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Private well groundwater quality in West Virginia, USA–2010

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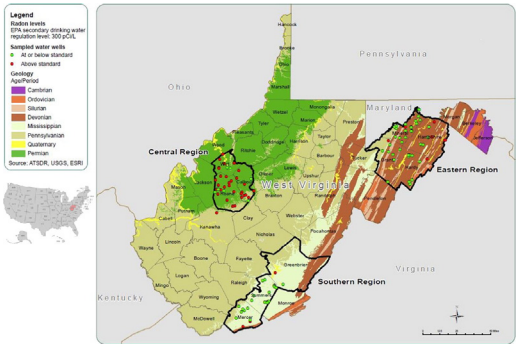
HIGHLIGHTS

- Characterize well water across aquifer geologies by testing drinking water in 10 WV counties
- We found arsenic and radon concentrations higher in Permian aquifers compared to other geologic ages.
- Private wells in Permian aged aquifers could benefit from targeted public health messaging.

GRAPHICAL ABSTRACT



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ABSTRACT

The Centers for Disease Control and Prevention (CDC), in collaboration with the West Virginia Bureau of Public Health (BPH), initiated an investigation to characterize private well water quality in West Virginia. The objective was to better characterize private well water across various aquifer geologies by testing household drinking water samples and comparing them to EPA's National Primary Drinking Water Standards. The BPH selected ten counties representing three regions to capture geologically diverse areas that represent varying aquifer geology. We collected well-water samples from participating households and analyzed all water samples for 20 constituents currently monitored in public drinking-water systems. We calculated geometric means for each constituent and compared metal concentrations to EPA maximum and secondary contaminant levels by the geologic age of the rock surrounding the aquifer where the sample was obtained. All participating households ($n = 139$) provided a water sample. We detected arsenic at levels higher than the EPA maximum contaminant level in 10 (7.2%) samples. We detected elevated radon-222 in 48 (34.5%) samples. Geologic age of the region was indicative of whether arsenic and radon-222 were present at levels that exceeded current EPA drinking water standards. We found arsenic and radon concentrations were higher in Permian aquifers compared to those of other geologic ages. Homeowners with private wells in areas with Permian aged aquifers could benefit from targeted public health messaging about potentially harmful constituent concentrations in the well water. This may help ensure proper testing and maintenance of private wells and reduce exposure to these constituents.
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1. Background

Approximately 44 million people in the U.S. (about 13% of U.S. households) rely on domestic wells for drinking water (U.S. Geological Survey, 2016a, b). The Environmental Protection Agency (EPA) regulates water

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from public sources but it does not regulate private wells. Various contaminants, particularly those that occur naturally in groundwater, may be found in private wells. The U.S. Geological Survey's (USGS) National Water-Quality Assessment Program assessed the water quality of 2100 domestic wells within 48 states and reported that more than one in five of the sampled wells contained one or more contaminants at a concentration greater than either EPA's maximum contaminant levels (MCLs) or USGS' health-based screening levels (HBSLs) (DeSimone, 2009). Testing, treatment, and maintenance of these private wells may prevent contamination and thus protect the health of the well users.

The 2010 U.S. Census estimated the rural population of West Virginia at 51.3%, the second highest rural population in the U.S. (U.S. Census Bureau, 2016). An estimated 23% of West Virginians obtain their water from private wells (Atkins, 2007). However, a comprehensive assessment of constituents in drinking water derived from private wells in West Virginia does not exist.

USGS has conducted several studies on basic groundwater quality in West Virginia (Kozar and Brown, 1995; Kozar and Mathes, 2001; Kozar et al., 2001; Larsen and Mann, 2005; Mathes et al., 1998). Most notably, USGS tested groundwater across various rock strata in West Virginia from 1993 to 2008, and testing indicated that the quality of these public drinking water sources before treatment varied highly across various aquifer geologies (Chambers, 2008; Shiber, 2005).

Because of its geology, the majority of West Virginia falls into Radon Zones 1 and 2 as categorized by the EPA, demonstrating moderate to high concerns for radon exposure (Fig. 1) (West Virginia -EPA Map of Radon Zones, 2016). Radon Zones are classified as Zones 1, 2, or 3 with Zone 1 representing counties with predicted average indoor radon screening levels greater than four picocuries per liter (pCi/L), Zone 2 for counties with levels between two and four pCi/L and Zone 3 for counties with levels lower than two pCi/L. The EPA has set the indoor radon screening level of 4 pCi/L as the action level where homeowners are recommended to take corrective measures to reduce exposure to radon gas. Radon-222 is a radioactive gas that can seep from groundwater into plumbing and accumulate in indoor air as it exits the spigot. Though studies indicate only a small proportion (<5%) of the total

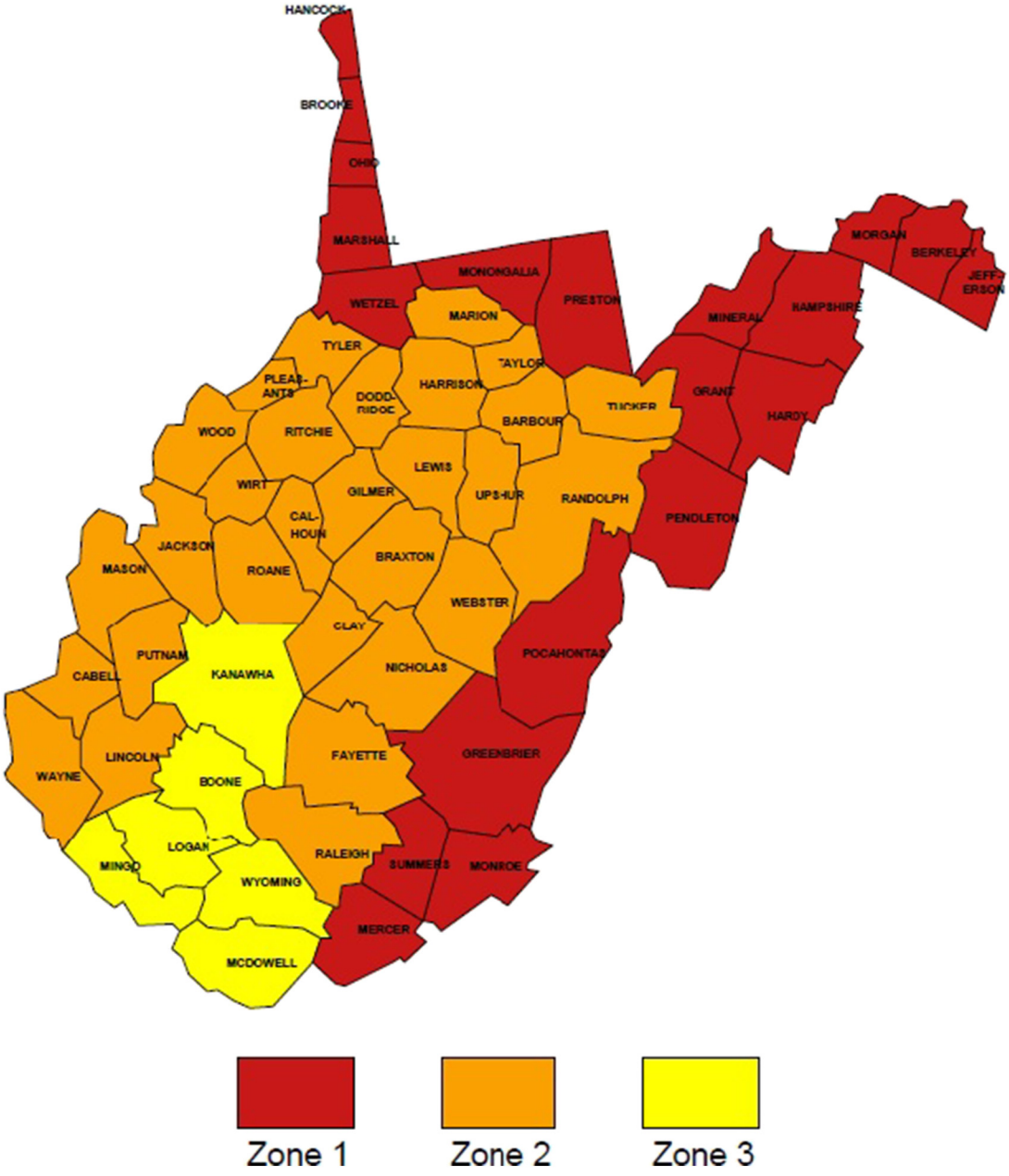

Fig. 1. Map of West Virginia Radon Zones.

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