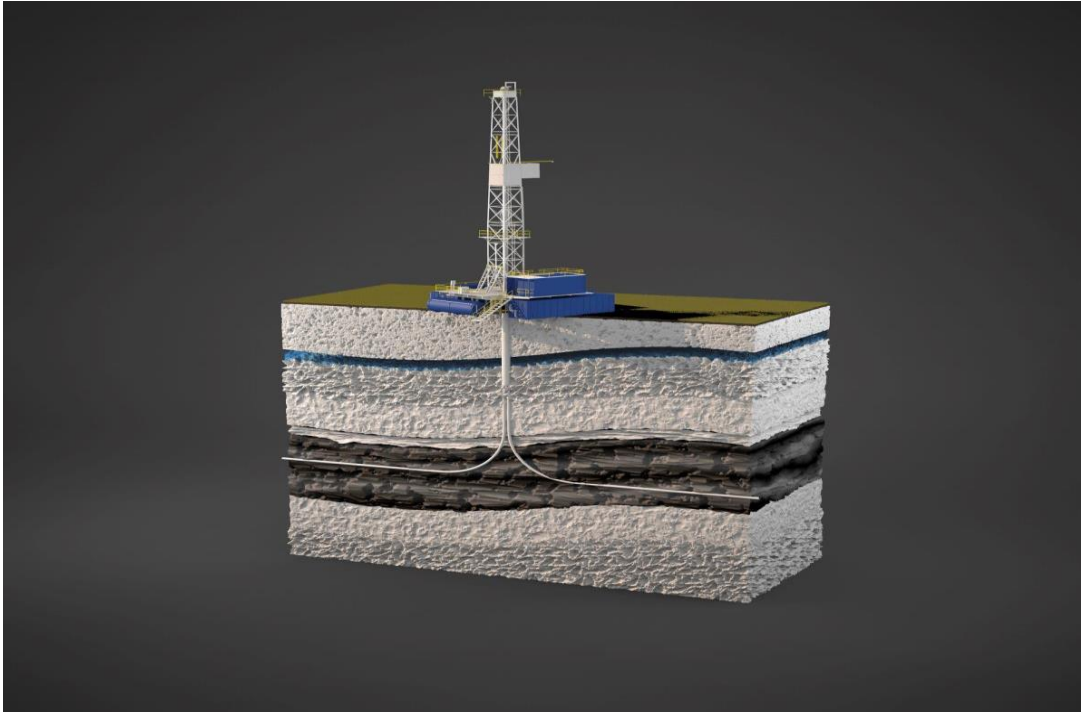


Chatham County North Carolina Hydraulic Fracturing Background Assessment 2nd Presentation

- **October 2017**
- **Submitted to Chatham County
Board of Commissioners**



Organization

- Summary of scientific findings and consensus among persons studying fracking
- Summary of key legal / regulatory provisions that may impact fracking in North Carolina
- A case study that illustrates what Chatham would be facing in the advent of a fracking industry in the county or nearby.
- ***This information is designed to complement the information from the first presentation.***

Science and hydraulic fracturing – key aspects and consensus among key researchers

- **Source:**

- Extensive review of shale gas environmental impacts from scientific literature 2010 – 2015. Environmental science and pollution research. Springer Verlag April 2017.

Finding one

- Wastewater characteristics are almost exclusively dependent on rock formations.
- Consensus – high.

Finding two

- Migration of methane and salts to groundwater as a result of fracturing rarely occurs
- Consensus is high

Finding three

- Contamination of surface water as a result of poor waste water treatment and handling is common
- Consensus is high

Finding four

- Wastewater organic contaminants tend to be highly biodegradable
- Consensus is moderate

Finding five

- Wastewater reuse after pretreatment is a simple method to limit negative impacts
- Consensus is high

Finding six

- Methane leakage percent lies with the .66 to 3.9% range
- Consensus is moderate

Finding seven

- Shale gas GHG life cycle emissions are lower for gas than for coal
- Consensus is high

Finding eight

- Seismicity from deep well injection is far more likely than for hydraulic fracturing
- Consensus is high

finding nine

- Seismicity is connected to preexisting faults
- Consensus is moderate

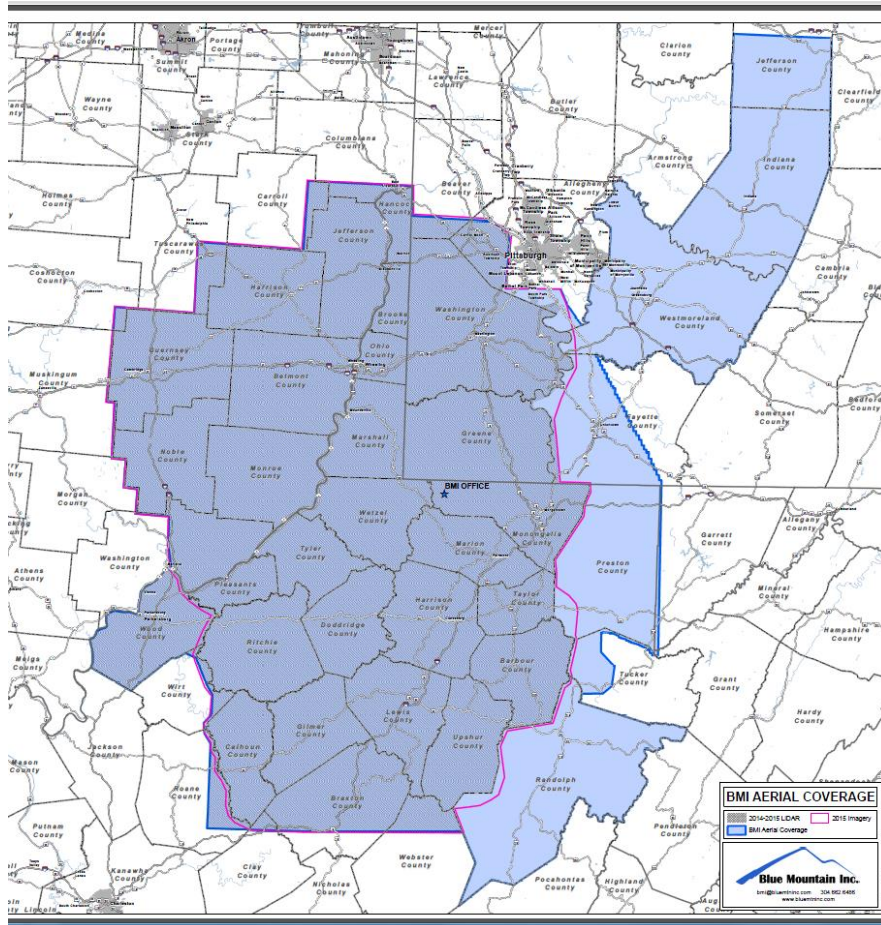
Key legal / regulatory provisions that impact potential fracturing in Chatham County

- **Use of injection wells for disposal of produced water from fracking.** Injection wells are prohibited in North Carolina. The result is that produced water would likely be recycled for reuse in fracking or disposed of utilizing surface disposal.
- **North Carolina Oil and Gas Commission regulations.** Current draft of the regulations covers most but not all aspects of fracking. Regulations will need to be reviewed and revised to address all critical aspects of hydraulic fracturing operations – from exploration to restoration and site abandonment and to comprehensive record keeping and report

- Most aspects of the proposed regulations for North Carolina do reflect current science and practice. However, the utility of many of the regulations (such as borehole cementing and surface well site water control measures) require rigorous inspection and enforcement to be effective.
- **Local regulation of hydraulic fracturing.** Generally applicable local regulations can be applied to hydraulic fracturing as authorized in state laws. Typically, local regulations cannot address any aspects regulated by state law. Zoning, subdivision regulations, and other design review / siting ordinances may address aspects of fracking operations so long as such ordinances do not preclude or severely limit the development of hydraulic fracturing operations.
- However, it must be noted that the application of local ordinances can be appealed to the Oil and Gas Commission to determine whether such regulation is overly restrictive or unnecessary.
- **Surface owner property rights.** Deference is given to the mineral owner such that the surface owner(s) cannot diminish the value of the mineral resource. This applies to all surface aspects of fracking operations except for thru pipelines and roadways. Right-of-ways for thru pipelines and roadways (not directly required for on-site development) must be negotiated separately.

- **Forced or mandatory pooling of mineral leases.** North Carolina does not have forced or mandatory pooling of mineral leases. Eastern states typically do not have forced pooling due to complex surface and mineral ownership patterns.
- **Hydraulic fracturing moratoriums.** Moratoriums can be enacted, if such moratoriums are: of fixed duration; and relate to specific goals and objectives, such as the need for additional study; and not simply as a “delaying tactic.”
- **State regulations and conditions found specifically in Chatham County.** Proposed state regulations (primarily setback requirements) potentially do not adequately address a number of critical environmental conditions found in Chatham County. These include: igneous and metamorphic geologic features such as dikes which are often sites susceptible to groundwater pollution from surface sources; proximity to the Deep River mainstem and riparian zone and the ecological importance of the Deep River; and the shallow depths of the Cumnock Formation in the County and the resulting close proximity of groundwater source formations to the formation suitable for natural gas development. This close proximity potentially increases the likelihood of groundwater pollution of fracturing activities.

Case study – Greene County and Marshall County



- Area of early gas development
- Area with significant gas resources
- Rural / agricultural with villages / hamlets
- The case study is the landscape along the major east / west route between Waynesburg and Moundsville
- ***Any dozen or so wells in the area probably will produce more gas than there is in North Carolina***

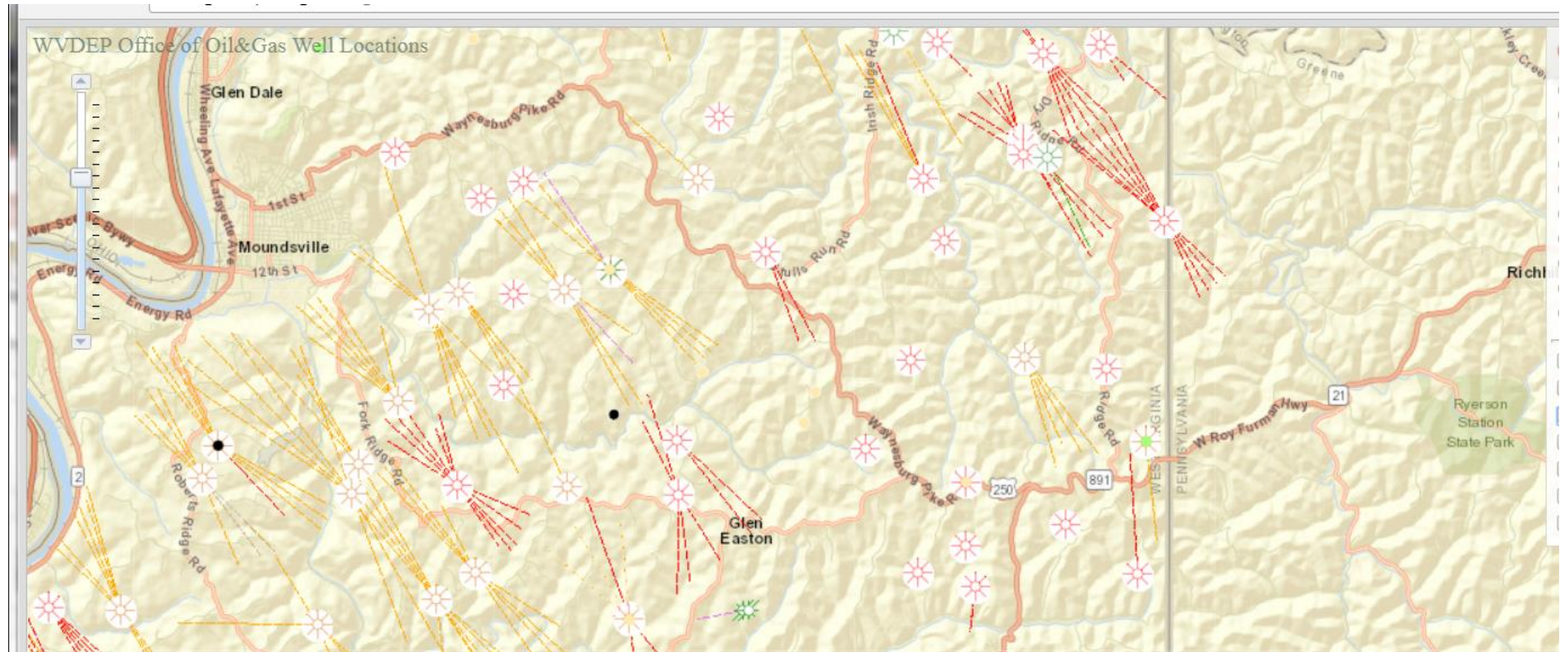
The landscape – historic mining and traditional natural gas with unconventional gas now dominating



View from the road – a fracking well with multiple laterals in production mode with recent pipeline regrading in the background



So how much development is there in a intensively developed area?



Details of the well – operators do not anticipate any refracking of these wells



View of the road that carries most of the well development traffic



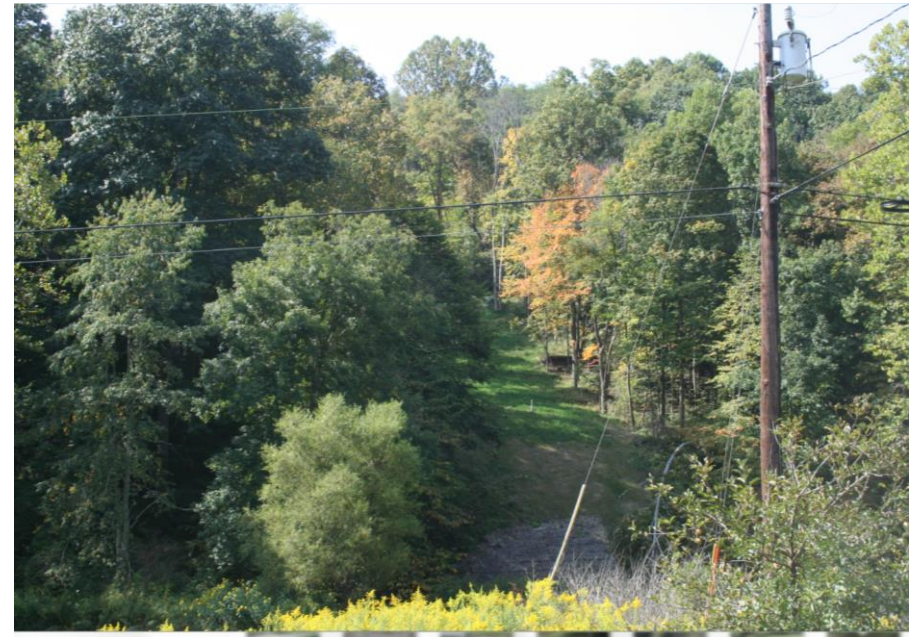
Some counts for the area

- Area of roughly 400 square miles
- One drill rig currently operating in the area – typical for a region of this size
- Three wells in various stages of fracking
- Road counts in a random hour of monitoring
 - Six fluid trucks
 - Four sand trucks
 - Seven pipe trucks

Fluid trucks and a local compressor station



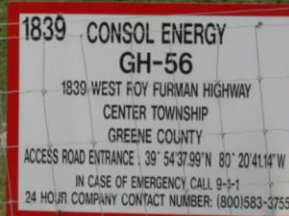
Views of pipelines – wells have pipelines to connect to compressors and compressors have pipelines to connect with gathering compressors



Well locations and location of the drill rig in the region



Gathering locations are intensively developed



Workforce – 70 – 80 out of state workers in the region – most of the workforce is local but out of state expertise needed for deep drilling experience



Gathering facility construction



Compressors at gathering location



Two wells with numerous laterals –
companies often pool resources



Venting and flaring stacks



Larger views of a portion of the facility – view from the road



Another well that is a well with only two laterals



Pipeline construction on a steeper hillside – view from the road



A few other facts

- No reported groundwater well damage
- A number of spills were reported with some significant surface water damage
- No significant community impacts were reported by the counties or municipalities – law enforcement except for vehicle moving violations for workers and service trucks
- Amount of venting and flaring appears to be significant
- A number of secondary unpaved roads have become unpassable to normal vehicle traffic – paved road conditions appeared to be suitable for all traffic