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Challenges and Benefits of Using Mine Pool Water for Hydraulic Fracturing

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OUTLINE

- Availability of mine water
- Mine water characteristics
- Benefits of using mine water
- Challenges of using mine water
- Evaluation and permitting
- Mine pool management
- Example projects
- Conclusions

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PENNSYLVANIA'S CURRENT AMD ISSUES

- 2,400 miles of abandoned mine drainage (AMD) polluted streams
- PADEP has limited funding for treatment of discharges and cleaning streams
- Four main classes of discharges:
  - Active operator, treated discharge
  - Closed mine, treated discharge
  - Orphaned discharge (Pre-1977), no treatment
  - Legacy / Forfeited, discharge treated by DEP

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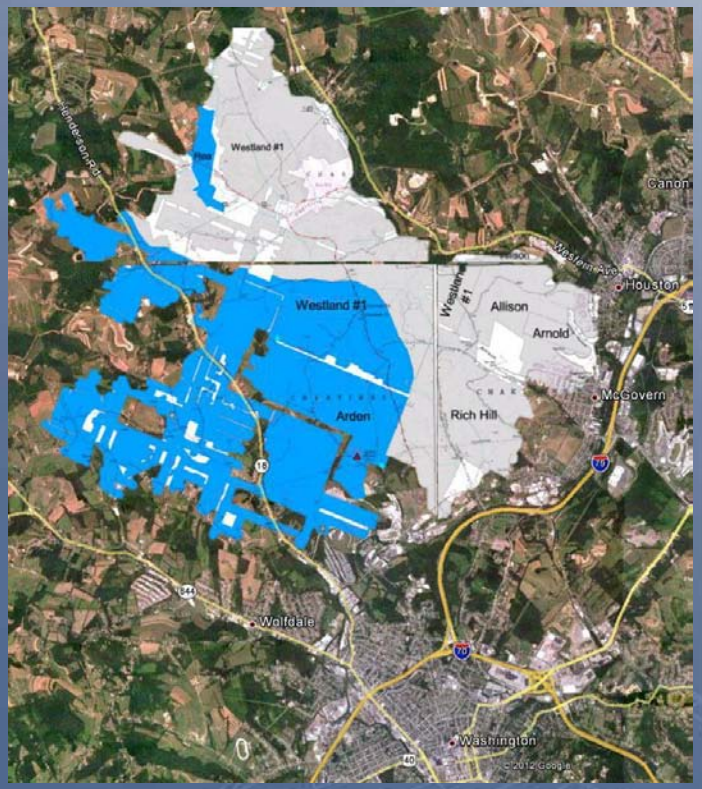
AVAILABILITY OF MINE WATER

- Hydraulic fracturing requires large volumes of water
  - Water sources are limited
    - Surface water
    - Ground water
  - Water delivery challenges
    - Trucking
    - Piping
- Large quantities of water are available from abandoned mines
- Mine pools are present throughout the Marcellus Shale Play



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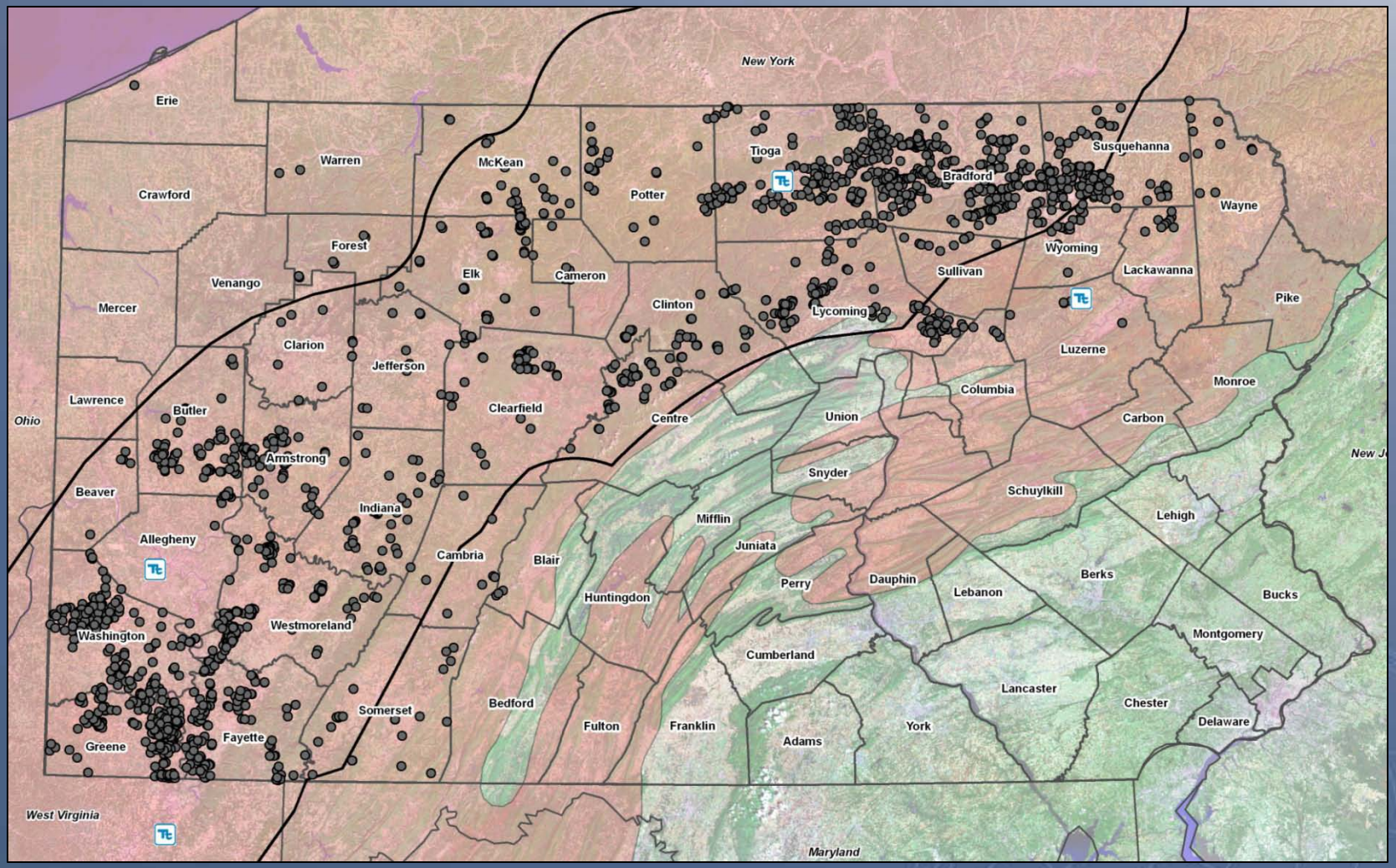
MARCELLUS SHALE MAP – WELLS ONLY



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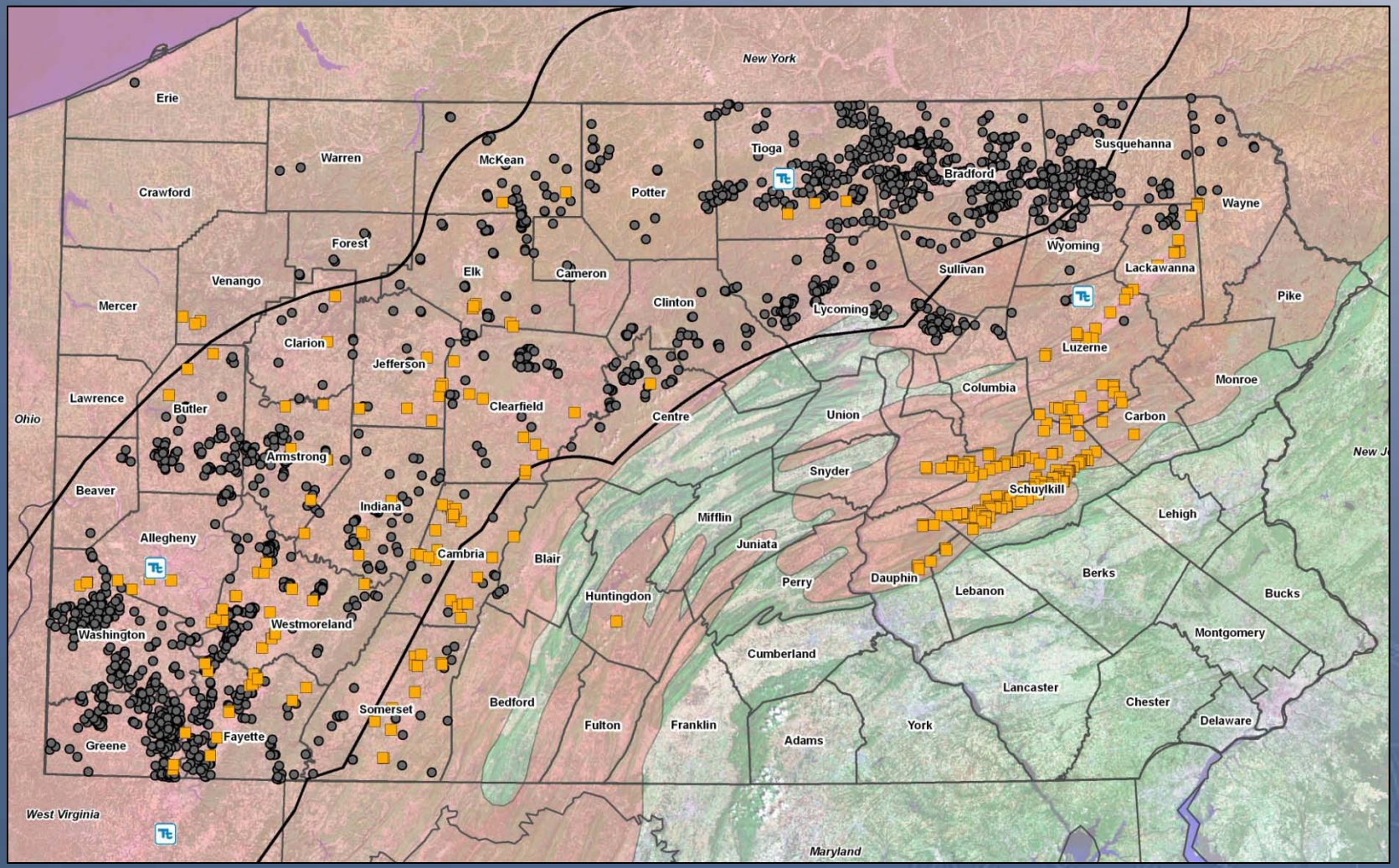
WELLS AND MINE DISCHARGES



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MINE WATER CHARACTERISTICS

- Typical flow ranges from 300 gpm to 3,000 gpm (1/2 MGD to 1.5 MGD)
- Acidic or neutral
- Iron 1 ppm to 100 ppm
- Aluminum, manganese
- Sulfates 50 ppm to 1,000 ppm

BENEFITS OF USING MINE WATER

- Goodwill / Environmental benefit - reduce metal loadings and pollutants to watersheds
- Reduce ‘clean’ water withdraw
- General close proximity and abundant supply of mine water
- For active mines – existing infrastructure and clear ownership
- Less road damage

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CHALLENGES OF USING MINE WATER

- Water Quality
  - Treatment may be required
  - Quality varies
- Abandoned discharges – unclear ownership of water and liability
- Impact of withdraw from mine pool
  - Destabilization of mine
  - Flow may be required for a stream
- Interbasin transfers

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EVALUATION AND PERMITTING

- PADEP white paper: *Utilization of Mine Influence Water in Well Development for Natural Gas Extraction*
  - Environmental impact from mine water and benefit to watershed
  - Current mine water flow and volume at the site
  - Proposed volume to be used
  - Characterization of the mine water
  - Proposed site development, including storage facilities
  - Spill Prevention Plan
  - Evaluation of mine pool
    - History of mining
    - Mine pool recharge rate
    - Potential of impacts due to subsidence
    - Potential of impacts to water supplies
- Water Management Plan, E&S Plan, NPDES?

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MINE POOL MANAGEMENT

- Lower or maintain pool levels to eliminate unmanaged discharge
- Complex issues
  - History of mining, multiple discharges
- Treatment
- Quality varies with change in pool elevation
- Operating & maintenance
- Not an exact science – need for experience

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EXPLORATION AND PRODUCTION FIRMS

- Need water – 5mil gallon/frac
- Need goodwill – environmental benefit
- Want low water cost/less road damage
- Environmental compliance managed by PADEP

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EXAMPLE PROJECT – DELAWARE RIVER BASIN

- **Project Driver**: DRBC surface water use limitations
  - DRBC – Severe limits on GW/SW withdrawals
  - Supports use of treated mine water imported from Susquehanna River
  - PADEP & Lackawanna River Groups support mine water use

- **Tetra Tech**:
  - Developed concept to use mine pool water
  - Installed weirs & monitored flows and quality
  - Developed conceptual treatment/ transport plan/cost estimate

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EXAMPLE PROJECT – GLADDEN MINE

- Gladden Mine Pool
- South Fayette Township, PA
- Project participants:
  - South Fayette Conservation District
  - PA DEP
  - Range Resources
  - Tetra Tech

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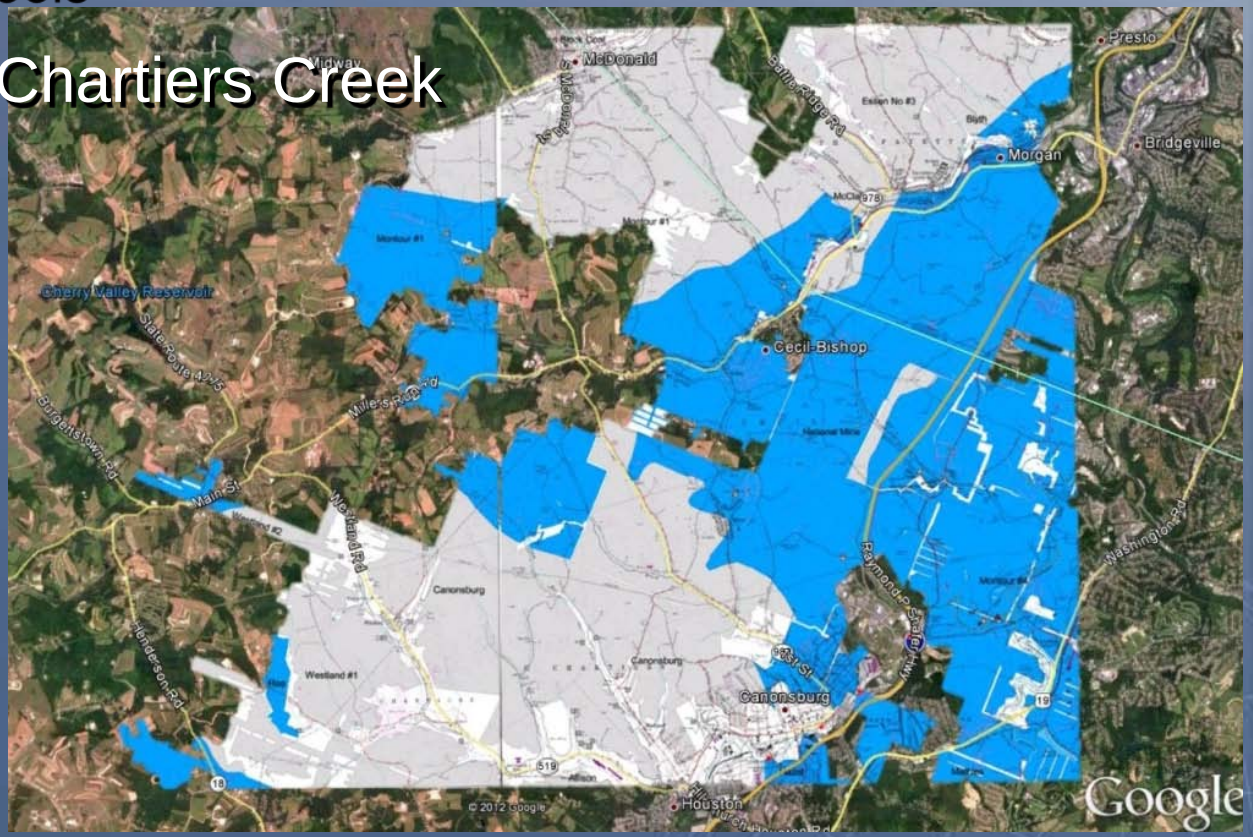
EXAMPLE PROJECT – GLADDEN MINE

- Mine history
  - Three mine pools
- Discharge to Chartiers Creek



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EXAMPLE PROJECT – GLADDEN MINE

- 2005 report by Chartiers Nature Conservancy
  - "Without treatment of Gladden Mine discharge, Millers Run or Chartiers Creek could not be restored"
- Discharge characteristics:
  - Flow ~700 gpm
  - pH 6.0
  - Iron 100 ppm
  - Sulfate 760 ppm

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EXAMPLE PROJECT – GLADDEN MINE

- **DEP goal**:
  - Clean the stream
    - Acid neutralization
    - Iron removal
    - Sustainable treatment

- **Range Resources goals**:
  - Water supply for well development of adequate quantity/quality
  - Reasonable cost
  - Goodwill

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EXAMPLE PROJECT – GLADDEN MINE

- Concept
  - Hydrated lime (or similar material) treatment system
  - Lower mine pool
  - Add second treatment stage for use well use
  - Pump treated water to impoundments at wells
  - Discharge excess water to stream
  - 3rd party operator
  - Cost share
    - Capital
    - Operating and Maintenance
    - Trust Fund
- At end of drilling, plant and trust fund donated to DEP

CONCLUSIONS

- Issues
  - Liability
  - Cost sharing
  - Environmental compliance
  - Drilling schedule
  - Cost of gas
  - Incentives
  - EPA acceptance

CONCLUSIONS

- Self control vs. regulated
- Don’t miss other opportunities
  - CSO
  - Alkaline Ash

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THANK YOU!

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