Attachment H

Abandoned and Orphan Oil and Gas Wells in Pennsylvania

(Office of Oil and Gas Management, Pennsylvania Department of Environmental Protection)

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Oil and Gas Management

Citizens Advisory Council

Abandoned and Orphan Oil and Gas Wells in Pennsylvania

Bureau of Oil and Gas Planning and Program Management

Division of Subsurface Activities

January 19, 2021

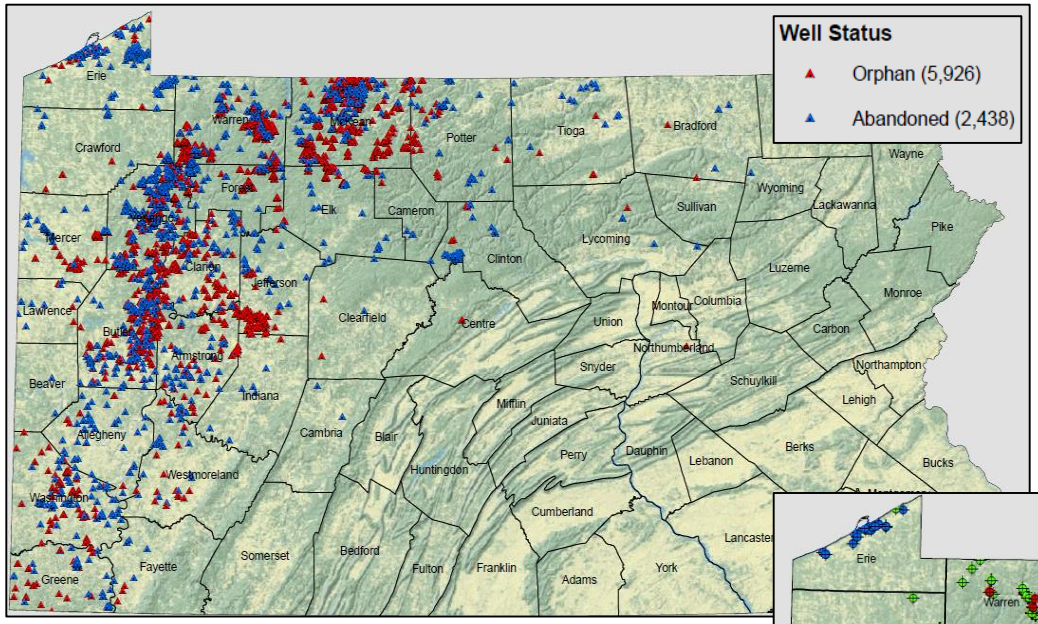
Presentation Outline

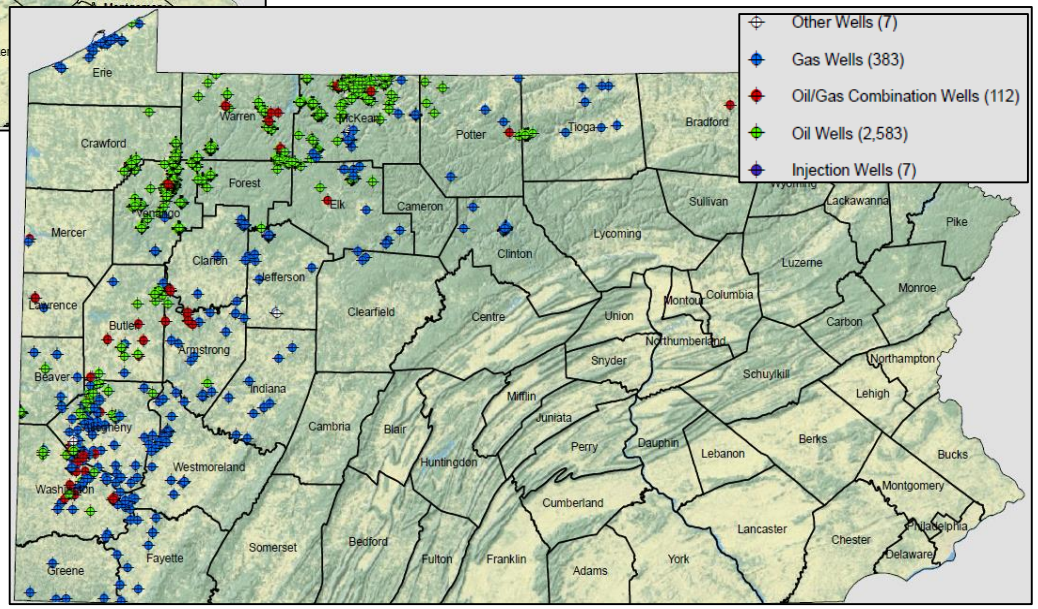
- Plugging Program Status Update
  - Funding
  - Emergency Procurement
  - Estimated Unfunded Liability
- Emerging Environmental/Safety Issues
  - Plugging Effectiveness
  - Short-term Environmental and Safety Risks
  - Emissions
- Summary

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Plugging Program Status Update

DEP Abandoned, Orphan, and Plugged Wells

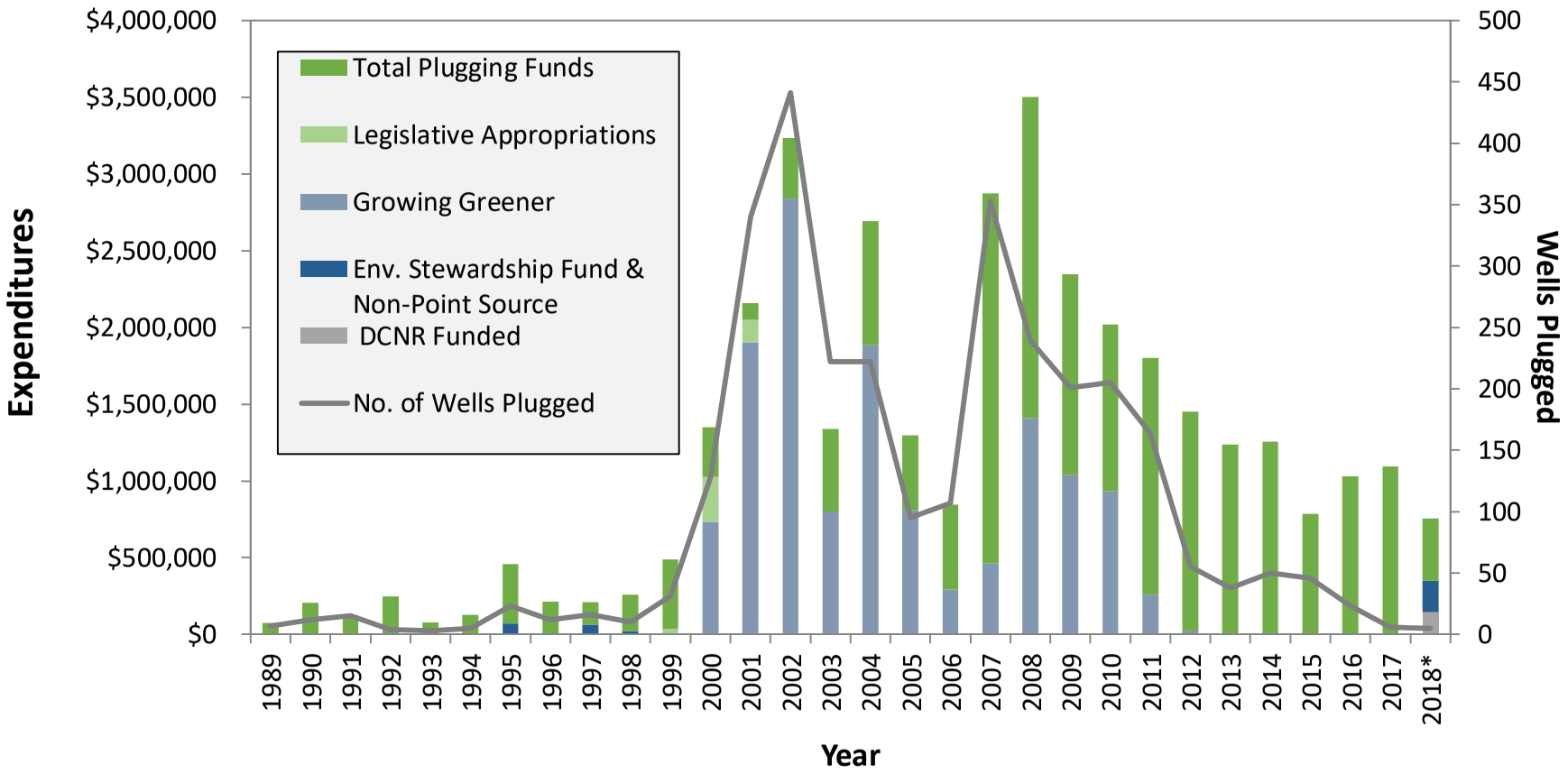




Plugging Program Status Update

DEP Plugging Program Funding

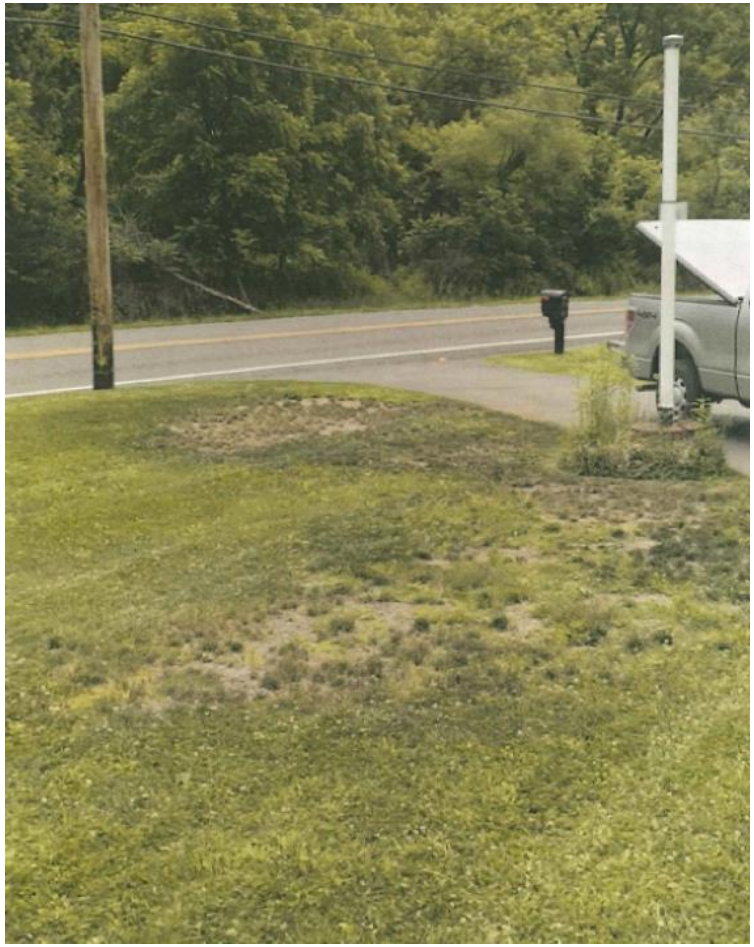
- Since 1985, DEP has received $150-$250 surcharges for every drilling permit



Plugging Program Status Update

Recent Emergency Procurement Trends

- Antaki Well: $14,000 for stray gas mitigation system



Plugging Program Status Update

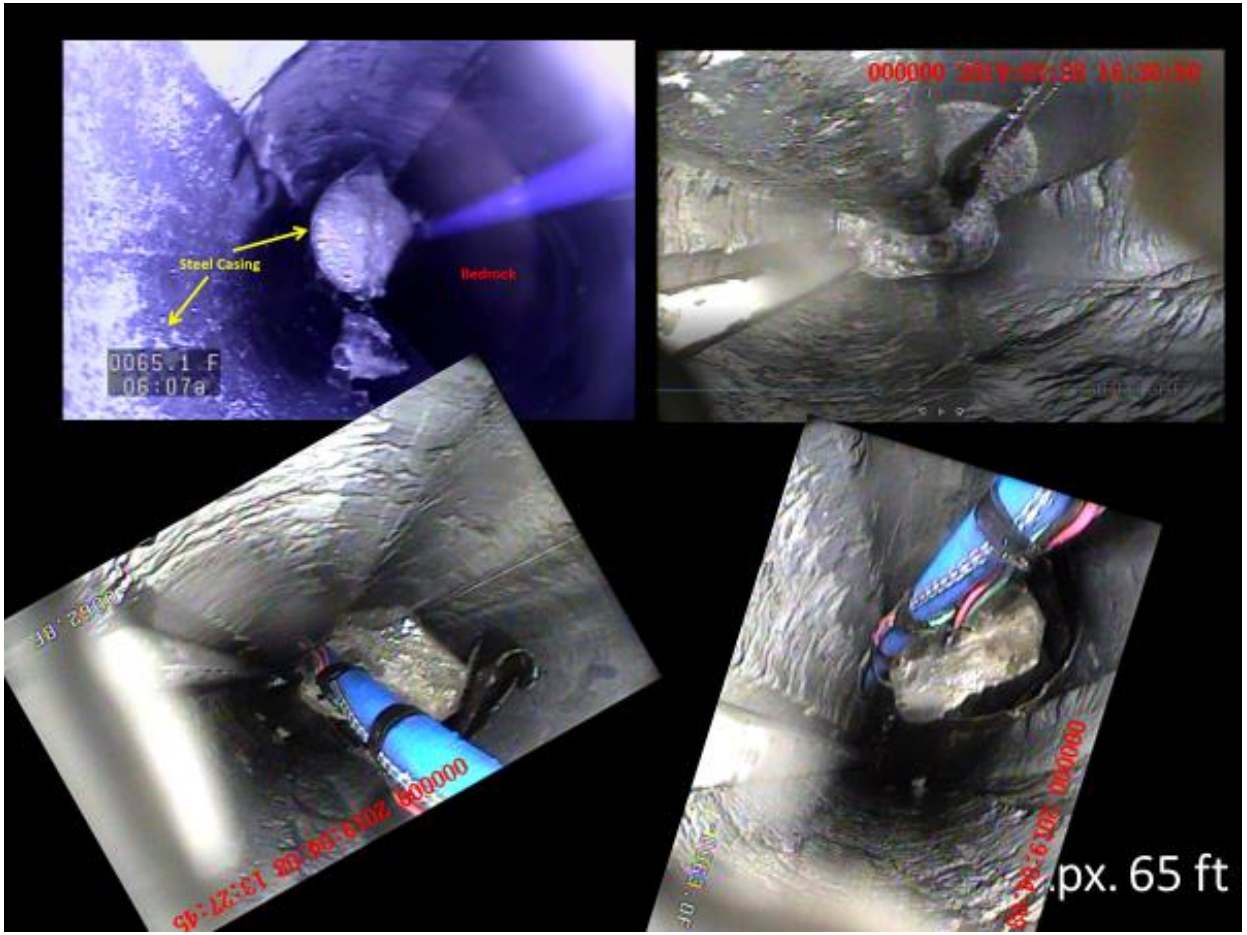
Recent Emergency Procurement Trends

- Antaki Well: $14,000 for stray gas mitigation system

Plugging Program Status Update

Recent Emergency Procurement Trends

- Antaki Well: Approximately $350,000 for plugging



Plugging Program Status Update

Recent Emergency Procurement Trends

- John Barron Well: $179,000 for flaring and plugging

Plugging Program Status Update

Recent Emergency Procurement Trends

- John Barron Well: $179,000 for flaring and plugging

Plugging Program Status Update

Recent Emergency Procurement Trends

- John Barron Well: $179,000 for flaring and plugging

Plugging Program Status Update

Recent Emergency Procurement Trends

- Monahan Well: $160,000 for plugging

Plugging Program Status Update

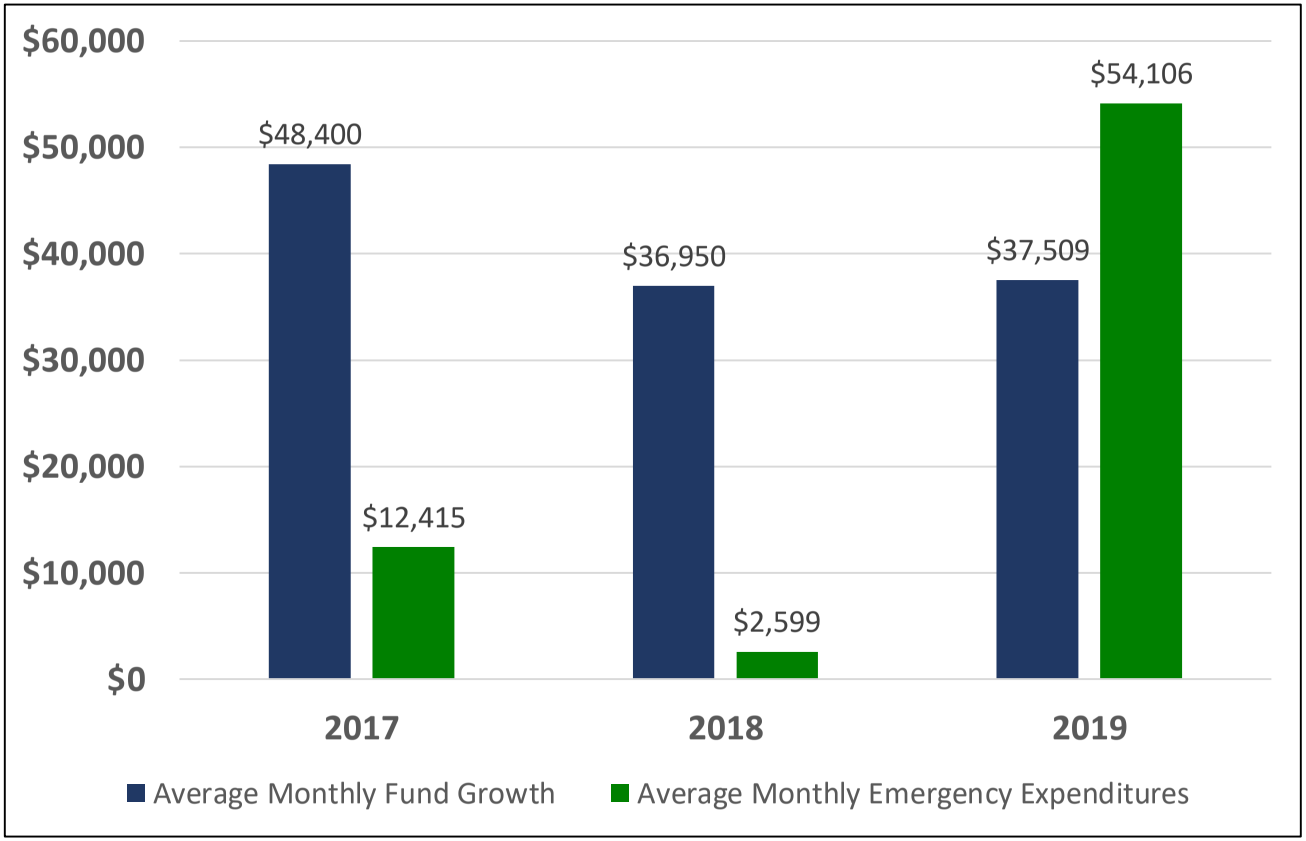
Recent Emergency Procurement Trends

- Monahan Well: $160,000 for plugging

Plugging Program Status Update

Recent Emergency Procurement Trends

- DEP's emergency procurement trends also suggest expenditures have the potential to exceed fund growth



Plugging Program Status Update

Mass Abandonment

- In 2018 two operators with major holdings abandoned approximately 2,750 wells
- Tens of thousands of conventional oil and gas wells will eventually need to be plugged but they may not have a viable owner that can afford to plug them
- Bonding levels do not equate to actual plugging costs
  - $2,500 single conventional well bond
  - $25,000 blanket bond (unlimited number of conventional wells)
  - Thousands of wells are under a single blanket bond or have no bonds at all (Pre-Act wells)

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Plugging Program Status Update

Crunching the Numbers

- There are more than 8,000 wells in DEP's Abandoned and Orphan Well database – DEP has the statutory authority to plug these wells
- Over the last four years, DEP has added 345 wells to its Abandoned and Orphan Well database
- Mass abandonment is likely to continue increasing DEP's plugging liability
- Since 1989, DEP has plugged a little over 3,000 wells
- Comparing peer reviewed research (Dilmore et al., 2015; Kang et al., 2016) to public databases, there could be as many as 200,000 additional legacy wells, many of which will require plugging as they are discovered

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Plugging Program Status Update

Cost Modeling/Liability Forecasting

- A conservative estimate of $33,000 per well has been derived from reviewing contract costs
- Liability forecasting changes significantly based on per-well cost assumptions
  - At $33,000 per well, DEP's plugging liability ranges somewhere between $280 million (8,500 wells) and $6.6 billion (200,000 wells)

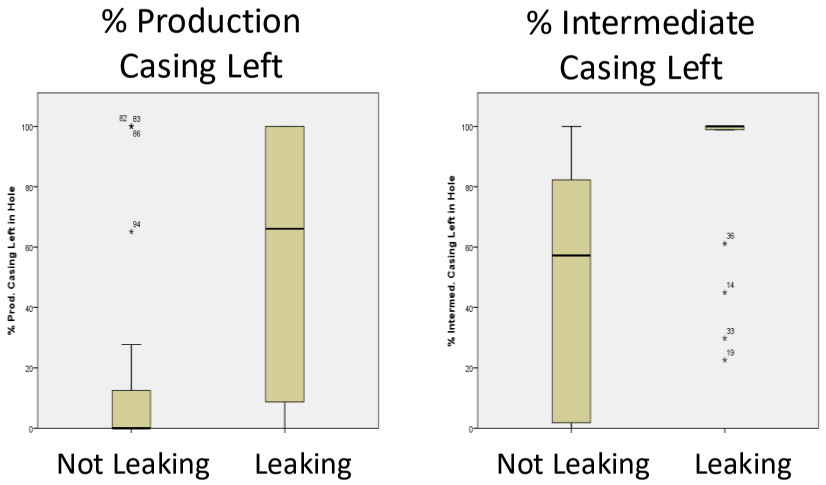
pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Emerging Environmental/Safety Issues

Plugging Effectiveness: Field Investigation and Statistical Analysis

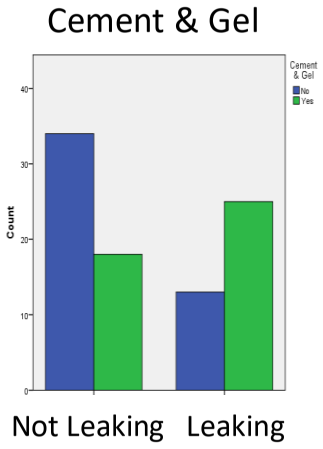
- Conduct well site investigations utilizing high sensitivity gas monitoring equipment to determine if plugs are leaking
- Analyze field data and compare to other leaking plugged wells and non-leaking plugged wells to determine variables that may be influencing rate of plug failure

Emerging Environmental/Safety Issues



Box Plots Suggest:

- Leaking wells have substantially more production or intermediate casing left in the ground than non-leaking wells – differences are statistically significant ($p<0.05$)



Bar Charts Suggest:

- Leaking wells have a greater ratio of cement & gel plugs

Emerging Environmental/Safety Issues

Shallow Charged Zones Possibly Attributable to Legacy Activities

Emerging Environmental/Safety Issues

Risks associated with Abandoned, Orphan, and improperly plugged wells can be compounded by mine-influenced water in areas of coal mining

Emerging Environmental/Safety Issues

Encroachment

- High population density areas/regions of active development may introduce intersections between legacy wells and occupied enclosed spaces
- During Phase I/Phase II site assessments, a thorough review of legacy development is critical for mitigating client liability
  - PA Geologic Survey Farmline Maps
  - PASDA
  - DEP Oil and Gas Mapping Tool
  - Local Government Resources
- The Good Samaritan Law affords liability relief for third parties who volunteer to decommission legacy wells for which there is no responsible party

Emerging Environmental/Safety Issues

Encroachment

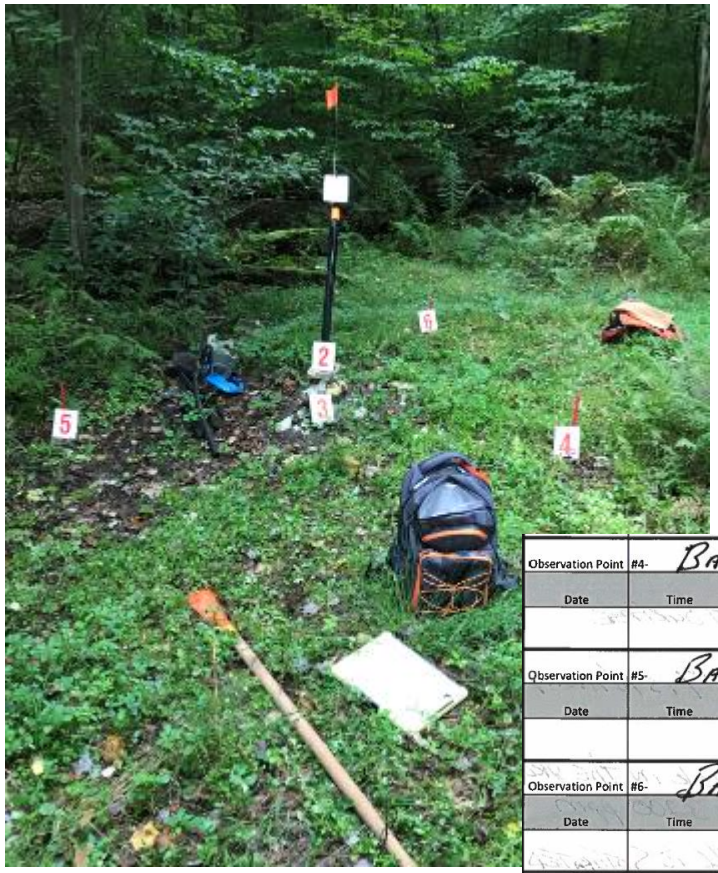
Emerging Environmental/Safety Issues

Improperly Decommissioned Gathering Systems

- Stubbed off segments of gathering lines have the potential to introduce stray gas into the subsurface if not properly decommissioned during well plugging
- Recent DEP field work has identified elevated soil gas concentrations in association with such systems

Emerging Environmental/Safety Issues

Improperly Decommissioned Gathering Systems



Observation Point	#4-	Bar Hole	#4				
Date	Time	Gas Concentration	Concentration Unit (ppm or %)	Volume ft³/day	Barometric Pressure (inHg)	Ambient Temperature (°F)	
		6620	ppm				
Observation Point	#5-	Bar Hole	#5				
Date	Time	Gas Concentration	Concentration Unit (ppm or %)	Volume ft³/day	Barometric Pressure (inHg)	Ambient Temperature (°F)	
		7860	ppm				
Observation Point	#6-	Bar Hole	#6				
Date	Time	Gas Concentration	Concentration Unit (ppm or %)	Volume ft³/day	Barometric Pressure (inHg)	Ambient Temperature (°F)	
		500	ppm				
Observation Point	#7-	Bar Hole	#7	10' Away			
Date	Time	Gas Concentration	Concentration Unit (ppm or %)	Volume ft³/day	Barometric Pressure (inHg)	Ambient Temperature (°F)	
		360	ppm				

Abbreviations
OH: Open Hole
VPL: Venting Pipeline

Emerging Environmental/Safety Issues

Emissions

- McGill University
  - Kang et al. (2016) found a high occurrence of leaking abandoned and plugged wells
  - Isotopic signatures support deep, oil-associated origin
  - In some cases, gas was found to be flowing through the soil beyond the footprint of the outermost well casing
  - DEP is currently working to understand if Kang et al.'s (2016) emission regression model can be used as a risk-management tool

Summary

- Pennsylvania has a significant history of legacy oil and gas development and the potential for hundreds of thousands of wells with no associated responsible party
- Unfunded plugging liability is currently estimated at $280 million, but could be much higher – it is forecasted to grow
- An analysis of failed plugs suggests that further improvements may be necessary to ensure long-term plug integrity
- Legacy wells are contributing to environmental and public safety risks

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Oil and Gas Management

Thank You!
Questions?

Seth Pelepko, P.G.
Program Manager
Division of Subsurface Activities
mipelepko@pa.gov

Bureau of Oil & Gas Planning & Program Mgmt
717.772.2199

Many thanks to my co-authors: Serena Oldhouser, Liz Cushman, Harry Wise, Rick Swank, and Jim Braunns!

Rewriting Pennsylvania's Legacy (dep.pa.gov/legacy wells)