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COMPARISON OF PUBLIC-SUPPLY WELL VULNERABILITY TO CONTAMINANTS IN TWO MAJOR KARST AQUIFERS

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ABSTRACT: Processes controlling the vulnerability of public supply wells (PSWs) to contamination were assessed in two highly productive karst aquifers: the Edwards aquifer (EA) in San Antonio, Texas, and the Upper Floridan aquifer (UFA) near Tampa, Florida. Selected anthropogenic and naturally-occurring compounds and age-dating tracers were analyzed in multiple water samples from PSWs and monitoring wells within modeled contributing recharge areas to the PSWs in the two study areas. There are major differences between the UFA and EA study areas in terms of climate, hydrogeology, recharge, contaminant sources and loading, redox conditions, and PSW depth. Despite these differences, PSWs in both systems are highly susceptible to anthropogenic contaminants. For each PSW, zones of preferential flow were identified and water withdrawn by PSWs in both aquifers was composed of mixtures of groundwater with a predominantly young age component (< 5 years). Similar occurrences of volatile organic compounds (chloroform, tetrachloroethene) and pesticide compounds (atrazine, deethylatrazine) in low concentrations (<1 µg/L) likely reflect local urban sources. Higher nitrate-N concentrations (median 2.2 mg/L) in the EA PSW than the UFA PSW (0.9 mg/L) are likely to persist because of the oxic conditions in the EA, but nitrate likely is attenuated because of the suboxic/anoxic conditions in the UFA. Differences in bedrock mineralogy and redox conditions between the EA and UFA account for differences in arsenic and other naturally occurring contaminants. Elevated arsenic concentrations (3-19 µg/L) in the UFA PSW were caused by mobilization of arsenic from pyrite due to pumpage-induced introduction of oxic water from overlying surficial units into reducing waters in the UFA. No natural contaminants were found at levels of concern in the EA and increases in arsenic or other natural contaminants would be unlikely given the oxic conditions throughout the aquifer. Study results, including changes in pumping conditions, variations in groundwater quality resulting from temporal changes in hydrologic conditions, and simulated water-quality responses to future changes in land use and contaminant loading, have important implications for monitoring programs and protection efforts for these systems and public supply wells in other karst aquifers.

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