WATER FACT SHEET

U.S. GEOLOGICAL SURVEY, DEPARTMENT OF THE INTERIOR

National Water-Quality Assessment Program— The Upper Mississippi River Basin

In 1991, the U.S. Geological Survey (USGS), U.S. Department of the Interior, began a National Water-Quality Assessment (NAWQA) program. The long-term goals of the NAWQA program are to describe the status and trends of the quality of a large, representative part of the Nation's surface- and ground-water resources, and to identify the natural and human factors that affect the quality of these resources. Factors such as geomorphology, climate, hydrology, land use, and land cover that affect water-quality, are being studied relative to specific water-quality issues that affect large hydrologic regions of the United States. In addressing these goals, the NAWQA program will produce water-quality information that will be useful to policy makers and managers at the National, State, and local levels.

Because it would be impractical to assess the water quality in the entire Nation, major activities of the NAWQA program take place within a set of hydrologic systems called study areas. Study areas at 60 locations comprise diverse hydrologic systems of river basins, aquifer systems, or both, ranging in size from 1,000 mi^2 (square miles) to more than 60,000 mi^2. These study areas collectively encompass about 45 percent of the land area in the conterminous United States and represent 60 to 70 percent of the Nation's water use and population served by public water supply.

Upper Mississippi NAWQA Study Area

The Upper Mississippi River Basin was selected as a NAWQA study area because it represents a major hydrologic region where good-quality water is vital. Water quality of the Mississippi River, the largest river in the Nation, is of concern because it contains large agricultural and urban areas. The Upper Mississippi NAWQA study area encompasses about 19,500 mi^2 in Minnesota and Wisconsin and includes a portion of the basin which covers the seven-county Twin Cities (Minneapolis and St. Paul) Metropolitan Area. The study area includes the part of the Upper Mississippi River drainage from Lake Pepin upstream to include all of the St. Croix River Basin and to points on the Minnesota and Mississippi Rivers where long-term water-quality data are available to assess contributions from portions of tributary basins upstream from these points (fig. 1). The study focuses on understanding the effect of the seven-county Twin Cities Metropolitan Area (fig. 2) on water quality with emphasis on ground water. The ground-water part of the study focuses on major bedrock aquifers in the Twin Cities Artesian Basin and on the Anoka Sand Plain (an unconfined aquifer).

Geology, geomorphology, climate, hydrology, and urban, suburban, and rural land use and land cover in the Upper Mississippi study area are diverse and control the occurrence and flow of water and, therefore, the distribution of concentrations of water-quality constituents. Landforms within the study area primarily are the result of the actions of Pleistocene glaciation. Soils derived from the geological deposits range from heavy, poorly drained clays developed on ground moraine to light, well-drained sands on outwash plains. Agriculture is the dominant land use in the southern and western part of the study area; forests cover much of the northern and eastern part of the study area, and the Twin Cities Metropolitan Area dominates the east-central part of the study area.

The climate of the study area is subhumid. Air masses from different source regions commonly pass over the area causing frequent and rapid changes in weather. The average monthly temperature ranges from 11 degrees Fahrenheit in January to 74 degrees Fahrenheit in July. Average annual precipitation increases from about 22 inches in the west to 29 inches in the east of the study area. About three-fourths of the annual precipitation falls from April through September.

The three major tributaries of the Upper Mississippi River Basin are the Mississippi River, the Minnesota River, and the St. Croix River (fig. 1). Average flow of the Mississippi River, 10 miles upstream from Minneapolis, is 7,900 cubic feet per second (ft^3/s). The average flow of the Minnesota River at Jordan, Minnesota is 3,760 ft^3/s. Average flow of the St. Croix River at St. Croix Falls, Wisconsin (52 miles upstream from its mouth) is 4,300 ft^3/s. Runoff varies annually, but most occurs in spring and early summer from rainfall on saturated soils. Water quality in the three major tributaries is significantly different. Among the three rivers, concentrations of total-suspended solids and total-suspended sediment are greatest in the Minnesota River and least in the St. Croix River.

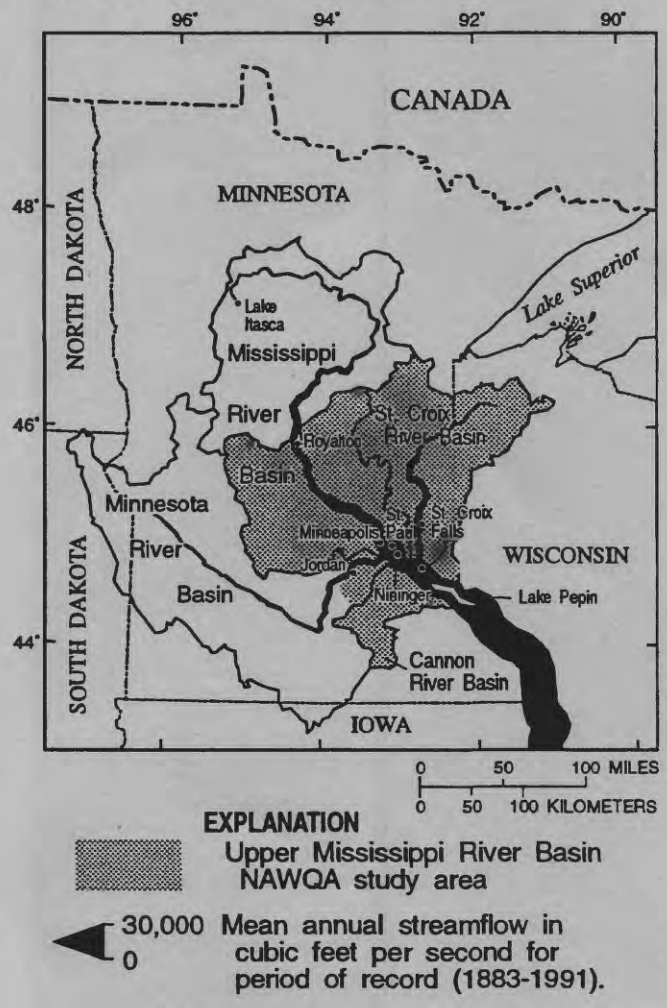

Figure 1. Upper Mississippi River Basin and NAWQA study area.

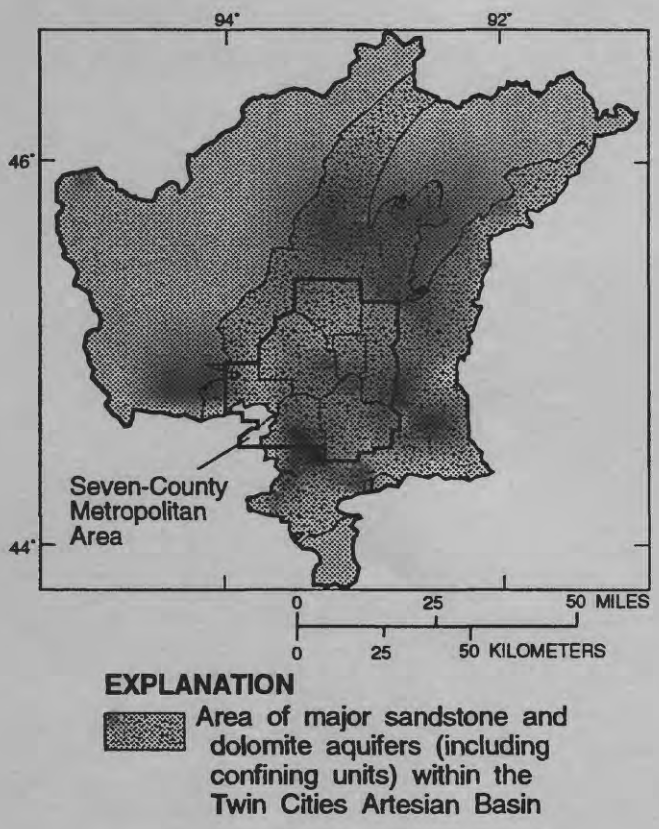

Figure 2. Major bedrock hydrogeologic systems in the Upper Mississippi River Basin study area in Minnesota and Wisconsin.

The estimated population of the study area is about 3,030,000 people, most of which (2,290,000) live in the seven-county Twin Cities Metropolitan Area. In 1990, public water supplies served about 2,100,000 people in the study area. An average of 360 million gallons of water per day were used; 53 percent was from ground-water sources and 47 percent was from surface-water sources. The suburban areas predominantly use ground water as a source of municipal-water supply. Surface water is predominantly used for the cities of Minneapolis and Saint Paul, and is taken from the Mississippi River upstream of downtown Minneapolis. About 60 percent of the land in the study area is in agriculture. Principal crops include corn, soybeans and hay. About 23 percent of the land is forest and the remaining 17 percent of the study area consists of water (about 5 percent), wetlands (about 7 percent), urban and suburban (about 5 percent), and small amounts of mining and barren lands.

The study area is underlain by glacial sediments and by a thick sequence of limestone, shale, shaly sandstone, and sandstone of Precambrian and Paleozoic age. Glacial deposits in the western part of the study area are composed of ground moraine and outwash deposits, and the land surface is relatively flat; the eastern part of the study area contains numerous end moraines and has significant local relief. Glacial meltwater left numerous flat plains of outwash sand throughout the study area. Surficial deposits more recent than glacial origin are present as windblown silts and sands and as river alluvium.

The hydrogeologic units in the glacial deposits include surficial and buried aquifers and confining units. The Anoka Sand Plain aquifer is a major surficial aquifer that extends for 1,700 mi^2 in parts of several counties. Wells completed in this surficial aquifer can yield more than 500 gallons of water per minute. Many other stratified-drift aquifers cover small areas and have little hydraulic connection with other aquifers.

Bedrock aquifers and confining beds are part of a thick sequence of sedimentary rocks that were deposited in a generally north-south trending trough commonly referred to as the Twin Cities artesian basin. The thick sequence of these rocks lies over the deepest part of this trough which is directly beneath the Seven-County Metropolitan Area (fig. 2).

The bedrock hydrogeologic system of the study area can be divided into four major aquifers separated by confining units. The aquifers are, in descending order, the St. Peter, the Prairie du Chien-Jordan, the Ironton-Galesville, and the Mt. Simon-Hinckley. The confining units are the Platteville and Glenwood, the basal portion of the St. Peter Sandstone, the St. Lawrence-Franconia and the Eau Clair. Crystalline rock and minor aquifers and confining units underlie these major aquifers.

Water-Quality Issues

Protection of water in rivers and in aquifers in the study area from contamination is a concern. The Metropolitan Waste Control Commission recently has undertaken a major project to reduce phosphorus loading from treated sewage effluent to the Mississippi and Minnesota Rivers. Surface -water contamination from urban runoff is a major water-quality issue in the Twin Cities Metropolitan Area. The U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service currently are involved in a project to conduct long-term monitoring and to evaluate long-term changes in water quality in the Mississippi River. The U.S. Park Service is actively involved in resource-management issues that affect the Lower St. Croix River National Scenic Riverway. In 1988, Congress added the Mississippi National River and Recreation Area in the Twin Cities Metropolitan Area to the National Park System. The Twin Cities Metropolitan Council has prepared the Metropolitan Area Water Supply Plan that calls for coordinated area-wide efforts to safeguard the water supply of the Twin Cities Metropolitan Area.

Water-quality issues include the following, not in order of priority:

- Point and nonpoint sources of nutrients, sediments, metals, and organic compounds in sections of the Mississippi and Minnesota Rivers and in tributary basins caused by agricultural and urban land uses.
- Point and nonpoint sources of nutrients and pesticides to aquifer systems caused by agricultural land uses.
- Introduction of toxic substances to ground water from industrial activity, including volatile organic compounds, polynuclear aromatic hydrocarbons, phenols, and leachate from landfills. The Twin Cities Metropolitan Council (Gary Oberts, oral commun., 1994) estimates that 16 percent of the water in the Prairie du Chien-Jordan aquifer is contaminated. In addition, there are 78 superfund sites in the Twin Cities Metropolitan Area.
- Contamination of surface and ground water in areas undergoing rapid urbanization.
- Biological degradation including loss of riparian habitat, effects of reservoir operation on fish population, loss of habitat for bottom-dwelling organisms, eutrophication, and deterioration of sanitary quality of river water.
- Introduction of toxic substances to bottom sediments in the rivers, subsequent release of these substances to the water column, and bioaccumulation of these substances in the food chain.

Communication and Coordination

Communication and coordination between the U.S. Geological Survey and other scientific and water-management organizations are critical components of the NAWQA program. Each study-area investigation will have a local liaison committee consisting of representatives from Federal, State, and local agencies, universities, and the private sector who have water-resources responsibilities. Liaison-committee activities include:

- exchanging information on water-quality issues of regional and local interest;
- identifying sources of data and information;
- assisting in the design and scope of project elements; and
- reviewing project planning documents and reports.

Selected References

Olcott, P.G., 1992, Ground-water atlas of the United States—Segment 9, Iowa, Michigan, Minnesota, and Wisconsin: U. S. Geological Survey Hydrologic Investigations Atlas 730-J, 31p.

Additional information on technical reports and hydrologic data related to the NAWQA program can be obtained from:

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