COMPARISON OF SHALLOW GROUND-WATER QUALITY IN THE BOSTON METROPOLITAN AREA TO NEARBY URBAN AREAS

A similar study of shallow ground-water quality was previously done in an adjacent basin (fig. 5), thus providing a basis against which to compare data from the BMA study. During 1993-95, 40 water samples were collected from similarly constructed shallow monitoring wells in urban areas in the Connecticut, Housatonic, and Thames River Basins (CONN) NAWQA study unit (Grady and Mullaney, 1998) (figs. 1 and 5). In that study, many wells sampled were in urban areas developed before 1970, compared to wells sampled in the more recently developed areas in the BMA study. The Wilcoxon rank-sum test, also known as the Mann-Whitney test, was used to compare differences in population density and water quality data between the two study units. The median population density near the wells in the CONN study (683 persons per square kilometer, or p/km^2) was significantly higher (p = less than 0.01) than the population density near the wells in the BMA study (261 p/km^2).

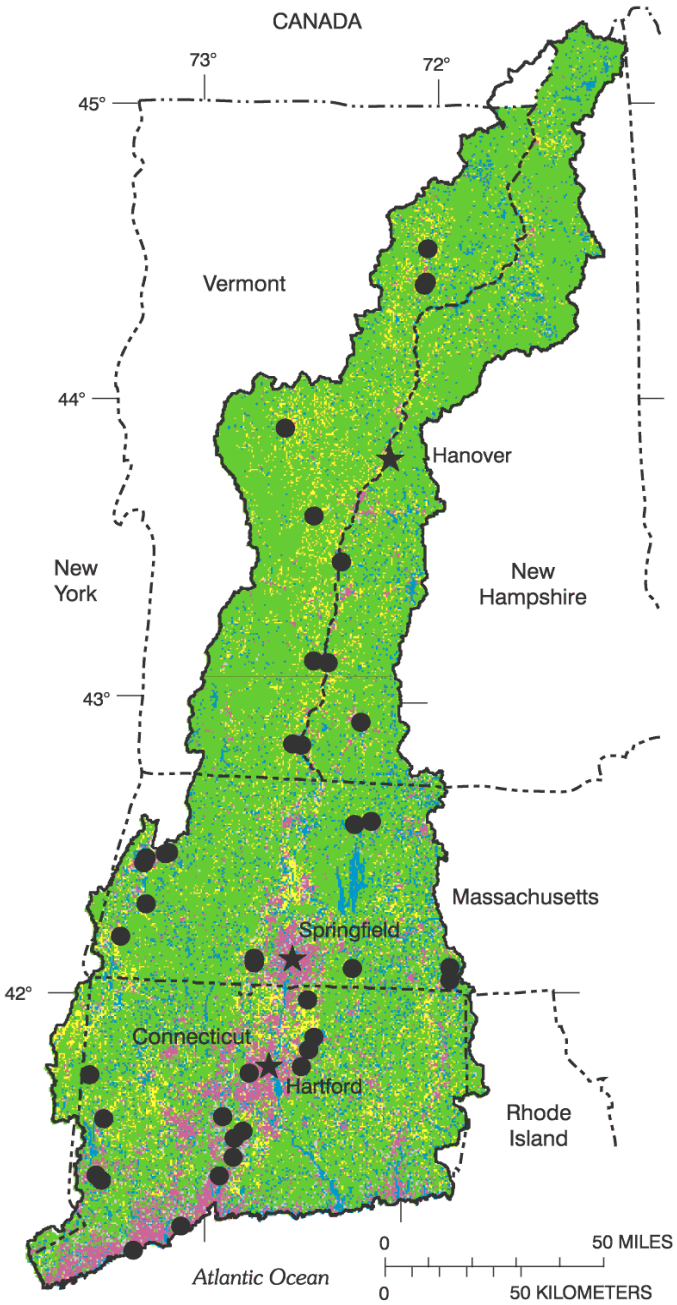
All VOC analytical results for the 40 wells in the CONN study area were censored by the NWQL to a reporting level of 0.2 µg/L. Since then, analytical methods have improved, resulting in differences in laboratory reporting levels between the two studies. To make detection rates comparable, the VOC analytical results for the 29 wells in the BMA study area also were censored to 0.2 µg/L in this section of the report. This resulted in significantly reducing the rates of detection for many of the VOCs in the BMA samples. For example, chloroform was detected in 69 percent of the BMA samples when including concentrations that ranged from 0.011 to 1.92 µg/L, but the detection rate was reduced to 13 percent when the samples were censored at 0.2 µg/L. Laboratory reporting levels for nutrients and pesticides were the same for the two studies.

The median concentrations of nitrate in waters from the two study areas were not statistically different (p = 0.60) (fig. 6). Grady (1994) noted that multiple factors related to nitrogen found in ground water in urban settings, such as leakage from sewer lines and heavy use of lawn fertilizer in residential areas.

The most frequently detected VOC in both study areas at the censored level of 0.2 µg/L was MTBE (fig. 7). Despite the difference in population density between the two study areas, the median concentrations of MTBE in samples were not statistically different (p = 0.32) (fig. 8). The detection rates for MTBE were nearly identical (38 and 40 percent, respectively) in the BMA and CONN studies (fig. 7). The similarity in concentrations and detection rates of MTBE reflects that MTBE has been widely used throughout New England.

Concentrations of chloroform in water samples from both studies were not statistically different (p = 0.16) (fig. 8). However, the rate of detection of chloroform, tetrachloroethylene (PCE), trichloroethylene (TCE), and naphthalene in the two studies does differ (fig. 7). Many of the shallow wells in the CONN study area were installed in older, more densely populated areas than were the wells in the BMA, which could account for the high rate of detection for chloroform and other VOCs in water from wells in the CONN study area.

Fewer pesticides were detected—and at lower frequencies—in water from wells in the BMA than in water from wells in the CONN study area (fig. 9). The highest pesticide concentration in a sampled well from the CONN study area was 2.3 µg/L for atrazine (Grady and Mullaney, 1998). The highest pesticide concentration in a sampled well from the BMA study area was 0.011 µg/L for atrazine. Atrazine and other triazine herbicides are used primarily in agriculture but are also used on rights-of-way in urban areas.



Base from U.S. Geological Survey digital data 1:250,000, 1993; U.S. Environmental Protection Agency satellite imagery, 30-meter-pixel resolution; national land cover dataset, 1992

EXPLANATION

Land use

- Urban
- Agricultural
- Forest
- Water or wetlands

- State boundary
- Study area boundary
- Sampled well
- Major city

Figure 5. Land uses and sampled wells in the Connecticut, Housatonic, and Thames River Basins (CONN) NAWQA study unit.

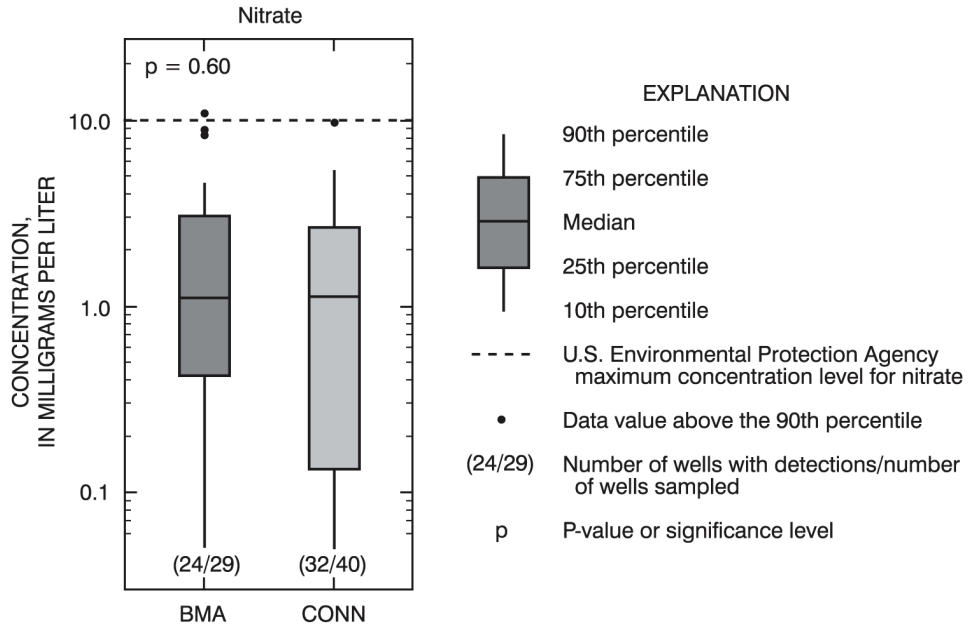


Figure 6. Distribution of nitrate concentrations in water samples from 29 shallow wells in the Boston metropolitan area (BMA) and 40 shallow wells in the Connecticut, Housatonic, and Thames River Basins (CONN) NAWQA study unit. A p-value above 0.05 indicates no statistical difference between the two study areas.

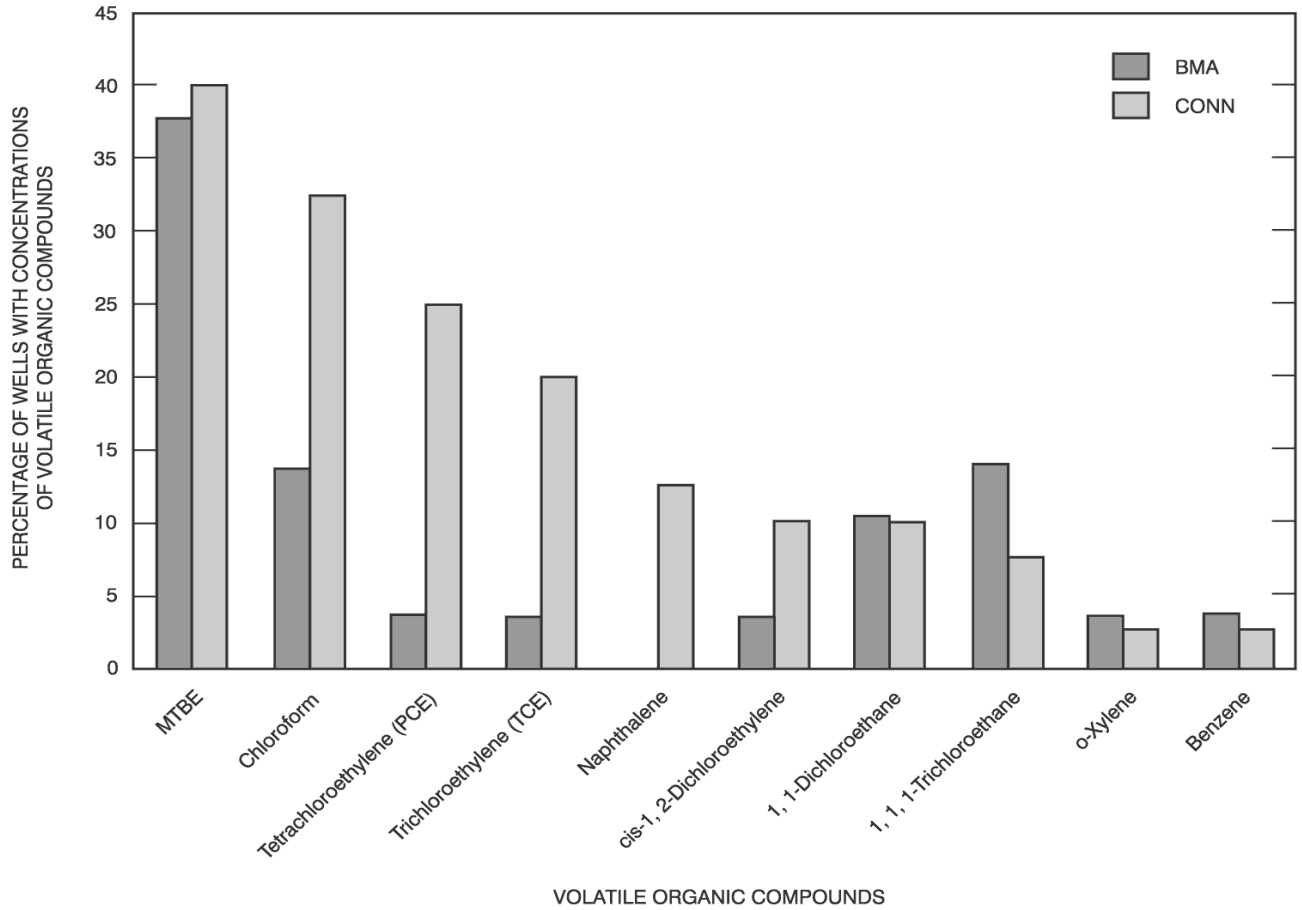


Figure 7. Percentage of wells with detections for 6 volatile organic compounds in water samples from 29 shallow wells in the Boston metropolitan area (BMA) and 40 shallow wells in the Connecticut, Housatonic, and Thames River Basins (CONN) NAWQA study unit.

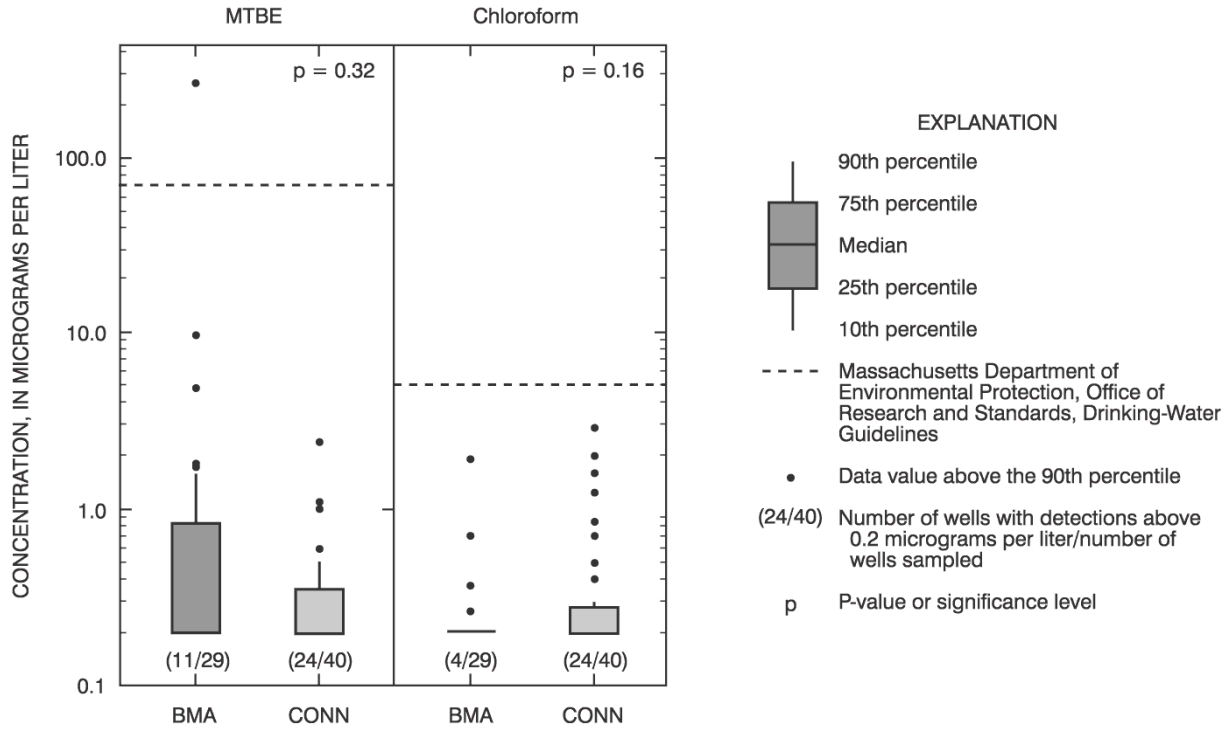


Figure 8. Distributions of MTBE and chloroform concentrations in water samples from 29 shallow wells in the Boston metropolitan area (BMA) and 40 shallow wells in the Connecticut, Housatonic, and Thames River Basins (CONN) NAWQA study unit. A p-value above 0.05 indicates no statistical difference between the two study areas.

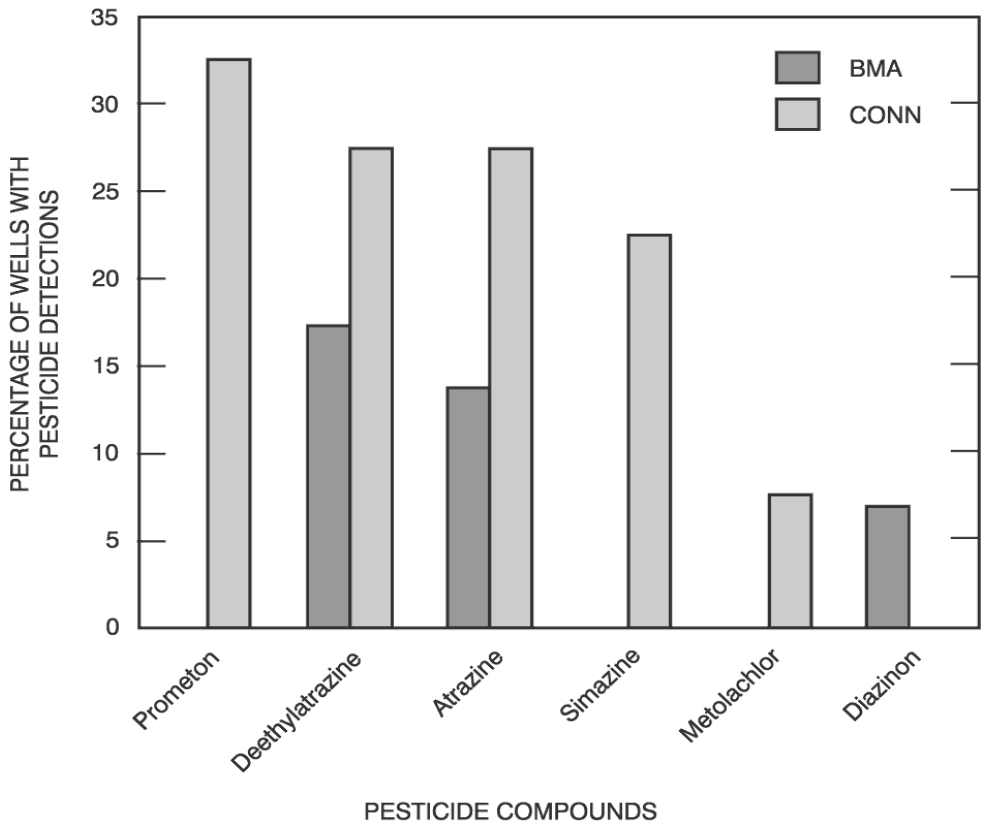


Figure 9. Percentage of wells with detections of 6 pesticides in water samples from 29 shallow wells in the Boston metropolitan area (BMA) and 40 shallow wells in the Connecticut, Housatonic, and Thames River Basins (CONN) NAWQA study unit.