TEMPORAL AND REGIONAL COMPARISONS OF GROUNDWATER QUALITY IN KINGS AND QUEENS COUNTIES, NEW YORK, DURING 1999-2011

Irene J. Fisher, Shawn C. Fisher, Christopher E. Schubert, and Erin K. O'Sullivan
U. S. Geological Survey New York Water Science Center
2045 Route 112, Bldg. 4, Coram, NY 11727

Human activities in urban land-use settings may potentially introduce contaminants into the groundwater system that can make their way into drinking and non-drinking water wells. Median concentrations of select constituents were evaluated from raw (untreated) groundwater samples collected by the U.S. Geological Survey (USGS) in Kings and Queens Counties, N.Y., during two time frames, 1999-2006 and 2008-2011. These samples were collected as part of a longer-term USGS program in cooperation with New York City Environmental Protection. As part of the cooperative program, the USGS has monitored the quality of groundwater in Kings and Queens Counties since the early 1980's as a possible alternative public water supply (pending any necessary treatment). The constituents analyzed included nitrate, chloride, dieldrin, tetrachloroethene (PCE), trichloroethene (TCE), methyl *tert*-butyl ether (MTBE), and total trihalomethanes (TTHMs—chloroform, bromoform, bromodichloromethane, and dibromochloromethane); these constituents were selected because they are typically associated with urban land use. A comparison of water-quality analyses from the two time periods provides a measure of groundwater-system response to recent changes in land-use and water-supply practices. The analyses of samples from wells sampled in New York City (NYC) were also compared to water-quality analyses for monitoring wells in other urban areas and drinking water wells of the Northern Atlantic Coastal Plain (NACP) regional-aquifer system using data available in the USGS National Water-Quality Assessment program database.

The water-quality analyses were evaluated first between the two time frames, and then between drinking water (formerly supplied by the Jamaica Water Supply Company) and non-drinking water wells. Reported concentrations were compared to a human-health benchmark established by the U.S. Environmental Protection Agency (EPA), the New York Department of Health (NYSDOH), or a USGS health-based screening level (HBSL). This enabled conditions in the NYC aquifer system to be compared to those found in the NACP and to select national benchmarks, such as those for drinking-water quality. The concentrations also were compared to one-tenth (10 percent) of the benchmark to examine if there is a potential for further contamination from a particular contaminant. Such contamination is not unexpected considering the long time frame and intensity of urban development in the NYC area compared with less intense urbanization of most other areas of the NACP.

The water-quality analyses from Kings and Queens Counties generally showed that a greater percentage of sampled wells exceeded human-health benchmarks for the selected contaminants than groundwater samples from the urban areas throughout the wider NACP (table 1). Concentrations of PCE, chloride, and TCE were detected above the benchmarks more frequently in Kings and Queens Counties than in other urban land-use settings of the NACP. In addition, the extent of groundwater contamination has increased through time in the NYC study area. A temporal comparison between the two time frames evaluated showed that the percentage of non-drinking water wells that exceeded benchmarks increased for chloride, dieldrin, and PCE, and the percentage of drinking water wells exceeding benchmarks increased for nitrate, dieldrin, PCE, TCE, and MTBE. None of the sampled wells exceeded the 80 micrograms per liter Maximum Contaminant Level for TTHMs during the time frames evaluated.

Table 1: A comparison of sampled wells from the Northern Atlantic Coastal Plain and from Kings and Queens Counties, New York, that exceeded established human-health benchmarks. [%, percent; —, not evaluated; NA, not applicable]

Constituent	Human-health benchmark	Dataset[1]	All well types			Drinking water wells			Nondrinking water wells		
				Constituent detection			Constituent detection			Constituent detection	
			Number of wells sampled	Greater than benchmark (%)	Greater than one-tenth of benchmark (%)	Number of wells sampled	Greater than benchmark (%)	Greater than one-tenth of benchmark (%)	Number of wells sampled	Greater than benchmark (%)	Greater than one-tenth of benchmark (%)
Nitrate	10 mg/L	NACP	423	9.9	53.4	143	7	62.2	93	4.3	67.7
	EPA MCL[1]	NYC 1999–06	113	10	68	11	0	55	102	11	70
		NYC 2008–11	103	10	68	19	5	79	84	11	65
Chloride	250 mg/L	NACP	424	2.1	—	144	0	—	93	3.2	—
	EPA SMCL[2]	NYC 1999–06	113	13	84	11	0	91	102	15	83
		NYC 2008–11	103	17	83	19	0	74	84	20	85
Dieldrin	0.002 μg/L	NACP	389	11.6	12.1	136	18.4	19.1	89	19.1	20.2
	USGS HBSL[4] low	NYC 1999–06	113	10	NA	11	9	NA	102	10	NA
		NYC 2008–11	103	13	NA	19	16	NA	84	12	NA
Tetrachloroethene (PCE)	5 μg/L	NACP	356	1.4	3.4	143	2.8	4.9	94	1.1	5.3
	EPA MCL[1]	NYC 1999–06	113	13	35	11	27	82	102	12	29
		NYC 2008–11	103	18	33	19	32	53	84	15	29
Trichloroethene (TCE)	5 μg/L	NACP	370	0.5	1.6	143	1.4	3.5	94	0	1.1
	EPA MCL[1]	NYC 1999–06	113	7	16	11	0	36	102	8	14
		NYC 2008–11	103	6	16	19	5	11	84	6	17
Methyl-*tert* butyl ether (MTBE)	10 μg/L	NYC 1999–06	113	2	17	11	0	18	102	2	17
	NYSDOH MCL[5]	NYC 2008–11	103	3	10	19	5	11	84	2	10
Total trihalomethanes (TTHMs)	80 μg/L	NYC 1999–06	113	0	2	11	0	0	102	0	2
	EPA MCL[1]	NYC 2008–11	103	0	5	19	0	5	84	0	5

[1]Datasets of water-quality constituents sampled from groundwater wells in the Northern Atlantic Coastal Plain (NACP) from the U.S. Geological Survey (USGS) National Water-Quality Assessment program database, and from Kings and Queens Counties, New York (NYC), collected during 1999–2006 and 2008–2011.

[2]U.S. Environmental Protection Agency (EPA) Maximum Contaminant Level (MCL), measured in milligrams per liter (mg/L) or micrograms per liter (μg/L).

[3]U.S. Environmental Protection Agency (EPA) Secondary Maximum Contaminant Level (SMCL), measured in mg/L.

[4]USGS health-based screening level (HBSL), measured in μg/L.

[5]New York State Department of Health (NYSDOH) Maximum Contaminant Level (MCL), measured in μg/L.