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**APPLICATIONS AND MANAGEMENT IMPLICATIONS OF UTILIZING THE SPARROW MODEL FOR
DESCRIBING NUTRIENT SOURCES AND TRANSPORT IN THE MISSOURI RIVER BASIN**

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ABSTRACT: Nutrient enrichment has been identified as one of the leading causes of water-quality impairment in rivers. Nitrogen and phosphorus from the Missouri River Basin discharged into the Mississippi River contribute to hypoxia in the Gulf of Mexico. Impairments for nutrient-related criteria occur in multiple Missouri River Basin states. Understanding the sources and processes influencing nutrient transport in the Missouri River Basin has local, regional, and national implications for nutrient management efforts. SPATIALLY Referenced Regression on Watershed attributes (SPARROW) models were developed to provide spatially-explicit information on local and regional total nitrogen (TN) and total phosphorus (TP) sources and transport. Model results provide estimates of the relative contributions from the following TN and TP sources: developed land, point sources, manure and fertilizer, atmospheric deposition (TN only), and stream channel sediments (TP only). Nitrogen delivery to streams was affected by precipitation, air temperature, irrigated agricultural acreage, and loess in surficial geology; phosphorus delivery to streams was influenced by precipitation, soil permeability, and mean basin slope. The models also describe instream decay and reservoir and lake attenuation of nutrients. Throughout much of the Missouri River Basin fertilizer and manure applications were the largest sources of nutrients, although irrigation of agricultural land was found to decrease net delivery of TN to streams. Approximately 16 percent of the nitrogen load and 33 percent of the phosphorus load that would have otherwise reached the Mississippi River was retained in reservoirs and lakes in the Missouri River Basin. Nearly half (46 percent of the nitrogen load and 53 percent of the phosphorus load) of the attenuation occurred in the seven largest reservoirs and one natural lake. Nearly the entire nutrient load leaving the Kansas and Platte River subbasins reaches the Mississippi River, which may be explained by subbasin characteristics and locations of major point and nonpoint sources. Results aid in the prioritization of nutrient-reduction strategies by identifying major sources and delivery factors contributing to instream nutrient loads and stream reaches carrying the highest nutrient loads in the Missouri River Basin.

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