

Draft Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources

U.S. Environmental Protection Agency
Office of Research and Development
June 28, 2011



Public Concerns

- **Ground and surface water contamination**
- Air pollution
- Ecosystem impacts
- Seismic risks
- Public safety
- Occupational risks



Purpose of the Study Plan

In its FY 2010 Appropriations Committee Conference Report, Congress directed EPA to study the relationship between hydraulic fracturing and drinking water, using:

- Best available **science**
- **Independent** sources of information
- **Transparent, peer-reviewed** process
- **Consultation** with others

Purpose of EPA's Study

- To assess the potential impacts of hydraulic fracturing on drinking water resources
- To identify the driving factors that affect the severity and frequency of any impacts

This study is not intended to determine or evaluate best management practices.

Study Plan Development

- Science Advisory Board recommendations
 - Scoping document review (April 2010)
 - Draft study plan review (March-May 2011)
 - Full committee review (July 5, 2011)
- Stakeholder input
- Literature review
- Internal EPA review
- External federal agency review

EPA's draft study plan focuses on the water cycle in hydraulic fracturing.

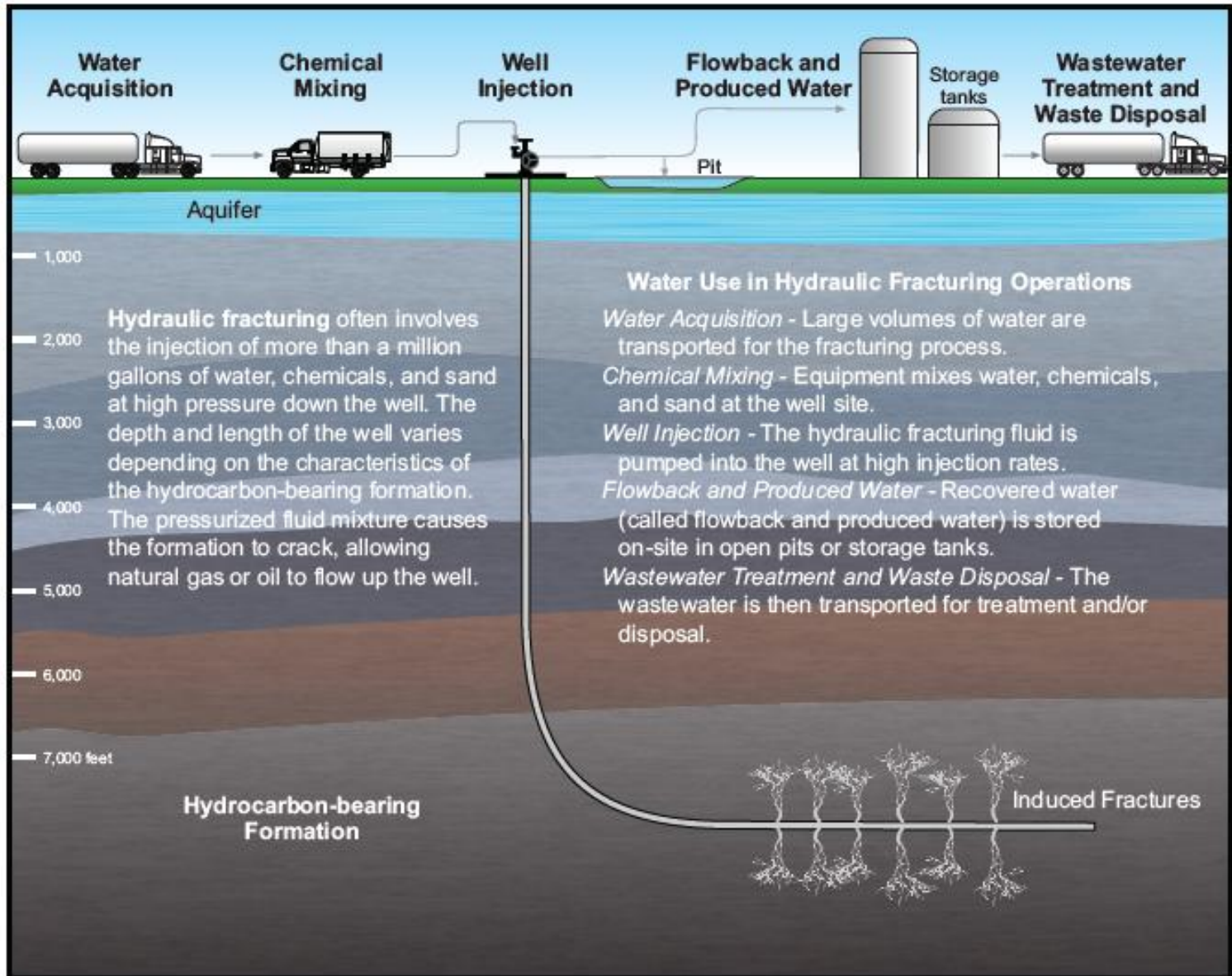
Past Stakeholder Input

- State and tribal consultations
 - Included interstate agencies (IOGCC, GWPC and others)
- Sector-specific meetings
 - Industry and non-governmental organizations
 - Federal agencies
- Informational public meetings
 - Held in Colorado, New York, Pennsylvania, Texas
 - Total attendance exceeded 3,500
- Technical workshops
 - Chemical and Analytical Methods (Feb. 24-25)
 - Well Construction and Operations (March 10-11)
 - Fate and Transport (March 28-29)
 - Water Resources Management (March 29-30)

Current and Future Stakeholder Input

- Review of the draft study plan
 - Interagency comments
 - Comments from the SAB
 - Stakeholder comments received by the SAB
- Potential partners for research implementation
 - Federal partners – DOE, USGS, EPA Regional Offices
 - State partners – oil and gas commissions, environmental agencies, interstate agencies
 - Local partners – cities, landowners, residents
 - Industry
 - Environmental groups

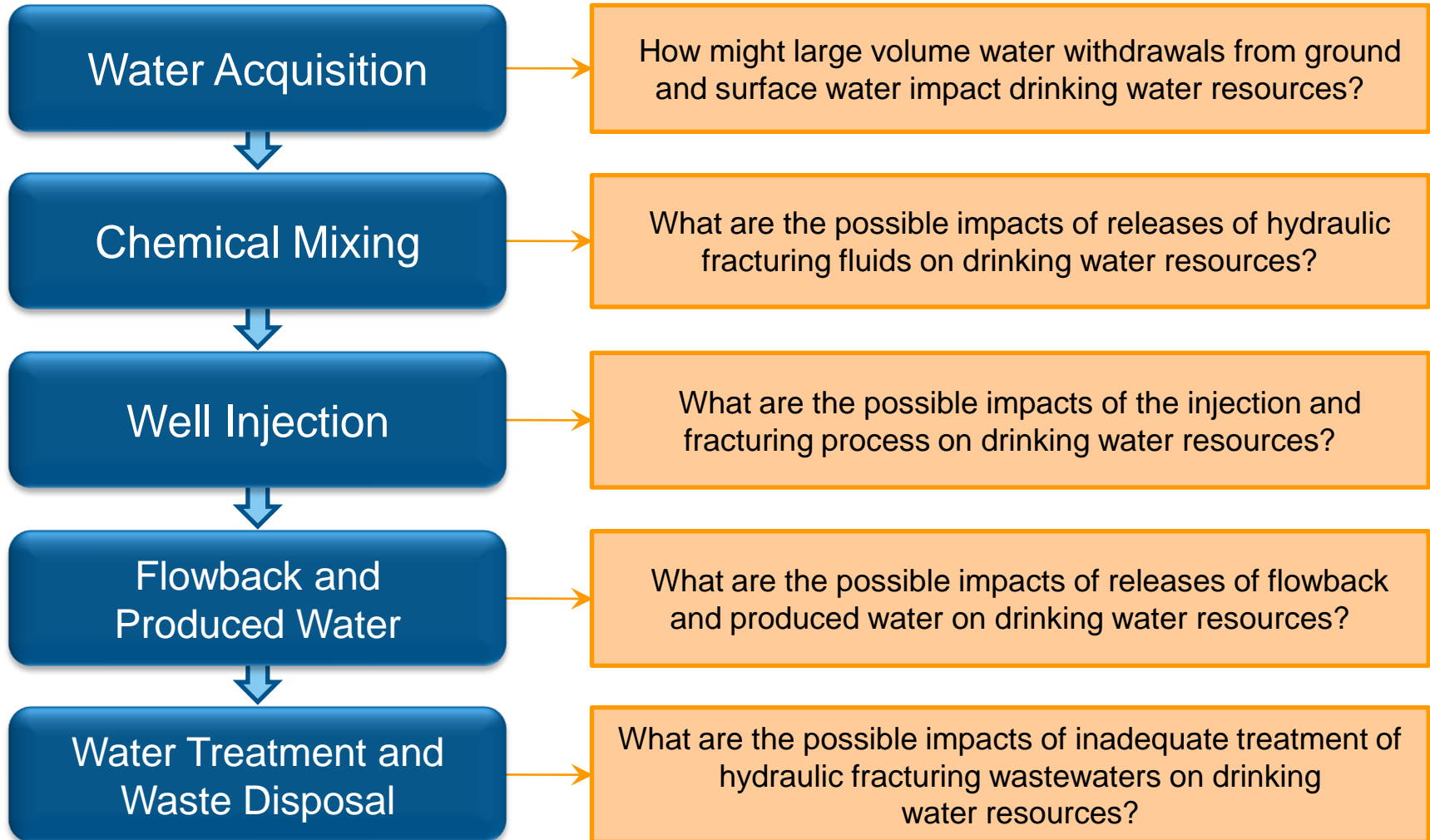
Hydraulic Fracturing



HF Water Cycle

Water Use in Hydraulic Fracturing Operations

Fundamental Research Questions



Research Approaches

- Gather and analyze existing data
- Case studies
- Scenario evaluations
- Laboratory studies
- Toxicological assessments

Qualitative Risk-Based Approach to Prioritize Research

- **Relevance:** Only work that may directly inform an assessment of the potential impacts of hydraulic fracturing on drinking water resources was considered.
- **Timing:** Work that needs to be completed before other work can be initiated received a higher priority.
- **Unique contribution:** Work already underway by others received a lower priority for investment by EPA.
- **Leverage:** Work that EPA can leverage with co-investigators received a higher priority.
- **Funding:** Work that is valuable but not affordable with the current budget was identified for consideration in later years.

Analysis of Existing Data

Sources of Existing Data

- Peer-reviewed literature
- Federal agencies – USGS, DOE, ACE
- State regulatory agencies – DEPs, DEQs
- Industry – HF service companies
- Other public sources

These data will be used to inform other research activities and to provide current information on hydraulic fracturing operations.

Case Studies

- Opportunity to evaluate hydraulic fracturing in different parts of the U.S.
- Retrospective and prospective
- Identification and selection
 - Stakeholder suggestions
 - 4 public meetings
 - EPA website input
 - Webinars
 - Conferences (e.g., GWPC, IOGCC)
 - Face-to-face meetings with state agencies, affected homeowners, and non-governmental organizations
 - EPA regional office input



More than 40 locations for potential case studies have been brought to our attention.

Case Studies

Nomination/Prioritization Criteria

- Geographic, land use variations
- Geologic diversity
- Proximity to populations potentially at risk
- Magnitude/Intensity of HF activity
- Impairment evidence (retrospective)
- Health and environmental concerns
- Available existing data
- Site access
- Potential to collaborate with others
- Ability to fill knowledge gap on HF and drinking water

Case Study Locations

Prospective Case Studies

Haynesville Shale – DeSoto County, LA

Marcellus Shale – Washington County, PA

Retrospective Case Studies

Bakken Shale – Killdeer, Dunn County, ND

Barnett Shale – Wise and Denton Counties, TX

Marcellus Shale – Bradford and Susquehanna Counties, PA

Marcellus Shale – Washington County, PA

Raton Basin – Las Animas County, CO

Case studies will use existing data and will include environmental field sampling, modeling, and/or parallel laboratory investigations.

Retrospective Case Studies

Location	Key Issues / Impacts
<p>Bakken Shale (oil) <i>Killdeer, Dunn Co., ND</i></p>	<ul style="list-style-type: none"> • Production well failure during horizontal fracturing • Potential contamination of USDW, adjoining streams, soils
<p>Barnett Shale (gas) <i>Wise and Denton Cos., TX</i></p>	<ul style="list-style-type: none"> • Spills, impoundment leaks, degraded water quality in private wells • Potential contamination of USDW (private wells)
<p>Marcellus Shale (gas) <i>Bradford and Susquehanna Cos., PA</i></p>	<ul style="list-style-type: none"> • Spills, leaks, methane in private wells • Potential contamination of USDW, streams, soils
<p>Marcellus Shale (gas) <i>Washington Co., PA</i></p>	<ul style="list-style-type: none"> • Impoundment leaks, spills • Potential contamination of USDW, streams, soils
<p>Raton Basin (CBM) <i>Las Animas Co., CO</i></p>	<ul style="list-style-type: none"> • Degraded water quality in private wells • Potential contamination of USDW

Scenario Evaluations

- Explore potential cumulative impacts from water withdrawals in a humid region and a semi-arid region
- Model various failure scenarios to determine the conditions under which subsurface contaminant migration may occur
 - Improper or inadequate well construction
 - Fractures reaching pre-existing wells or existing faults/fractures near the HF site
 - Fractures reaching ground water aquifers or permeable formations that communicate with ground water resources
- Explore potential cumulative impacts from surface water disposal of treated HF wastewater

Laboratory Studies

- Pilot-scale studies of HF wastewater treatability via conventional wastewater treatment technologies
- Explore reactions between HF fluid chemical additives and relevant environmental media (e.g., shale, soil)
- Modify existing analytical methods to support case study field monitoring activities

Laboratory studies will be targeted studies to investigate the ultimate fate and transport of chemical contaminants of concern.

Toxicological Assessments

- Assess toxicity using existing data on chemical, physical and toxicological properties

Examples of HF Fluid Additives

Hydrochloric acid
Polyacrylamide
Isopropanol
Potassium chloride
Guar
Ethylene glycol
Glutaraldehyde

Examples of Naturally Occurring Substances

Brine
Methane
Hydrogen sulfide
Lead
Arsenic
Radium
Polycyclic aromatic hydrocarbons

Where necessary, EPA may pursue additional toxicological studies (e.g., QSAR, ToxCast) to assess the toxicity associated with chemical contaminants of concern.

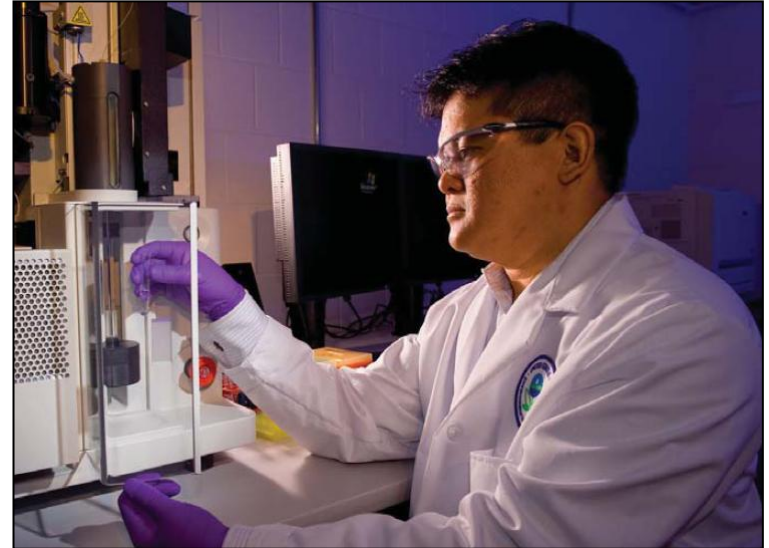
Draft SAB Panel Report

- EPA's use of the water lifecycle is an appropriate framework to characterize hydraulic fracturing and to identify potential impacts on drinking water resources
- Recommended clarifications of the proposed research identified for each stage of the water lifecycle
- Generally found EPA's research approach to be appropriate and comprehensive

The full SAB will be reviewing the Panel's report on July 5, 2011.

Timing

- 2011: Finalize study plan and conduct research
- 2012: Report of Results
 - Analysis of existing data
 - Retrospective case studies
 - Scenario evaluations
 - Laboratory studies
- 2014: Report of Results
 - Analysis of existing data
 - Retrospective and prospective case studies
 - Scenario evaluations
 - Laboratory studies
 - Toxicological studies

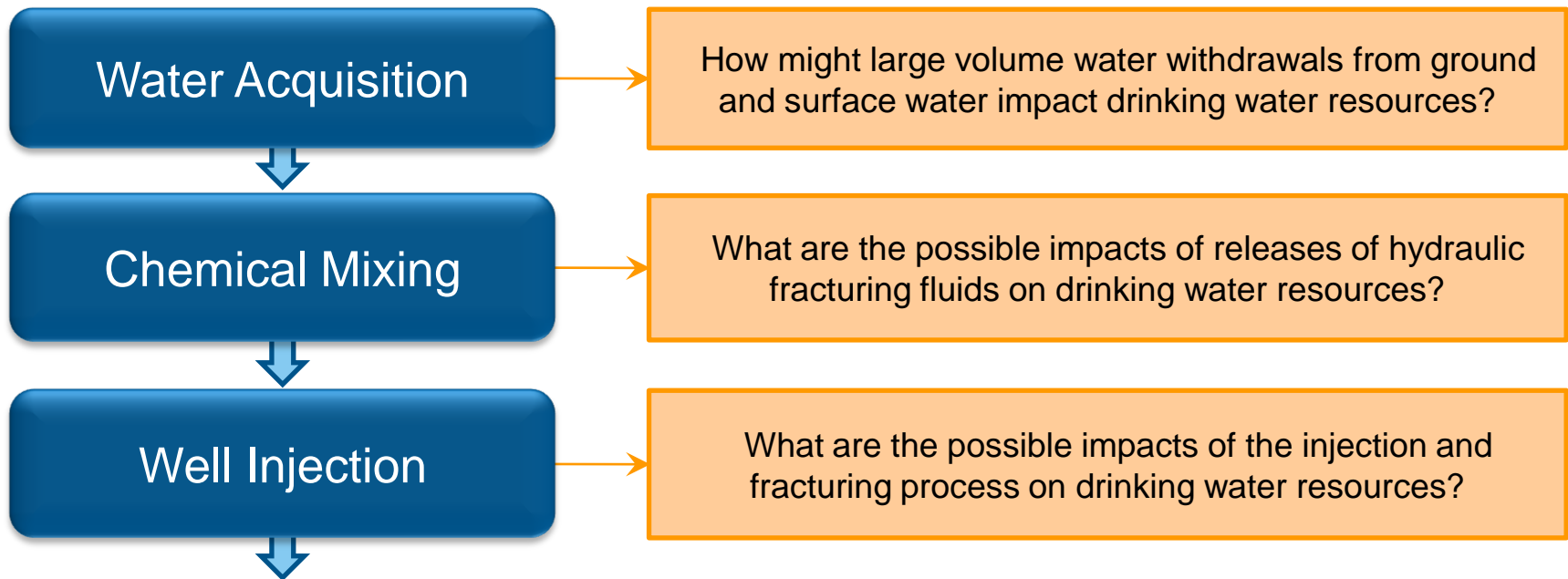


Conclusions

- This study will assess the potential impacts of hydraulic fracturing on drinking water resources by answering:

Water Use in Hydraulic Fracturing Operations

Fundamental Research Questions



Conclusions

Water Use in Hydraulic Fracturing Operations



Fundamental Research Questions

What are the possible impacts of releases of flowback and produced water on drinking water resources?

What are the possible impacts of inadequate treatment of hydraulic fracturing wastewaters on drinking water resources?

- This study will identify the driving factors that affect the severity and frequency of any impacts

Additional Information

- EPA's *Draft Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources*
 - <http://www.epa.gov/hydraulicfracturing>
- SAB review of the draft study plan
 - <http://yosemite.epa.gov/sab/sabproduct.nsf/02ad90b136fc21ef85256eba00436459/d3483ab445ae61418525775900603e79!OpenDocument&TableRow=2.2#2>.