EPA's Study of the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources

Presentation by the
U.S. Environmental Protection Agency
Office of Research and Development

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Issues Associated with Hydraulic Fracturing

- Energy production and independence
  - Part of “all of the above” energy policy
- Potential environmental concerns
  - Water quality and quantity
  - Air quality
  - Landscapes, land use, and ecology
  - Local and regional transportation
  - Induced seismicity
  - Increased noise and light
- Potential human health concerns
- Socioeconomic changes

USEPA's Hydraulic Fracturing Drinking Water Study

- In 2009, Congress urged EPA to study the relationship between hydraulic fracturing and drinking water

- EPA launched this study with the purpose to:
  - Assess whether hydraulic fracturing can impact drinking water resources (water quality and quantity)
  - Identify driving factors that affect the severity and frequency of any impacts

HF Study Progress

- EPA's HF study has produced multiple publications that focus on:
  - analysis of existing data
  - scenario evaluation and modeling
  - laboratory studies
  - specific case studies :
- **Draft Hydraulic Fracturing Drinking Water Assessment report**
- Completed products available online:

  www.epa.gov/hfstudy

Draft HF Assessment Report

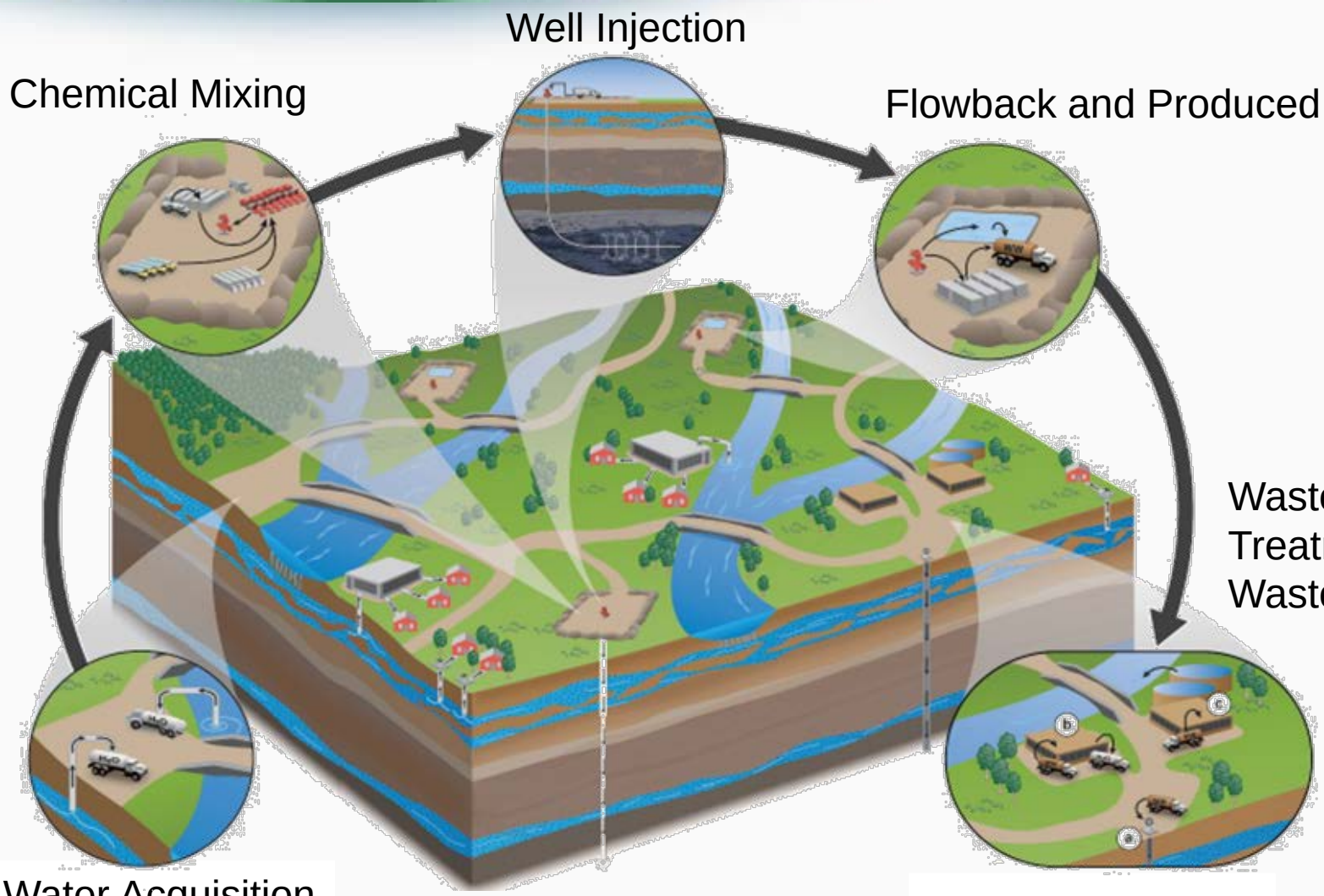
What it is:

- A state-of-the-science integration and synthesis of information concerning impacts on drinking water resources
- Based upon EPA research results, a robust literature review, and other information, including input from stakeholders
- Addresses objectives and questions identified in the *Study Plan* and *Progress Report*

What it is <u>not:</u>

- Not a human health, exposure, or risk assessment
- Not site specific
- Does not identify or evaluate best management practices
- Not designed to inform specific policy decisions
- Does not identify or evaluate policy options

Hydraulic Fracturing Water Cycle: Follow the water



Water Acquisition: Sources and volume

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- Sources of water used for HF include surface water, ground water, and reused wastewaters
- Cumulative water use nationally is at least 44 BG/year; Median water use for a well is approximately 1.5 MG
- HF water use is small (usually < 1%) compared with total water use and consumption at the national, state, and most county spatial scales
- Potential for impacts on drinking water resources is greatest in areas with high hydraulic fracturing water use, low water availability, and frequent drought
- Spatial scale is important

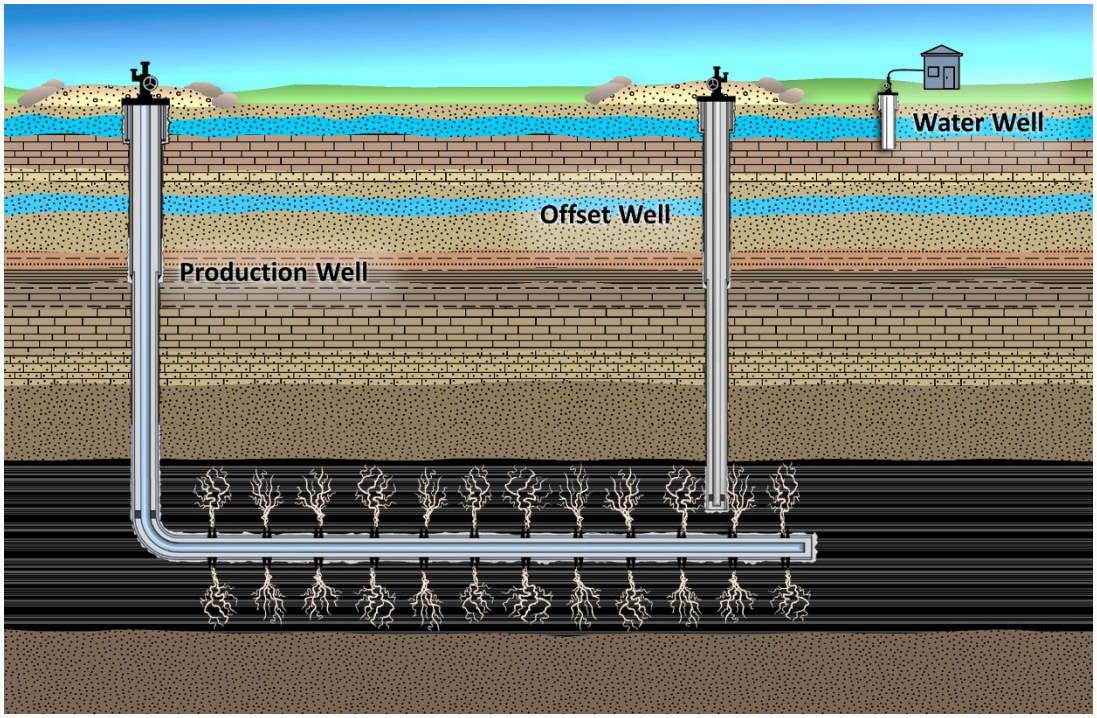
Chemical Mixing: HF Chemical Additives

- Chemical additives:
  - Perform multiple functions
  - Generally comprise <2% of injected fluid volumes
  - Thousands of gallons are potentially stored on-site and used in the HF process
- We identified more than 1000 chemicals used as components of HF fluids:
  - No single chemical used at all well sites across country
  - Chemicals used at >65% of well sites include: methanol, hydrotreated light petroleum distillates, hydrochloric acid

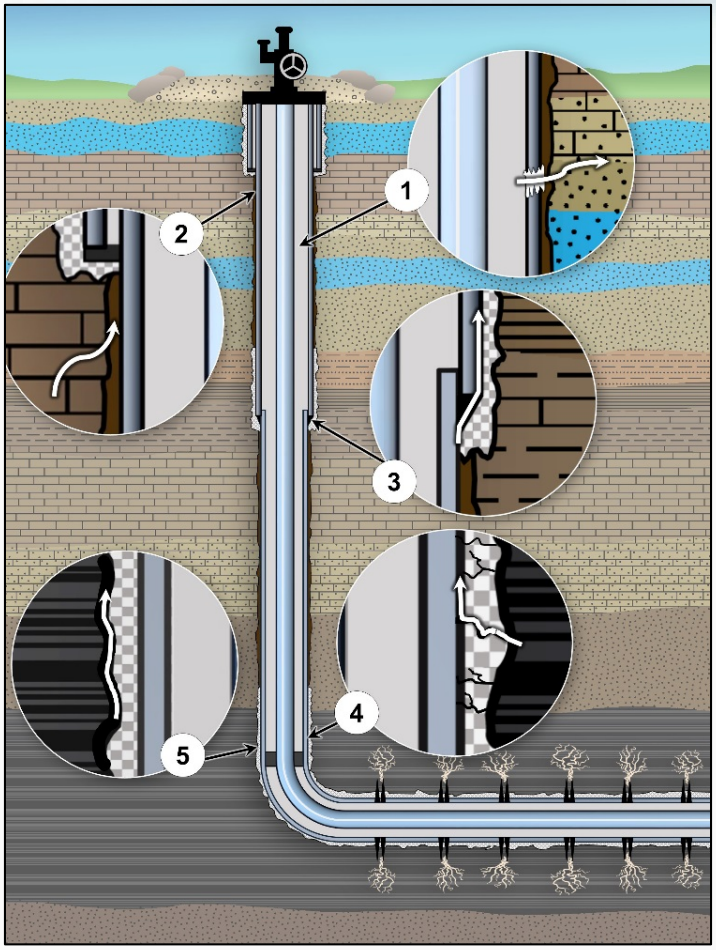
Fluid Injection

Well Injection: Potential subsurface pathways

- Movement of gas or liquids from the wellbore into a drinking water resource
- Movement of gas or liquids from production zone through subsurface rock formations into a drinking water resource

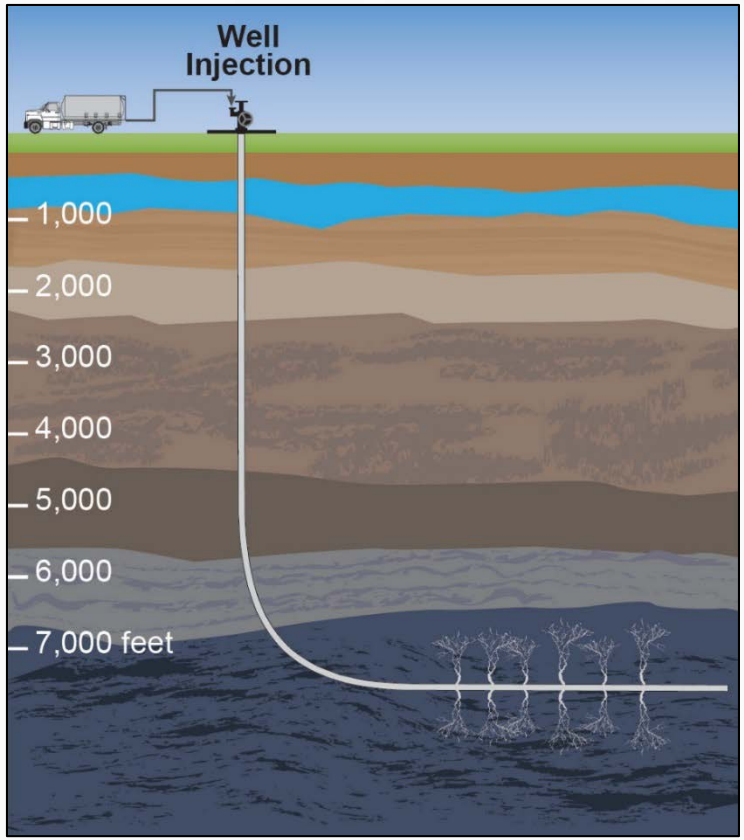


Well Construction and Integrity



- Casing and cement act together to form multiple barriers to prevent migration of gases and liquids
- Inadequate construction, defects and degradation of casings or cement, or absence of redundancies can create pathways leading to contamination of drinking water resources
- Specific rate of well failures unknown but generally increases over time

Sub-Surface Movement

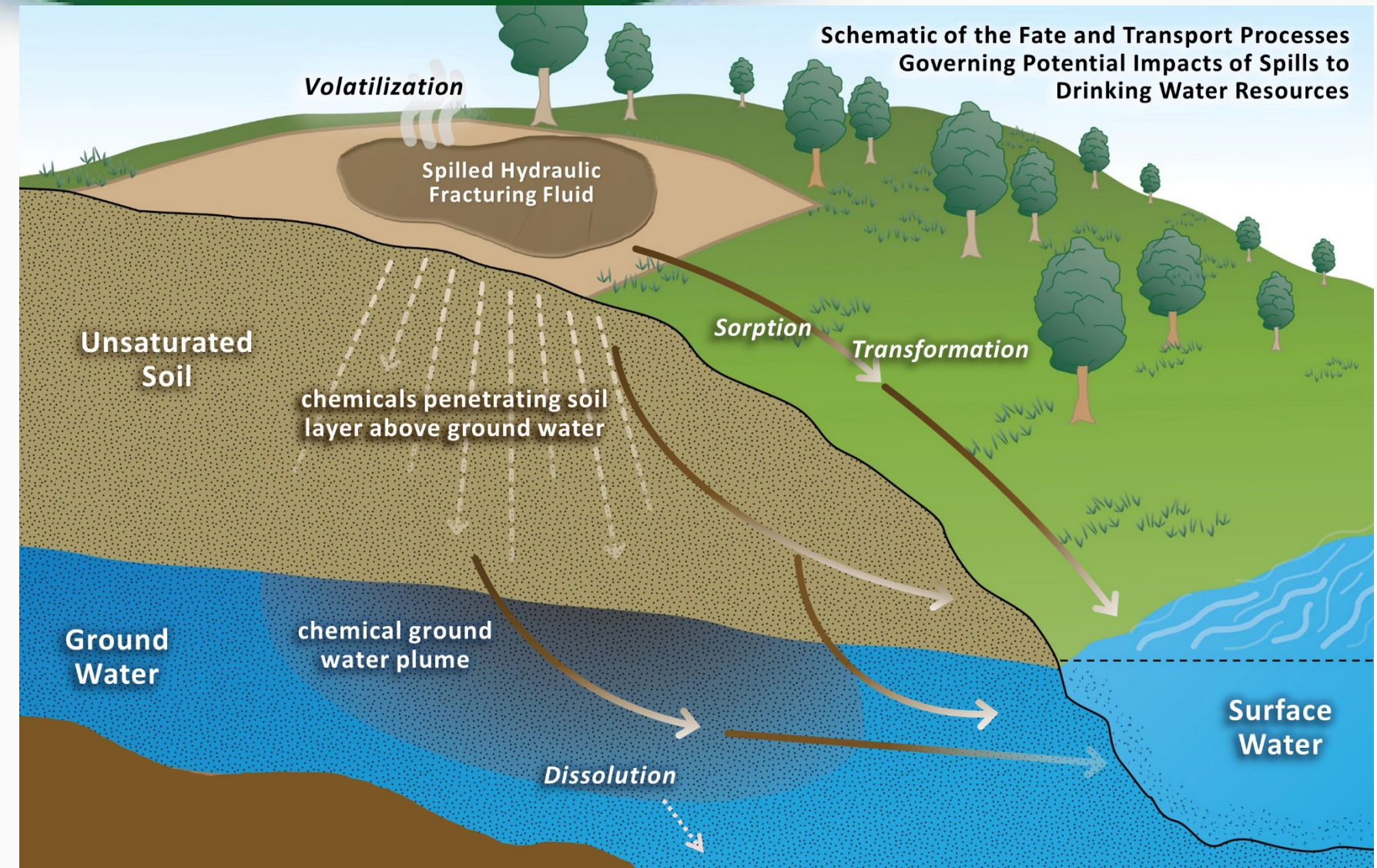


- Physical separation between the production zone and drinking water resources can minimize impacts
- Deep HF operations are unlikely to create direct flow paths from fracture production zones to shallow drinking water resources
- In some cases, the production zone is co-located with drinking water resources
- Well-to-well communications are also pathways for fluid movement into drinking water resources

Flowback and Produced Water

- Flowback and produced water come out of the well when pressure is released
- Amount of fracturing fluid returned to surface is generally 10% to 25% of injected fluid and varies widely
- Data on produced water composition limited:
  - 134 chemical detected specifically in FB/PW
  - High total disolved solids
  - Metals, organics
  - Naturally occurring radionuclides
- High TDS present analytical challenges for characterizing chemical composition

Spills of HF Fluids and Produced Waters



Spills of HF Fluids and Produced Waters

- Spills of HF fluids and produced waters have occurred; when spills occur, they can and have reached drinking water resources through multiple pathways
- Total number and frequency of spills due to HF activities unknown at the national level
- Based upon spill data reviewed:
  - Hundreds of spills of hydraulic fracturing fluids and produced waters have occurred
  - Spill volumes varied greatly: 2 gallons to 1.3 Million gallons
  - Most common causes of spills were equipment failure and human error
  - Of those spills reviewed, 8% of documented spills reached a surface or ground water resource; 64% reached soils

Hydraulic Fracturing Wastewater

- HF produces large volumes of wastewater
- Most HF wastewater is disposed of using underground injection control (UIC) wells
- Other management/disposal options:
  - Reuse – geographically variable
  - Centralized wastewater treatment facilities
  - Evaporation pits, land irrigation, road spreading
- Inadequately treated wastewater increases constituent concentrations in receiving waters
- Total dissolved solids, chloride, bromide and potentially radionuclides are of concern to downstream drinking water treatment facilities

HF Chemical Characterization

- 1,173 chemicals reportedly used in HF fluids or detected in flowback and produced water
- 147 have human oral toxicity reference values.
- Absence of toxicity reference values limits ability to conduct future site specific exposure/risk assessments
- CBI limits complete characterization of chemical use in HF operations:
    - From EPA's analysis of the FracFocus 1.0 database
    - One or more ingredients were claimed as confidential in more than 70% of disclosures
    - Operators designated 11% of all ingredient records as confidential business information

Assessment Conclusions

- Assessment identified existing and potential mechanisms and impacts to drinking water resources due to hydraulic fracturing activities
- These mechanisms include:
  - Water withdrawals in areas with low water availability
  - Spills of HF fluids and flowback/produced water
  - HF conducted directly in formations containing drinking water resources
  - Well integrity failures
  - Subsurface migration of gases and liquids
  - Inadequately treated wastewater

Assessment Conclusions

- The number of documented impacts on drinking water resources is small relative to the number of fractured wells
- This could reflect a rarity of impacts, or it could underestimate the number of impacts because of important sources of uncertainty
  - Paucity of long-term systematic studies
  - Insufficient pre- and post-fracturing data on the quality of drinking water resources
  - Presence of other sources of contamination precluding definitive link between hydraulic fracturing activities and a potential impact
  - Inaccessibility of some information on hydraulic fracturing activities and impacts

What's Next for EPA's Assessment

- Science Advisory Board (SAB) review of draft assessment:
  - Public, open process
  - Preliminary draft report released January 6, 2016; Second draft report released February 16, 2016
  - Opportunity to provide comments on the draft assessment throughout SAB review process
- Agency will use comments from public and SAB to revise draft assessment and release as final

HF Study Progress

- EPA's study results have increased understanding of hydraulic fracturing
- Study has stimulated dialogue and can inform future decisions concerning how best to protect drinking water resources now and in the future
- Completed products available online:
  - **www.epa.gov/hfstudy**

Well pad in NE Pennsylvania. Credit: J Henry Fair.