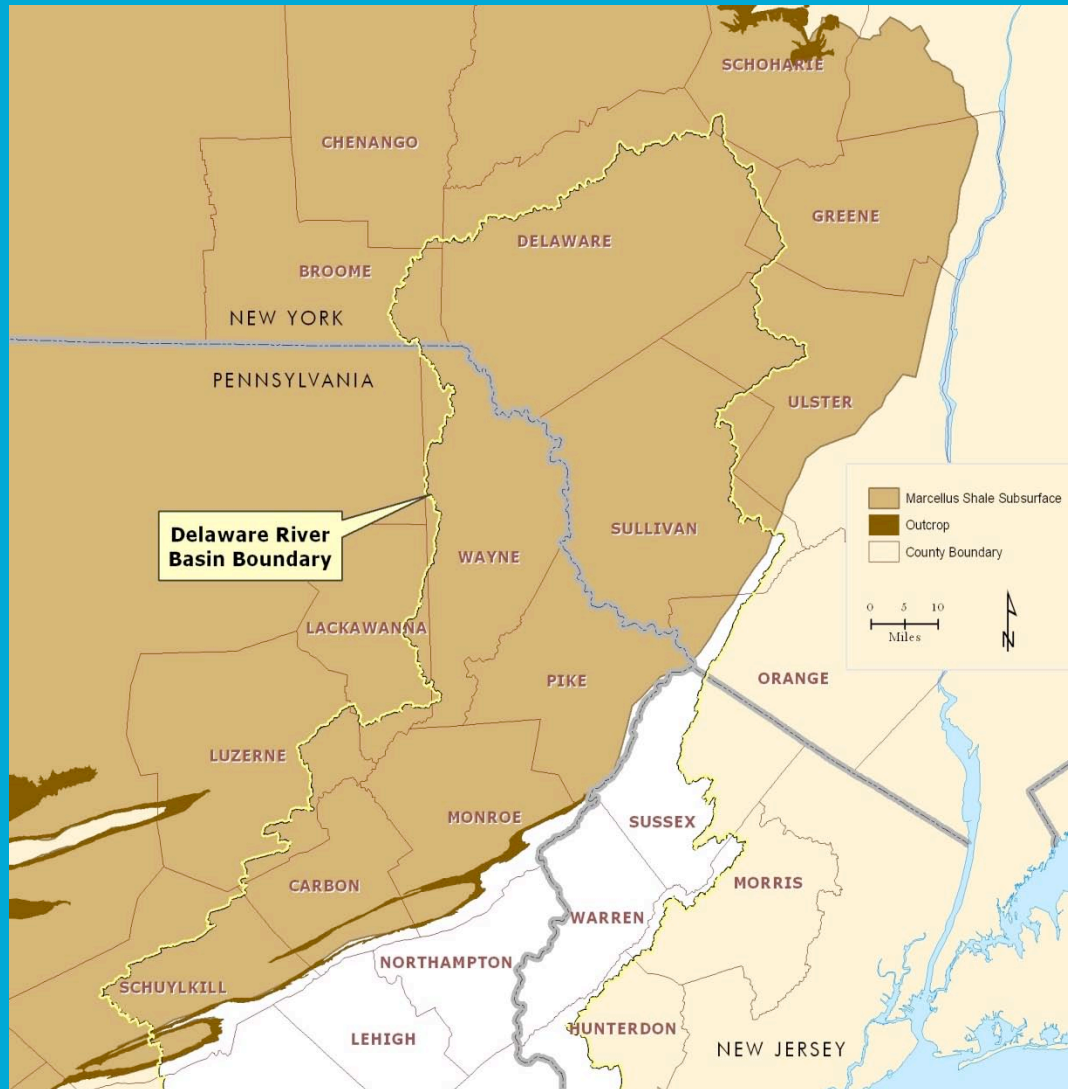


Hydro-fracking Phase –
(a week or two)

Injection pumps, supplies,
and many frack tanks for
fresh and flowback waters



Extent of Marcellus Shale Formation within the Delaware River Basin



**36% (4,937 mi²)
of the Delaware
Basin is
underlain by the
Marcellus Shale**

**100% of the
DRB
Headwaters**



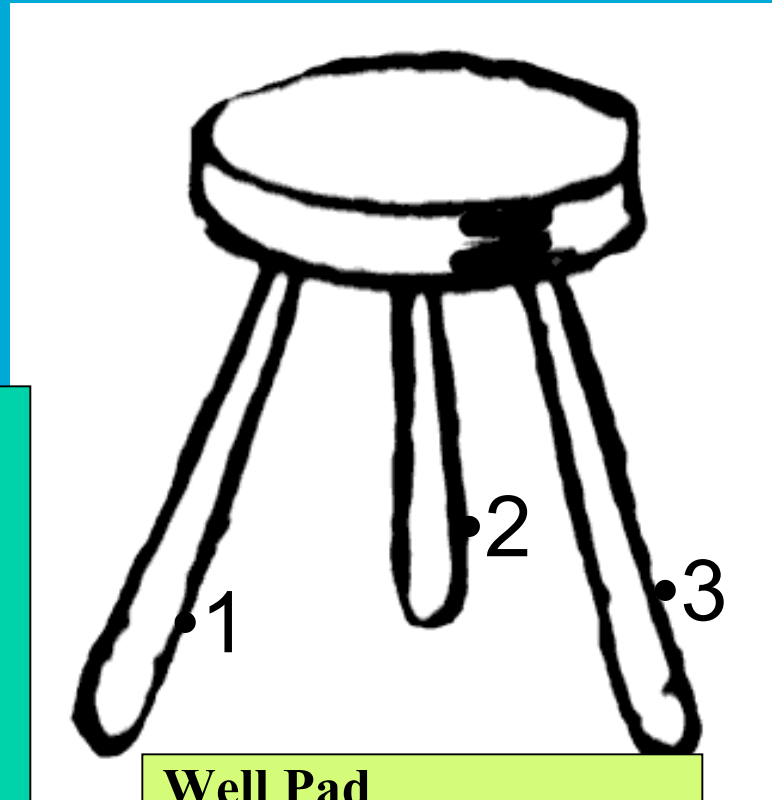
Value of Natural Gas Play

- Economic Value to Country, State, Region and Land Owners
- However, after the Play is finished this region will again depend on recreation, tourism, and the natural environment that has attracted people to the area.
- So.....We need to make sure the operations minimize impacts to the Upper Basin environment.

Delaware River Basin



DRBC Natural Gas Regulatory Strategy



Water Withdrawal

- Protect surface and groundwater supplies
- Preserve ecological flows
- Ensure assimilative capacity for discharges

Well Pad

- Protect forests that produce clean water
- Manage water use & disposal
- Ensure operations to protect surface & ground waters

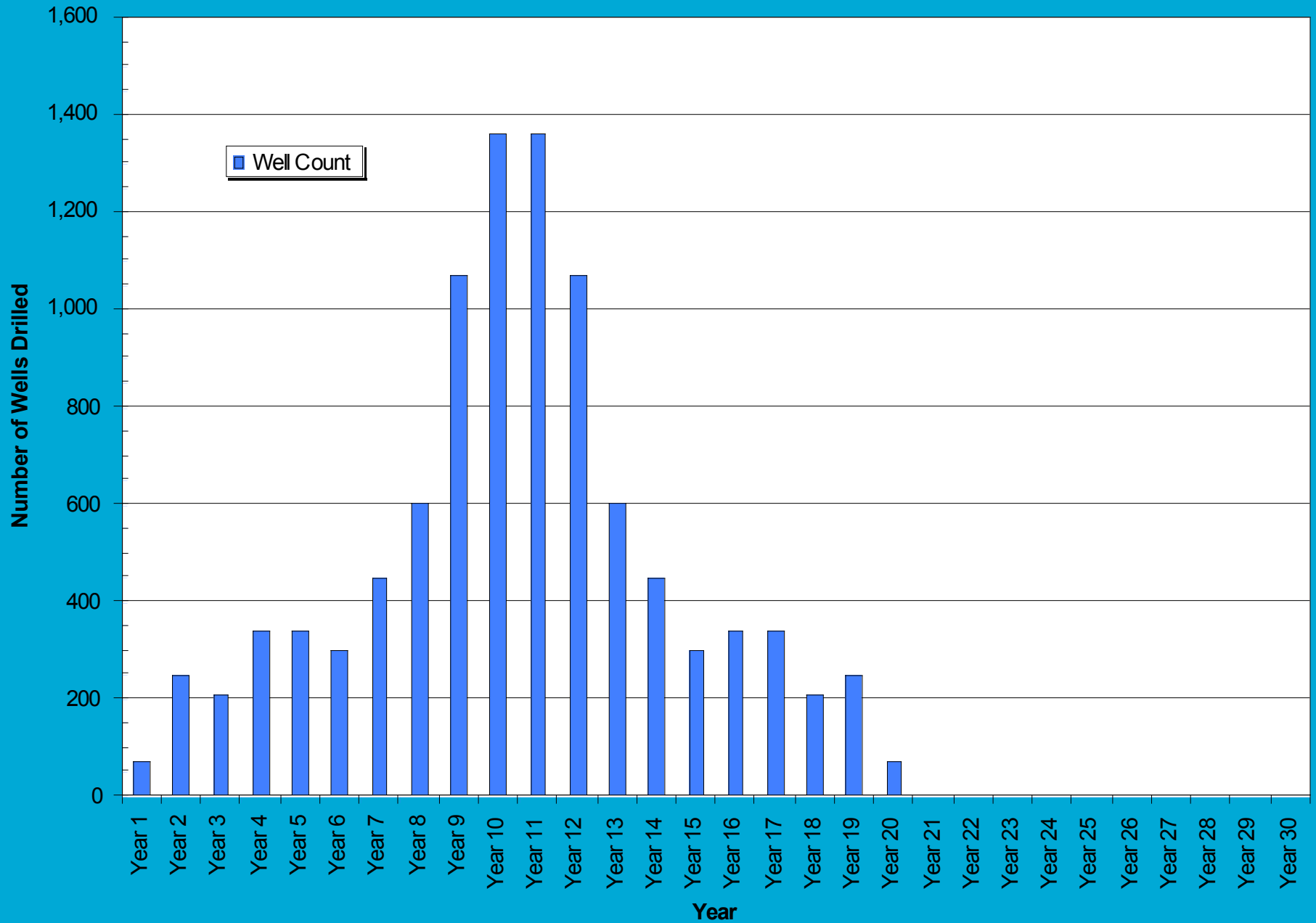
Wastewater Disposal

- Protect receiving water bodies
- Protect groundwater

Estimation of Number of Wells

- Geologic constraints
 - Appalachian structural front
 - Other structures
 - TOC, pore space, unknown w/o exploration
- Regulatory constraints
 - Could slow development pace
 - Areas designated as no drill zones
 - State spacing units
- Number of Drill Rigs
- Our estimates 7,200-28,000 wells
- Assume 10,000 Wells (all water consumptive)

Well Count Estimate
Total of 10,000 Wells, 1,361 Wells Drilled During Peak Years

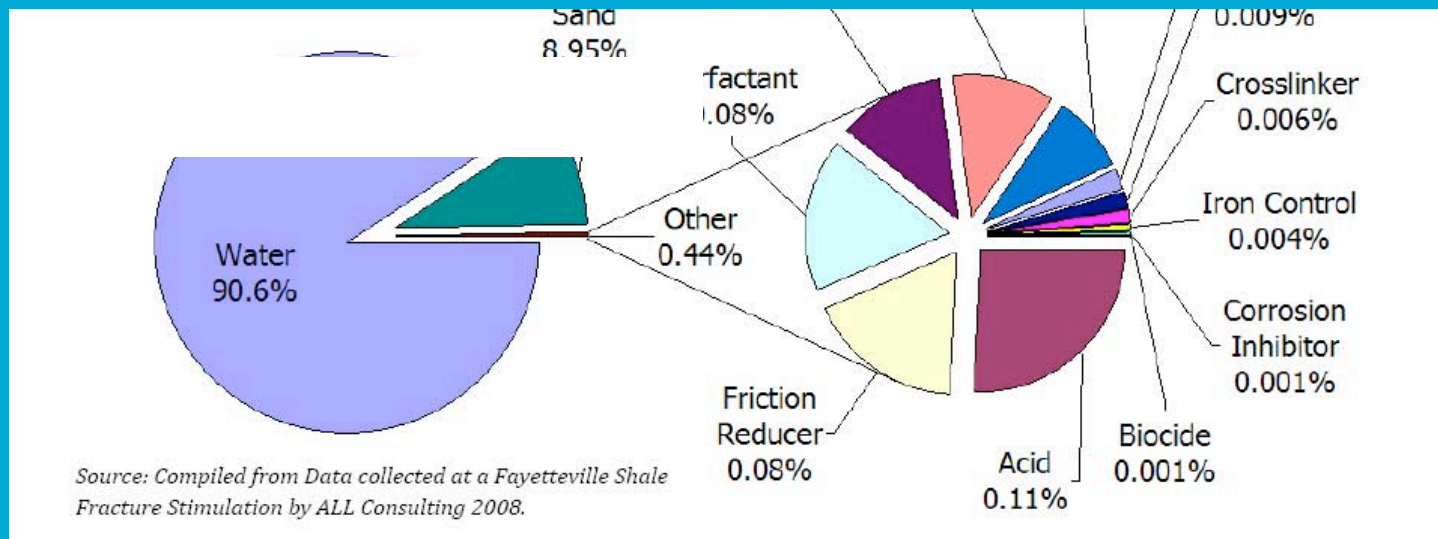


Other Estimates Corrected for DRB

- DRBC Estimate 15 - 19 mgd
- ALL Consulting 75 mgd (4.0 mgd in DRB)
 - calculated for entire Marcellus 95,000 miles²
- SRBC 25 mgd (6.25 mgd in DRB)
 - calculated for entire Marcellus in SRB 19,807 miles²
- Daily Water Withdrawal in DRB= 8.7 BGD

Typical Components of Frack Fluid

For a 1.5 million frack job, the 0.5 percent is equivalent to 7,500 gallons of “chemistry”.

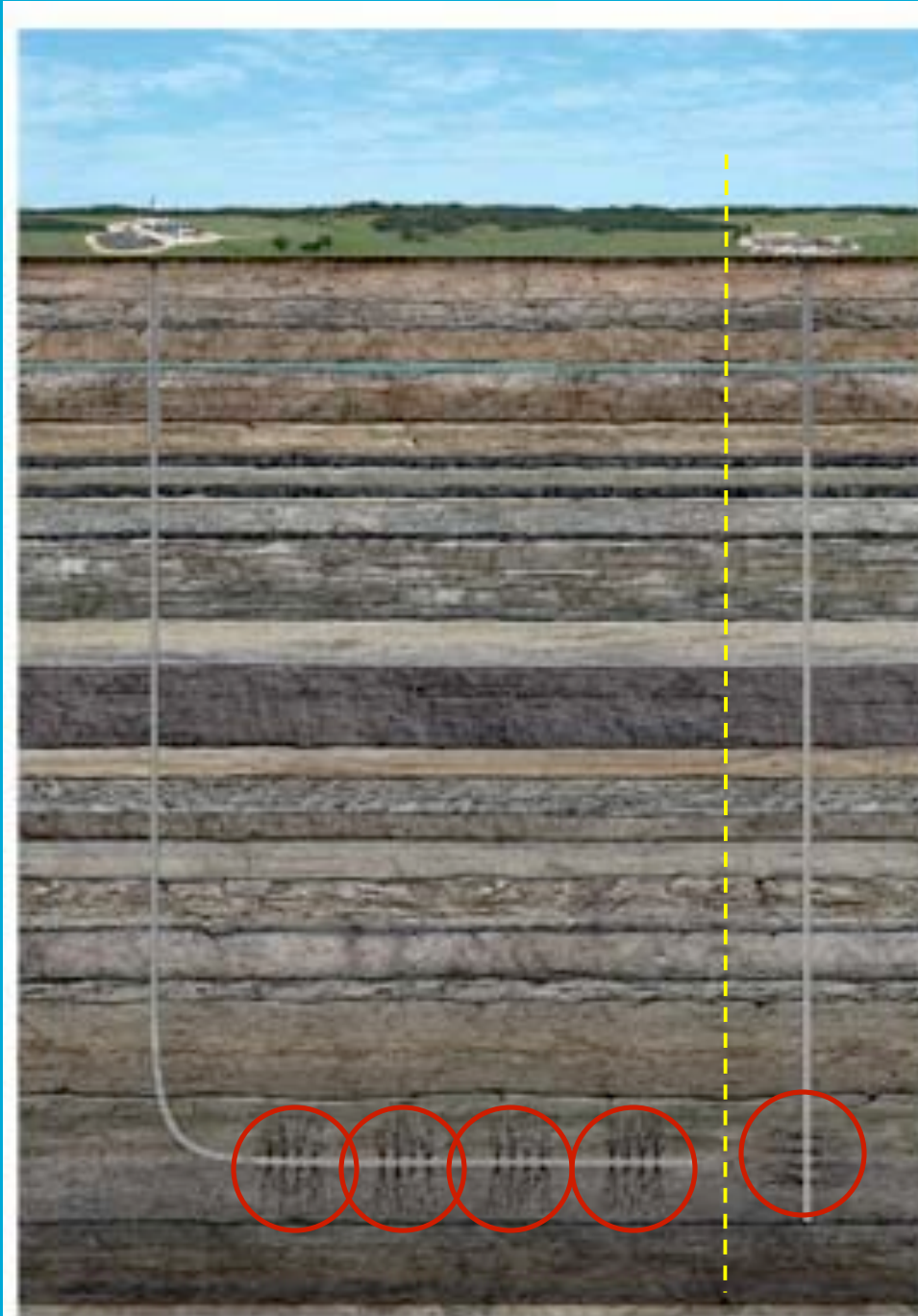


(Arthur, Bohn, Layne, 2008, ALL Consulting)
<http://www.all-llc.com/shale/GWPCMarcellusFinal.pdf>



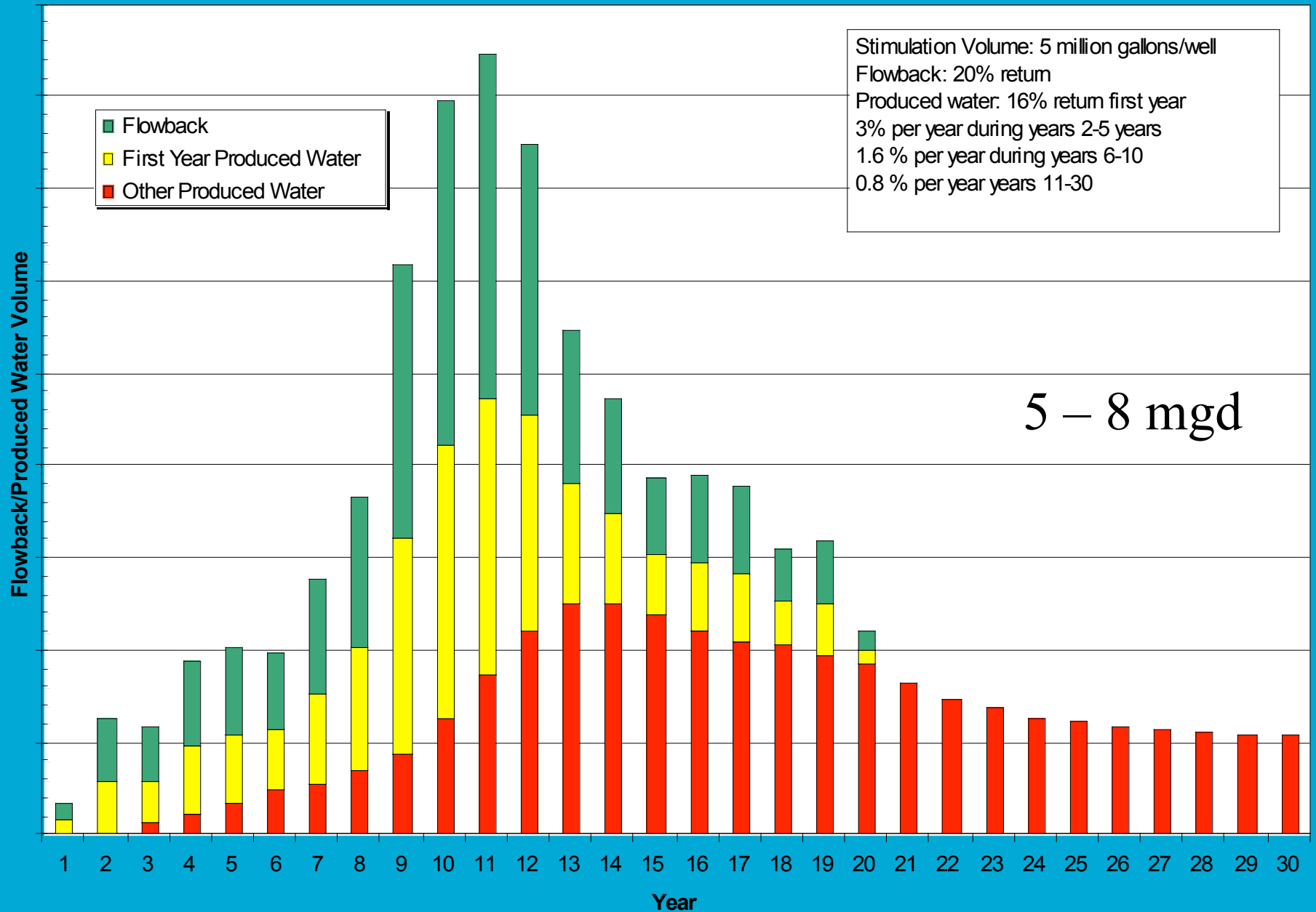
Typical well
with horizontal
leg and multiple
sets of hydro-
fractures

Marcellus Shale



Typical vertical
well with hydro-
fractures

Wastewater Type and Trend

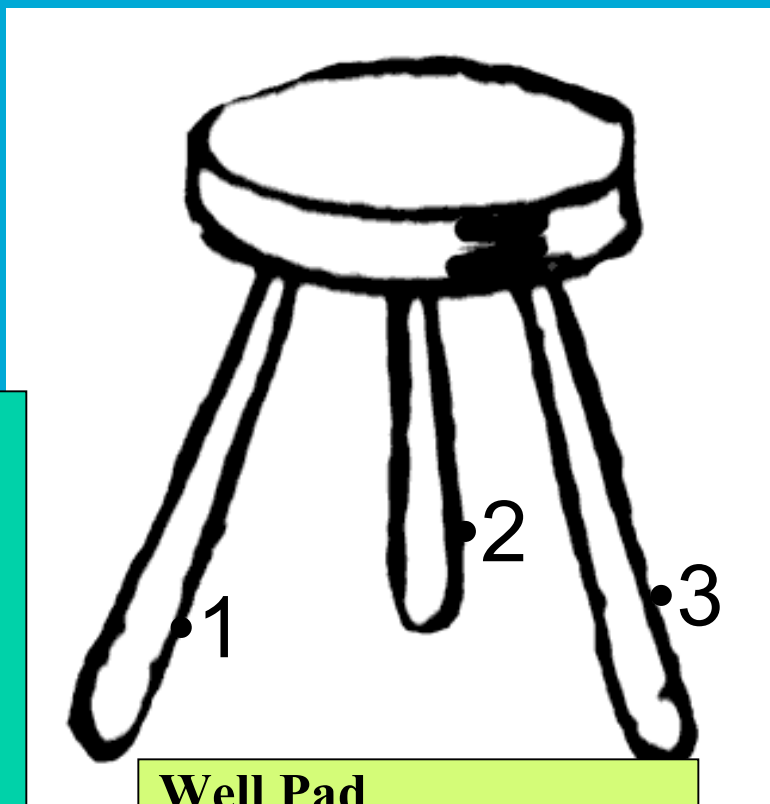


Vulnerability of Headwaters

- **Headwaters are the most sensitive areas of a watershed**
- **Existing contiguous forest is critical to water quantity and quality**
- **Multiple Factors**
 - Increasing Impervious Cover - development
 - Road cuts, pipeline connections,
- **Forest Fragmentation**
- **Philadelphia Source Water Protection Analysis**
 - #1 – Change in Delaware River Headwaters



DRBC Natural Gas Regulatory Strategy



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Well Pad

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Wastewater Disposal

- Protect receiving water bodies
- Protect groundwater



DRBC Intent

- **Not to prevent appropriate natural gas activities.**
- **Ensure proper environmental protections are in place and understood by natural gas developers.**
- **(Provide Directional Signals, Not Stop Signs –unless warranted)**

Relevant DRBC Regulatory Requirements

- **Section 3.8 of the DRBC Compact**
“No project having a substantial effect on the water resources Unless it shall have been first submitted to and approved by the Commission...”
- **Section 3.40 - Groundwater Protection**
- **Special Protection Waters Regulations**
- **Floodplain regulations**



Executive Director Determination Natural Gas Well Activates Within the Drainage Area of SPW May, 2009

- **Shale formations within the drainage area of SPW**
- **Natural gas well activities (NGWA) covered regardless of DRBC thresholds in RPP and Water Code (WC)**
- **NGWA may not commence without obtaining DRBC approval**

May 5, 2010 Public Business Meeting

- Commissioners direct Staff to draft regulations for natural gas well pad projects in shale formations in the Delaware River Basin.
- Natural gas well pad applications will be reviewed after the new regulations are in place.
- Water withdrawals related to natural gas extraction projects to proceed in accordance with existing DRBC regulations.
 - Stone Energy, West Branch Lackawaxen River Withdrawal was approved at July 14, 2010 hearing.

Proposed Regulations

- Three Legged Stool
- Prohibited Areas (Floodplains, etc.)
- Setbacks
- Natural Gas Development Plan
- Monitoring
- Working with PA & NY to reduce redundancy – Well Construction/Operation
- Available to Public – October, 2010

Take Home

- Need to Take a Watershed Approach
- Need to Protect Your Headwaters
- What Happens on the Land Affects the Water
- Natural Gas has high value to many, but we need to make sure it is done smartly!
- The regional economy will need other drivers in the future.
- Get involved!



QUESTIONS?

- www.DRBC.net