

## Retrospective Case Studies – Northeastern Pennsylvania

### EPA's Study of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources

#### Case Study Background

EPA conducted a retrospective case study in northeastern Pennsylvania to investigate reported instances of contaminated drinking water resources in areas where hydraulic fracturing activities occurred. EPA examined whether ground water quality anomalies existed in the vicinity of gas wells and, if so, whether they could be attributed to hydraulic fracturing, or other activities. This area of northeastern Pennsylvania has been the focus of natural gas extraction from the Marcellus Shale.

#### Goals and Scope of Research

EPA set out to determine if homeowner drinking water wells were impacted, and if so to better understand the potential sources of contamination. The case study was not intended to identify all source(s) of potential impacts in the study area nor conduct detailed contaminant transport and fate studies related to any potential impacts found.

#### EPA Research Approach

To determine if an impact to drinking water resources in northeastern Pennsylvania occurred, EPA collected samples on three separate occasions. Sampling locations are shown on the map below. EPA analyzed water samples for over 225 constituents, ensuring that a broad spectrum of indicators associated with various land uses, including but not limited to shale-gas drilling and production was covered. EPA then evaluated the water quality data and the results from this study against the historical background data which helped determine if potential impacts existed. EPA researchers also analyzed for any changes in general water quality, geochemistry, and isotopic parameters (also used to identify sources of impacts to ground water) at the shallow ground water locations sampled in the study area.

#### Key Findings from Research

- No evidence of impacts on homeowner wells and springs from flowback water, produced water or injected hydraulic fracturing fluids was found in the study.
- Background data showed that methane is naturally occurring in the study area; however, using multiple lines of evidence EPA concluded that up to nine of the 36 drinking water wells are impacted by stray gas (methane and ethane) associated with nearby hydraulic fracturing activities.
- EPA detected elevated levels of chloride and total dissolved solids in a pond in the study area. This pond is adjacent to a well pad that had reported releases of fluids and solids in 2009. This pond is not used as drinking water source.

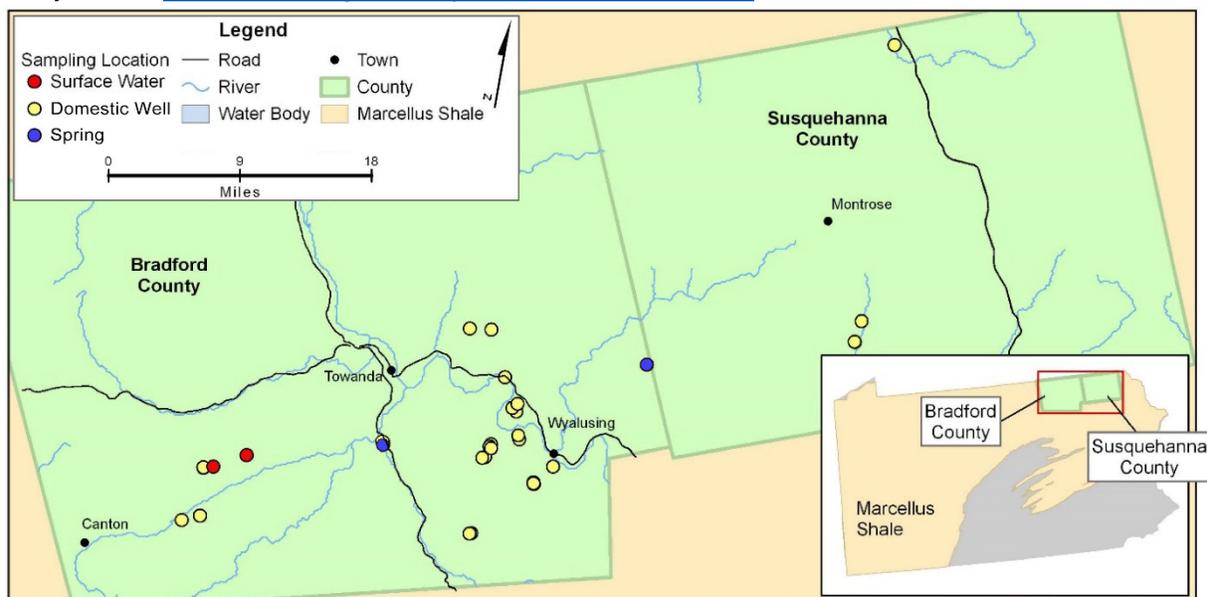
#### State Activities at the Case Study Location

The Pennsylvania Department of Environmental Protection (PADEP) took a multitude of steps to investigate and protect drinking water resources in response to complaints, including entering into a Consent Order Agreement with the company to replace impacted water supplies and remediate gas wells, fining the operator for gas migration, and overseeing a Corrective Action Plan to evaluate the mechanical integrity of area gas wells. PADEP continues to monitor the situation and have provided alternate drinking water when necessary. They also issued four notices of violation relating to releases and contamination at a pond, which was not being used as a drinking water source, and issued one Consent Assessment of Civil Penalty to date.

#### Sampling Activities

EPA completed three rounds of water sampling from October 2011 to May 2013 from domestic wells<sup>1</sup>, springs<sup>2</sup>, and surface water<sup>3</sup> locations. Sampling locations were selected primarily based on homeowner concerns and complaints regarding potential adverse impacts on private water supplies from drilling and/or other processes related to hydraulic fracturing (e.g. increased turbidity, effervescing, staining, odors, etc.).

A full listing of sampling results can be found in EPA's report: *Retrospective Case Study in Northeastern Pennsylvania* at <http://www2.epa.gov/hfstudy/published-scientific-papers>.



<sup>1</sup>Domestic well – A homeowner well that serves as source of potable and/or irrigation water for the household.

<sup>2</sup>Spring – Ground water naturally flowing from an aquifer to the earth's surface.

<sup>3</sup>Surface water – Water naturally open to atmosphere (e.g. lakes, streams, ponds, etc.).

### What are Retrospective Case Studies?

EPA conducted retrospective case studies at locations where hydraulic fracturing had already occurred, and where residents had reported concerns about contamination of drinking water resources. The retrospective case studies may provide information about which, if any, specific geologic and hydraulic fracturing conditions could contribute to impacts on drinking water resources by hydraulic fracturing activities. This is important because the conditions under which hydraulic fracturing occurs may vary between sites, so that the potential for impacts on drinking water resources could also be different. As part of this effort, scientists have looked for evidence of impacts to drinking water resources, and the possible cause(s) of such impacts, if applicable.

### How Were They Selected?

To select the retrospective case study sites, the EPA invited stakeholders from across the country to participate in the identification of locations for potential case studies through informational public meetings and the submission of electronic or written comments. Over 40 locations were nominated for inclusion in the study.

These locations were prioritized and chosen based on a rigorous set of criteria, including proximity of population and drinking water supplies, reported evidence of impaired water quality, health and environmental concerns, and knowledge gaps that could be filled by a case study at each potential location. Sites were prioritized based on geographic and geologic diversity, population at risk, geologic and hydrologic features, characteristics of water resources, and land use.

**Study Limitations:** Retrospective case studies are often constrained by a lack of baseline data (e.g., site-specific water quality data) which limited the EPA's ability to link drinking water resource impacts to definitive causes or sources. Despite the difficulties in determining the specific sources of potential impacts, scientists were still able to use the data collected to shed light on potential vulnerabilities to drinking water resources.