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

Dr. Kevin Teichman
March 7, 2011
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
How Results May be Used

• Inform decision makers regarding the key factors that may drive potential impacts of hydraulic fracturing on drinking water resources
  – Industry
  – Local communities
  – State regulators
  – Tribes
  – Federal agencies
Development of the Draft Study Plan

- SAB suggestions
- Stakeholder input
- Literature review
- Internal EPA review
- External federal agency review

EPA’s draft study plan focuses on the water cycle in hydraulic fracturing.
SAB Recommendations
June 2010

• Use a lifecycle framework to identify important research questions
• Direct initial research to sources and pathways of potential impacts of hydraulic fracturing on water resources, especially drinking water
• Include 5-10 in-depth case studies at locations representing the full range of regional variability across the nation
• Engage stakeholders throughout the research process
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
Current and Future Stakeholder Input

- Review of the draft study plan
  - Interagency comments
  - Comments from the SAB
  - Stakeholder comments received by the SAB
- Research implementation
  - Partner with industry, governmental and other stakeholders for case studies
Draft Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources

Jeanne Briskin
March 7, 2011
Hydraulic fracturing often involves the injection of more than a million gallons of water, chemicals, and sand at high pressure down the well. The depth and length of the well varies depending on the characteristics of the hydrocarbon-bearing formation. The pressurized fluid mixture causes the formation to crack, allowing natural gas or oil to flow up the well.

Water Use in Hydraulic Fracturing Operations

- **Water Acquisition** - Large volumes of water are transported for the fracturing process.
- **Chemical Mixing** - Equipment mixes water, chemicals, and sand at the well site.
- **Well Injection** - The hydraulic fracturing fluid is pumped into the well at high injection rates.
- **Flowback and Produced Water** - Recovered water (called flowback and produced water) is stored on-site in open pits or storage tanks.
- **Wastewater Treatment and Waste Disposal** - The wastewater is then transported for treatment and/or disposal.
Research Questions

Water Use in Hydraulic Fracturing Operations

Water Acquisition

Chemical Mixing

Well Injection

Flowback and Produced Water

Water Treatment and Waste Disposal

Fundamental Research Questions

How might large volume water withdrawals from ground and surface water impact drinking water resources?

What are the possible impacts of releases of hydraulic fracturing fluids on drinking water resources?

What are the possible impacts of the injection and fracturing process on drinking water resources?

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?
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

The results of the study will inform decision makers at the local, state and federal level.
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.
## Research Budget

<table>
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<tr>
<th>Fiscal Year</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
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<tbody>
<tr>
<td>(Enacted)</td>
<td>$1.9 M</td>
<td>$4.4 M</td>
<td>$6.1 M</td>
</tr>
<tr>
<td>(President’s Request)</td>
<td>(President’s Request)</td>
<td>(President’s Request)</td>
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</table>
Research Approach

- Literature reviews
- Data gathering and analysis
- Modeling
- Laboratory investigations
- Field investigations and case studies
# Research Summary

<table>
<thead>
<tr>
<th></th>
<th>2012 Report</th>
<th>2014 Report</th>
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<tbody>
<tr>
<td><strong>Water Acquisition</strong></td>
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<td>Water quality</td>
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<td>Factors that may influence contamination</td>
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<td>✓</td>
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<tr>
<td>Impacts of current practices</td>
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<tr>
<td>-------------------------------------------</td>
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<tr>
<td><strong>Well Injection</strong></td>
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<td></td>
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<tr>
<td>Well construction practices</td>
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<tr>
<td>Pre-existing pathways/features</td>
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<td>✓</td>
</tr>
<tr>
<td>Chemical/physical/biological processes</td>
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<td>✓</td>
</tr>
<tr>
<td>Toxic effects of naturally occurring substances</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Flowback and Produced Water</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composition and variability</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Factors that may influence contamination</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Impacts of current practices</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td><strong>Wastewater Treatment and Waste Disposal</strong></td>
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<td></td>
</tr>
<tr>
<td>Treatment and disposal methods</td>
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<td>✓</td>
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</tbody>
</table>
Possible Uses of the Research Results

• Research will identify key drivers for impacts of hydraulic fracturing activities on drinking water resources

• Results may be used by:
  – Industry
  – Local, state, tribal and federal governments
  – Communities
  – Environmental groups
Purpose of this Review

Provide an independent, peer-review of ORD’s Draft Study Plan

• Areas of Review
  – Water Use in Hydraulic Fracturing
  – Research Questions
  – Research Approach
  – Proposed Research Activities
  – Research Outcomes
1. **Water Use in Hydraulic Fracturing**
   - Please comment on the appropriateness of this framework for the study plan.
   - Within the context of the water lifecycle, does the study plan adequately identify and address the areas of concern?

2. **Research Questions**
   - Has EPA identified the correct research questions to address whether or not hydraulic fracturing impacts drinking water resources, and if so, what those potential impacts may be?
   - Please provide any recommendations for conducting the research outlined in this study plan, particularly with respect to the case studies.

3. **Research Approach**
   - Have the necessary tools been identified?
   - Please comment on any additional key literature that should be included to ensure a comprehensive understanding of the trends in hydraulic fracturing.
4. Proposed Research Activities
   • Will the proposed research questions adequately answer the secondary research questions for each stage of the water lifecycle?
   • Please provide any suggestions for additional research activities.

5. Research Outcomes
   • If EPA conducts the proposed research, will we be able to:
     – Identify the key impacts, if any, of hydraulic fracturing on drinking water resources; and
     – Provide relevant information on the toxicity and possible exposure pathways of chemicals associated with hydraulic fracturing?
Case Studies

Dr. Robert Puls
March 7, 2011
Purpose of Case Studies

• To evaluate potential impacts of hydraulic fracturing in different parts of the US

• Retrospective case studies
  – Investigate concerns regarding impacts on drinking water resources
  – Evaluate the extent to which any impacts may be associated with hydraulic fracturing
  – Identify the driving forces that contributed to impacts

• Prospective case studies
  – Understand potential impacts of hydraulic fracturing throughout the cycle
  – Establish baseline
  – Evaluate data available during and immediately after injection, including flowback and produced water quantity, flow rate and composition
Case Study 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 NGOs
  – EPA Regional Office input

More than 40 locations for potential case studies have been brought to our attention.
Cases 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
Retrospective Case Study Approach

• Evaluate existing data and information
• Conduct site visits
• Get stakeholder input and participation
• Conduct initial environmental sampling and testing
• Develop site conceptual models for fate and transport
• Collect additional samples (geoprobe, new wells), testing (geophysical) and more comprehensive analysis (including stable isotopic analyses)
• Perform modeling (hydrologic, geochemical)
Prospective Case Study Approach

- Evaluate existing data and information
- Conduct site visits
- Get stakeholder input and participation
- Conduct baseline environmental sampling, testing
- Develop site conceptual models for potential exposure
- Conduct environmental sampling during/following pad and well construction, including well integrity testing
- Conduct environmental sampling during/following hydraulic fracturing operations
- Collect additional samples over time during resource production
## Retrospective Case Study Finalists

<table>
<thead>
<tr>
<th>Location</th>
<th>Key Issues / Impacts</th>
</tr>
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<tbody>
<tr>
<td>Bakken Shale</td>
<td>• Production well failure during horizontal fracturing</td>
</tr>
<tr>
<td>Killdeer and Dunn Co., ND</td>
<td>• Potential contamination of USDW, adjoining streams, soils</td>
</tr>
<tr>
<td>Barnett Shale</td>
<td>• Spills, impoundment leaks, degraded water quality in private wells</td>
</tr>
<tr>
<td>Wise and Denton Cos., TX</td>
<td>• Potential contamination of USDW (private wells)</td>
</tr>
<tr>
<td>Marcellus Shale</td>
<td>• Spills, leaks, methane in private wells</td>
</tr>
<tr>
<td>Bradford and Susquehanna Cos., PA</td>
<td>• Potential contamination of USDW, streams, soils</td>
</tr>
<tr>
<td>Marcellus Shale</td>
<td>• Impoundment leaks, spills</td>
</tr>
<tr>
<td>Wetzel Co., WV, Green and Washington Cos., PA</td>
<td>• Potential contamination of USDW, streams, soils</td>
</tr>
<tr>
<td>Raton Basin (CBM)</td>
<td>• Degraded water quality in private wells</td>
</tr>
<tr>
<td>Las Animas Co., CO</td>
<td>• Potential contamination of USDW</td>
</tr>
</tbody>
</table>
# Potential Prospective Case Study Sites

<table>
<thead>
<tr>
<th>Shale Play</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bakken Shale</td>
<td>Berthold Indian Reservation, ND</td>
</tr>
<tr>
<td>Barnett Shale</td>
<td>Flower Mound / Bartonville, TX</td>
</tr>
<tr>
<td>Marcellus Shale</td>
<td>Washington County, PA</td>
</tr>
<tr>
<td>Niobrara Shale</td>
<td>Laramie County, WY</td>
</tr>
</tbody>
</table>
Potential Partners for Case Studies

• Federal partners
  – Department of Energy
  – U.S. Geological Survey
  – EPA Regional Offices

• State partners
  – State oil and gas commissions
  – State environmental agencies
  – Interstate agencies

• Local partners
  – Cities
  – Landowners and residents

• Industry

• Environmental groups