

**The U.S. Geological Survey National Water-Quality Assessment Program:
Advances in Understanding Sources, Transport, and the Biological Effects of
Nutrientsf Headwater Streams to Coastal Rivers**

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The U.S. Geological Survey implemented the National Water-Quality Assessment (NAWQA) Program in 1991 to provide nationally consistent information on the status and long-term changes in the physical, chemical, and biological condition of streams and rivers. This information directly supports national, regional, state, and local information needs and decisions related to water-quality management and policy. The NAWQA Program uses a combination of monitoring-based observations and watershed models to assess nutrient and biological conditions in streams, nutrient transport from headwaters to coastal waters, and effects of human activities and natural processes on nutrient conditions. Agricultural and urban land uses are major sources of stream nutrients, with the highest nitrogen concentrations associated with agricultural streams and the highest phosphorus concentrations associated with agricultural and urban streams. NAWQA studies of nitrogen processing in small streams indicate that nutrient-enriched agricultural streams are ineffective at removing nitrogen from the water column because of high nutrient inputs and reduced retention time, and therefore export a large fraction of their nitrogen load to downstream waters. Although biological communities in streams are influenced by various natural and anthropogenic factors, nutrient enrichment has a strong influence on community structure. For example, NAWQA determined that the condition of algal, invertebrate, and fish communities decreased in streams nationwide as nutrient concentrations increased. Additionally, regional- and national-scale models were developed that provided information on the downstream fate of nutrients and the effect of hydrological and biogeochemical processes on delivery of nitrogen and phosphorus loads from inland watersheds to coastal estuaries. These assessments reveal that agricultural sources (cultivated crops, livestock manure) in the central and eastern Mississippi River Basin contribute a majority of the nitrogen and phosphorus to the northern Gulf of Mexico, where elevated nutrients have contributed to long-term seasonal hypoxia. New regional-scale models, based on updated geospatial and stream monitoring data, currently are under development for six major river basins of the conterminous United States. Results from these models will be used to identify the nutrient sources and watersheds that contribute elevated nutrient loads to estuaries and other receiving waters, including those in the South Atlantic and Gulf of Mexico, inland and coastal waters of the Northeast, the Upper Mississippi and Great Lakes, and Puget Sound.