

*40<sup>th</sup> Anniversary*

**S R B C**

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*1971-2011*

New York, Pennsylvania, Maryland, United States

# Natural Gas Industry Effects on Water Consumption and Management

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# Susquehanna River Basin

## The Basin:

- 27,510-square-mile watershed
- Comprises 43 percent of the Chesapeake Bay watershed
- 4.2 million population
- 60 percent forested
- 32,000+ miles of waterways



## The Susquehanna River:

- 444 miles, largest tributary to the Chesapeake Bay
- Supplies 18 million gallons a minute to the Bay



# What Does SRBC Regulate?

- Surface Water Withdrawals (100,000 gpd)
- Groundwater Withdrawals (100,000 gpd)
- Consumptive Use (20,000 gpd)
- For Natural Gas Industry (From Gallon One)

Energy in the Basin?

It's Not All About  
Marcellus Shale!

# 2008 Electric Generation Capacity within the Basin

Approximately 58 Active Power Plants

<u>Energy Source</u>	<u>MW</u>	<u>Energy Source</u>	<u>MW</u>
Nuclear	5,876	Mun. Solid Waste	96
Coal	4,779	Wind	85
Natural Gas	1,900	Landfill Gas	50
Hydro	1,878	Black Liquor	39
Petroleum	401	Wood	31

**Est. Total Capacity**

**15,134 MW**

Reference: U.S. Energy Information Administration 2008

# Estimated Consumptive Water Use by Energy Source within the Basin

## Energy Sources

## Gal/Day per MW

Municipal Solid Waste

29,000

Wood

23,000

Coal

19,000

Nuclear

18,000

Landfill Gas

13,000

Natural Gas

6,000

Ethanol

3-5 gal H<sub>2</sub>O per gal  
Ethanol

References: SRBC 2010; U.S. Energy Information Administration 2008

# NOTICE:

Following Comments Pertain  
Only to Marcellus Shale!

Gas Development in Other Shale  
Formations Likely to Follow!



# Geographic Location of Marcellus Shale within Susq. River Basin

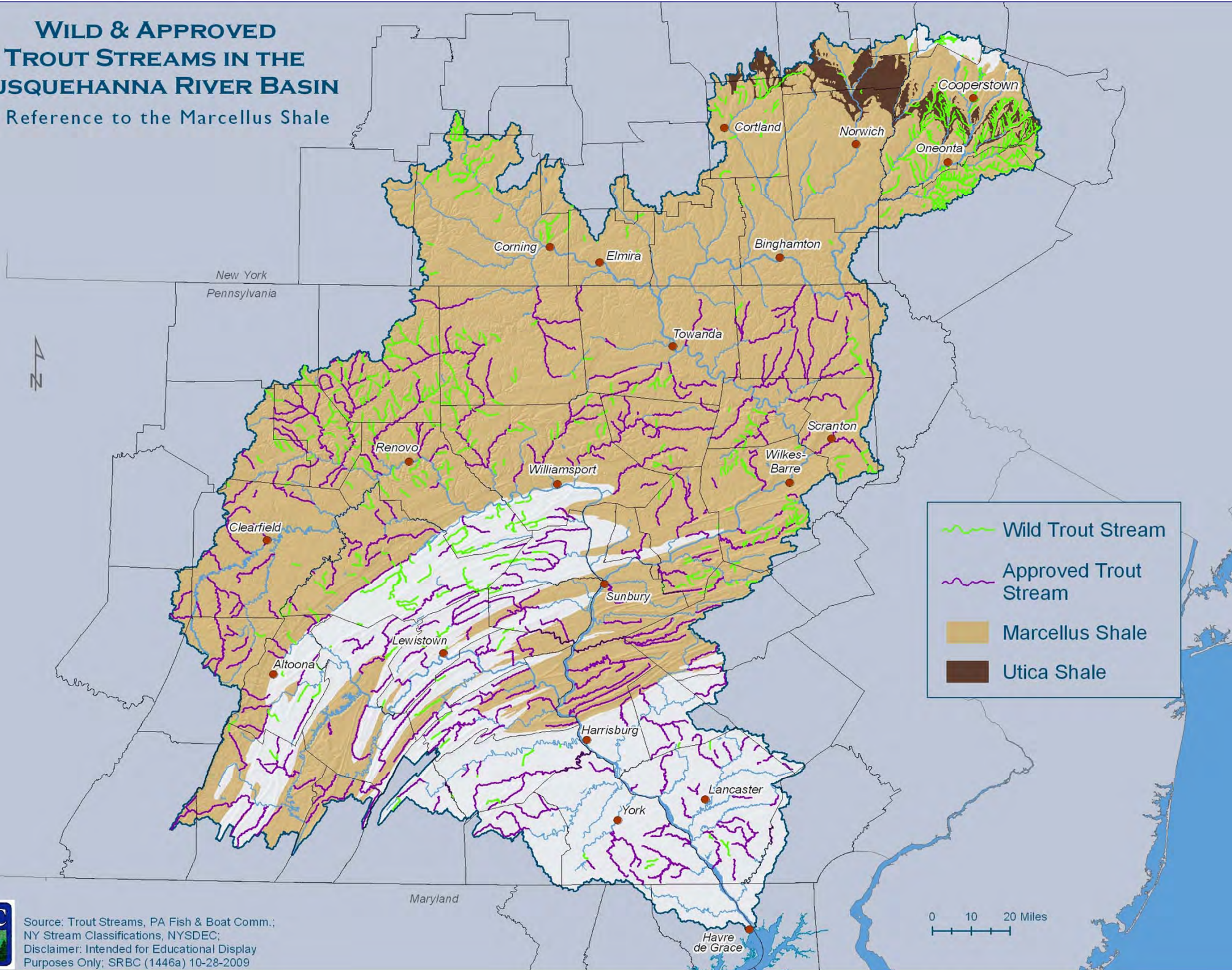
72% of Basin  
(20,000 Sq. Miles)  
Underlain  
by Marcellus Shale





# WILD & APPROVED TROUT STREAMS IN THE SUSQUEHANNA RIVER BASIN

in Reference to the Marcellus Shale

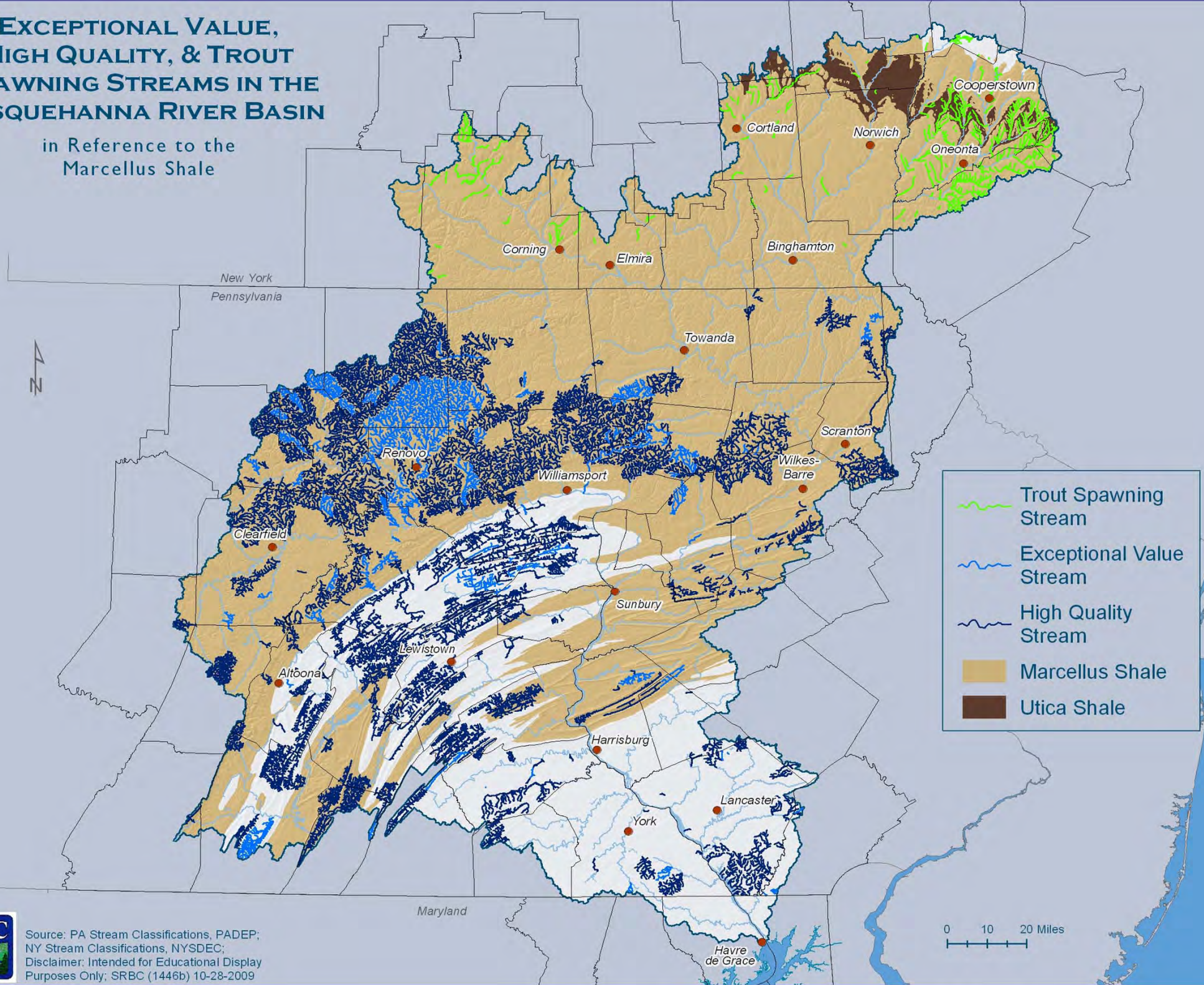


Source: Trout Streams, PA Fish & Boat Comm.;  
NY Stream Classifications, NYSDEC;  
Disclaimer: Intended for Educational Display  
Purposes Only; SRBC (1446a) 10-28-2009



# EXCEPTIONAL VALUE, HIGH QUALITY, & TROUT SPAWNING STREAMS IN THE SUSQUEHANNA RIVER BASIN

in Reference to the  
Marcellus Shale



Source: PA Stream Classifications, PADEP;  
NY Stream Classifications, NYSDEC;  
Disclaimer: Intended for Educational Display  
Purposes Only; SRBC (1446b) 10-28-2009

# Distribution of PA Exceptional Value (EV) and High Quality (HQ) Headwater Streams (Based on Stream Miles)

- Appalachian Plateau; EV 78%, HQ 57%
- Valley and Ridge; EV 21%, HQ 38%
- Blue Ridge; EV 0%, HQ 2%,
- Piedmont; EV 1%, HQ 3%.



# Where Does Gas Industry Get Their Water?

- Surface Water Withdrawals (65%)
- Public Water Systems (35%)
- Groundwater Withdrawals (>0%)



# Actual Water Use Marcellus Gas Wells

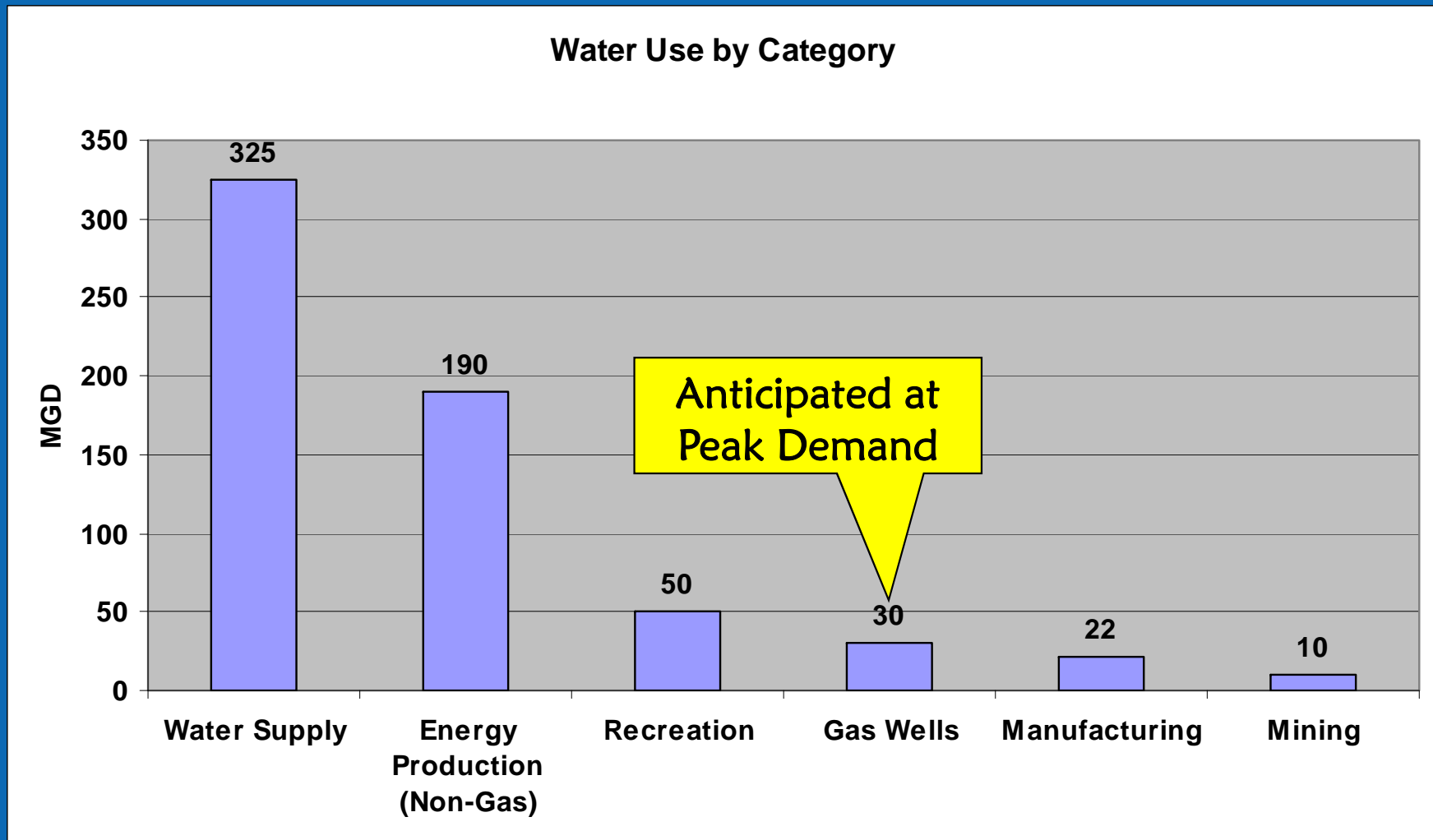
- Total Water Consumed (7/1/08 – 2/14/11): 1,605 mgal
  - Approximately 1,800 gas wells drilled to date w/i basin
  - Approximately 553 wells hydro-fractured to date w/i basin
  - 555 mgal from public water supply (35%)
  - 1,050 mgal from surface water sites (65%)
- Average Total Vol. of Fluid Used per Well: 4.2 mgal
  - Average fresh water used per well: 3.8 mgal
  - Average flowback reuse per well: 0.4 mgal
- Average Recovery of Fluids: 8-12% (First 30-days)

# SRBC Natural Gas Approvals

## As of December 31, 2010

- Surface Water Withdrawals - 141
- Groundwater Withdrawals - 1
- Public Water Supply Systems – 27
- Wastewater Effluent/AMD - 2
- Approvals by Rule (Well Pads) – 1,318
- PADEP Well Approvals - ~ 1,800

# Maximum Daily Consumptive Use Anticipated in Susquehanna River Basin



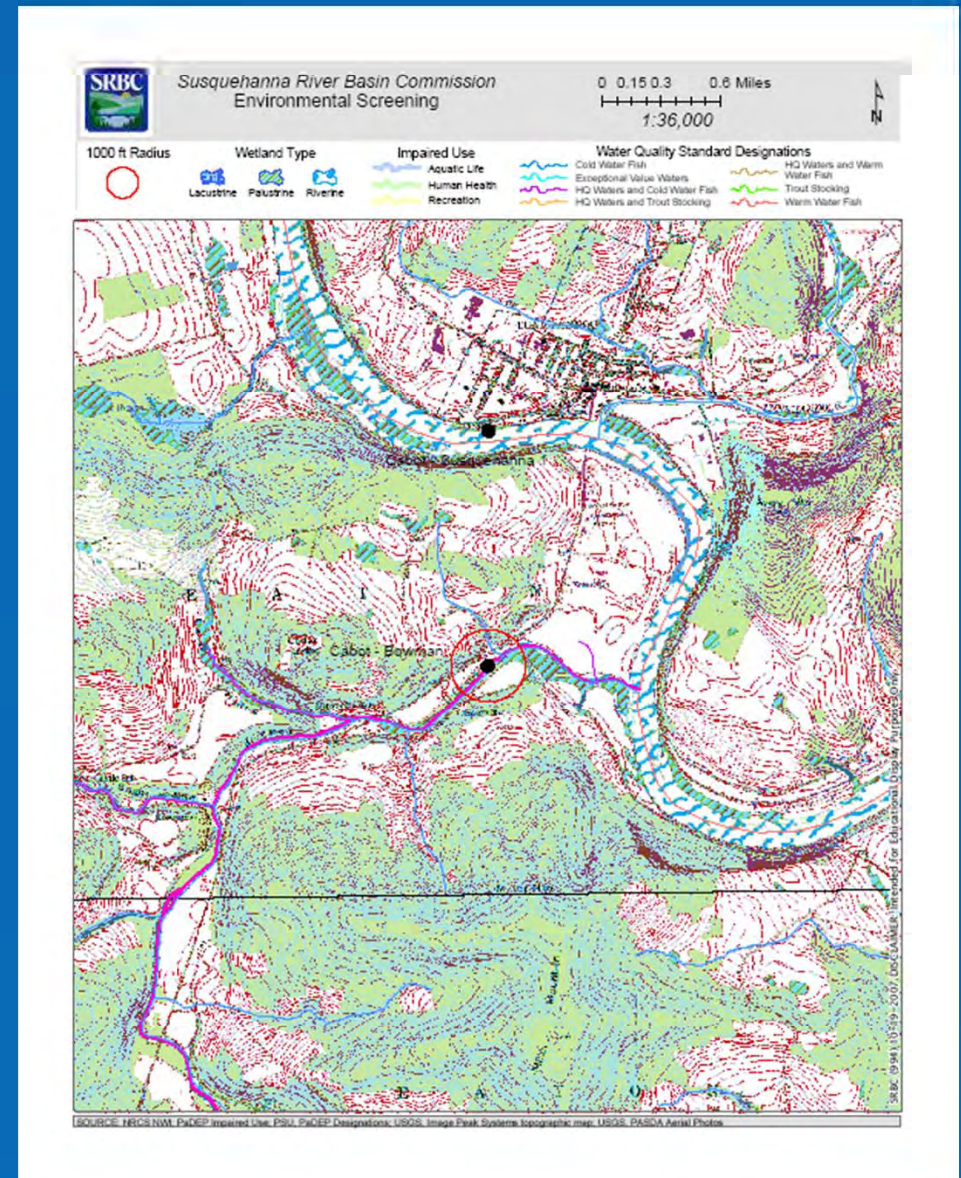
# Surface Water Withdrawals

- Application Data Requirements
- Environmental Review
- Safe Yield Calculation
- Cumulative Impact Analysis - Upstream Uses
- Cumulative Impact Analysis – Downstream Uses
- Passby Flow Determination
- Regulatory Applications
- Planning Applications



# Environmental Screenings

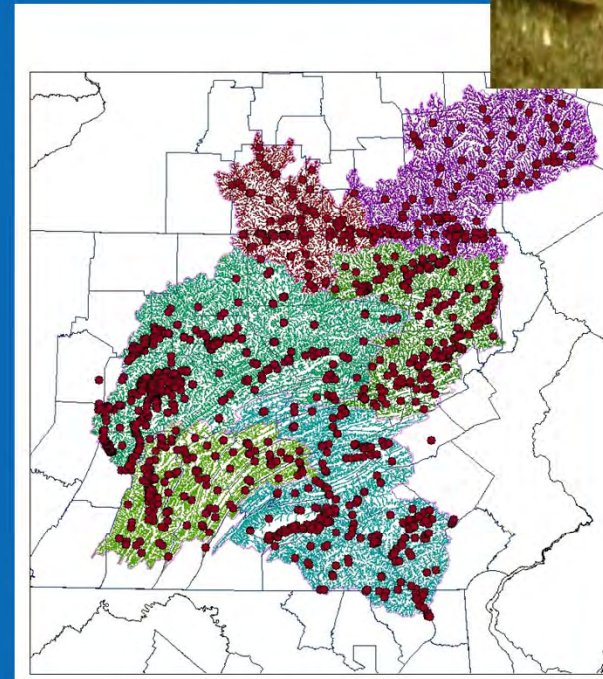
- Stream Classifications
  - Special Protection
  - Wild Trout Fishery
- 303(d) List or PWL Status
  - Type of Impairment
  - TMDL Development





# Environmental Screenings (Cont.)

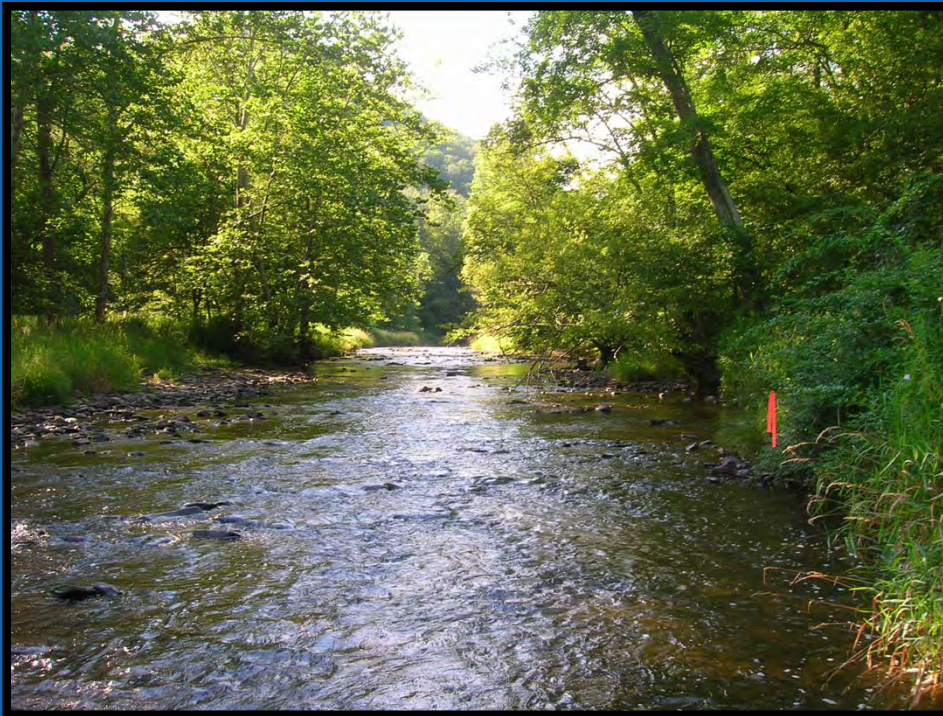
- Adjacent Wetlands
- Wild/Scenic Rivers
- Natural Diversity Inventory Search
  - PFBC
  - PADCNR
  - USFWS
- Any Additional Water Quality Issues
  - Aquatic Nuisance Species





# Aquatic Resource Surveys

- When no data available
- When information obsolete
- For special protection streams
- For background data
- To correct protection level
- When passby needed



# Passby Flow Determination

If **Cumulative Water Demand** is:

- $\leq 10\% Q_{7-10}$  (de minimis Standard), Passby Flow Not Required
- $> 10\%$  of  $Q_{7-10}$ , Passby Flow Required
  - Determine Passby Flow Condition (SRBC Policy No. 2003-01)
  - **Or**, Reduce Proposed Withdrawal Rate to  $\leq 10\% Q_{7-10}$

# Passby Flow

Think “Interruptible” Withdrawals

# What is $Q_{7-10}$ ?

It's a “Drought flow”  
Condition

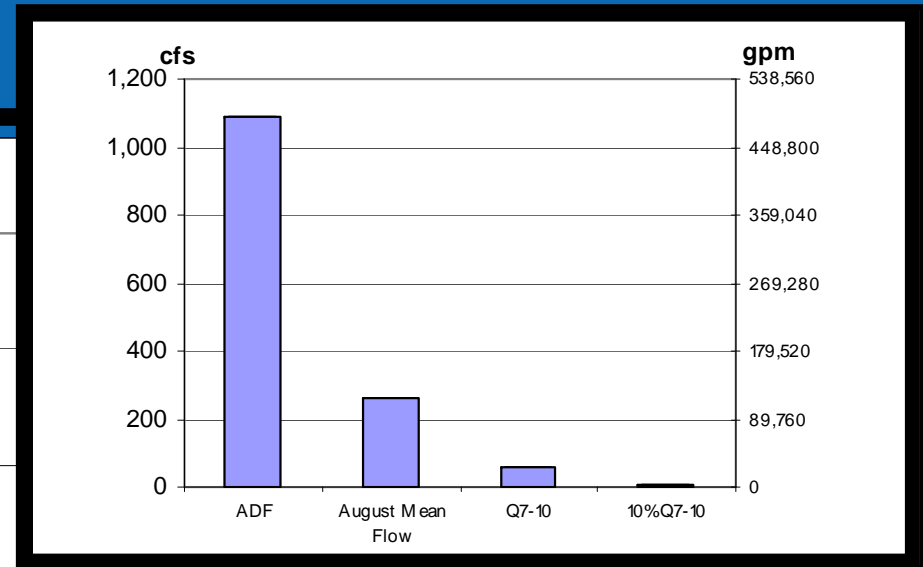
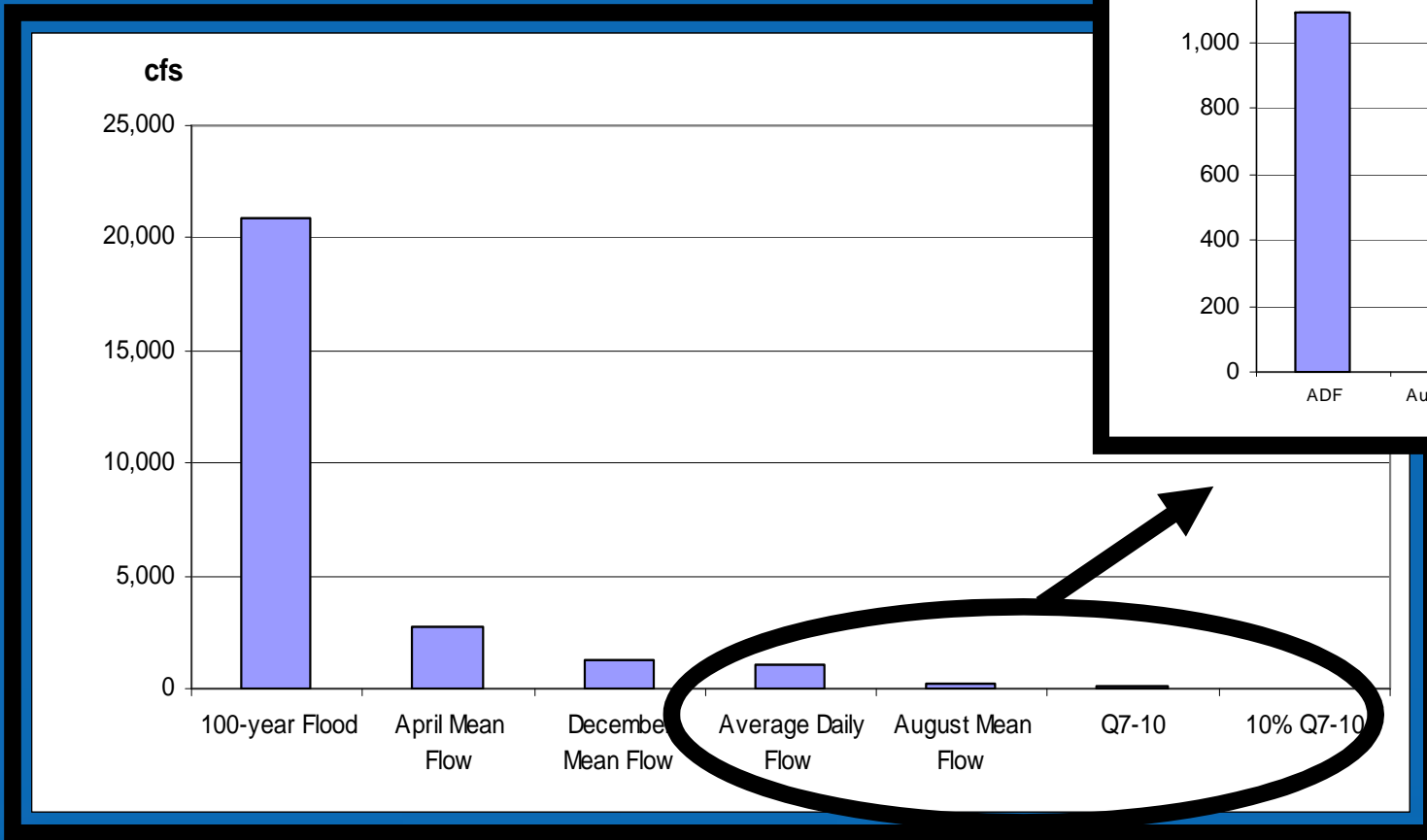
Lowest average flow experienced  
during a consecutive 7-day period  
that is estimated to recur on average  
once every 10 years



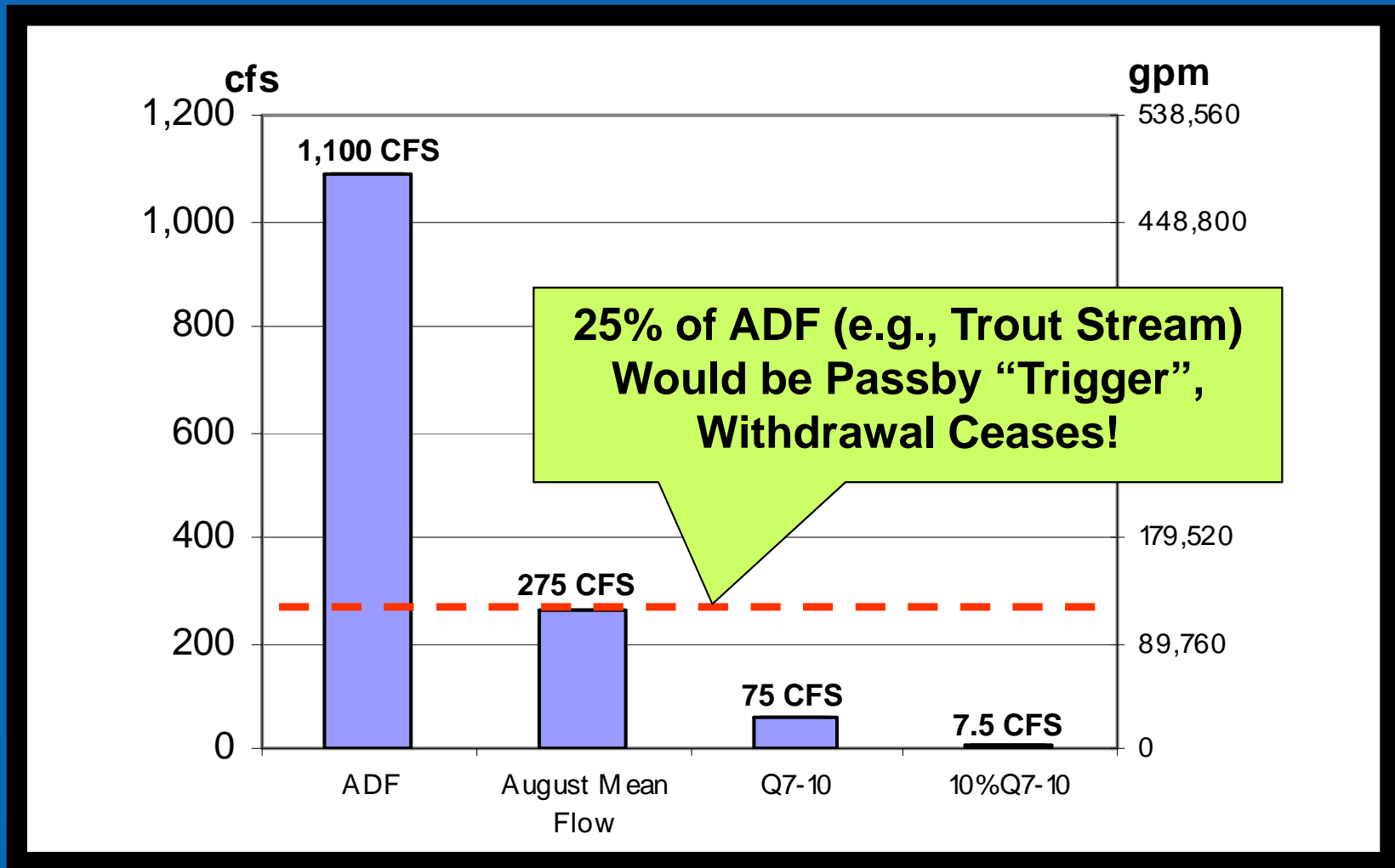
What is ADF?

Average Daily Flow

# Example of Low Flow Statistics for Rivers and Streams



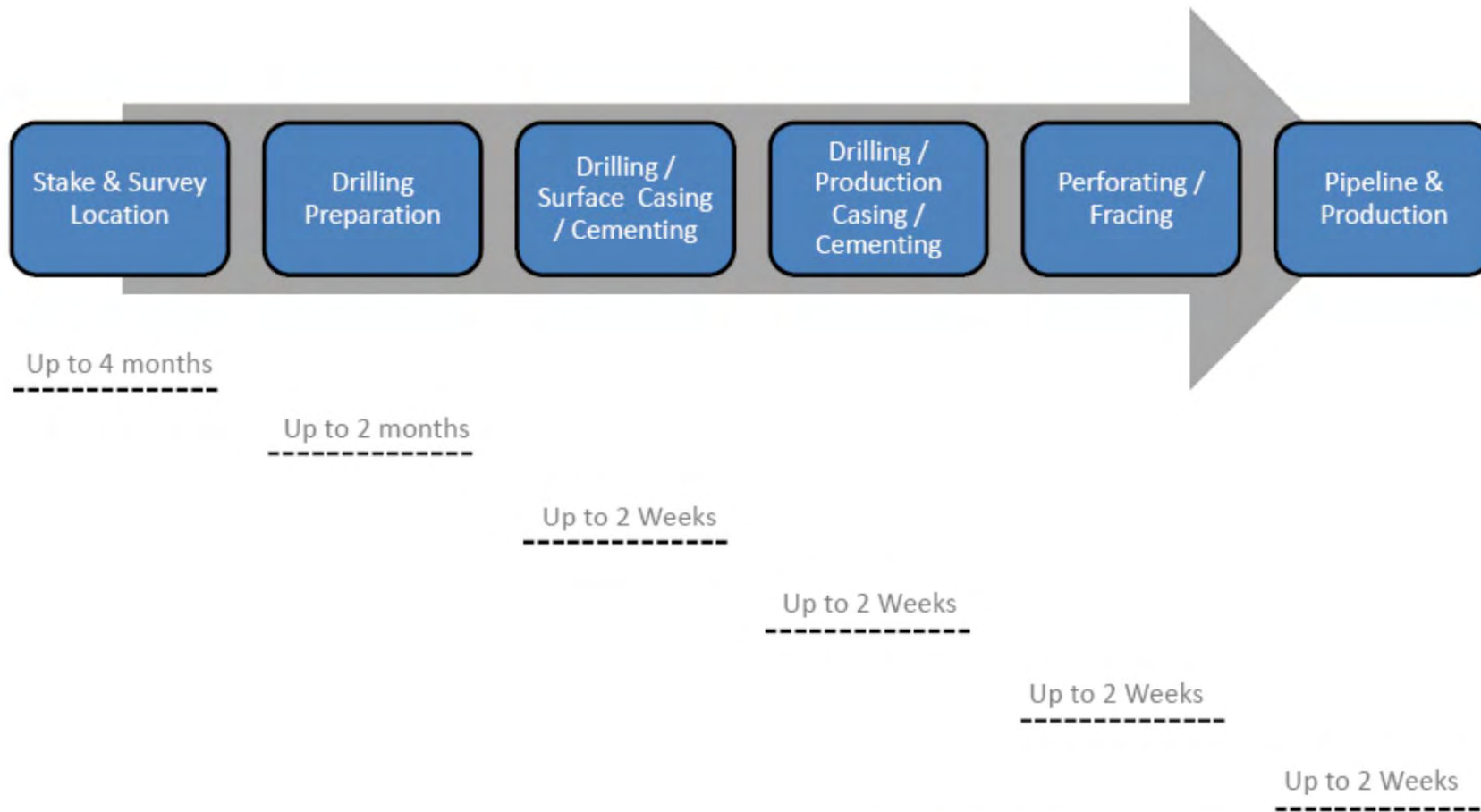
# Example of Low Flow Statistics for Rivers and Streams



# Summary of SRBC “Conclusions”

- Science-based decision making,
- Cumulative impacts critical,
- Timing and location of withdrawals important,
- Passbys are used to minimize impacts during low flow periods,
- The move from exploration to production may necessitate yet more regulatory changes,
- Gas industry water use can be accommodated.

# Drilling Process Timeline



Susquehanna River Basin Commission | July 2010



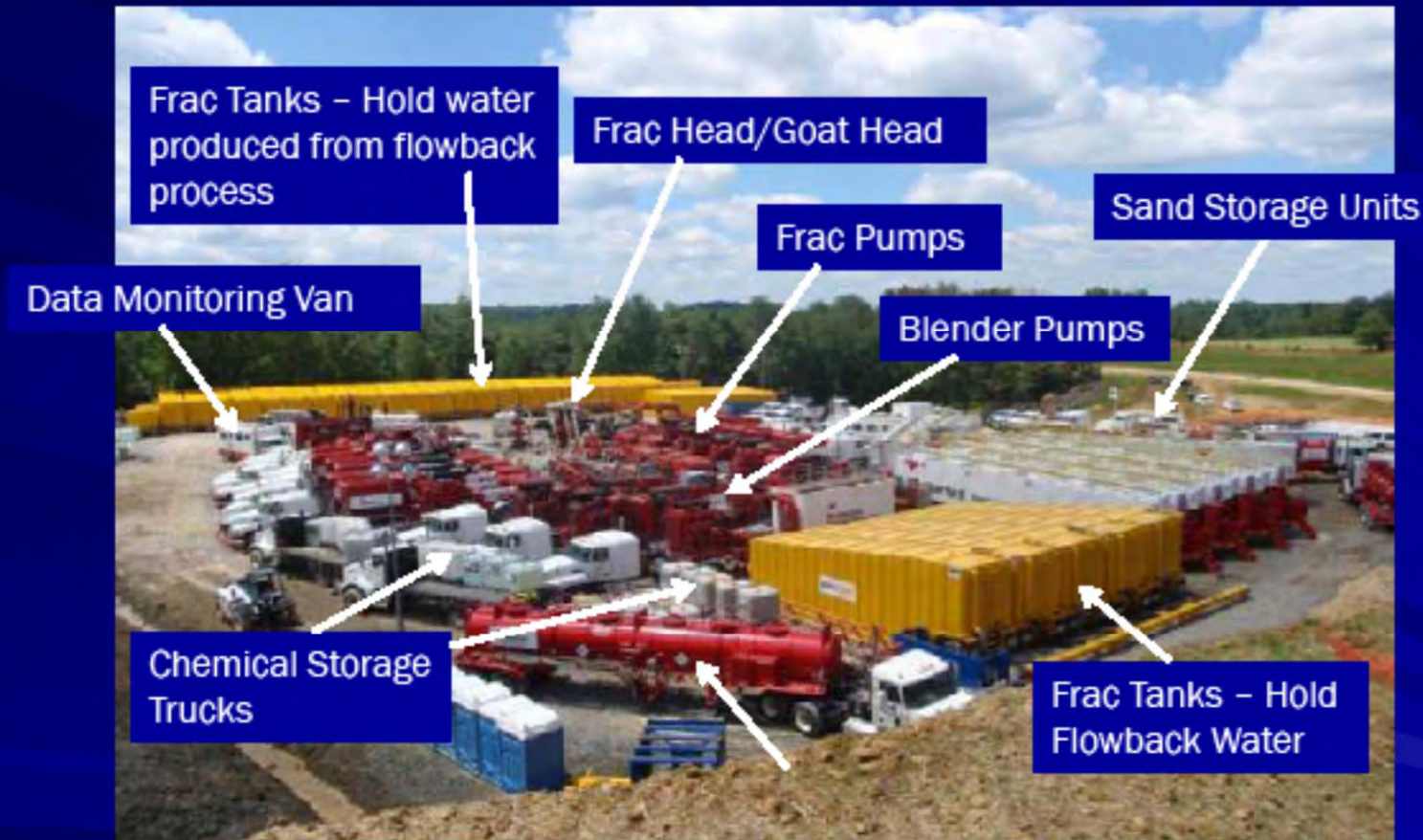








# Typical Site Layout



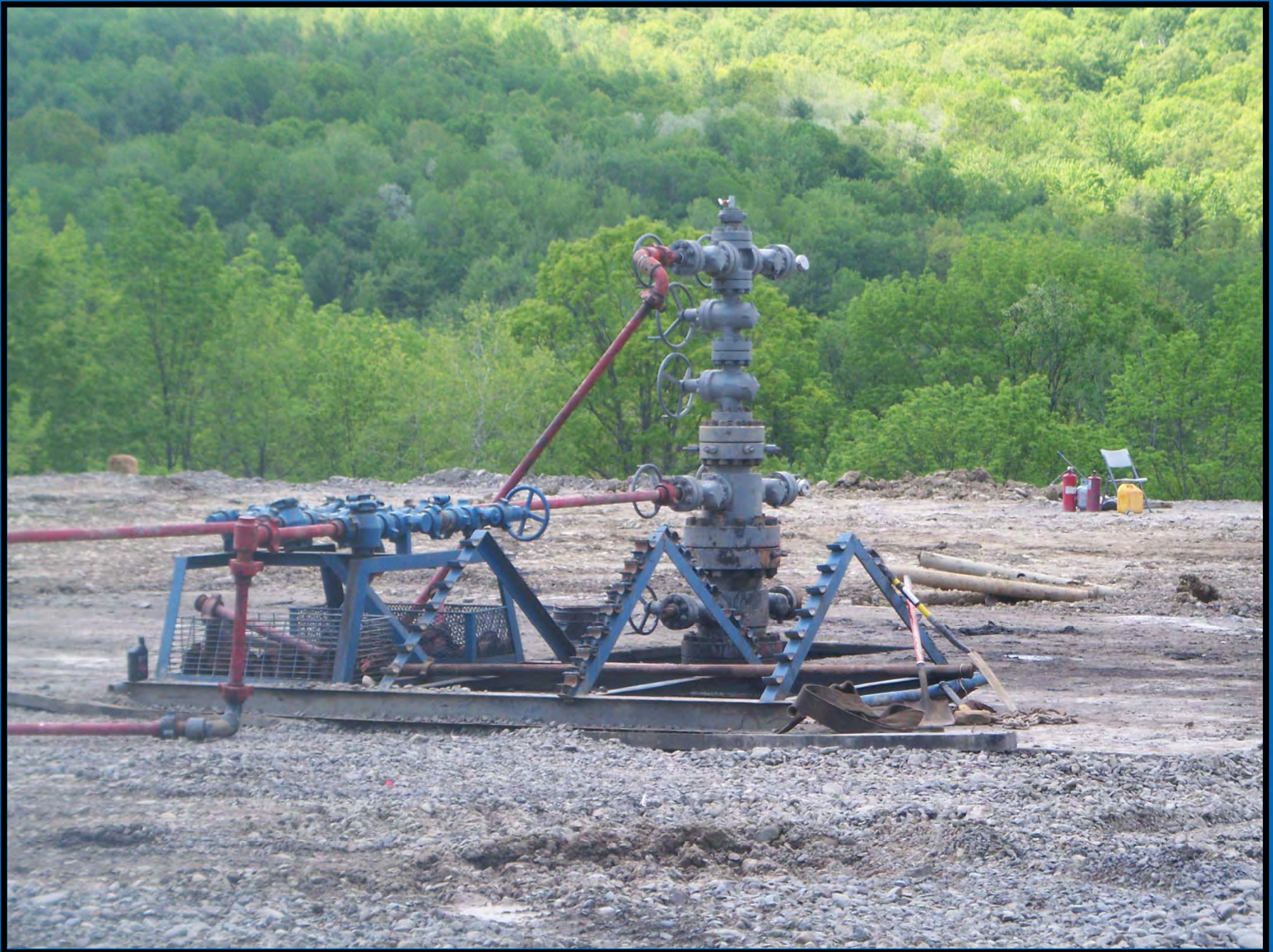
















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