

## Retrospective Case Studies – Southwestern 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 southwestern Pennsylvania to investigate reported instances of contaminated drinking water resources in areas where hydraulic fracturing activities occurred. EPA examined potential drinking water impacts, including changes to drinking water quality from suspected contamination, stray gas in wells, and the evaluation of historic surface spills as related to hydraulic fracturing and other land use activities. This area has been the focus of natural gas extraction from Marcellus Shale.

#### Goals and Scope of Research

EPA set out to determine if homeowner drinking water wells or springs were impacted, and if so 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 transport and fate studies related to any potential impacts found.

#### EPA Research Approach

To determine if an impact to homeowner wells occurred, EPA collected samples on three separate occasions. Sampling locations are shown in the map below. EPA analyzed water samples for over 235 constituents, ensuring that the broad spectrum of indicators potentially related to local land use activities, 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 the changes in general water quality, geochemistry, and isotopic parameters (used to identify sources of impacts ground water) of samples collected from domestic wells, springs, and surface water in Washington, County.

#### Key Findings from Research

- EPA found increased levels of chloride in ground water at locations near an impoundment site which was used to store hydraulic fracturing drilling waste and wastewaters. The chloride contamination likely originates from the impoundment site based on multiple lines of evidence.
- Background data showed that methane is naturally occurring in this area and was detected in 24% of the samples collected from domestic wells. The isotopic signature of the methane present in domestic wells was not similar to that of gas produced from the shale being hydraulically fractured.

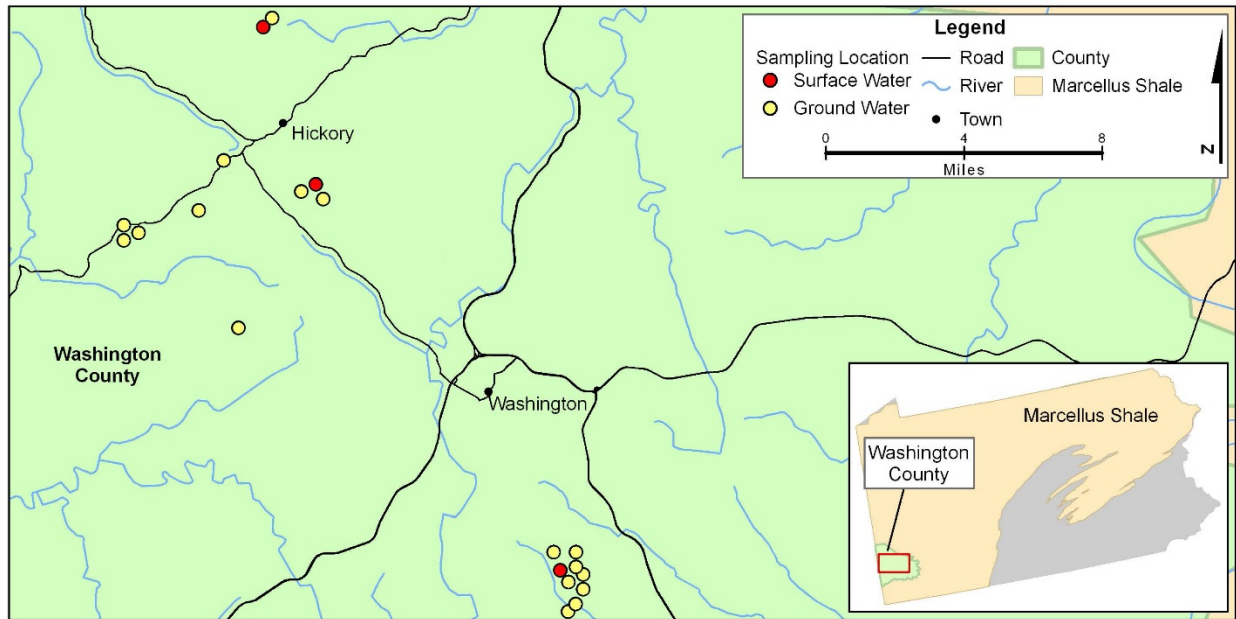
#### State Activities at the Case Study Location

Pennsylvania's Department of Environmental Protection has taken a multitude of steps to protect drinking water resources in the case study area, including issuing fines, working with the company to close the impoundment, overseeing the replacement of water supply wells, monitoring, and issuing notices of violations.

#### Sampling Activities

EPA completed three rounds of water sampling from July 2011 to May 2013. Water samples from several locations across Washington County, PA were collected from domestic wells<sup>1</sup>, springs, and surface water<sup>2</sup> where homeowners expressed concerns regarding potential adverse impacts on their well water and possible association with drilling or processes related to hydraulic fracturing.

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



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

<sup>2</sup>Surface water – Water naturally open to the 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., 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.