SLIDES: What We Know (and Don’t Know) about the Effects of Oil and Gas Development on Water Quality

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What We Know (and Don’t Know) about the Effects of Oil and Gas Development on Water Quality

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Shielding ensures safety

In the hydraulic fracturing process, there are about 10 inches of steel and concrete shielding underground aquifers.

That's comparable to an armored door on a bank vault.

Hydraulic fracturing wells go far below underground aquifers.

They reach approximately 6,000 feet or more under the earth's surface - almost the distance of 4 Empire State buildings stacked on top of each other.

Ten inches of steel and concrete; that's the shield protecting Mother Nature as rigs extract much-needed clean-burning natural gas from deep beneath shale formations from Pennsylvania to Texas.

This vault-thick armor isn't just on a few of the natural gas wells, it's the industry standard. Hydraulically fractured wells have multiple layers of steel and concrete to protect underground aquifers and isolate the wellbore. On top of this protection, state regulators and the industry are also making sure that well construction meets an additional host of rigorous safety standards.
Is water quality at risk?

- source
- receptor
- pathway
source
(a release of a hazardous compound)

receptor

pathway
source
(release of a hazardous compound)

receptor
(humans using groundwater supply)

pathway
source
(release of a hazardous compound)

receptor
(humans using groundwater supply)

pathway
(transport of hazardous compound to receptor)
source

receptor

pathway

potential risk
Possible and Probable Pathways

- Surface spills
  - possible surface water contamination
  - possible groundwater contamination
  - remediation – sometimes prompt, sometimes not
- Weld County, July 2010-June 2011
  - 77 spills involving benzene, toluene, ethylbenzene, xylenes
  - 84% remediated by May 2012

Analysis of BTEX groundwater concentrations from surface spills associated with hydraulic fracturing operations

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Possible and Probable Pathways

- Probability of surface spills

\[ V_{\text{spill}} = P_{\text{spill}} \times f_{\text{fluids spilled}} \times V_{\text{fluids on site}} \]

- \( P_{\text{spill}} \): probability of a spill – 0.1 to 0.5
  - frequency of spills (all known and reported?)
  - number of sites (active or total?)

- \( f_{\text{fluids spilled}} \): fraction of fluid spilled – 0.0001 to 1
  - reported volume of spills

Water Pollution Risk Associated with Natural Gas Extraction from the Marcellus Shale

Risk Analysis, Vol. 32, No. 8, 2012

Daniel J. Rozell and Sheldon J. Reaven
Possible and Probable Pathways

- Subsurface releases
  - possible groundwater contamination
  - scenarios
    - well casing integrity
    - abandoned wells
    - existing faults and fractures
    - etc.
  - groundwater flow and transport modeling
    - EPA
    - AWG SRN
- groundwater sampling
Methane contamination of drinking water accompanying gas-well drilling and hydraulic fracturing

Stephen G. Osborna, Avner Vengoshb, Nathaniel R. Warnerc, and Robert B. Jacksona,b,c1

aCenter on Global Change, Nicholas School of the Environment, bDivision of Earth and Ocean Sciences, Nicholas School of the Environment, and cBiology Department, Duke University, Durham, NC 27708
Possible and Probable Pathways

- Probability of subsurface release by well failure

\[ V_{\text{release}} = P_{\text{well failure}} \times f_{\text{fluids released}} \times V_{\text{fluids injected}} \]

- \( P_{\text{well failure}} \): probability of casing failure – 10^{-8} to 0.02
  - what is failure?
  - how to measure failure?

- \( f_{\text{fluids released}} \): fraction of fluid released – 10^{-6} to 0.1
  - what is the severity of the failure?
Possible and Probable Pathways

- Probability of subsurface release by fractures

\[ V_{\text{release}} = P_{\text{fractures}} \times f_{\text{fluids released}} \times V_{\text{fluids injected}} \left(1 - f_{\text{returned}}\right) \]

- \( P_{\text{fractures}} \): probability of fractures as pathway
  - \( 10^{-6} \) to 0.1

- need more data, field and modeling!
“Will I be able to drink the water from my well?”
“Will I be able to drink the water from my well?”

“The probability that your well will be contaminated is somewhere between 0.55 and 10,350 in a million.”
“Will I be able to drink the water from my well?”

“Maybe.”