A photograph of a Marcellus shale rock formation. The rock is dark grey and highly fractured, showing a grid-like pattern of cracks. A wooden frame, possibly made of planks or logs, is laid out on the rock surface, forming a rectangular shape. The background is a dense field of similar rock formations.

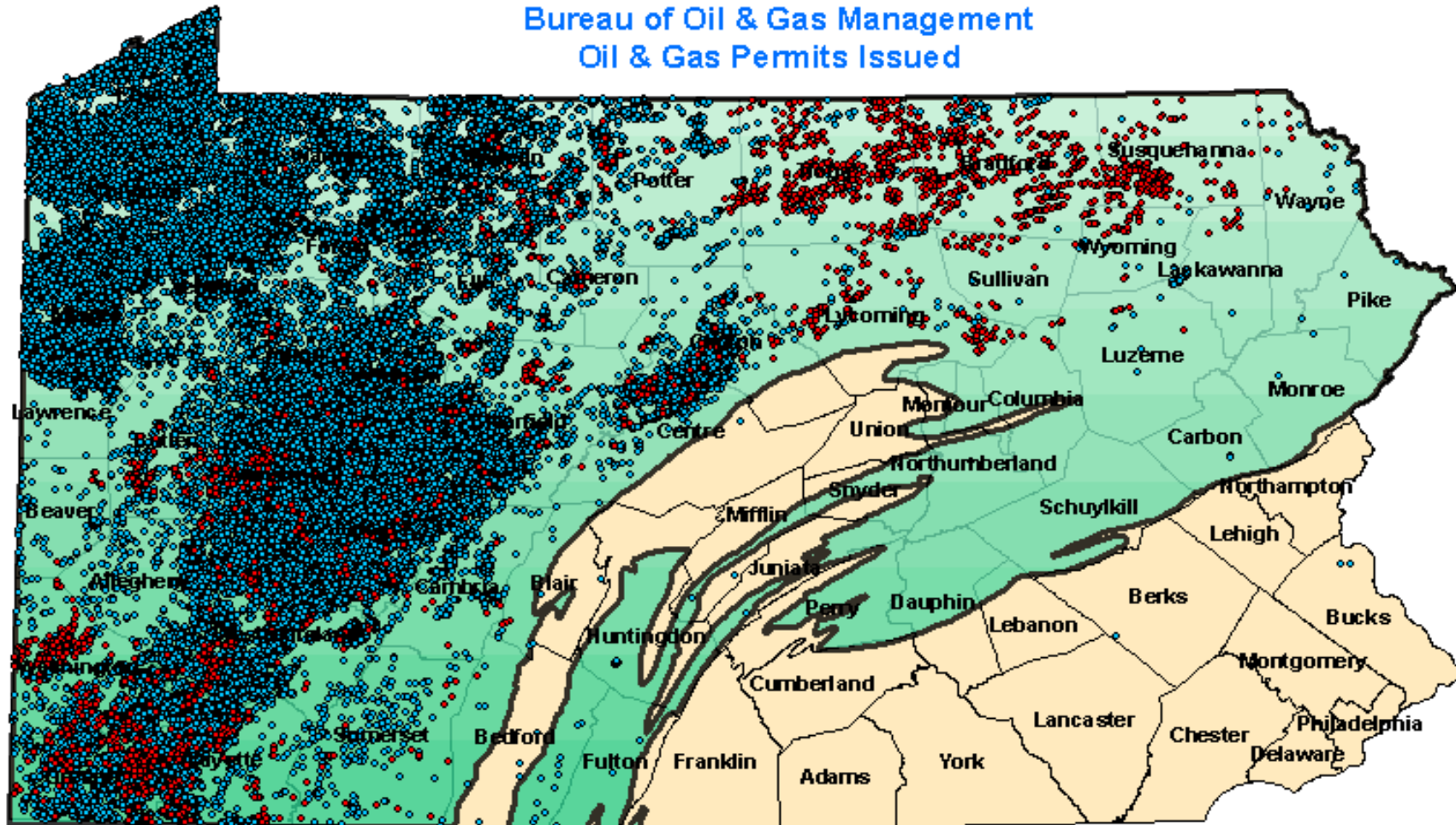
*Environmental Protection and  
Marcellus Shale Well  
Development*



Scott Perry  
Director  
Bureau of Oil and Gas Management



Pennsylvania Department of Environmental Protection  
Bureau of Oil & Gas Management  
Oil & Gas Permits Issued



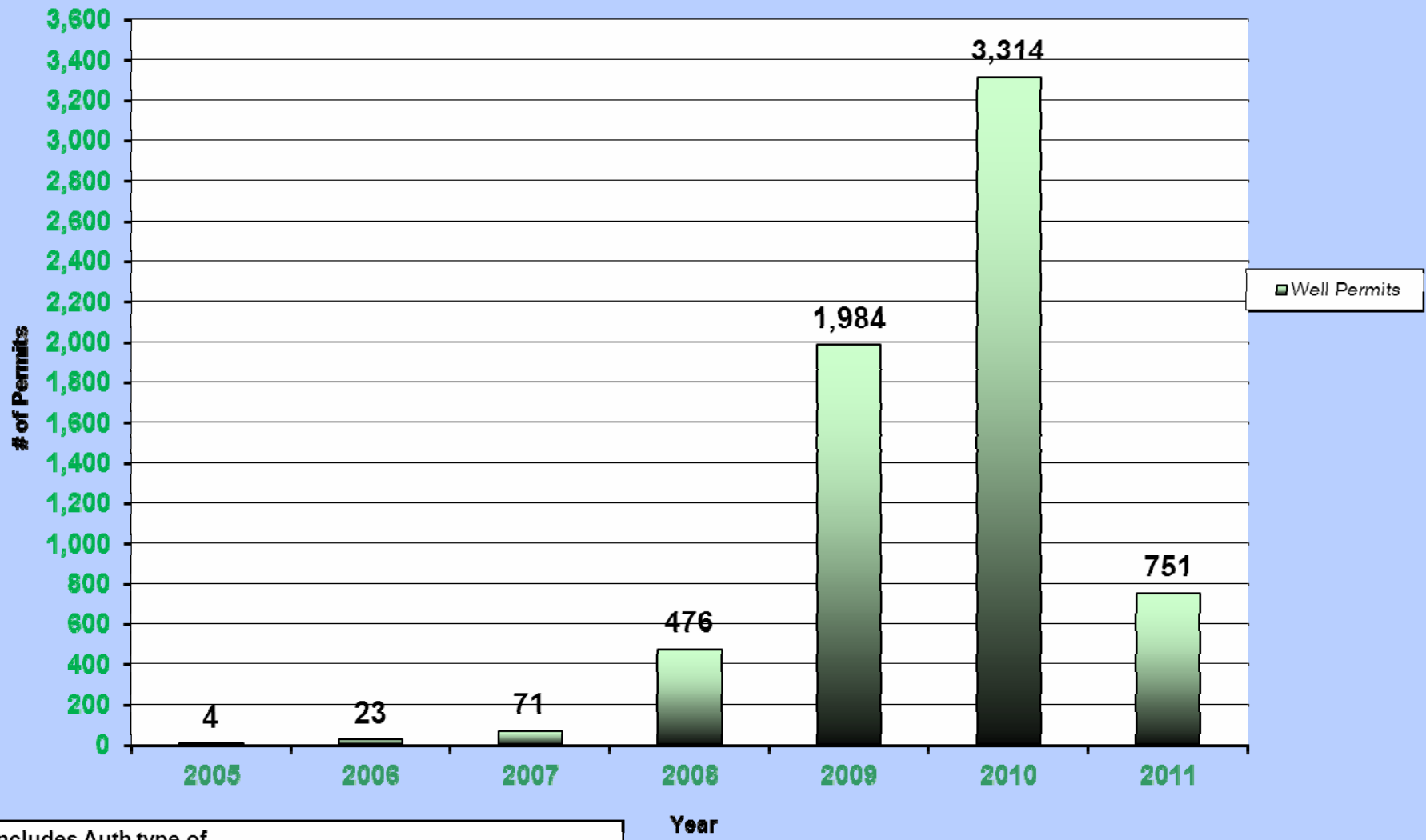
 = Marcellus Shale Formation     = Non-Marcellus Shale Well     = Marcellus Shale Well



Department of Environmental Protection  
Bureau of Oil and Gas Management

Marcellus Shale  
Well Permits Issued by Year

03/18/2011

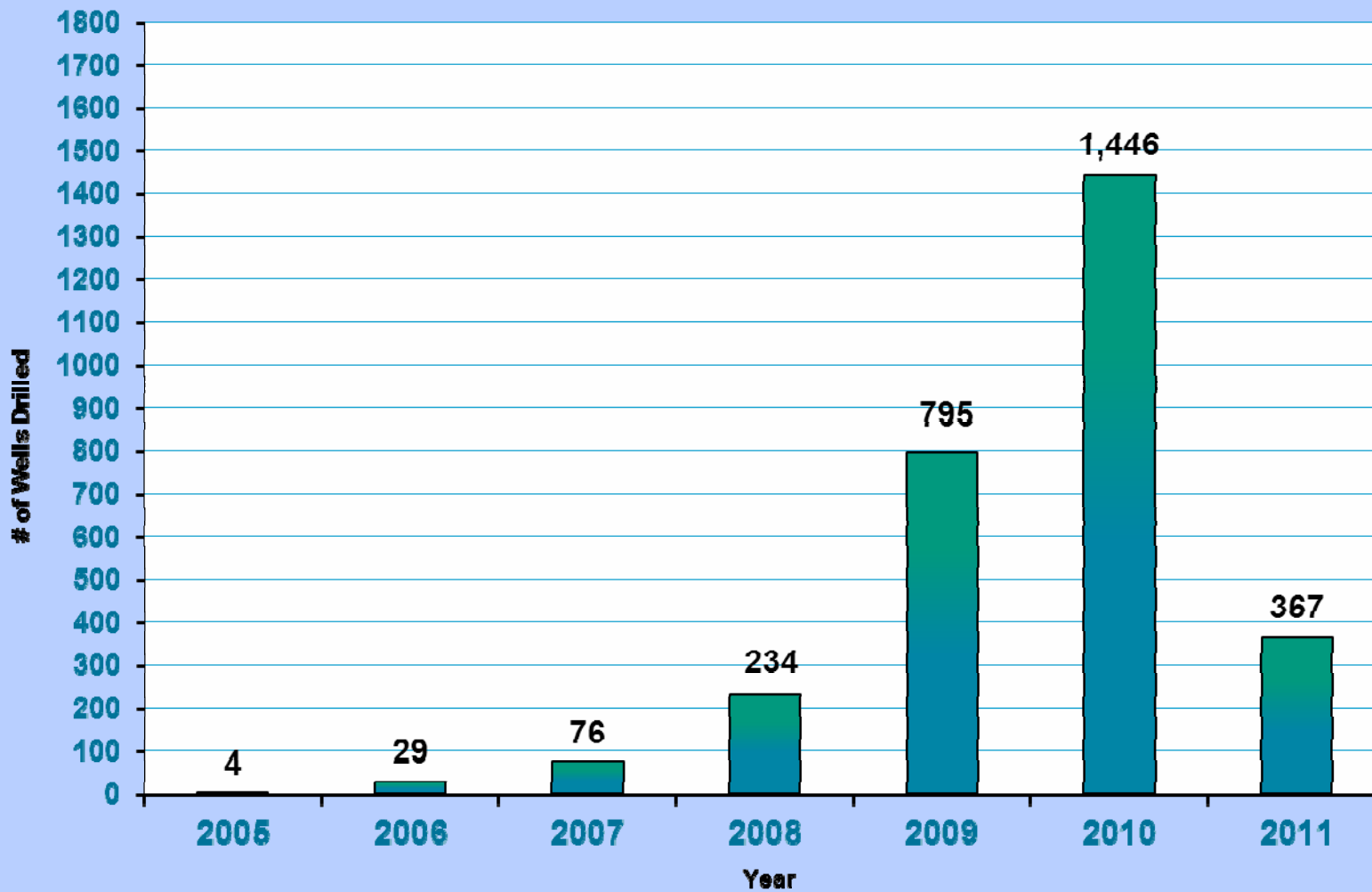


Includes Auth type of  
Drill & Operator Well Permits, Drill Deeper and Redrills.

Department of Environmental Protection  
Bureau of Oil and Gas Management

Marcellus Shale  
Wells Drilled by Year

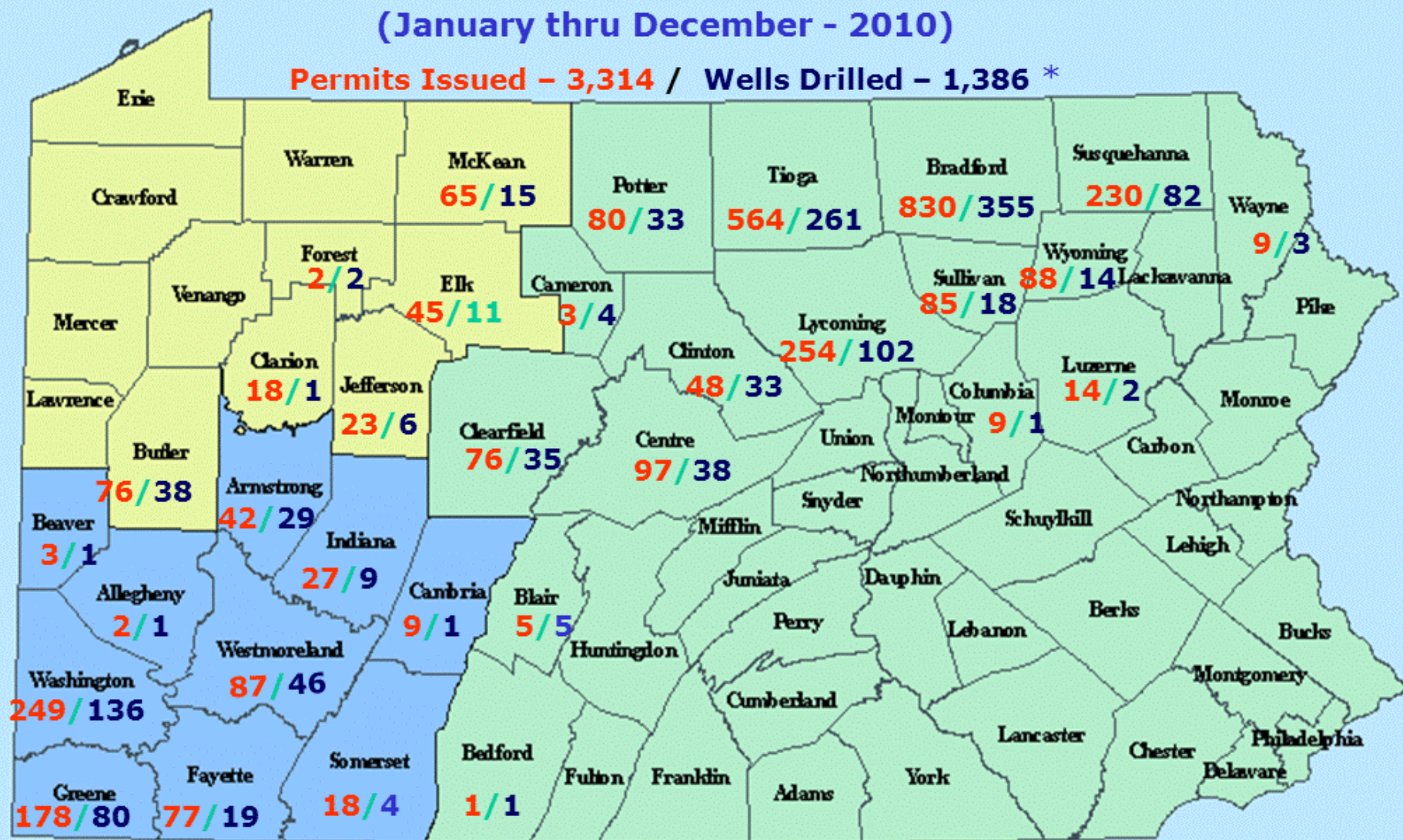
03/18/2011





Department of Environmental Protection  
 Bureau of Oil and Gas Management  
 Marcellus Shale Permits Issued & Wells Drilled  
 (January thru December - 2010)

Permits Issued - 3,314 / Wells Drilled - 1,386 \*

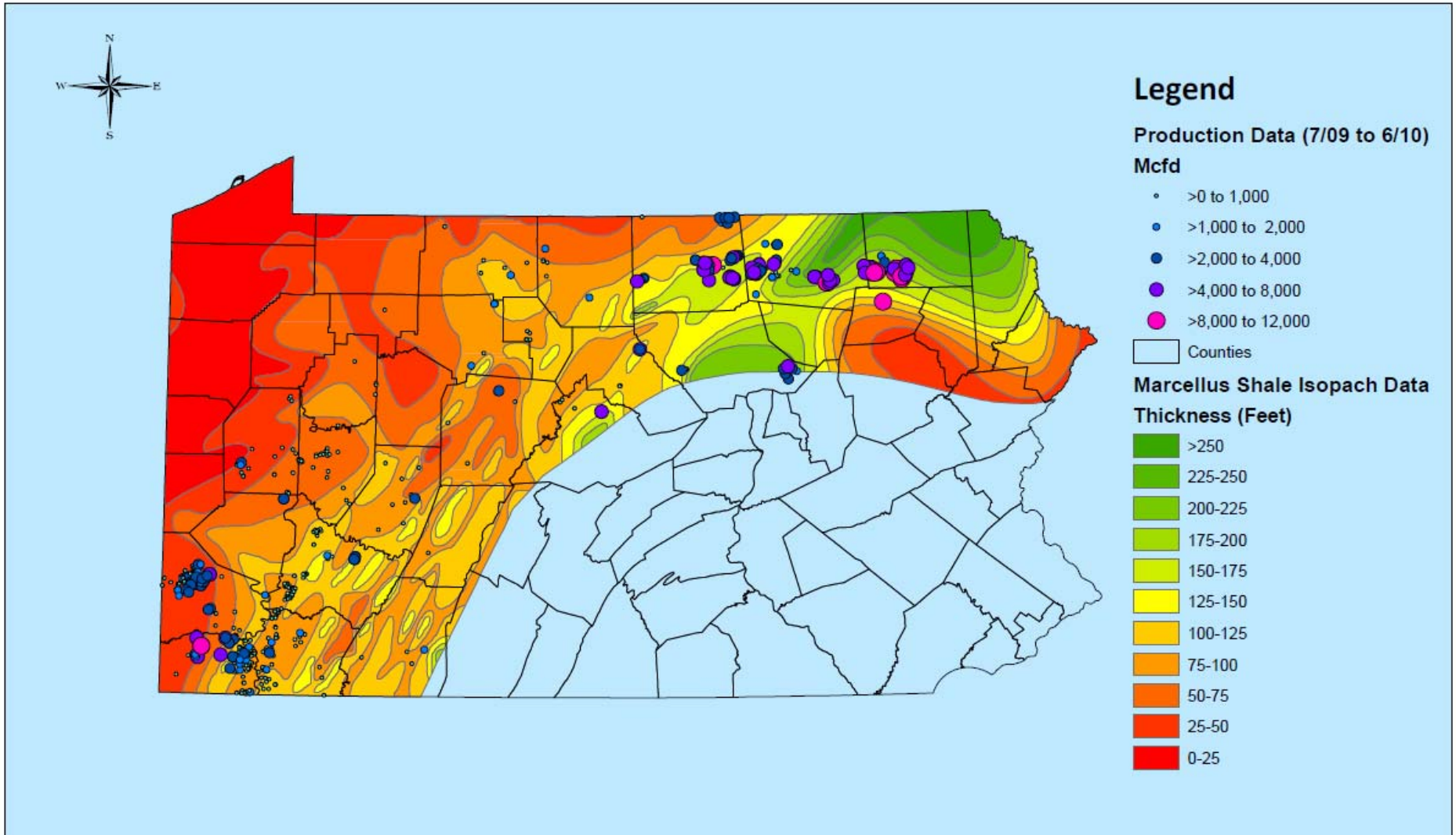


Updated 01/05/2011

\* As reported by Operators

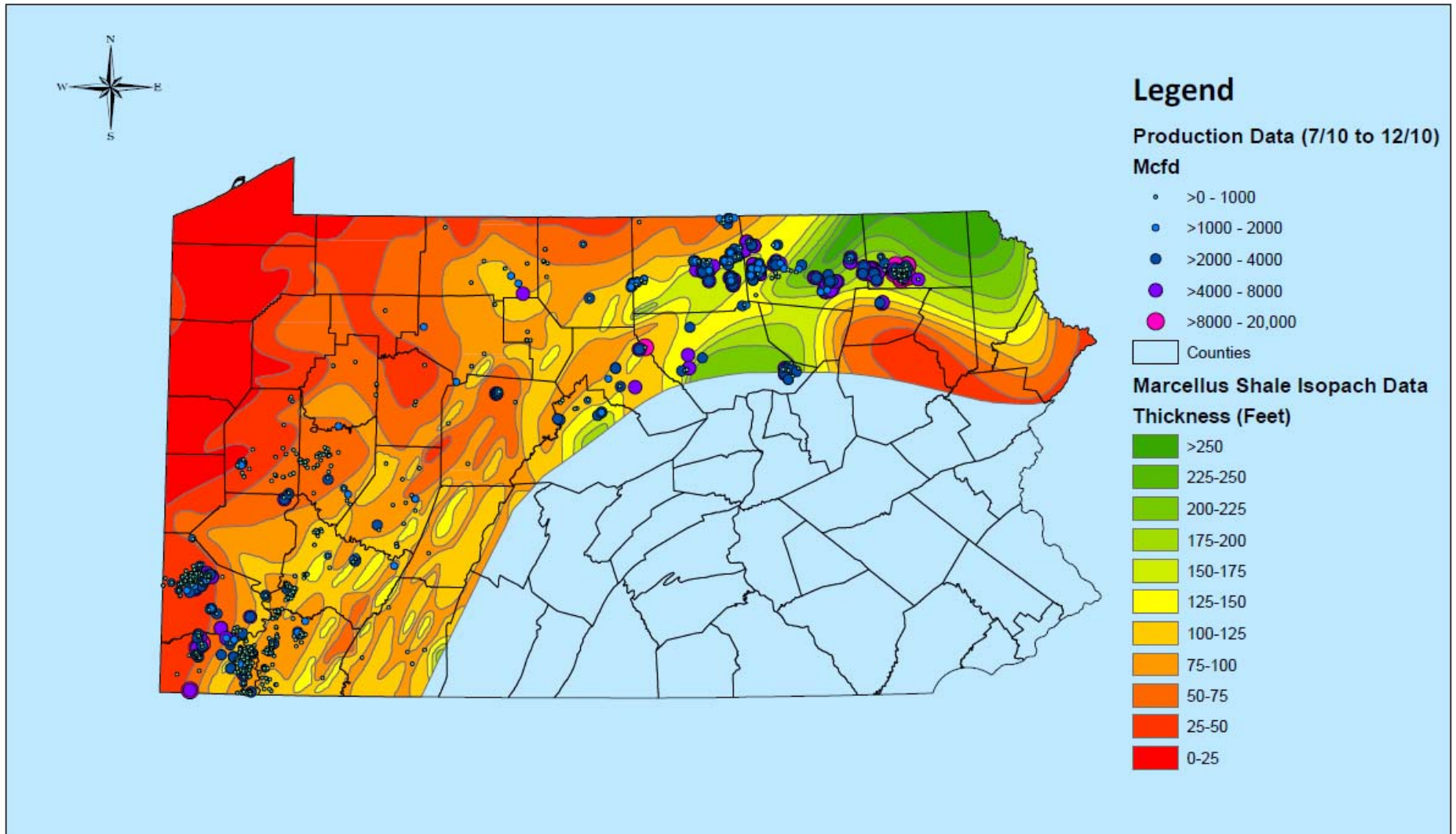


Marcellus Shale Production Data (Basemap Depicts Thickness of Target Formation)



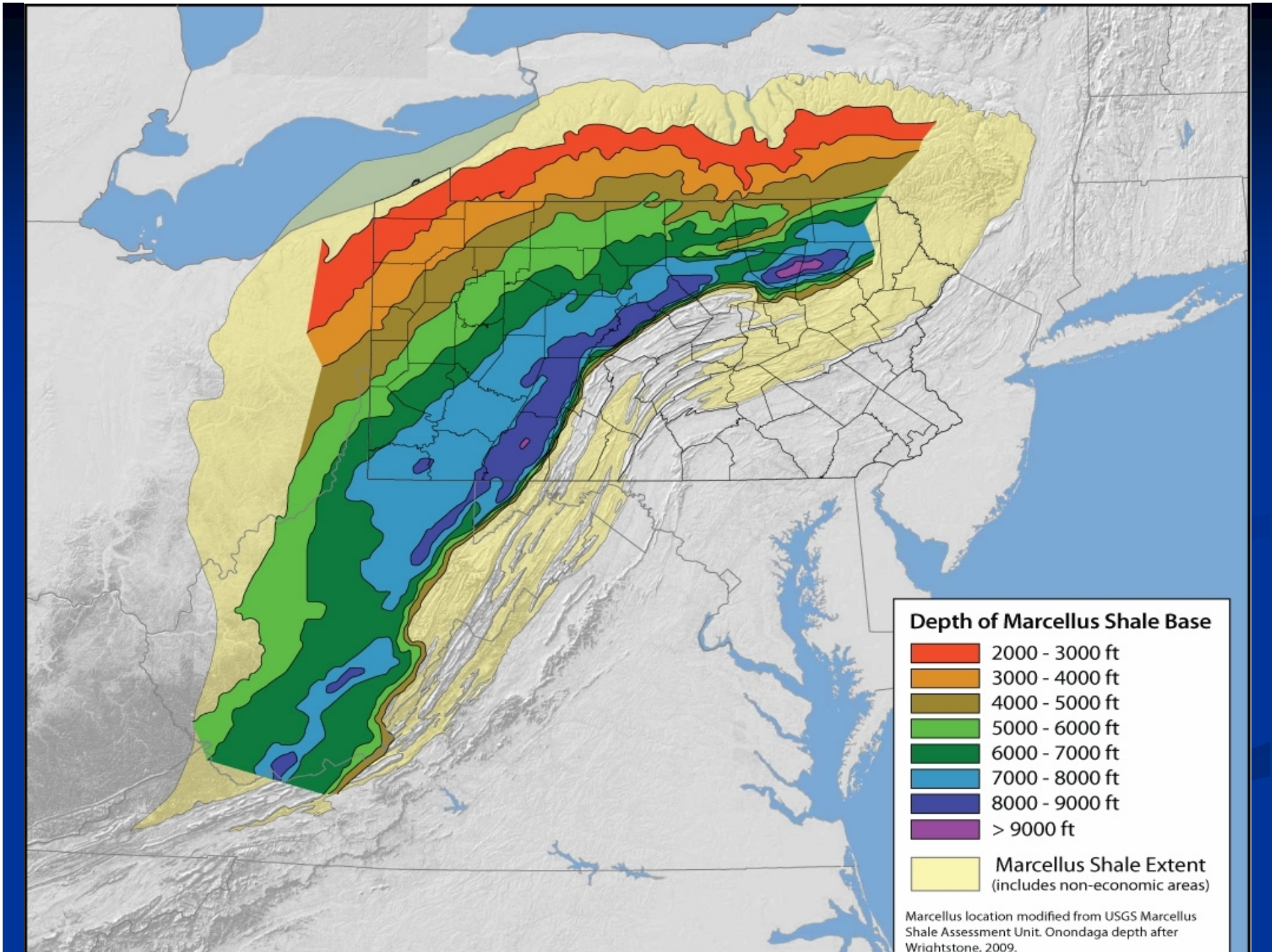
0 12.5 25 50 75 100 Miles

Marcellus Shale Production Data (Basemap Depicts Thickness of Target Formation)



0 12.5 25 50 75 100 Miles





# Laws and Regulations

- Oil and Gas Act
- Coal and Gas Resource Coordination Act
- Oil and Gas Conservation Law
  - 25 Pa Code Chapter 78
- Clean Streams Law
  - 25 Pa Code Chapters 91-102
- Dam Safety and Encroachments Act
  - 25 Pa Code Chapter 105
- Solid Waste Management Act
- Air Pollution Control Act
- Storage Tank and Spill Prevention Act
- Environmental Laboratory Accreditation Act



# Well Permitting

- Notice provided to surface landowner, owner of water supplies, coal owners
- Permit must be issued or denied in 45 days (15 day extension possible)
- Well must be located:
  - 100 feet from streams and other bodies of water identified on topo map
  - 100 feet from wetlands greater than 1 acre
  - 200 feet from buildings and water supplies
- Distance restrictions may be waived
- Bond: \$2,500 for single well or \$25,000 blanket bond for all wells.

# Erosion and Sediment Control

- Erosion and Sediment Control General Permit
  - 5 Acres or more of earth disturbance.
  - For expedited review NOI, E&S and site restoration plan signed and sealed by registered professional.
  - Documents submitted 14 business days prior to earth moving.



# Surface Control Issues Associated with Hydraulic Fracturing

- Water withdrawal.
- PPC Plan.
- Pits, tanks and centralized impoundments.
- Hydraulic fracturing wastewater management.

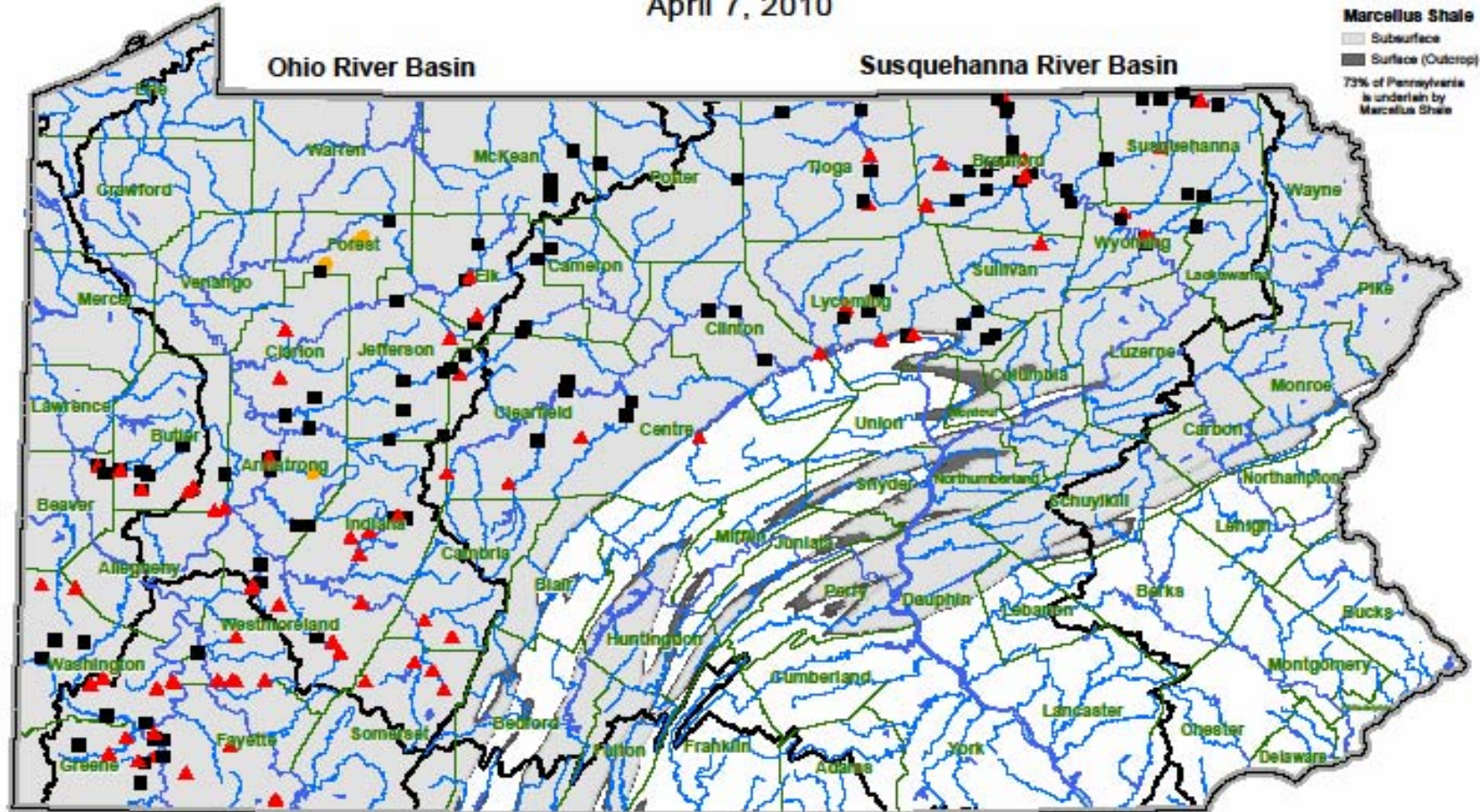
# Water Withdrawal

- Single water management plan covers multiple well sites.
- Applies in Ohio, Susquehanna and Delaware basins.
- Required to protect existing and designated uses – 25 Pa. Code Chapter 93.
- Water Resources Planning Act (Act 220) registration.
- Use of alternative water sources.
  - AMD-impacted water.
  - Treated effluent.



# Marcellus Shale Natural Gas Well Development in Pennsylvania Water Management Plans (WMPs)

April 7, 2010



WMP Summary for State and River Basins

Number of Gas Operators	Individual Sources	Approved Daily Maximum Use, mgal/d			Reported Water Use		
		Susquehanna	Ohio	State	Susquehanna	Ohio	State
34	Type						
	Surface water	61	66	117	57.4	61.8	139.2
	Ground water	0	10	10			
	Purchase	31	55	86			
	<b>Total</b>	<b>92</b>	<b>121</b>	<b>213</b>			
	%	43%	51%				

WMP Withdrawal Sources

Source Type

- Ground water
- Surface water
- ▲ Purchase



Disclaimer: Intended as general information and may not include all WMP information submitted to DEP for the period stated.



# PPC Plan

- Operators must review their operations and identify all pollutional substances and wastes that will be used or generated, as well as identify the methods for control and disposal of these substances or wastes.
- Operators are required to identify potential risks and plan for the possibility of an accident occurring at the well site during hydraulic fracturing operations.



# Pits, Tanks and Centralized Impoundments

- All pits and impoundments must be impervious and structurally sound.
- Low impact centralized impoundments that store wastewater are permitted by regional oil and gas staff.
- High impact impoundments permitted by dam safety.
  - Impact wetlands, on streams, breach threatens welfare/property.

# Hydraulic Fracturing Wastewater Management

- Follow Residual Waste Regulations.
  - Generator, transporter and treatment facility regulatory and record-reporting requirements.
- Chemical characterization of frac waste required.
  - Reporting mechanism: *Form 26R, Chemical Analysis of Residual Waste, Annual Report by the Generator.*
  - Industry and DEP working to establish baseline for wastewater throughout flowback period.

# Hydraulic Fracturing Wastewater Management, continued

- TDS strategy
- New and Expanded Sources Only
  - 500 Mg/l TDS
  - 250 Mg/l Chlorides
  - 10 Mg/l Barium and Strontium
- Underground Injection Control Program
  - EPA administers
  - Only 7 class II UIC disposal wells in PA.
  - Over 20 injectivity applications before EPA



# Well Construction and Groundwater Protection

- Planning and preparation: well drilling, completion, stimulation, production and plugging.
- Well construction practices: structural integrity of the well is essential in containing hydraulic fracturing fluids within the wellbore.
- Reporting requirements.

# Water Supply Protection

- Operator responsible for replacing water supply if quality or quantity affected
- Complaint – DEP has 10 days to investigate and 45 days to make a determination
- Presumed to cause pollution if drilled within 6 months and 1000 feet from water supply

# Well Construction -Planning

- Casing and cementing plan
  - Must be on site for review by DEP.
  - DEP may request submittal of plan for approval.
  - Revisions to plan can be made on site to meet well conditions.
  - Plan includes casing type and specifications; location of centralizers; anticipated depth and pressure of producing formations; cement type, yield, additives and volume.



# Well Construction Practices

- Cement job log
  - Documents the actual procedures and specifications of the cementing operation.
  - Record includes cement type, additives, volume, yield and density, and amount returned to the surface.
  - Record also includes cementing procedural information such as pumping rates, pressures, cementing procedure time and sequence of events.

# Well Construction Practices

- Upgrades casing standards:
  - Pressure ratings for new casing
  - Pressure testing of new and welded casing.
- Upgrades cement standards:
  - Notice before cementing surface casing
  - Eight-hour cement set period
  - Zone of critical cement

# Well Construction Practices

- Surface hole must be drilled with air or freshwater-based fluids.
- Centralizers must be placed 50' from the surface casing seat and every 150 ' above.
- New subsections on lost circulation and intermediate and production casing.
- New provision to allow DEP to designate areas of alternative methods, requiring well drilling practices beyond those required in Chapter 78.



# Well Construction Practices

- Enhances blow-out prevention equipment requirements.
- Decreases allowable pressure on surface casing seat.
- Prohibits the use of surface casing as production unless it is an oil well that does not produce gas or an operator can demonstrate pressure limits will not be exceeded.

# Reporting Requirements

- Requires mandatory electronic production reporting to DEP.
- New well record and completion reporting requirements submitted by the operator as part of the stimulation record include pump rates, pressure, total volume and list of hydraulic fracturing chemicals used, the volume of water used, and the identification of water sources used pursuant to an approved water management plan.

# Inspection and Investigation

- Quarterly inspection of operating wells.
  - Immediate remediation and notice to DEP required
- Operators must respond and investigate any complaint of gas migration.
  - Report results of investigation to DEP
  - Immediate action may be required