Going Public:
Water Quality Issues

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USGS study unlocks new findings on contaminants

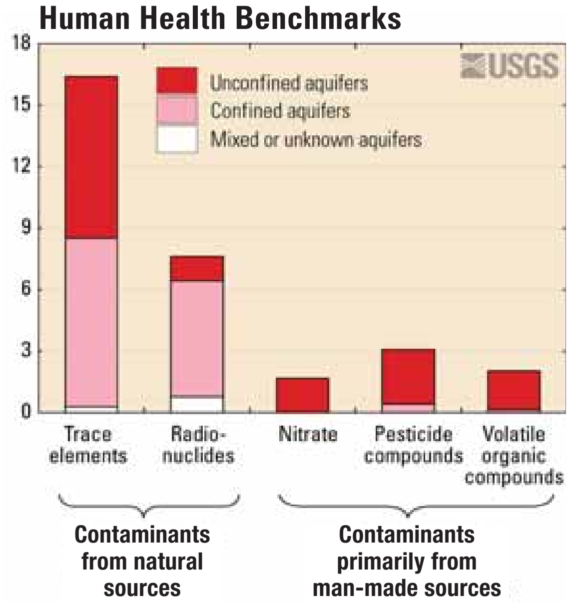
About 105 million people in the U.S.—more than one-third of the nation's population—receive their drinking water from about 140,000 public water systems that use groundwater as their source. Long-term protection and management of groundwater, a vital source of drinking water, requires an understanding of the occurrence of contaminants in untreated source water.

In a recent study by the National Water-Quality Assessment Program of the U.S. Geological Survey (USGS), water quality conditions were assessed in source (untreated) groundwater from 932 public supply wells and in source and finished water from a subset of 94 wells. One groundwater sample was collected from each well from 1993 to 2007. Two objectives of this study were to evaluate the occurrence of contaminants in source water from public wells and their potential significance to human health, as well as whether contaminants that occur in source water also occur in finished water after treatment.

The public wells are widely distributed nationally and include wells in selected parts of 41 states that withdraw water from parts of 30 regionally extensive aquifers used for public water supply in the U.S. All source water samples were collected prior to any treatment or blending that potentially could alter contaminant concentrations. As a result, the sampled groundwater represents the quality of the source water and not necessarily the quality of finished water ingested by the people served by these public wells.

A greater number of chemical contaminants—as many as 337—both naturally occurring and man-made, were assessed in this study than in any previous national study of public wells. All constituents analyzed in this study are referred to as "contaminants," regardless of their source, concentration or potential for health effects. The contaminants included major ions, nutrients, radionuclides, trace elements, pesticide compounds, volatile organic compounds (VOCs), personal care and domestic use products and other organic contaminants such as manufacturing additives.

Percentage of Source Water Samples with Concentrations Greater Than Human Health Benchmarks



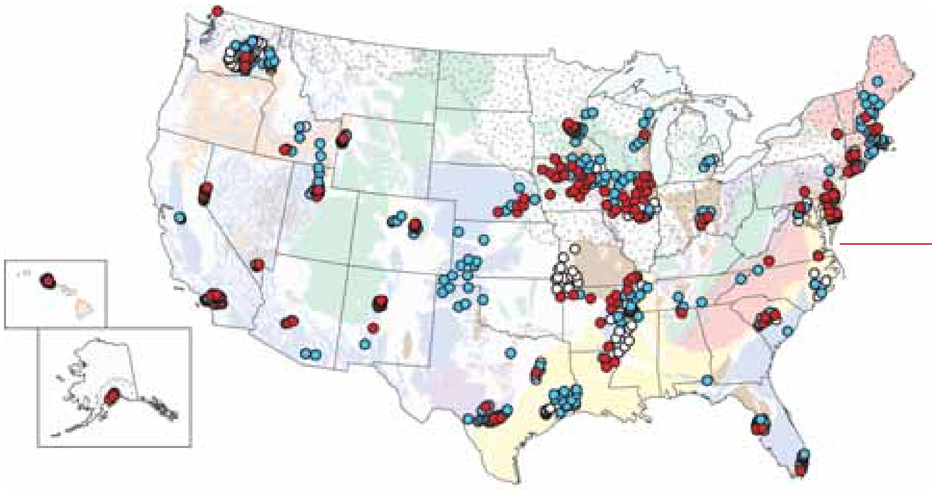
To evaluate the potential significance of contaminant occurrence to human health, contaminant concentrations were compared to human health benchmarks—regulatory U.S. Environmental Protection Agency (EPA) Maximum Contaminant Levels (MCLs) for contaminants regulated in drinking water under the Safe Drinking Water Act (SDWA) or nonregulatory USGS Health-Based Screening Levels (HBSLs) for unregulated contaminants, when available. Of the contaminants analyzed in this study, 83% (279) are not regulated in drinking water under the SDWA. The EPA uses USGS data on the occurrence of unregulated contaminants to fulfill part of the SDWA requirements for determining whether specific contaminants should be regulated in drinking water in the future.

By focusing primarily on source water quality, and by analyzing many contaminants that are not regulated in drinking water by the EPA, this study complements the extensive sampling of public water systems that is routinely conducted for the purposes of regulatory compliance monitoring by federal, state and local drinking water programs. Some major findings are summarized below, and more information is available from the authors and online at http://water.usgs.gov/nawqa/studies/public_wells/.

Study Results

More than one in five source water samples from public wells contained one or more naturally occurring or man-made contaminant at concentrations greater than human health benchmarks. This finding indicates that source water from a substantial proportion of public wells—about one of every five sampled—would require treatment or blending with higher-quality water sources to decrease contaminant concentrations to less than human health benchmarks. A total of 80% of samples contained one or more contaminants at concentrations greater than one-tenth of benchmarks. Most individual contaminant detections, however, were less than one-tenth of human health benchmarks. These results indicate the ubiquitous nature of natural and man-made contaminant sources and that all principal aquifer rock types included in this study are vulnerable to contamination. Early attention to potential groundwater contamination is vital because it is difficult and costly to reverse once it occurs.

Contaminants from natural sources accounted for about three-quarters of contaminant concentrations greater than human health benchmarks in source water samples, and



- One or more contaminants at concentrations greater than human health benchmarks (206 wells; 22%)
- One or more contaminants at concentrations greater than one-tenth of human health benchmarks (539 wells; 58%)
- No contaminants at concentrations greater than one-tenth of human health benchmarks, or no contaminants detected (187 wells; 20%)

Source: U.S. Geological Survey

contaminants from man-made sources accounted for one-quarter of such concentrations. Ten contaminants were detected at concentrations greater than human health benchmarks in at least 1% of source water samples and collectively accounted for most concentrations greater than benchmarks. Seven of these contaminants occur naturally, including three radionuclides (radon, radium and gross alpha-particle radioactivity) and four trace elements (arsenic, manganese, strontium and boron); three of these contaminants (dieldrin, nitrate and perchloroethene) primarily have man-made sources.

Radon activities were greater than the proposed MCL of 300 picocuries per liter (pCi/L) in 55% of source water samples and were greater than the proposed alternative MCL of 4,000 pCi/L in 0.6% of samples. The remaining six contaminants from natural sources were detected at concentrations greater than benchmarks in 3% to 19% of samples. Pesticides and VOCs were detected in about two-thirds of source-water samples, but dieldrin (a historical insecticide), PCE (a solvent) and nitrate each were detected at concentrations greater than benchmarks in 1% to 3% of samples.

Traditional wellhead protection approaches designed to reduce man-made sources of contaminants to groundwater generally are not designed to protect against natural sources of contaminants and, therefore, most occurrences of naturally occurring contaminants at concentrations greater than benchmarks are unlikely to be affected by these approaches. Based only on comparisons of contaminant concentrations to individual human health benchmarks, contaminants from man-made sources may have less potential human health significance in public wells than contaminants from natural sources. Human health benchmarks are not available for many organic contaminants analyzed in this study, however, and the full significance of their occurrence to human health cannot yet be assessed.

Many organic contaminants detected in source water also were detected in finished water at similar concentrations. As many as 272 organic contaminants were analyzed in a subset of 94 paired source and finished water samples from public wells. Considering all organic contaminants that were detected in at least 10% of source water samples, concentrations generally were similar in source and finished water, which indicates that commonly used disinfection practices do not reduce concentrations of many organic contaminants. Because disinfection is not designed to treat organic contaminants, and because pesticide compounds or VOCs were frequently detected in source water samples, the frequent occurrence of these organic contaminants in finished water is likely, although usually at concentrations less than benchmarks. *wqp*

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