# Results of Sampling for Selected Wastewater Constituents In Ground Water In the Silver Springs Basin, North Central Florida

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## Abstract

During January through July 2002, 35 wells in the Silver Springs groundwater basin, north central Florida, and three vents of Silver Springs were sampled for a suite of compounds commonly found in wastewater. Of the 67 compounds analyzed, 38 were detected, nearly all in very low concentrations. The most frequently detected compound was the insecticide DEET (N,N-diethyl-meta-toluamide), which was evident in 27 wells and all three spring samples. Estimated concentrations of DEET ranged from about 0.03 to 5.8 micrograms per liter. Other commonly detected compounds were phenol (evident in 24 wells and two spring samples in concentrations ranging from 0.3 to 1.4 micrograms per liter) and bisphenol A (evident in ten wells in concentrations ranging from 0.05 to 4.4 micrograms per liter).

DEET was developed by the U.S. Army in 1946 for direct application to the skin to repel, rather than kill, mosquitoes. The U.S. Environmental Protection Agency has determined that DEET is in Toxicity Category III (slightly toxic, the second lowest of four categories). DEET enters the wastewater when the user bathes. The chemical is of low solubility and does not break down easily; thus, DEET appears to be a useful tracer for the presence of reused water. In a karst area, such as the Silver Springs groundwater basin, the presence of DEET in numerous ground water samples is indicative of the widespread recharge characteristic of karst areas. The presence of DEET also may result from the use of septic tanks throughout much of the basin.

The geology surrounding the wells seemed to affect the presence or absence of DEET in the water samples; land-use type generally did not affect the occurrence of DEET. Of the 35 wells sampled, nine were in the outcrop area of the Ocala Limestone, the principle water-bearing unit of the Upper Floridan aquifer. DEET was detected in all nine samples. The estimated concentrations ranged from 0.7 micrograms per liter to 0.2 micrograms per liter. Of the 35 samples, DEET was not detected in eight samples, all of which were in areas where the Ocala Limestone is covered by younger sediments. Samples in which DEET was not detected were collected in the following land-use types: low density residential, commercial, crops and nurseries, tree plantations, and other upland forests. The highest DEET concentration was from a well in a commercial urban area where the Ocala Limestone is overlain by sediments of the Hawthorn Group. Local sinkholes may breach the Hawthorn Group confining unit, allowing surface water to recharge the aquifer in the immediate vicinity of the well sampled.

Only one or two compounds were detected in most of the wells and spring vents sampled; however, several compounds were detected in two wells. In downtown Ocala, water from one well contained DEET (5.8 micrograms per liter) and 19 other compounds including caffeine (0.14 micrograms per liter). Caffeine breaks down quickly and is considered an

indicator of relatively recent recharge by wastewater. The concentration of cholesterol, a fecal indicator, was 5.2 micrograms per liter. Phenol was detected at a concentration of 6.3 micrograms per liter and the concentration of bisphenol A was 4.4 micrograms per liter. Another well, located at a site formerly used as a pasture but surrounded by residential areas, contained three fecal indicators: 3beta-coprostanol (2.4 micrograms per liter); cholesterol (7.2 micrograms per liter); and an estimated detection of 3-methyl-1(H)-indole (0.23 micrograms per liter). The concentration of nonylphenol, diethoxy- (total; NPEO2), a nonionic detergent metabolite and a known endocrine disrupter, was estimated at 2.7 micrograms per liter. The concentration of DEET in this sample was estimated at only 0.4 micrograms per liter.