Regulatory Framework for Shale Development in Ohio

Division of Oil & Gas Resources Management, ODNR

Utica Shale Issues
09-13-12
On Behalf of ODNR

Director: James Zehringer
Assistant Director: Fred Shimp
Chief: Richard Simmers
Presenter: Mike McCormac
Today’s Presentation

- Overview of oil and natural gas in Ohio
- Shale development to date
- Vertical & horizontal well differences
- Regulatory Framework
  - Temporary minimum spacing Order
  - Well construction rules
- 5 yr. review rule update
- Upcoming Rules
ODNR Organization Changes

Oil & Gas program became a stand alone division Oct. 1, 2011

- Acknowledgement of the importance for a direct focus on oil and natural gas development, in particular, shale development
Oil and Gas Fields in Ohio

275,000 + wells drilled
### Ohio’s Historical Drilling Activity

<table>
<thead>
<tr>
<th>Year</th>
<th>Wells Drilled</th>
</tr>
</thead>
<tbody>
<tr>
<td>1895</td>
<td>6,147</td>
</tr>
<tr>
<td>1930</td>
<td>2,134</td>
</tr>
<tr>
<td>1980-82</td>
<td>5,167 (avg)</td>
</tr>
<tr>
<td>2008</td>
<td>1,087</td>
</tr>
<tr>
<td>2010</td>
<td>431</td>
</tr>
<tr>
<td>2011</td>
<td>460</td>
</tr>
</tbody>
</table>

64,000 Well Exist in Ohio Today
Legal Authority For The Regulation of Oil and Natural Gas Development

- Ohio Revised Code 1509
- Ohio Administrative Code 1501
- ORC 1509 effective in 1965:

The Division has sole authority over the permitting, location and production of oil and natural gas in Ohio.
Cardington Township, Scale: 1 Inch = 1,320 Feet, Secs. 22 & 27, Lots 8, 9 & 20, The Village Of Cardington; Example Of Map Detail At Working Scale; Midcontinent-Wood, Inc., c. 1967; Courtesy Of Exhibit Pro, Columbus, Ohio.
Basis for Oil & Gas Laws and Rules

- Protection of the environment
- Conservation
- Public health & safety
Permit Conditions - Examples

- Pre-site review
- As drilled surveys
Shale Development in the United States and Ohio
Application of Two Established Technologies

- Directional Drilling
- Hydraulic Fracturing
Location of Shale Development

Shale Gas Plays, Lower 48 States

- Devonian (Ohio)
- Marcellus
- Utica

Legend:
- Red: Shallowest / Youngest
- Blue: Deepest / Oldest
Utica and Marcellus Shale
Marcellus Shale Drilling in Ohio through 08/31/12

- Horizontal Permits Issued: 16
- Horizontal Wells Drilled: 7
- Producing: 5

No Change for weeks
The Game Changer

- The Utica Shale may contain **significant** quantities of natural gas liquids

- It appears the liquids potential increases as you move westward toward central Ohio
Shale – Possible Productive Extent

- Geologically: 40 + counties
- 10,000,000 + acres
- 14,000 + sq mi

Productive areas - still being defined
Utica/Point Pleasant Shale Drilling in Ohio through 08/31/12

- Horizontal permits issued: 359
- Horizontal wells drilled: 129
- Producing wells: 27
<table>
<thead>
<tr>
<th>County</th>
<th>Value</th>
<th>County</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carroll</td>
<td>134</td>
<td>Belmont</td>
<td>9</td>
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<tr>
<td>Columbiana</td>
<td>49</td>
<td>Tuscarawas</td>
<td>7</td>
</tr>
<tr>
<td>Harrison</td>
<td>32</td>
<td>Coshocton</td>
<td>3</td>
</tr>
<tr>
<td>Jefferson</td>
<td>28</td>
<td>Muskingum</td>
<td>3</td>
</tr>
<tr>
<td>Guernsey</td>
<td>20</td>
<td>Knox</td>
<td>2</td>
</tr>
<tr>
<td>Monroe</td>
<td>17</td>
<td>Trumbull</td>
<td>2</td>
</tr>
<tr>
<td>Mahoning</td>
<td>13</td>
<td>Ashland</td>
<td>1</td>
</tr>
<tr>
<td>Stark</td>
<td>13</td>
<td>Geauga</td>
<td>1</td>
</tr>
<tr>
<td>Noble</td>
<td>12</td>
<td>Holmes</td>
<td>1</td>
</tr>
<tr>
<td>Portage</td>
<td>10</td>
<td>Medina</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wayne</td>
<td>1</td>
</tr>
</tbody>
</table>
# 2011 Utica Production

## 2011 Utica Shale Production

<table>
<thead>
<tr>
<th>Owner Name</th>
<th>County</th>
<th>Well Name/Well Number</th>
<th>Oil (Barrels)</th>
<th>Gas (MCF)</th>
<th>Brine (Barrels)</th>
<th>Days in Production *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chesapeake Appalachia LLC</td>
<td>CARROLL</td>
<td>CALVIN MANGUN 8H</td>
<td>12,334</td>
<td>322,435</td>
<td>23,585</td>
<td>206 **</td>
</tr>
<tr>
<td>Chesapeake Appalachia LLC</td>
<td>CARROLL</td>
<td>SHAW 20-14-5 5H</td>
<td>818</td>
<td>0</td>
<td>10,263</td>
<td>11 ***</td>
</tr>
<tr>
<td>Chesapeake Appalachia LLC</td>
<td>CARROLL</td>
<td>BURGETT 7-15-6 8H-RS</td>
<td>654</td>
<td>0</td>
<td>2,010</td>
<td>5 ***</td>
</tr>
<tr>
<td>Chesapeake Appalachia LLC</td>
<td>CARROLL</td>
<td>BUCEY 3H</td>
<td>2,167</td>
<td>137,192</td>
<td>2,403</td>
<td>53</td>
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<tr>
<td>Chesapeake Appalachia LLC</td>
<td>CARROLL</td>
<td>HARVEY 8H</td>
<td>6,096</td>
<td>183,142</td>
<td>9,102</td>
<td>92</td>
</tr>
<tr>
<td>Chesapeake Appalachia LLC</td>
<td>CARROLL</td>
<td>NEIDER 3H</td>
<td>9,444</td>
<td>395,290</td>
<td>9,519</td>
<td>130</td>
</tr>
<tr>
<td>Chesapeake Appalachia LLC</td>
<td>HARRISON</td>
<td>KENNETH BUELL 8H</td>
<td>13,472</td>
<td>1,523,465</td>
<td>8,937</td>
<td>198</td>
</tr>
<tr>
<td>Chesapeake Appalachia LLC</td>
<td>MAHONING</td>
<td>GEATCHES MAH 3H</td>
<td>758</td>
<td>0</td>
<td>8,389</td>
<td>79 ***</td>
</tr>
<tr>
<td>Chesapeake Appalachia LLC</td>
<td>PORTAGE</td>
<td>HOSEY POR 6H-X</td>
<td>583</td>
<td>0</td>
<td>1,796</td>
<td>20 ***</td>
</tr>
</tbody>
</table>

| Total                          |            |                       | 46,327        | 2,561,524 |                 |                     |

* This number reflects the actual days in production and does not include any days of down-time.

** The first oil sale commenced on June 1 with commercial production starting July 24.

*** Oil was recovered and sold during completion/flowback in 2011. There was no commercial production in 2011.
Shale Companies Currently in Ohio

- Anadarko E&P
- Antero Resources
- BP
- Carrizo
- Chesapeake
- Chevron
- CNX Gas
- Devon Energy
- Enervest
- Gulfport Energy
- Hess Ohio Resources
- HG Energy
- Mountaineer Keystone
- Eclipse Resources
- XTO Energy Inc.
- R E Gas Dev.
- Shell
What to Expect

- 2012 - steady drilling growth & infrastructure building: 200 Shale wells will be drilled
- 2013 - exponential drilling growth
- 2014 - drilling at maximum until…?
Differences Between a Horizontal Well and Traditional Vertical Well

- Everything is bigger – It takes longer
  - Well site 3-5 acres vs. 1-2 acres
  - Shale rig is much larger
  - Associated equipment – more of it
Differences Between a Horizontal Well and Traditional Vertical Well

• One month/well to drill vs. one week
• 6 or more wells can be drilled from one well site pad
• $5 million (and higher) vs. $400,000
Carroll County - Utica Shale Horizontal Drilling
# Spacing Categories

<table>
<thead>
<tr>
<th>Depth</th>
<th>Acres</th>
<th>Unit Lines</th>
<th>Distance Bet. Wells</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 1,000’</td>
<td>1</td>
<td>100’</td>
<td>200’</td>
</tr>
<tr>
<td>1 to 2K</td>
<td>10</td>
<td>230’</td>
<td>460’</td>
</tr>
<tr>
<td>2 to 4K</td>
<td>20</td>
<td>300’</td>
<td>600’</td>
</tr>
<tr>
<td>4,000 +</td>
<td>40</td>
<td>500’</td>
<td>1,000’</td>
</tr>
</tbody>
</table>
Minimum Acreage Needed for a One Mile Horizontal Well

6,280’ * 1,000’/43,560 = 144.16 acres
TYPICAL ORIENTATION OF HORIZONTAL UTICA WELLS IN OHIO
Temporary Minimum Spacing Order

- OAC 1501:9-04(D)
- Approved Technical Advisory Council
- Signed by Chief
- Effective August 21, 2012
- Spacing is from first and last “take points”
- Plat shows proposed “take points”
- As drilled plat shows actual “take points”
Proper Well Construction

- **Well Construction Rules**
  - Application – proposed plan
  - Requires operators to set and cement surface casing to isolate and protect all Underground Sources of drinking Water
  - Fresh water based drilling system
Protective Barriers

Approximate base of potable groundwater:
- Black Hand Member ("Big Injun")
- Berea Sandstone
- Bedford Shale/Ohio Shale/Olentangy Shale
- Marcellus Shale
  - Onondaga Limestone
  - Griswold Sandstone
- Bass Islands/Salina Group
  - Lockport Dolomite
  - "Clinton" sandstone
- Queenston Shale/Cincinnati group
  - Utica Sandstone
- Trenton Limestone/Black River Group
- Beechmont dolomite
- Rose Run sandstone
- Copper Ridge dolomite/Conasauga Group
- basal sandstone
- Precambrian

Utica Shale Well:
- (rastering width exaggerated)
- Typical water well depth (~100 ft)

Depth (feet below ground surface):
- 0
- 1,000
- 2,000
- 3,000
- 4,000
- 5,000
- 6,000
- 7,000
- 8,000
- 9,000

Diagram includes layers of:
- Interbedded sandstone, siltstone, shale, coal, and limestone
- Interbedded salt, anhydrite, dolomite, and shale
- Sand and Gravel
- Sandstone
- Shale
- Limestone
- Dolomite
- Precambrian
• Surface casing set at least 50 feet below the USDW
• Protect up to 10,000 ppm TDS
Proper Well Construction

• Requires operators notify the O & G inspector at least 24 hours prior to every cement job
Proper Well Construction

- **Casing**
  - Multiple cemented casing strings to protect groundwater
  - Conductor, Surface, Intermediate, Production
Casing Strings on a Pipe Rack
5 year review rules:

- “Clean-up”
  - SB 165
  - Definitions
- Compact and Contiguous
Upcoming Rules:

- Spill Prevention (SPCC) Rules
- Pipeline development
- Freshwater impoundments
- Well pad construction
Questions??