National Park Service
U.S. Department of the Interior
Geologic Resources Division
Natural Resource Stewardship and Science

Development of Shale Oil and Gas Through High Volume Hydraulic Fracturing - Scale, Scope, and Concerns

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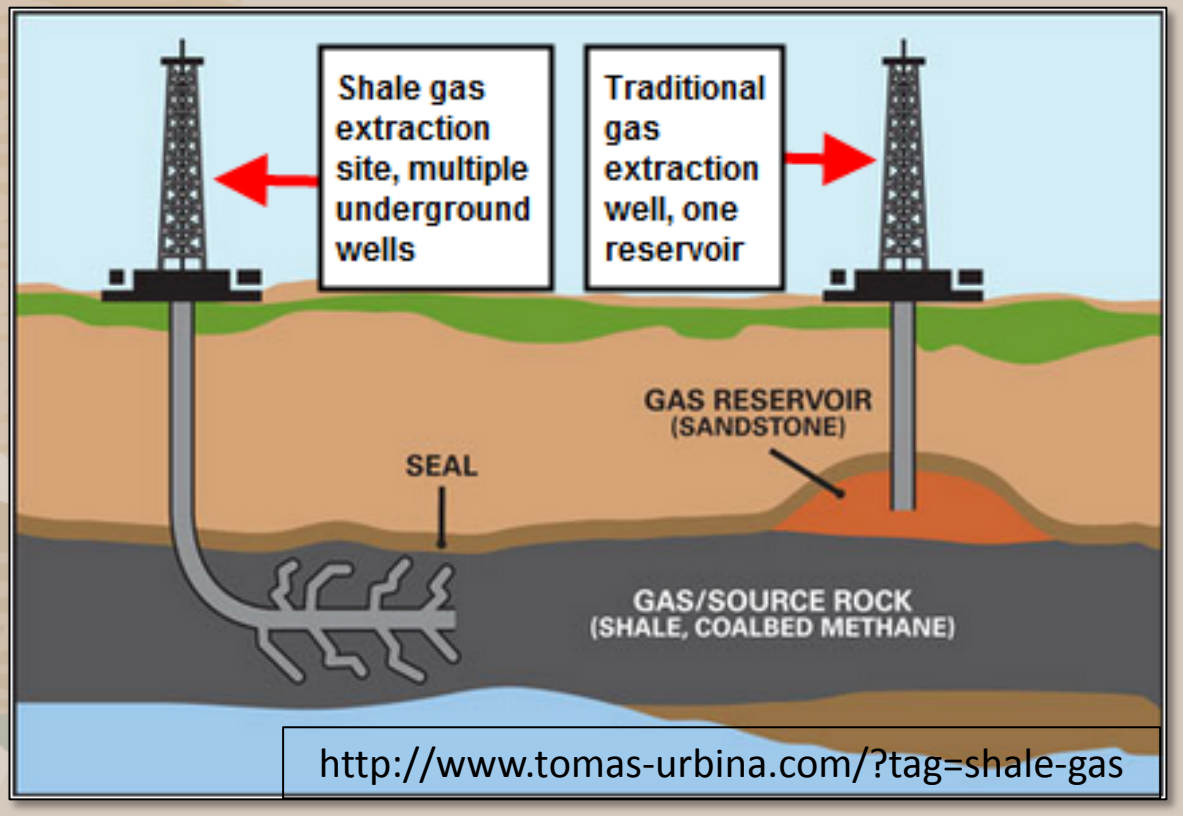
Shale Oil and Gas Development

- Unconventional development = production of oil and gas from low permeability rocks,
- Regional in extent,
- No obvious seals and traps,
- Close to, or are source rocks,
- Horizontal drilling,
- Fracking used so that hydrocarbons will flow at commercial rates.

Conventional Oil and Gas Development

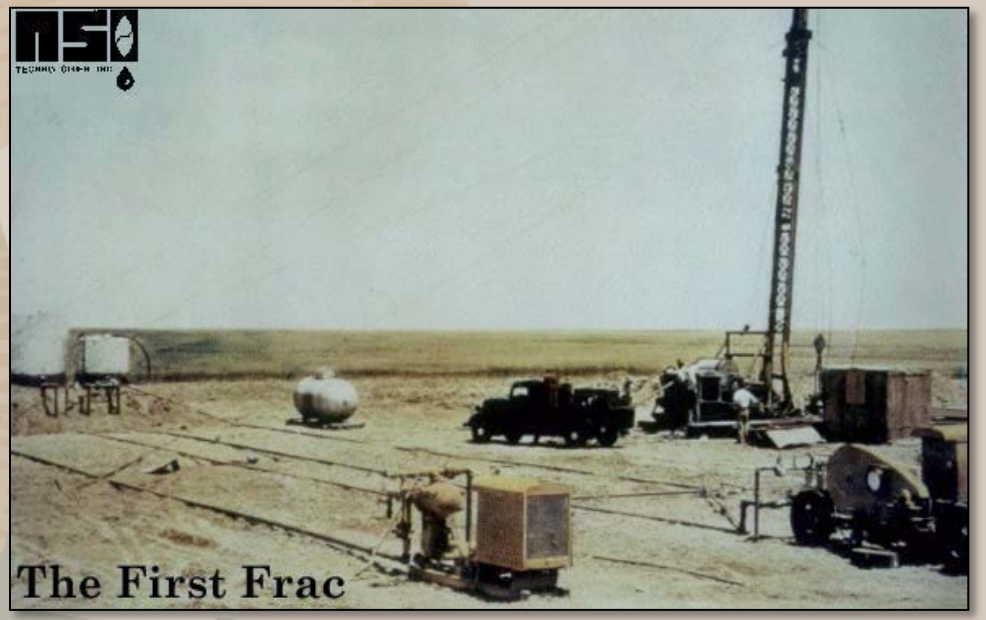
- Reservoirs are continuous or discontinuous,
- Have inter-connected pores spaces,
- Drilled vertically, directionally, and horizontally,
- O&G flows naturally or is pumped to the surface, and
- Fracking may be used to complete or stimulate wells.



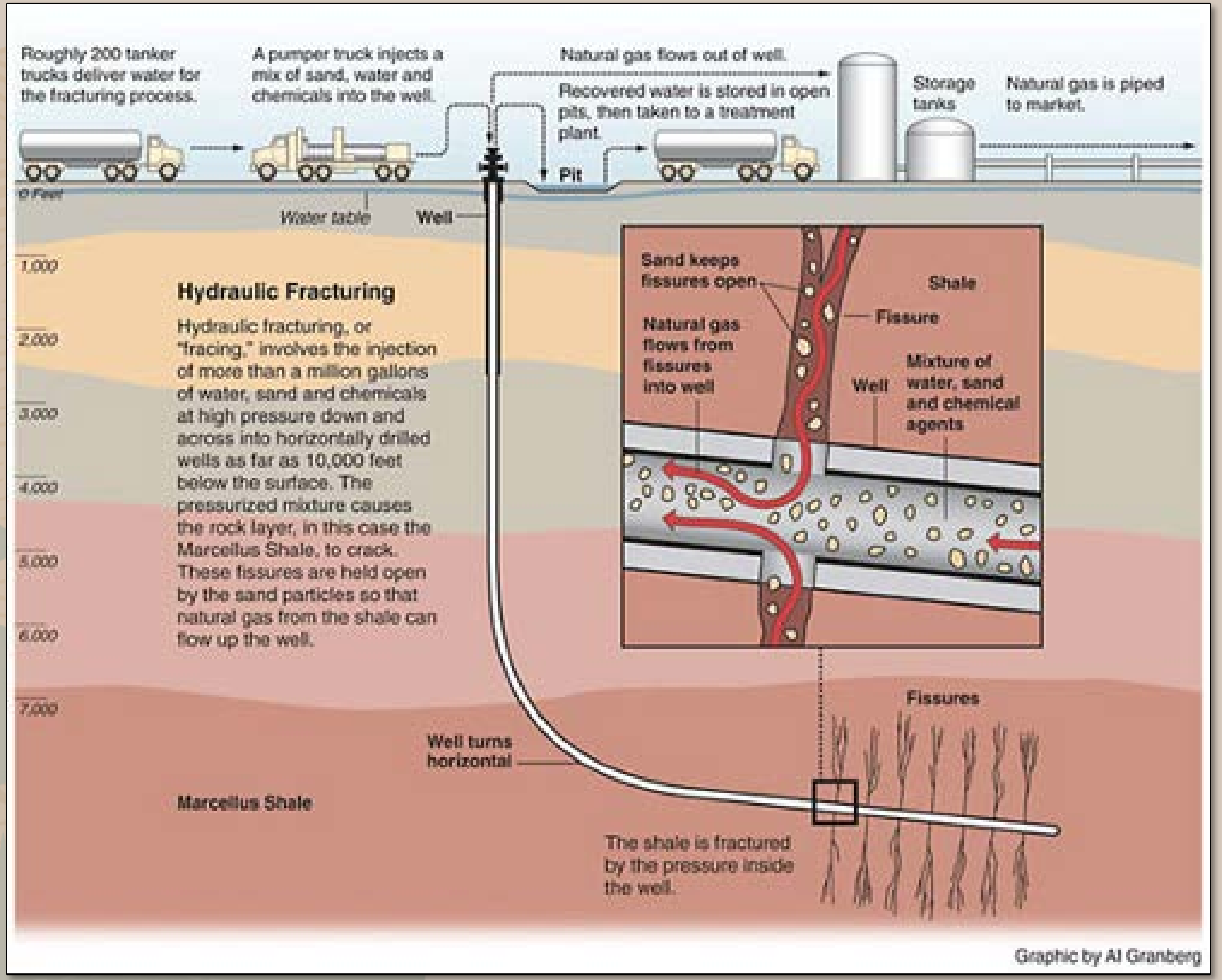
Source: U.S. Energy Information Administration based on data from various published studies. Canada and Mexico plays from ARI.
Updated: May 9, 2011

What is Hydraulic Fracturing?

- "Fracking" is <u>well stimulation process</u> to increase well production.
- Commonly used incorrectly to describe <u>every aspect</u> of shale oil & gas development.
- First frack in KS in 1947, technology patented in 1953.
- Widespread use increased ~2007 with boom in shale O&G development.



Klepper Gas Unit #1 well, Hugoton Gas Field, KS


Roughly 200 tanker trucks deliver water for the fracturing process.
A pumper truck injects a mix of sand, water and chemicals into the well.
Natural gas flows out of well.
Recovered water is stored in open pits, then taken to a treatment plant.
Storage tanks
Natural gas is piped to market.
Pit
0 Feet
Water table
Well
1,000
2,000
3,000
4,000
5,000
6,000
7,000
Hydraulic Fracturing
Hydraulic fracturing, or "fracing," involves the injection of more than a million gallons of water, sand and chemicals at high pressure down and across into horizontally drilled wells as far as 10,000 feet below the surface. The pressurized mixture causes the rock layer, in this case the Marcellus Shale, to crack. These fissures are held open by the sand particles so that natural gas from the shale can flow up the well.
Sand keeps fissures open
Shale
Fissure
Natural gas flows from fissures into well
Well
Mixture of water, sand and chemical agents
Fissures
Well turns horizontal
Marcellus Shale
The shale is fractured by the pressure inside the well.
Graphic by Al Granberg

Hydraulic-fracking Operation

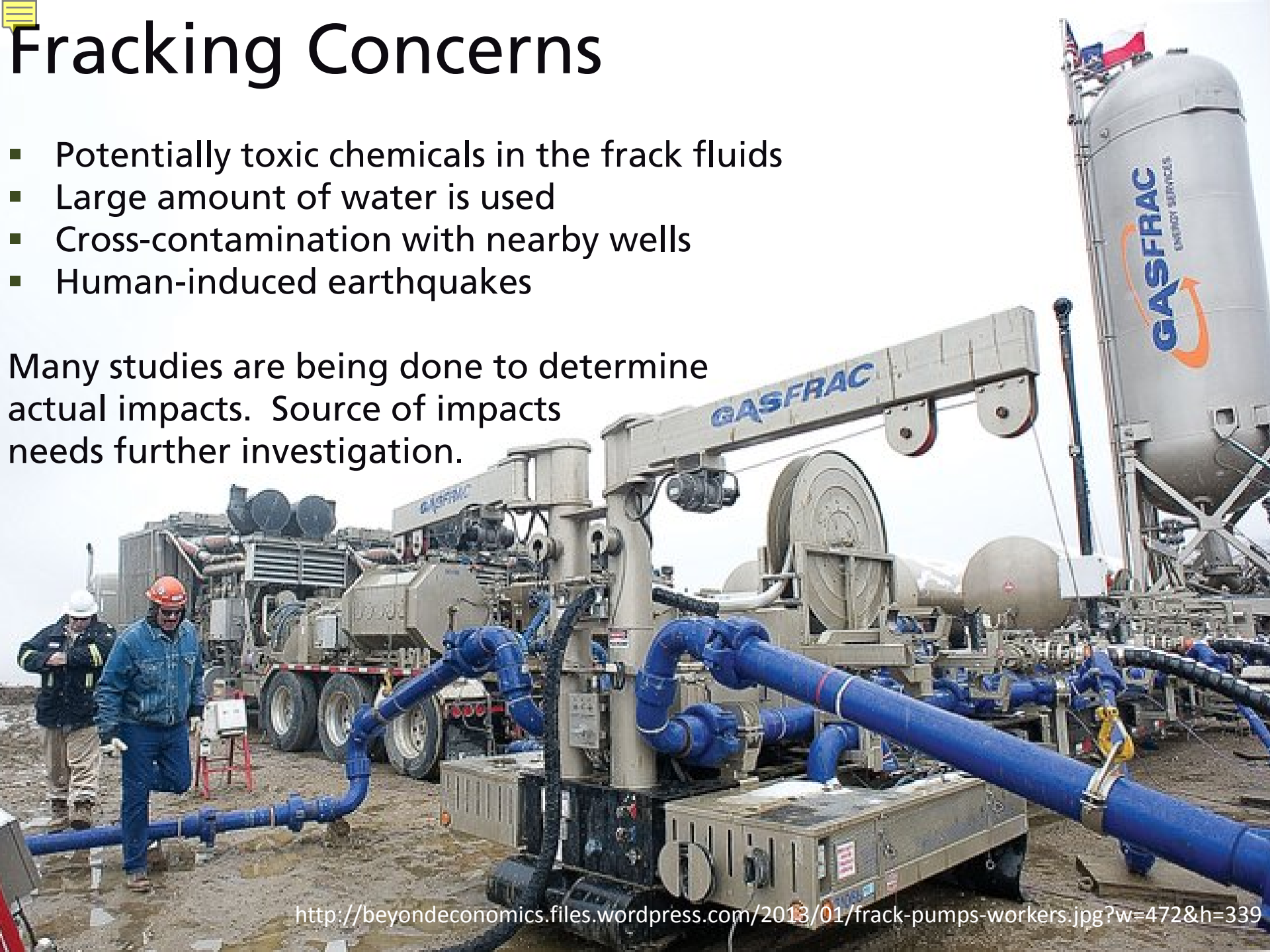
Impacts - O&G Development

- Shale O&G development - same impacts as conventional oil and gas operations, **BUT** scale and scope of shale operations could result in greater impacts.
- Well construction, drilling, stimulation, production, and maintenance operations can impact:
  - geology/soils,
  - air quality/visibility,
  - water quality/quantity,
  - wildlife,
  - vegetation,
  - natural sounds,
  - night skies,
  - cultural resources,
  - viewsheds, and
  - climate change.

Fracking Concerns

- Potentially toxic chemicals in the frack fluids
- Large amount of water is used
- Cross-contamination with nearby wells
- Human-induced earthquakes

Many studies are being done to determine actual impacts. Source of impacts needs further investigation.



http://beyondeconomics.files.wordpress.com/2013/01/frack-pumps-workers.jpg?w=472&h=339

Societal Impacts from Large-scale Shale Development

Scale and scope of operations has a significant effect on:

- Decreased quality of life for local citizens and park visitors
- Increased traffic, noise, and air pollution
- Increased demand and costs for housing, products and services

Other Talks in this Session:

- **Bakken shale development in ND, MT** – impacts and tools to proactively address impacts (Valerie Naylor)
- **Infrastructure associated with shale development** and what it means to parks (Mary Krueger)
- **Subsurface migration risks** and the effects on aquifers (Pete Penoyer)
- **Air resource/viewshed impacts** and tools to address and mitigate potential impacts (Andrea Stacy)
- **Natural sound and night sky impacts** and mitigation strategies (Frank Turina)

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