Marcellus Shale Development Process
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Marcellus Shale Development

Preparation  Drilling  Completion & Production  Reclamation
Preparation

Geoscientists determine drilling locations

- Surface, sub-surface maps
- 3-D seismic measurements
- State-of-the-art Technology
Seismic Survey
Leases are Acquired

- Oil & gas owners (frequently the surface owner) are offered compensation for leasing rights to their property.

- In addition to initial lease payment, oil & gas owners also receive royalties on natural gas sold from the property.
Royalties are divided in proportion to the percentage of land that each land tract contributes to the total unit.
Construction

- Well pad
- Access Roads
- Impoundments
- Pipelines
- E&S Plan Onsite
- BMP’s in Place
Site Preparation
Drilling

- State-of-the-art technology
- Multiple wells, single site
- Footprint is 3-5 acres

Range’s pioneering spirit continues...Patterson 315 was the first “walking” Marcellus Shale drilling rig
Horizontal Technology

- Drill 5,000-8,000’ vertical up to 3,000’ horizontal
- Roughly 2 miles of drilling, spot-on accuracy
- Reduce surface disturbance, with less environmental impact
... an 8-1/2” hole 2 miles long
Horizontal Technology

John Perez Graphics
Total surface disturbance during drilling, including access road, drilling pad and required pipeline infrastructure:

- Horizontal (yellow) develop 500 acres per pad with 2% surface disturbance
- Vertical (purple) on 1,000-foot spacing develop 23 acres per well with 19% total surface disturbance
Horizontal

- Greatly reduce surface impact
- Disturbance minimized
- Decrease construction time

Vertical

- More costly
- More surface disturbance
- Longer construction time

General representation for visualization purposes
How Do You “Drill Horizontally”?  

Small bend in drilling motor assembly, roughly 1-2°, drills the curve over the course of 900’, at a rate of 10° per 100’ to achieve a 90° turn horizontally.

It’s not abrupt, rather a gradual sweeping motion.

Weatherford drilling technology
Protection of Water Aquifers and Shallow Zones

Zonal isolation provided by multiple layers of steel casing and cement
Generalized casing design for a Marcellus Shale gas well

- 24" conductor casing (30-60 feet)
- Fresh Water Aquifers
- 20" casing (200-500 feet), cemented to surface
- Coal-bearing interval
- 13-3/8" casing (up to 1,000 feet), cemented to surface
- Shallow sandstones & shales (gas & brine)
- 9-5/8" casing, if necessary to seal off shallow oil, gas or brine-bearing zones
  (casing for vertical and horizontal wells identical to this point)

- Marcellus Shale
- 5-1/2" casing, cemented to 500 feet above Marcellus

Another Look at Protections
Steel Casing
Drilling
Drilling
Completion

Hydraulic Fracturing

- Fresh water and sand are pumped at high rates and pressure into the formation creating fractures.
- The water is flowed out leaving the sand to prop open the fractures.
- The propped fractures represent an increase in surface area allowing economic volumes of natural gas to travel back to the wellbore.
Fracturing
Fracturing
Frac Van
Fracturing
Fracturing
Water Impoundment
Water Transfer
- Following frac, water is flowed back and gas flow is tested to ensure proper completion
- Small footprint – wellhead, separator, produced water tanks
Production, roughly size of a 1-2 car garage
Production
Work hard to restore property to a condition the same as or better than before the process began.
Flowback and Testing

Paxton #1H, Washington County, Pennsylvania

5 Months Later
Renz #1H, Washington County, Pennsylvania

First Modern Marcellus Well, initial reclaim
Partial Reclamation
Partial Reclamations
Final Reclamation
Reclamation
Thank You, Questions?

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