

Update on EPA's Retrospective Case Studies

Technical Workshop on Case Studies to Assess Potential Impacts of Hydraulic Fracturing on Drinking Water Resources

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Case Studies

- Purpose: To determine if drinking water contamination has occurred at the case study locations and, if so, identify possible sources of contamination.
- Identification and selection
 - Stakeholder suggestions
 - Public meetings
 - EPA website
 - Webinars
 - Conferences
 - Regional input



More than 40 locations for potential case studies were considered.

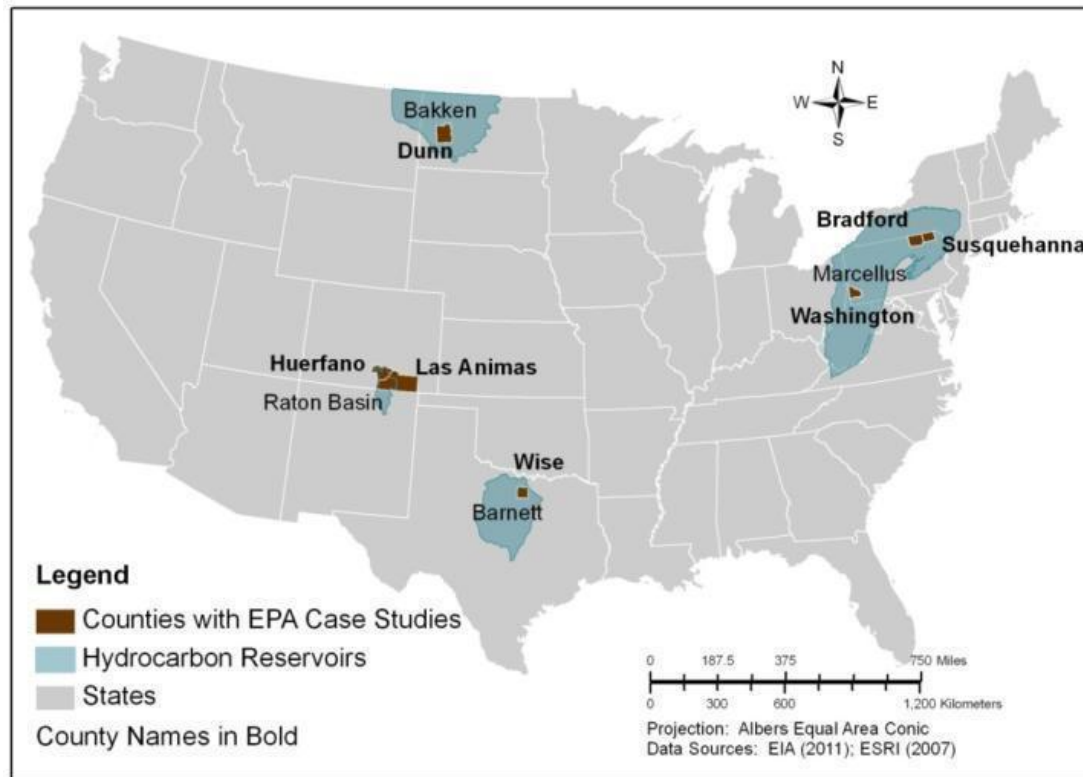
Retrospective Case Studies

Approach

- Identified and selected case studies based on various criteria:
 - Proximity of population and drinking water supplies
 - Evidence of impaired water quality
 - Health and environmental concerns
 - Knowledge gaps that could be filled by the case study
- Prioritized case studies based on:
 - Geographic and geologic diversity
 - Population at risk
 - Site status (planned, active, or completed)
 - Unique geologic or hydrologic features
 - Characteristics of water resources
 - Land use

Retrospective Case Studies

- Selected 5 case studies to investigate reported drinking water impacts
- **Case study locations**
 - Bradford County, PA
 - Washington County, PA
 - Marcellus, PA
 - Susquehanna, PA
 - Wise County, TX
 - Barnett, TX
 - Huerfano, CO
 - Las Animas, CO
 - Raton Basin, CO
 - Bakken, ND
 - Dunn, ND



General Analyte List

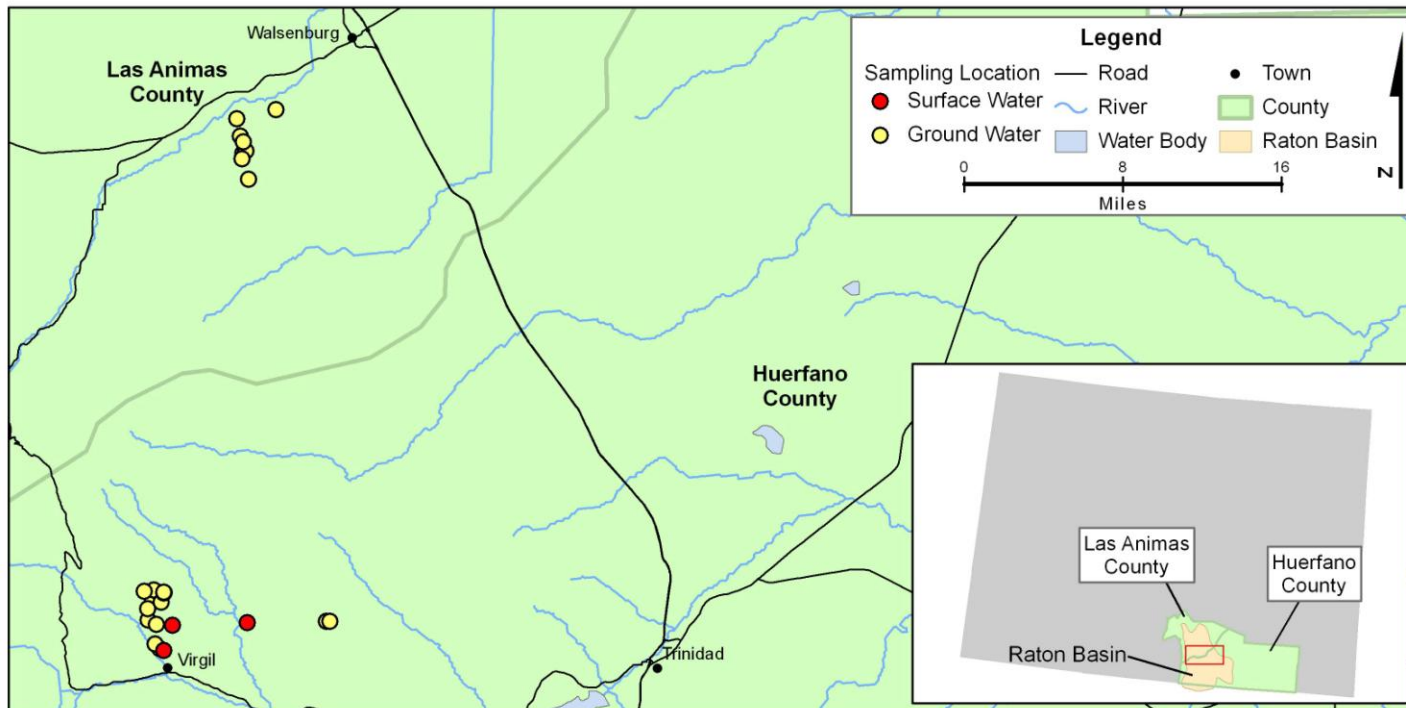
- Gasoline & Diesel Range Organics (DRO and GRO)
- Volatile and Semi-volatile Organics (VOCs and SVOCs)
- Glycols and Alcohols
- Carboxylic Acids
- Dissolved Organic and Inorganic Carbon (DOC and DIC)
- Major & Trace Cations (metals) and Anions
- Dissolved Gases (methane, ethane, propane, n-butane)
- Stable isotopes (O and H in water; C and H in methane, if detected; C in DIC; in some cases, S in sulfate/sulfide)
- Sr isotopes
- Radionuclides (Gross alpha/beta; Ra-226 and Ra-228)
- General Water Quality Parameters (pH, ORP, etc.)

Las Animas/Huerfano Counties (Raton Basin), CO

HF Target Formation – Coal Bed Methane (Vermejo & Raton Formations)

Drinking Water Resources – Poison Canyon Formation and nearby underground sources of drinking water

Research Focus – Ground water and surface water



Las Animas/Huerfano Counties (Raton Basin), CO

Progress

- Sampling events:
 - October 2011
 - May 2012
 - November 2012
 - April/May 2013
- Locations sampled:
 - Domestic wells
 - Production wells
 - Monitoring wells
 - Surface water (streams)



- Participants: Landowners, Colorado Oil and Gas Conservation Commission, Pioneer, Petroglyph

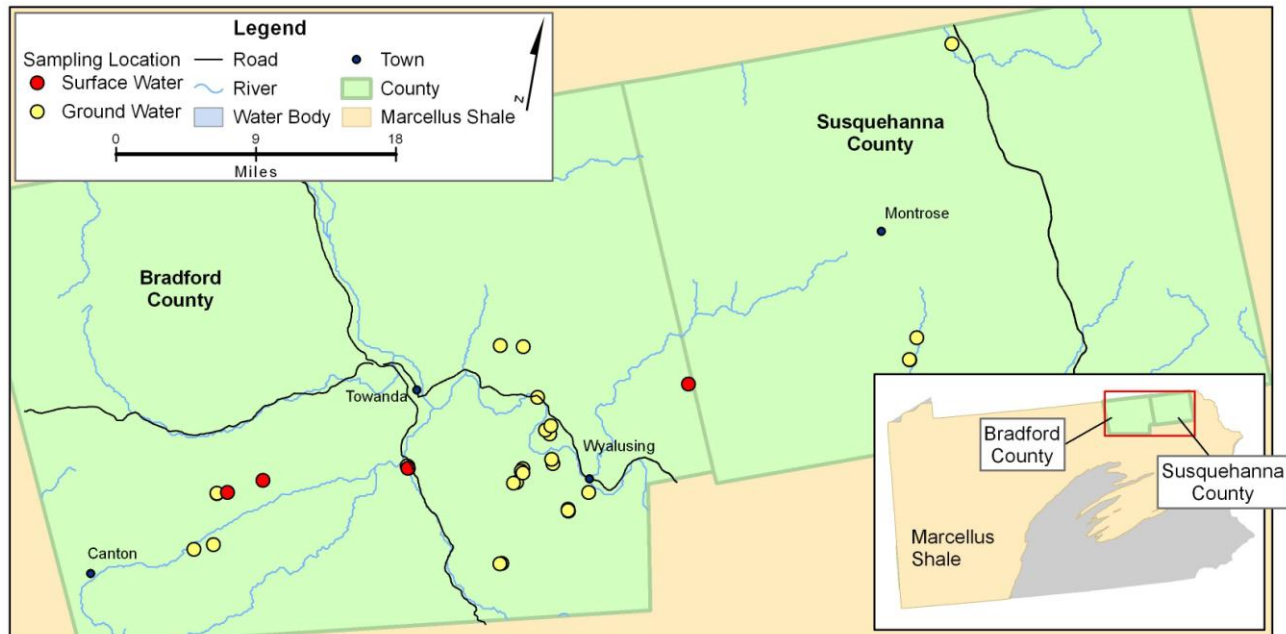
Bradford County, PA

HF Target Formation – Marcellus Shale

Drinking Water Resources – Stratified drift & bedrock aquifers and surface water

Research Focus

- Ground water and surface water studies
- Reports of methane in multiple drinking water wells



Bradford County, PA

Progress

- Sampling events:
 - October/November 2011
 - April/May 2012
 - May 2013
- Locations sampled:
 - Domestic wells
 - Surface water (springs, streams, ponds)
- Participants: Landowners, PA Department of Environmental Protection, Chesapeake, Cabot



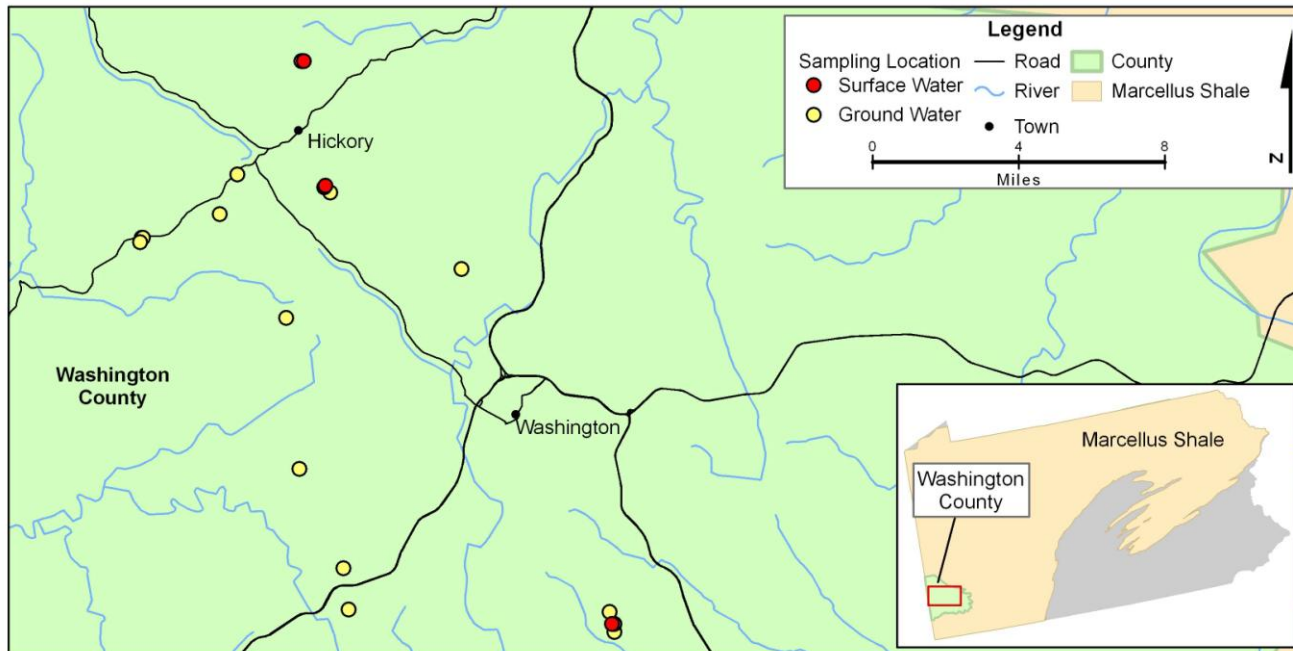
Washington County, PA

HF Target Formation – Marcellus Shale

Drinking Water Resources – Surficial & shallow confined aquifers and surface water

Research Focus

- Reported changes in drinking water quality
- Reported methane in wells



Washington County, PA

Progress

- Sampling events:
 - July 2011
 - March 2012
 - May 2013
- Locations sampled:
 - Domestic wells
 - Surface water (springs, stream)
- Participants: Landowners, Range Resources, Atlas Energy



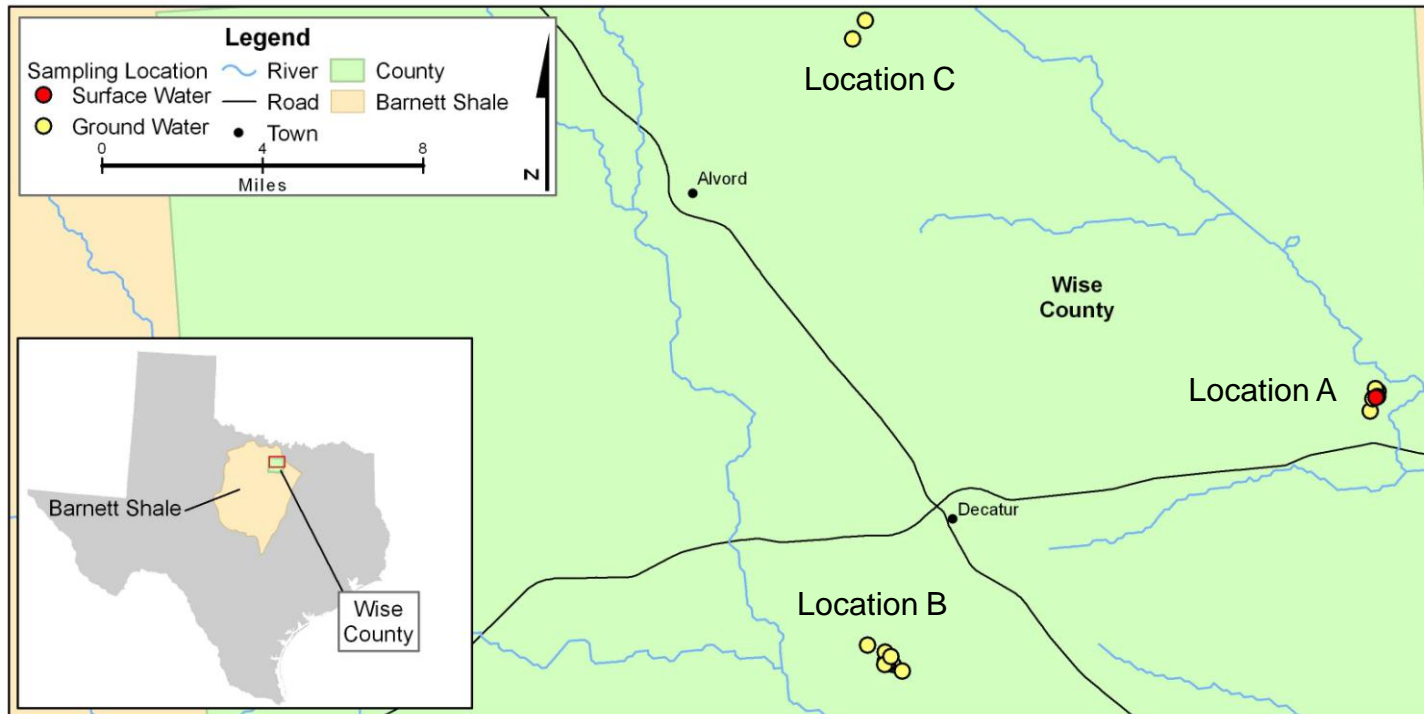
Wise County, TX

HF Target Formation – Barnett Shale

Drinking Water Resources – Trinity aquifer and surface water

Research Focus

- Drinking water wells



Wise County, TX

Progress

- Sampling events:
 - September 2011
 - March 2012
 - September 2012
 - Limited (1 production well and 2 domestic wells in Location B)
 - December 2012
 - May 2013
- Locations sampled:
 - Domestic wells
 - Industrial well
 - Surface water (ponds)



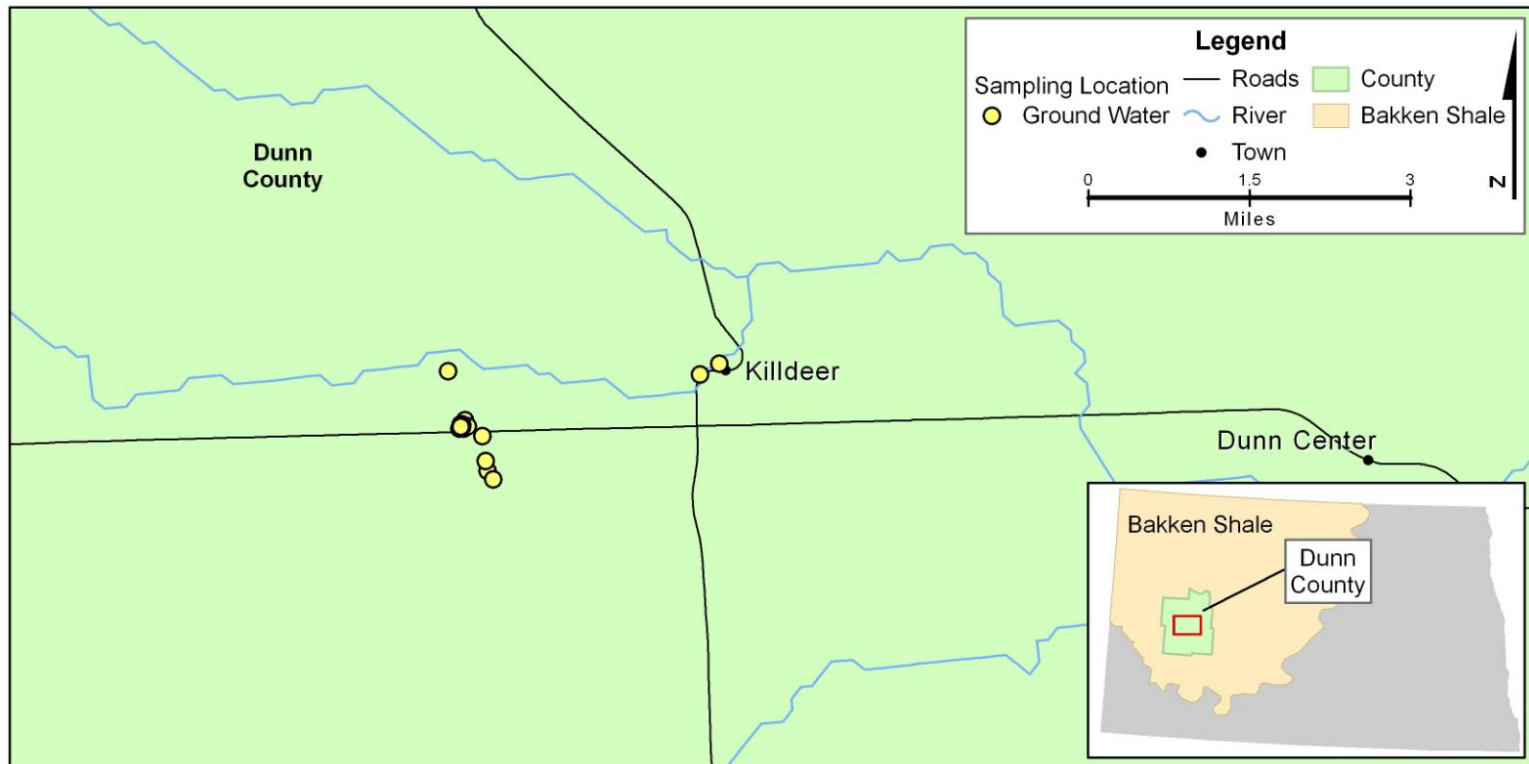
Dunn County (Killdeer), ND

HF Target Formation – Bakken Shale

Drinking Water Resources – Killdeer aquifer

Research Focus

- Drinking water aquifer



Dunn County (Killdeer), ND

Progress

➤ Sampling events:

- July 2011
- October 2011
- October 2012

➤ Locations sampled:

- Monitoring wells
- Domestic wells
- Supply wells
- Municipal well



➤ Participants: Landowners, Denbury, North Dakota Industrial Commission's Oil and Gas Division

Retrospective Case Studies: Next Steps

- Data Evaluation
 - Statistics
 - Comparison with existing data
 - Temporal/spatial evaluation
 - Geochemical modeling & evaluation
 - Environmental record searches