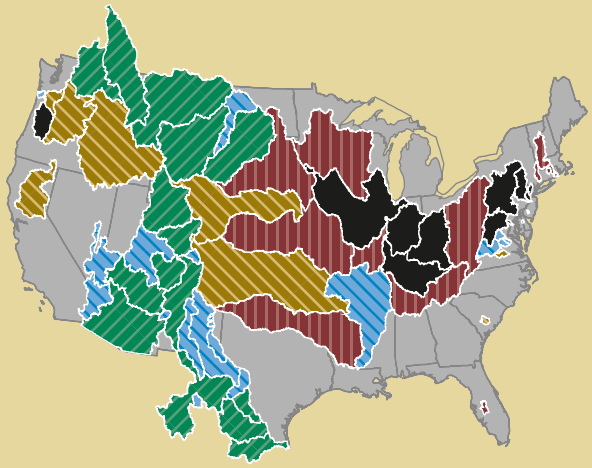
The Movement of Nitrogen

Yield of Total Nitrogen from Major Watersheds (1996–1999)



Data Source: U.S. Geological Survey National Stream Quality Network (NASQAN), National Water Quality Assessment (NAWQA), and Federal–State Cooperative Program. Coverage: selected areas of lower 48 states.

What Is This Indicator, and Why Is It Important? This indicator reports the yield of nitrogen from major watersheds: pounds of nitrogen per square mile of watershed area that enters rivers and streams through discharges, runoff, and other sources. It also reports the load of nitrate, a common form of nitrogen, from major rivers: tons of nitrate carried to the ocean each year by the four largest U.S. rivers.

Nitrogen is a component of protein and is essential to all life. Nitrate is an important plant nutrient and is often the most abundant form of nitrogen that is readily usable by aquatic plants, including algae. Nitrate and other forms of nitrogen occur both naturally and as a result of human activities.

In excess, however, nitrogen can cause significant water quality problems by stimulating the growth of algae. Overabundance of algae can reduce oxygen levels to near zero, especially in coastal waters (see Areas with Depleted Oxygen, p. 71). "Dead zones," or areas where oxygen levels are so low that fish and shellfish cannot live, are created when nutrients, particularly nitrate and other forms of nitrogen, are overabundant. The largest of these dead zones occurs every summer in the Gulf of Mexico, covering 5,000 or more square miles of one of the nation's most important commercial and recreational fisheries. Excess nitrogen in certain forms is also toxic to human beings and other animals.

Sources of nitrogen include wastewater treatment plants, runoff from fertilized lawns and cropland, failing septic systems, runoff from animal manure storage areas, and industrial discharges that contain corrosion inhibitors. Atmospheric deposition is also a significant source of added nitrogen in ecosystems. Burning of fossil fuels releases nitrogen into the atmosphere, where it can travel for long distances before being deposited in snow, rain, or dust.

Although this indicator reports on nitrogen in aquatic systems, excess nitrogen in soil, often derived from atmospheric deposition, can change the number and type of species in an ecosystem and otherwise alter the way the system functions.

What Do the Data Show? The map shows 1996–1999 average annual yield of total nitrogen from major watersheds for which data are available. Watersheds in the upper Midwest and the Northeast contribute the most nitrogen per square mile to rivers and streams ("yield").

The amount of nitrate carried by most major U.S. rivers ("load") has increased over the past several decades. The four largest rivers in the United States—the Mississippi, Columbia, St. Lawrence, and Susquehanna—together account for approximately 55% of all freshwater flow to the sea from the lower 48 states. The Mississippi has had the most striking increase in nitrate load. The Mississippi, which drains more than 40% of the area of the lower 48 states, carries roughly 15 times more nitrate than any other U.S. river, and this amount has approximately tripled since the 1950s. The increases in nitrate load for the Columbia and Susquehanna rivers are also significant, although some multiyear declines also occurred during the period.

The Movement of Nitrogen *(continued)*

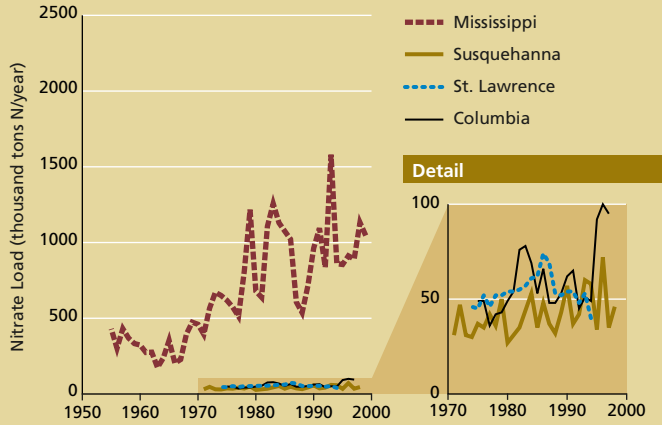
The peaks and valleys within the overall upward trend generally reflect years with higher rainfall (peaks) and those with less rainfall (valleys). In wet years, increased runoff from land surface carries more nitrogen into streams, increasing nitrogen loads; the reverse is true in dry years.

Discussion Higher values for both loads and yields reflect greater "leakage" of nitrogen from a watershed, with potentially significant downstream effects, particularly on marine ecosystems.

Total nitrogen is the preferred form for reporting on the amount of nitrogen delivered from the U.S. landscape to our coastal waters, but because the historical record for it for the Mississippi River is short, we chose instead to present river nitrate loads. Nitrate is the largest component of total nitrogen and serves as a strong indicator of total nitrogen loads. The longer historical record for nitrate reveals the significant increases that have occurred over the past few decades. Future reports may present loads of total nitrogen.

Other indicators (see pp. 95, 122, 164, and 186) report on the amount of nitrate dissolved in streams or groundwater in farmlands, forests, grasslands and shrublands, and urban and suburban areas.

Nitrate Load Carried by Major Rivers



Data Source: U.S. Geological Survey National Stream Quality Network (NASQAN), National Water Quality Assessment (NAWQA), and Federal–State Cooperative Program. Coverage: selected major rivers.

The technical note for this indicator is on page 210.