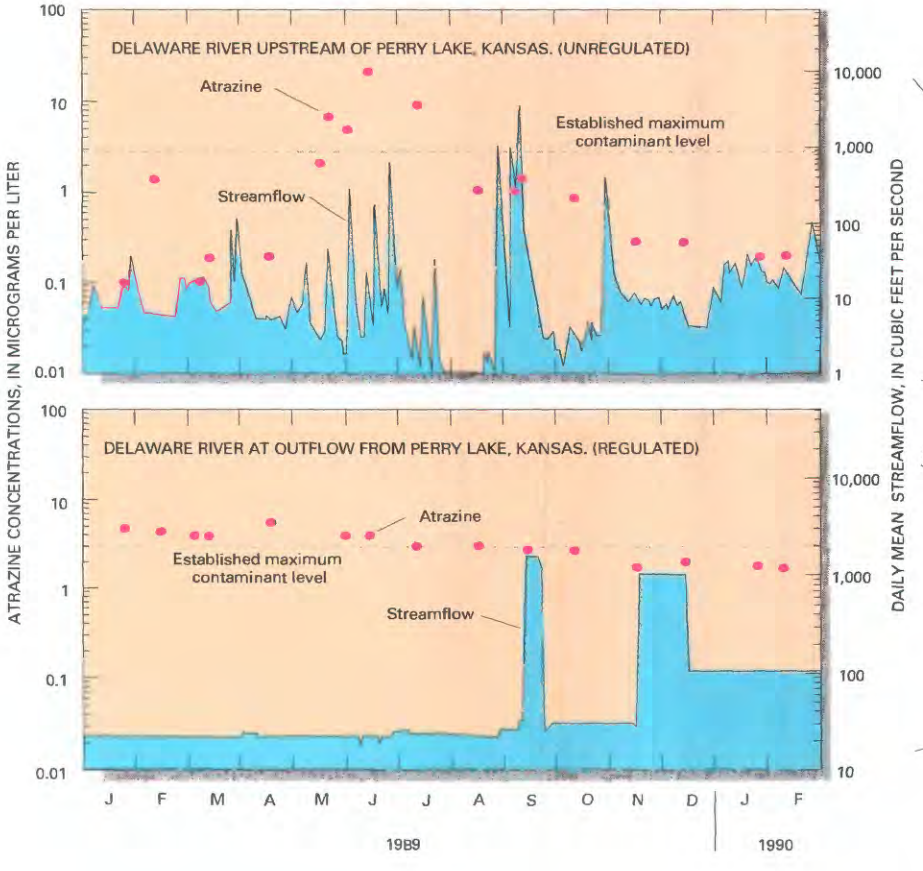
U.S. Department of the Interior
U.S. Geological Survey

Atrazine Concentrations in the Delaware River, Kansas

Contamination of surface and ground water from nonpoint agricultural sources is a national issue. Nonpoint-source contaminants from agricultural activities include pesticides, sediment, nutrients (nitrogen and phosphorus), and fecal bacteria. Of these contaminants, pesticides in water receive the most attention because at elevated levels, many are potential human carcinogens and are toxic to aquatic life.

Farmers depend on pesticides, including herbicides, to increase crop yields. Herbicides prevent or inhibit the growth of weeds that compete for nutrients and moisture needed by the crops. If weeds are harvested with the crops, then the value of the crop decreases. Herbicides, including atrazine, are applied before planting and (or) as pre- and postcrop emergent compounds during or after planting. In addition to agricultural usage, herbicides are used in urban areas and in large quantities for weed control in industrial applications, such as along railroad right-of-ways. The amount and timing of pesticide use, as well as the quantity of streamflow at certain times of the year, can affect concentrations of pesticides in water.

In 1986, as part of the National Water-Quality Assessment (NAWQA) Program, the U.S. Geological Survey (USGS) began a study of the quality of surface water in a 15,300-square-mile (mi^2) area of the lower Kansas River Basin in southeastern Nebraska and northeastern Kansas (see location map). The Delaware River Basin, which is a subbasin of the lower Kansas River Basin, drains an area of 1,117 mi^2 at the outflow from Perry Lake. The subbasin is characterized by deposits of glacial till, which comprises silt, clay, sand, gravel, and boulders. The topography is hilly, particularly in areas in the headwaters of the subbasin. About 85 percent of the Delaware River Basin is agricultural land with about 40 percent in row crops such as sorghum, soybeans, wheat, and corn. Mean annual precipitation is about 35 inches, and mean annual runoff is about 8 inches. Most of the precipitation falls from April through September, which generally coincides with the growing season. Mean monthly runoff is larg-



est in spring and summer and smallest in fall and winter. Perry Lake is used for flood control, recreation, and public-water supply. Outflows from the lake contribute about 9 percent of the streamflow in the Kansas River and can substantially affect the water quality downstream on the Kansas River.

Herbicides, including, atrazine, alachlor, cyanazine, and metolachlor have been extensively applied in the Delaware River Basin. Atrazine was applied in the largest amounts and was the herbicide most frequently detected in the Delaware River. In 1989, an estimated 240,000 pounds of atrazine was applied to fields planted with corn and sorghum in the basin.

From January 1989 to February 1990, water samples were collected at least monthly from the Delaware River upstream from Perry Lake near Muscotah, Kansas, and at the outflow of the lake (see map). A markedly different pattern in seasonal fluctuations of atrazine concentrations in streamflow is apparent between the unregulated upstream reaches of the Delaware River and the regulated reach of the river downstream from Perry Lake. Atrazine concentrations (shown as dots in graph) in the Delaware River upstream from the lake were lowest in January, March, and April before atrazine was applied to the fields and highest in May, June, and July after it was applied to the fields. The increase in atrazine concentrations from May through July reflects the effects of precipitation and the subsequent surface runoff to streams. The largest concentrations were 22 micrograms per liter (µg/L) in June 1989 and 9.4 µg/L in July. After July, regardless of the amounts of streamflow in the Delaware River (shown as blue in graph), atrazine concentrations began to decline; by February 1990, they had decreased to 0.2 µg/L. The mean atrazine concentration for the 1989 calendar year was 2.8 µg/L.

In contrast to the unregulated upstream reach of the Delaware River, atrazine concentrations in water samples collected from the Delaware River at the outflow of Perry Lake showed little or no seasonal variability. Concentrations of atrazine gradually decreased from 5.0 µg/L in January 1989 to 1.7 µg/L in February 1990. The mean atrazine concentration for the 1989 calendar year was 3.5 µg/L, which is greater than the maximum contaminant level (MCL) of 3.0 µg/L for atrazine that has been established by the U.S. Environmental Protection Agency. Because the volume of water in Perry Lake is large in relation to its inflows, the lake appears to attenuate the seasonal fluctuations in atrazine concentrations in the lake. Atrazine concentrations in samples collected from the outflow of the lake are representative of atrazine concentrations in the lake.

Public-water supplies are withdrawn from Perry Lake for two rural water districts and several Federal- and State-owned recreational areas. Water withdrawn from the Delaware River and Perry Lake receives no special treatment to remove atrazine. Water in the Kansas River downstream from Perry Lake also is used for public-water supplies for Lawrence, Kansas, and the Kansas City, Kansas, metropolitan area. Because withdrawn water from the Delaware River and Perry Lake is not treated, concentrations of atrazine in these water supplies can potentially exceed the annual MCL of 3.0 µg/L. Several studies have shown that atrazine can be hazardous because of its extensive use, persistence in water, and water solubility and because conventional water treatment (flocculation, sand filtration, chlorination) does not effectively remove atrazine from the finished water.

Results from the NAWQA study were used by the Technical Advisory Committee of the Kansas State Board of Agriculture as the basis for establishing the Delaware River Basin as a Pesticide Management Area (PMA). This PMA is the first in the Nation in which land-management strategies focus on decreasing the amount of atrazine in runoff that enters inland surface waters. Administration of the PMA includes components of management and conservation practices, education, monitoring, research, enforcement, and evaluation. The USGS provides streamflow and water-quality information that is useful for the research and monitoring components of the PMA through a Federal–State Cooperative Program between the USGS and the State of Kansas.

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For information and selected readings about the lower Kansas River Basin study, write to:

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