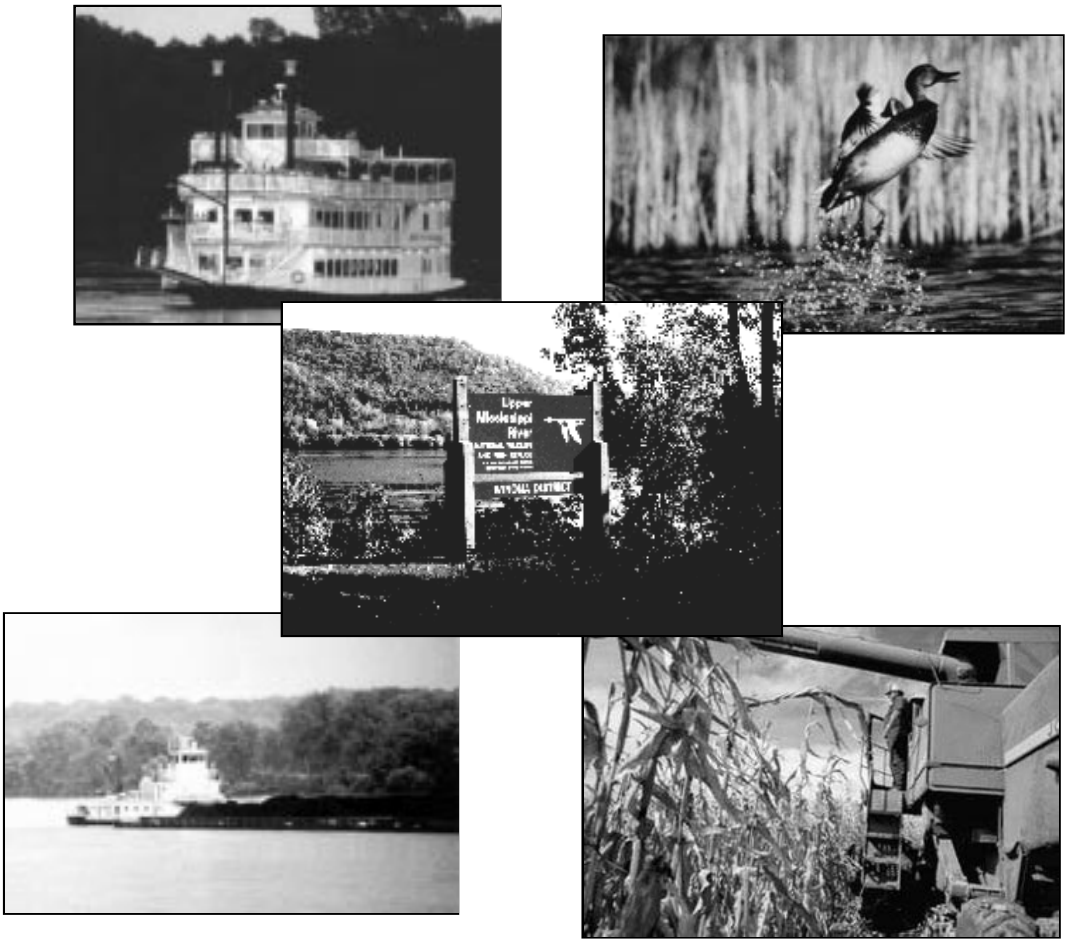
ECONOMIC PROFILE OF THE UPPER MISSISSIPPI RIVER REGION



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Economic Profile of the Upper Mississippi River Region

Prepared for:

Division of Economics
U.S. Fish and Wildlife Service
U.S. Department of the Interior

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The draft report was distributed to a number of interested parties in addition to the reviewers listed above. We thank the following people for their review and comments: Terry Moe (Wisconsin Department of Natural Resources), John Duvyejonck (USFWS), James Williams (Missouri Department of Natural Resources), Bob Delaney (U.S. Geological Services), Dick Lambert (Minnesota Department of Transportation), and Dan Ray (The McKnight Foundation). Finally, we wish to thank the many people that provided valuable information for the report. These individuals and their organizations are listed in Appendix C of the report.

Table of Contents

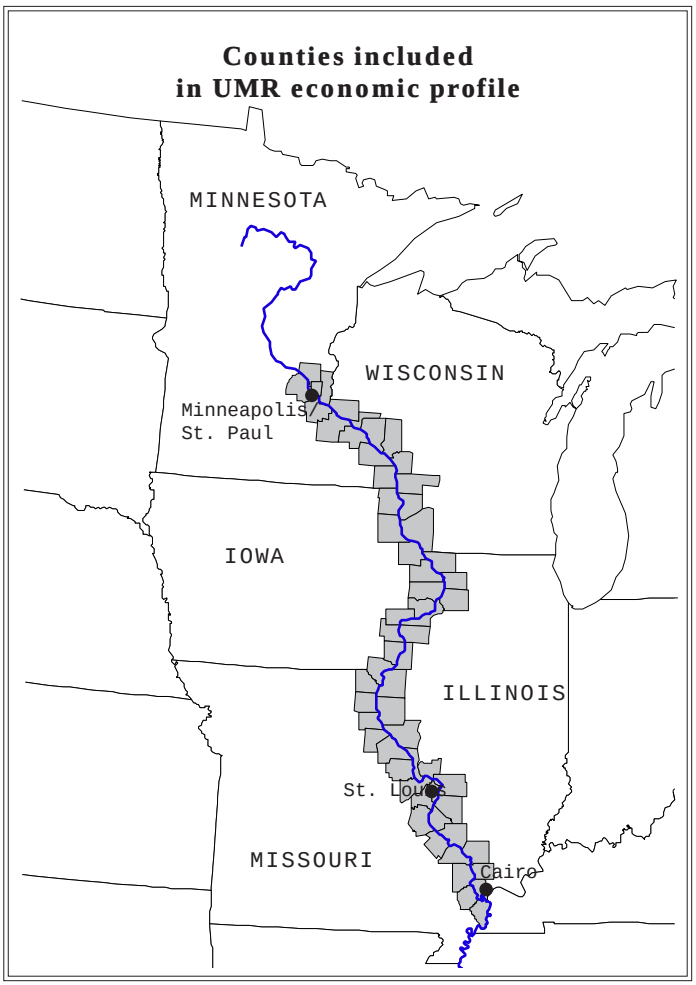
Executive Summary

Consistent with its prominent role in our nation's history and culture, the Mississippi River is critical to our economic well being. Individuals and businesses have come to rely on the river for transportation, water, food, recreation, and a variety of other goods and services. As a result, the regional economies surrounding the river, as well as the national economy, benefit from careful conservation and management of the Mississippi.

This economic profile report was directed by Upper Mississippi River Coordinating Committee member agencies and is intended to accomplish two key goals:

- Provide a "snapshot" of current regional economic activity dependent on the Upper Mississippi River (UMR), defined as the main stem of the river from Minneapolis/ St. Paul to the mouth of the Ohio River (in Cairo, Illinois).

- Help government agencies, legislative bodies, private organizations, and individual citizens understand the economic significance of the UMR and provide information for future river management decisions.



The report uses available databases and literature to characterize ten key economic sectors:

- Commercial Navigation
- Harvest of Natural Resources
- Water Supply
- Recreation
- Tourism and Cultural/Historical Resources
- Mineral Resources
- Agriculture
- Energy Production
- Manufacturing
- Other Natural Resource Services

The report isolates the economic activity most clearly associated with the UMR by focusing the study on the 60 counties that abut the river—the UMR "corridor."

- **Reliance of the Regional Economy on the UMR:** The degree to which the river influences economic activity varies across sectors. Types of reliance on the river include:

  - **Transportation**—shipments of farm products, coal, minerals
  - **Water Use—**drinking water, cooling water for energy production, industrial process water
  - **Natural Resource Harvests—**fishing, trapping, sand and gravel extraction
  - **Natural Resource Services—**wildlife habitat that supports recreation and tourism

- **Revenue and Employment:** Considered together, the ten economic sectors account for about $145 billion in revenue to businesses in the corridor. Approximately 870,000 jobs are associated with this economic activity. This revenue and employment reflects direct output from corridor businesses and does not include multiplier effects. The revenue generated by the ten sectors represents about 40 percent of the total output of the corridor, and 18 percent of the economic activity in the five-state region.

KEY FINDINGS FOR ECONOMIC SECTORS

- ***Commercial Navigation***—The waterway transportation industry ships 125 million tons of commodities on the UMR each year. These commodities consist primarily of farm products (55 million tons), coal (24 million tons), and non-metallic minerals (21 million tons). Commercial navigation generates about $1 billion in revenues per year and employs approximately 6,300 people.

- ***Commercial Harvest of Natural Resources***—The primary commercial harvest activities are fishing, musseling, and trapping. Depending on the harvest year, revenues vary from about $3 million to $9 million and employment varies from 1,200 to 4,000 people. While commercial fishing and trapping have remained stable in recent years, musseling has declined dramatically.

- ***Water Supply***—About 7.2 billion gallons of water are withdrawn from the UMR each day for use by the energy, agriculture, mining, manufacturing, and water supply sectors. Most of this water (6.4 billion gallons per day) is used as cooling water in the energy production process and returned to the river. Twenty-two cities obtain drinking water from the UMR as well. Public water supply systems employ about 1,000 people and generate about $130 million in annual revenues.

- ***Recreation***—People enjoy over 11 million recreational visits to sites along the UMR each year, with most people engaging in fishing, boating, hiking or sightseeing. This recreation generates more than $200 million in

revenue for local businesses. The economic importance is even greater when other recreation in the region that depends on the UMR's ecology is taken into account. For example, about 40 percent of all waterfowl in North America rely on the Mississippi Flyway; waterfowl hunting and viewing generate over $1 billion in revenue in the UMR's five-state region.

- ***Tourism***—Tourists come to the UMR corridor to visit the more than 1,700 cultural landmarks and sites, and to enjoy river festivals, riverboat tours, and riverboat gaming. Leisure travelers to the corridor spend about $6.6 billion per year, which supports about 140,000 jobs, mostly in the hotel, restaurant, and retail industries.

- ***Mineral Resources***—The primary mining activities in the corridor are crushed stone, coal, sand and gravel, cement, and lime production. These mining operations generate over $1.2 billion in revenues per year and employ over 6,500 people, mostly in Missouri and Illinois.

- ***Agriculture***—The corridor's 52,600 farms generate more than $5 billion in revenue per year and employ 94,000 people (including part-time and seasonal workers). Corridor farms primarily produce corn, soybeans, cattle, hogs, and dairy products. These products are used as inputs to food processing industries, which produce commodities such as corn oil, fructose, soybean oil, processed milk, and meat products.

- ***Energy Production***—The corridor's 49 power plants generate about 7,500 megawatts of electricity per year, about 20 percent of the total power generated in the UMR five-state region. The energy sector depends on the river for cooling water, transportation of coal, and as a direct fuel source for hydroelectric generation. Power plants and distribution facilities in the corridor employ over 13,000 people and generate $4.7 billion in annual revenues.

- ***Manufacturing***—The corridor's manufacturing sector is composed of numerous diverse industries, of which the largest are food processing, machinery, transportation equipment, and chemicals. Manufacturing generates $126 billion in annual revenue and employs over 600,000 people.

- ***Natural Resource Services***—The river provides many services that may not be directly reflected in the commercial economy.

  - **Wastewater Treatment:** Approximately 280 facilities use the UMR as a "sink" for discharging wastewater. Dischargers include manufacturers and municipal sewage treatment plants.
  - **Wetland Services:** Over 400,000 acres of wetlands in the corridor provide benefits associated with flood control, protection of water quality, water supply, and habitat for wildlife.
  - **Wildlife Species and Habitat:** Environmental quality and the health of habitat and species have an intrinsic value, irrespective of human use. This value is reflected in the many past and ongoing efforts to restore and preserve UMR habitat.

Summary of the Economic Significance of UMR Sectors (Based on Activity in the 60 Corridor Counties)			
Sector	**Revenue ($millions)**	**Employment (number of jobs)**	**Other Features and Trends**
Commercial Navigation	$1,050	6,300	• UMR shipments of 125 million tons represent 20 percent of total commerce shipped on the nation's inland waterway system. • Shipments on the Mississippi River System have grown an average of 1.8 percent per year over the past decade. • Army Corps of Engineers forecasts a 90 percent increase in shipments from 1991-93 to 2050.
Harvest of Natural Resources	$3 - $9	1,200 - 4,000	• Over 11 million pounds of fish are commercially harvested from the UMR each year. • Commercial fishing and trapping are stable; musseling has declined dramatically in recent years.
Water Supply	$130	1,000	• Twenty-two cities use water from the UMR. • Total public supply deliveries of surface water have declined by almost 10 percent from 1990 to 1995, primarily due to conservation efforts by domestic users.
Recreation	$200	3,000	• The most common recreational activities are fishing, boating, hiking and sightseeing. • UMR affects recreational activity beyond its banks (e.g., waterfowl hunting and viewing); expenditures outside of the corridor are significant.
Tourism and Cultural/Historical Resources	$6,600	140,000	• Traveler expenditures influence numerous businesses such as hotels, restaurants, casinos, car rentals, and retail shops. • Tourism in the UMR corridor is increasing; travel expenditures have increased 3-6 percent per year from 1993-1997.
Mineral Resources	$1,200	6,500	• Major products include coal, crushed stone, sand and gravel, cement, and lime. • Activity focused primarily in Missouri and Illinois. • Increased mining output in recent years due to strong demand from construction industry.
Agriculture	$5,010	94,000	• Dominant land use in the corridor with land value of approximately $23 billion. • Major products include corn, soybeans, cattle, hogs, and dairy products. • Number of farms decreasing, farms consolidating.
Energy Production	$4,700	13,000	• Corridor power plants (primarily fossil fuel burning) supply 7,500 megawatts of power each year, or 20 percent of the total power generated in the UMR's five-state region. • Uncertain period as deregulation forces energy sector into a new era of competition.
Manufacturing	$126,469	601,500	• Largest single sector, although composed of numerous diverse industries; the largest of these include food processing, machinery, transportation equipment, and chemicals.
Other Natural Resource Services	NA	NA	• Economic services not reflected in the commercial economy include treatment of wastewater, wetland services, and provision of wildlife habitat.
TOTAL	**~$145,000**	**~870,000**	• Total revenue represents about 40 percent of the corridor economy's revenue. • Total employment represents about 22 percent of the corridor economy's employment.

Chapter

1

Introduction and Purpose

Consistent with its prominent role in our nation's history and culture, the Mississippi River is critical to our economic well being. Individuals and businesses have come to rely on the river for transportation, water, food, recreation, and a variety of other goods and services. As a result, the regional economies surrounding the river, as well as the national economy, benefit from careful conservation and management of the Mississippi.

The purpose of this study is to develop a profile of the regional economic activity dependent upon the Upper Mississippi River (UMR), the portion of the Mississippi flowing through the midwestern region of Minnesota, Wisconsin, Iowa, Illinois, and Missouri. The profile provides a "snapshot" of economic activity associated with the river today, and discusses past and future trends. The ultimate objective of this report is to help government agencies, legislative bodies, private organizations, and individual citizens understand the economic significance of the UMR, and to serve as an information source for future river management decisions.[1]

SECTORS EXAMINED

We develop an economic profile of the region by examining individual economic sectors that rely on the river. Exhibit 1-1 summarizes the rationale for the sectors included in the economic profile. As shown, each of the ten sectors either relies on the river for transportation, water, other natural resources, or socioeconomic services such as support of recreational activity.

It is noteworthy that these sectors vary in terms of the intensity of the economic relationship to, or level of dependence on, the river. For example, harvesting of natural resources represents a sector directly and explicitly dependent upon the river, e.g., without the river, commercial fishing would not exist. Other sectors have a more indirect connection to the river. For example, while agricultural producers depend on the river for transport of products, agriculture would likely exist without the river, although other (probably more costly) modes of transport would be needed to bring goods to market. As we examine the economic significance of the various sectors, it is important to bear in mind how the river influences and supports the economic activity in question.

[1] Note that this study examines the *economic significance* of different sectors, and therefore focuses on revenue, employment, and other practical measures of significance. We do not address issues of *net economic value* or changes in *social welfare*, i.e., measures of economic benefits minus the cost of producing those benefits.

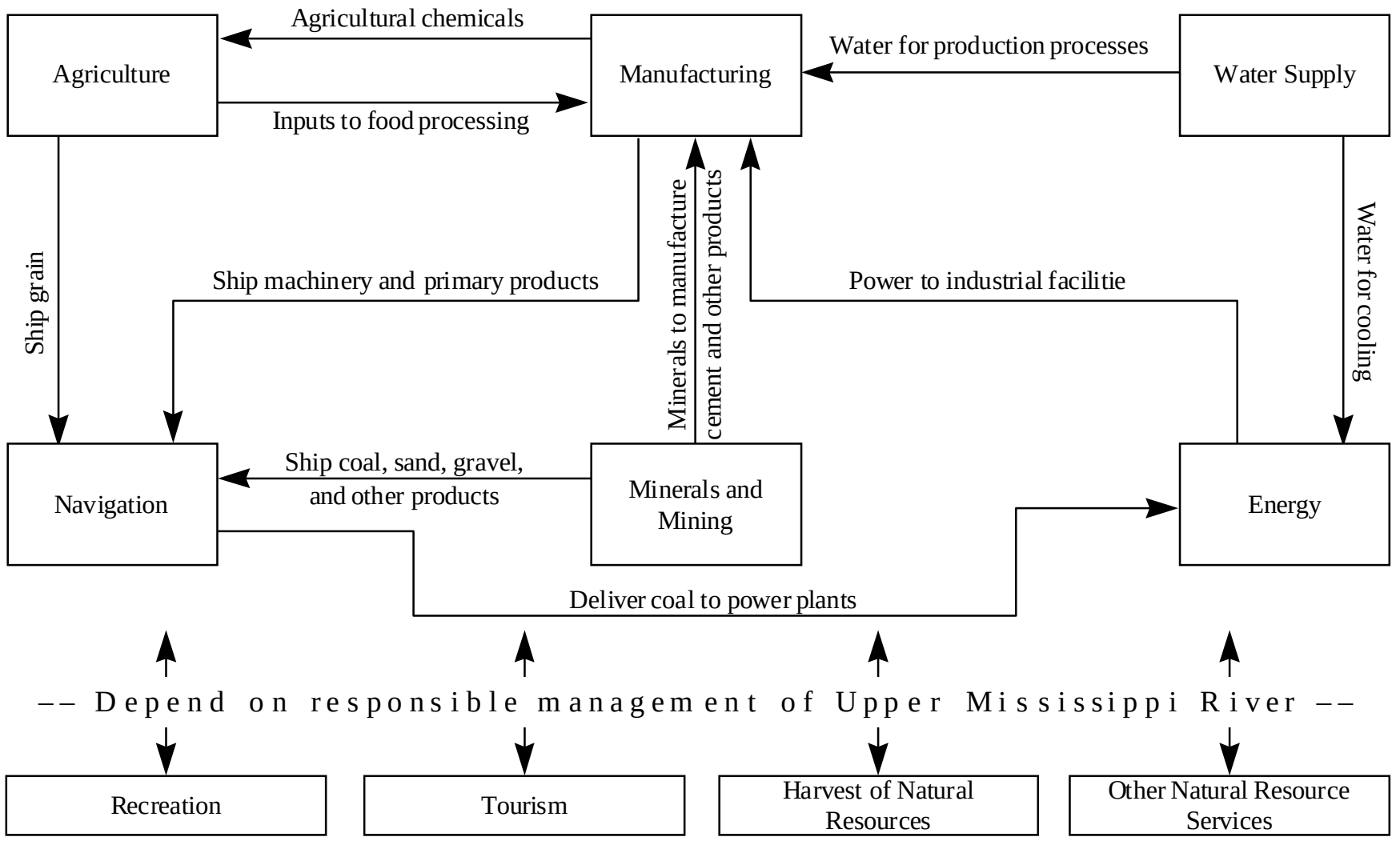
Exhibit 1-1
Economic Sectors and Their Reliance on the UMR

Sector	Definition	Rely on UMR for Transportation of Inputs and Products	Use Water from the UMR	Harvest Goods Directly from UMR	Socioeconomic Reliance on UMR Services
Commercial Navigation	Inland waterway towing industry	✓			
Agriculture	Agricultural activity in the UMR study area	✓	✓		
Energy	Electrical power generation facilities	✓	✓		
Minerals and Mining	Harvest of limestone, gravel, etc.; production of end-use materials (e.g., cement)	✓	✓	✓	
Manufacturing	Manufacturing of primary and finished goods	✓	✓		
Water Supply	Facilities supplying water for domestic, commercial, and industrial use		✓		
Harvest of Natural Resources	Commercial harvest of fish and animals			✓	
Recreation	Outdoor recreational activity pursued on the UMR (e.g., boating, fishing)			✓	✓
Tourism and Cultural Resources	Sightseeing, gaming, travel, and other enjoyment of cultural and historical sites				✓
Natural Resource Services	Other river-related services not reflected in the commercial economy, including wetland services (e.g., flood control), wastewater treatment, and wildlife habitat.				✓

Looking beyond these general categories of reliance, the interactions between the economic sectors are diverse and complex. First, the sectors interact in the commercial economy, purchasing inputs from one another. Exhibit 1-2 illustrates this set of linkages, highlighting some of the major points of interaction. For example, coal mined within the UMR corridor may be shipped via commercial navigation to power plants along the river.

Second, the linkages between economic activity, recreational activity, and ecological quality are significant. The sectors addressed in this report not only derive value from the river, but in turn influence the quality of the river. For example, pollution from agricultural runoff affects the quality of water in the UMR. Often, the sectors compete for the river and its resources. For example, navigation improvements may affect the quality of fish and wildlife habitat, in turn affecting recreational and commercial fishing activity. Information on the economic significance of key sectors can support river management decisions, facilitating balanced and economically beneficial treatment of the different sectors.

Exhibit 1-2
Major Links Between UMR Economic Sectors



STUDY AREA

For the purposes of this study, the UMR is defined as the main stem of the Mississippi from Minneapolis/St. Paul to the mouth of the Ohio River (in Cairo, Illinois). This stretch of the river runs through a five-state area that includes Minnesota, Wisconsin, Iowa, Illinois, and Missouri. To isolate economic activity most clearly associated with the river, most of the sector characterizations focus on the 60 counties that abut the river, i.e., the UMR "corridor" (see Exhibit 1-3).[2] For example, we report tourism expenditures and manufacturing output in these 60 counties using county-based data. Appendix A to this report lists the 60 corridor counties.

In a number of instances, the nature of the economic activity calls for consideration of a more extensive study area; for example, we report county as well as statewide agricultural production data because grain from the entire region is transported on the UMR.

The UMR is divided by a system of locks and dams built to allow more efficient and reliable navigation (see Exhibit 1-4). The locks and dams segment the river into a series of reaches or "pools" that extend from the Twin Cities (Lock and Dam 1) to St. Louis (near Lock and Dam 27), ending in a large unimpounded reach above Cairo, Illinois. Throughout this report, we make reference to different pools where key activity is concentrated (e.g., boating on Pool 4).

DATA SOURCES

As directed, this study relies exclusively on existing reports and data bases to develop the economic profile. First, for output and employment figures in several sectors, we rely on county-level economic data bases. Most significantly, we draw data from the IMPLAN regional economic modeling system. IMPLAN is a modeling program that public and private-sector planners use to estimate how changes in specific industries affect regional economies. One of the components of the model is a county-level data base that includes industry output (the value of production), employment, and other economic data. The data are drawn or estimated from data gathered in surveys conducted by the U.S. Census Bureau and Bureau of Labor Statistics. Appendix B of this report reviews the IMPLAN model and the county-level data base in more detail.

We gather other county-level economic data from the County Business Patterns database. Compiled by the U.S. Census Bureau, the County Business Patterns data provide county-level information on employment and number of establishments (i.e., locations at which business is conducted) by industry. The data are drawn from the Census Bureau's Business Register, a file of all known companies based on surveys conducted by the Bureau.

[2] The 60 counties referred to include 59 counties plus the City of St. Louis.

Exhibit 1-3
Counties Included in the UMR Economic Profile

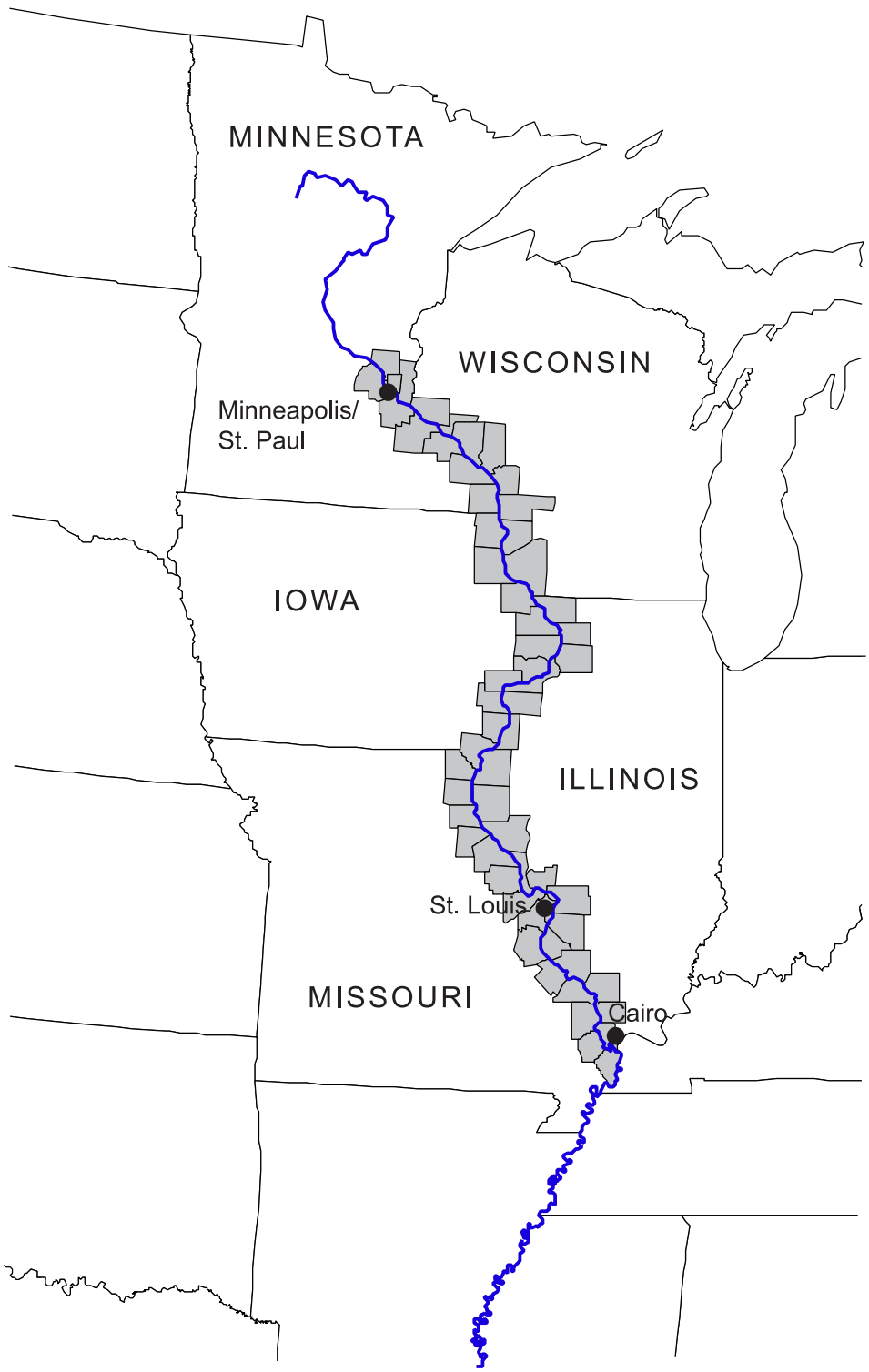


Exhibit 1-4
Lock and Dam System in the UMR Study Area

Second, existing reports by government agencies and conservation organizations provided a foundation for examining the significance of the UMR to the regional economy. Some of these studies provided a broad perspective on the economy and ecology of the area.[3] Numerous other reports and data bases provided detailed material for the different economic sectors. The Methodology and Data Sources section at the beginning of each chapter reviews sources instrumental for each sector.

Finally, we gathered much of the information compiled for this report from experts in state government, federal agencies, and non-profit research organizations. Appendix C provides a listing of all individuals contacted.

SUMMARY ECONOMIC PROFILE

A number of different measures can be used to characterize the significance of the economic sectors reliant upon the UMR. Below, we review three ways to contrast the sectors:

- revenue and employment in the sector;
- the sector's reliance on surface water; and
- land use in the study area and its relationship to the sectors.

In the sections below we summarize our findings relative to these different measures.

Revenue and Employment

We focus on revenue and employment as the primary indicators of economic activity across the sectors. Considered together, the river-related sectors examined here account for about $145 billion in revenue to businesses in the 60-county UMR corridor.[4] Approximately 870,000 jobs are associated with this economic activity. This economic output represents about 40 percent of the total output of the corridor, and 18 percent of the economic activity in the five-state region.

Comparison of the importance of different sectors requires a close look at the available data as well as the nature of the sectors and their reliance on the UMR. Exhibit 1-5 shows that manufacturing is by far the largest sector, with about $126 billion in revenues and 602,000 jobs. Manufacturing is, however,

[3] For example, see McKnight Foundation, *The Mississippi River in the Upper Midwest: Its Economy, Ecology, and Management*, 1996; and U.S. National Park Service, *Mississippi River Corridor Study, Vol. 2, Inventory of Resources and Significance*, 1996.

[4] To adjust for inflation and allow consistent comparison, revenue and other dollar figures in this report have been converted to 1997 dollars using the Gross Domestic Product (GDP) deflator as reported in the 1998 *Economic Report of the President*.

Exhibit 1-5

Summary of the Economic Significance of UMR Sectors (Based on Activity in the 60 Corridor Counties)

Sector	Revenue ($millions)	Employment (number of jobs)	Other Features and Trends
Commercial Navigation	$1,050	6,300	• UMR shipments of 125 million tons represent 20 percent of total commerce shipped on the nation's inland waterway system. • Shipments on the Mississippi River System have grown an average of 1.8 percent per year over the past decade. • Army Corps of Engineers forecasts a 90 percent increase in shipments from 1991-93 to 2050.
Harvest of Natural Resources	$3 - $9	1,200 - 4,000	• Over 11 million pounds of fish are commercially harvested from the UMR each year. • Commercial fishing and trapping are stable; musseling has declined dramatically in recent years.
Water Supply	$130	1,000	• Twenty-two cities use water from the UMR. • Total public supply deliveries of surface water have declined by almost 10 percent from 1990 to 1995, primarily due to conservation efforts by domestic users.
Recreation	$200	3,000	• The most common recreational activities are fishing, boating, hiking and sightseeing. • UMR affects recreational activity beyond its banks (e.g., waterfowl hunting and viewing); expenditures outside of the corridor are significant.
Tourism and Cultural/Historical Resources	$6,600	140,000	• Traveler expenditures influence numerous businesses such as hotels, restaurants, casinos, car rentals, and retail shops. • Tourism in the UMR corridor is increasing; travel expenditures have increased 3-6 percent per year from 1993-1997.
Mineral Resources	$1,200	6,500	• Major products include coal, crushed stone, sand and gravel, cement, and lime. • Activity focused primarily in Missouri and Illinois. • Increased mining output in recent years due to strong demand from construction industry.
Agriculture	$5,010	94,000	• Dominant land use in the corridor with land value of approximately $23 billion. • Major products include corn, soybeans, cattle, hogs, and dairy products. • Number of farms decreasing, farms consolidating.
Energy Production	$4,700	13,000	• Corridor power plants (primarily fossil fuel burning) supply 7,500 megawatts of power each year, or 20 percent of the total power generated in the UMR's five-state region. • Uncertain period as deregulation forces energy sector into a new era of competition.
Manufacturing	$126,469	601,500	• Largest single sector, although composed of numerous diverse industries; the largest of these include food processing, machinery, transportation equipment, and chemicals.
Other Natural Resource Services	NA	NA	• Economic services not reflected in the commercial economy include treatment of wastewater, wetland services, and provision of wildlife habitat.
TOTAL	**~$145,000**	**~870,000**	• Total revenue represents about 40 percent of the corridor economy's revenue. • Total employment represents about 22 percent of the corridor economy's employment.

a highly diverse sector, ranging from food processing to chemical production, making it somewhat less comparable to the other sectors that generally focus on one activity or industry.

A more meaningful comparison of the sectors is possible when manufacturing is removed from consideration. Exhibit 1-6 shows the relative importance of the remaining sectors based on revenue and employment. As shown, revenue data suggest that tourism, agriculture, energy, and commercial navigation are the dominant sectors.[5] The comparison is similar when we consider employment.

The remaining sectors — recreation, water supply, and harvest of natural resources — are less significant from the standpoint of revenue and employment. However, it is important to note that these sectors are more directly dependent on the water and ecological quality of the UMR. For example, recreational anglers and boaters may be discouraged from participating in these activities if water quality is poor. Likewise, withdrawal of water and harvest of other resources (e.g., fish) are possible only if water quality and general ecological quality are maintained. This relationship is depicted in Exhibit 1-7 where we array revenue along with a more qualitative measure of reliance on water quality. While sectors such as recreation, water supply, and harvest of natural resources may be associated with less economic output than other sectors, they are highly sensitive to the quality of the UMR ecosystem and therefore warrant close consideration when weighing management options that affect the quality and physical structure of the UMR. As a result, these sectors should not be considered "less significant" than those with less direct connections to the river.

Water Use

Another measure of the value that different economic sectors derive from the UMR is the

Exhibit 1-6
Relative Economic Significance of Sectors (Excluding Manufacturing)

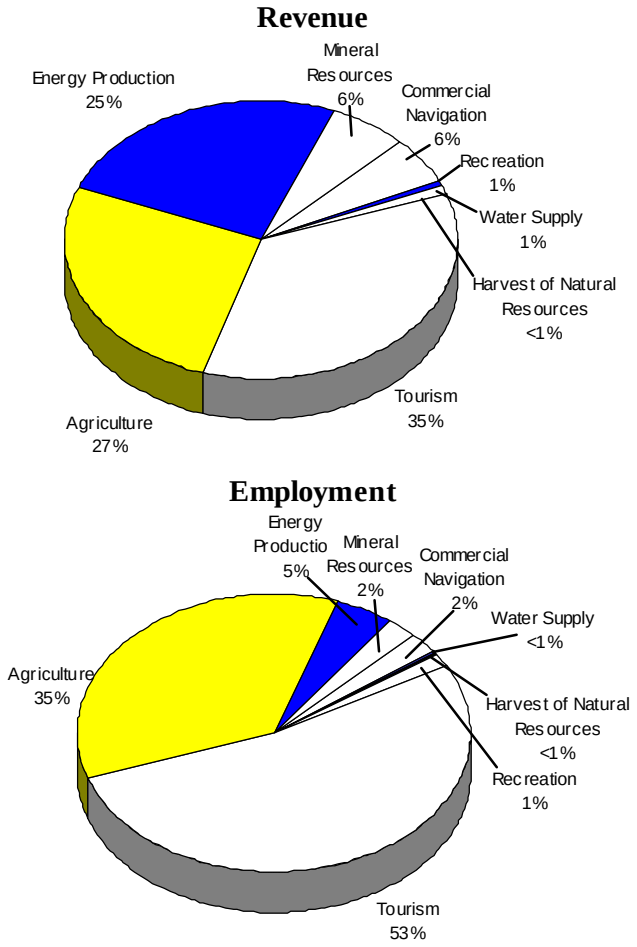
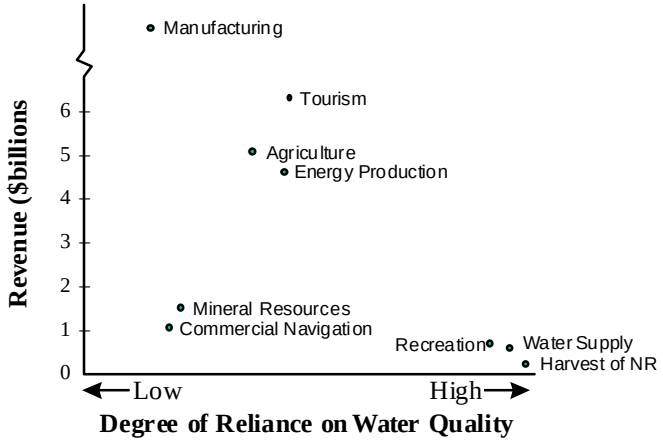


Exhibit 1-7
Combining Considerations of Economic Activity and Reliance on Water Quality



[5] Traveler expenditures and associated employment estimates include the effect of urban tourism and business travel; the effect of direct river-related tourism (e.g., tours of historical sites along the river) is likely lower.

Exhibit 1-8
Surface Water Use By Type (Millions of Gallons Per Day) in UMR Corridor in 1995

User Category	Public Water Deliveries from Surface Water	Self-Supplied Surface Water	Total Surface Water Use
Thermoelectric Power	2.3	6,388.2	6,390.5
Industrial	99.7	224.9	324.6
Domestic	269.2	0.0	269.2
Commercial	79.3	19.7	99.0
Mining	0.0	17.5	17.5
Agriculture	0.0	13.5	13.5
Municipal Use and Delivery Losses	106.7	0.0	106.7
TOTAL	557.2	6,663.9	7,221.1

Source: U.S. Geological Survey, *Water Use in the United States, 1995*, obtained from "http://water.usgs.gov/watuse/" on 11/12/98.

degree to which the sector withdraws and uses water from the river. To estimate surface water usage by relevant economic sectors, we rely on data from the U.S. Geological Survey's (USGS) *Water Use in the United States* data base. The USGS compiles these data through surveys of water supply authorities and from state records of water use by industrial and commercial entities. The data allow us to examine surface water withdrawal and use in the 60-county UMR corridor.[6]

Households and businesses use a total of 7.2 billion gallons of surface water per day in the UMR corridor, with most of the water coming from the UMR and its tributaries. Exhibit 1-8 presents a breakout of surface water use. As shown, energy producers are by far the largest water users. It is noteworthy, however, that most of this water is self-supplied and used for cooling, after which it is returned to the river. Other major water users include industrial manufacturing facilities and households.

As shown, the public water supply system, a subset of overall water use, provides over 550 million gallons of water per day from surface water supplies in the UMR corridor. Households are the dominant users of publicly supplied water from surface water.

Land Use and Land Value

Land use provides another indicator of the relative importance of different economic sectors in the study area. While data for each economic sector are not available, we can reach a number of conclusions based on more aggregate land use information.[7]

Agricultural land dominates the corridor counties. As shown in Exhibit 1-9, agricultural land represents over 70 percent of land in the corridor counties. As we review in our agricultural chapter, data on average value per acre of agricultural land in different states suggest that the agricultural land in the

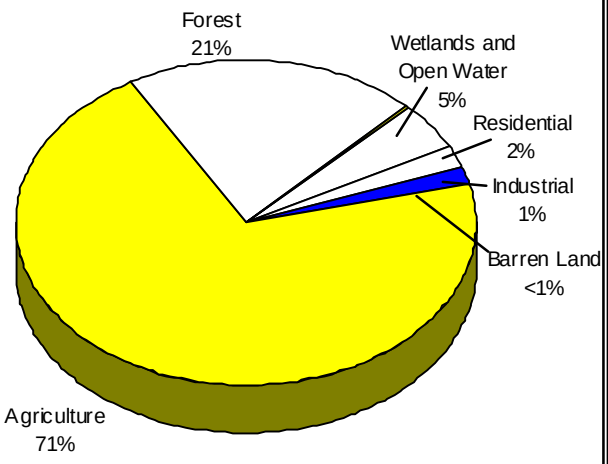
[6] Note that the data are for all surface water withdrawals in each of the counties. Therefore, the estimates reflect water withdrawn from the UMR main stem as well as tributaries and other surface water bodies in each county.

[7] Land use data were acquired from the USGS Environmental Management Technical Center in LaCrosse, Wisconsin. The data are based on the U.S. EPA's GIRAS data and reflect land use in the early 1980s as determined by satellite imagery. County data were available only for counties entirely located in the UMR drainage basin. Therefore, the data presented do not include eight counties in the study area, seven of which are near the confluence with the Ohio River.

corridor counties is worth approximately $23 billion. The abundance of agricultural land and its value are consistent with the prominence of agriculture in the regional economy, as reflected in the revenue and employment figures presented above.

The second most prevalent land use in the study area is forested land. While forest land is not aligned directly with any one sector, it is potentially most relevant to recreation and tourism. This conclusion is supported by the fact that much of the forested land in the immediate vicinity of the river is publicly owned. For example, over half of the floodplain land in the upper reach of the river (Pools 1 through 13) is publicly owned.[8] Based on land value estimates for the Upper Mississippi River Wildlife and Fish Refuge, the 3.9 million acres of forested land in the corridor counties is worth approximately $1.4 billion.[9]

Exhibit 1-9
Land Use in the UMR Corridor



Source: USGS EnvironmentalManagement Technical Center; US EPA GIRAS data.

Other land uses in the study area are relatively minor. Wetland and open water areas are the next most significant, representing about five percent of the corridor counties. Residential and industrial land represent only small portions of the study area. While reliable data on the value of this land are not readily available, it is likely valuable as a result of its proximity to transportation routes and population centers.

REPORT STRUCTURE

The remainder of this report consists of individual chapters for each of the economic sectors under consideration. Each chapter begins with a summary of the major findings regarding economic significance of the sector. We then describe data sources used to develop the economic profile, present the profile information, and discuss past and expected future trends in the sector. We present the sectors in the following order:

- Chapter 2 - Commercial Navigation
- Chapter 3 - Harvest of Natural Resources
- Chapter 4 - Water Supply

[8] USGS, Long Term Resource Monitoring Program, data on land use and land cover, provided by Chuck Theiling.

[9] This estimate assumes an average value per acre of $350 based on appraisals reported in Christensen, Gene H., *Shared Revenue Appraisal, Upper Mississippi River National Wildlife and Fish Refuge, Numerous Counties and Other Government Jurisdictions*, U.S. Fish and Wildlife Service, August 5, 1994.

- Chapter 5 - Recreation
- Chapter 6 - Tourism and Cultural/Historical Resources
- Chapter 7 - Mineral Resources
- Chapter 8 - Agriculture
- Chapter 9 - Energy Production
- Chapter 10 - Manufacturing
- Chapter 11 - Natural Resource Services not Reflected in the Commercial Economy

Chapter

2

Commercial Navigation

The UMR's waterway transportation industry provides shipping services to a wide range of economic sectors in the nation's interior, including agriculture, energy, mining, and manufacturing. These sectors use UMR commercial navigation to shipp millions of tons of farm products, coal, minerals, and other commodities. Overall, the waterway transportation industry shipped close to 125 million tons of commodities on the UMR in 1995.

Commercial navigation on the Mississippi River has been made possible through the construction of a system of locks and dams, as well as a series of thousands of wing dams that guide the river. In addition to providing bulk cargo transport, the waterway transportation industry supports a network of businesses and ports that store, load, unload, and transport cargo to land-based modes of transportation such as rail and trucking. In 1995, waterway transportation generated approximately $1 billion in revenues and employed about 6,300 people.

In this chapter we present an overview of UMR navigation and the water transportation industry, including information on commodity shipments, revenues and employment, and likely future trends.

DATA SOURCES AND METHODOLOGY

For information on shipments, revenues, and employment of the waterway transportation industry, we relied primarily on the following sources:

- U.S. Army Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1995*, Waterborne Commerce Statistics Center, 1997.
- Price Waterhouse, *The Economic Activity Associated with the Commercial Utilization and Maintenance of the Upper Mississippi River-Illinois Waterway*, prepared for the Midwest Area River Coalition (MARC 2000), April 1994.
- IMPLAN model data, 1994.

Revenue and employment estimates are based on estimates from Price Waterhouse and IMPLAN model data. Price Waterhouse defines the waterway transportation industry to include the economic activity of barge and towboat operations, port facility services, and cargo transportation services within the port facility area. Revenue estimates are based on Bureau of the Census data

and primary data collected through a Price Waterhouse survey of the UMR water transportation industry. Employment estimates are based on data from the Bureau of Labor Statistics and Bureau of the Census. Because the Price Waterhouse study reflects economic activity of the five-state region (including the Illinois River) rather than the UMR corridor alone, we consider its revenue and employment figures to be upper bound estimates.

For a lower bound estimate, we use IMPLAN model data. IMPLAN data only reflect the economic activity of the waterway transportation industry in the 60-county UMR corridor. Because it is possible that some towing companies operating on the UMR are located outside of the corridor, IMPLAN provides more conservative (i.e., lower bound) revenue and employment estimates. IMPLAN data are based on Standard Industrial Classification code 4400, which includes water transportation as well as cargo handling operations.

Estimates of commodity shipments on the UMR are based on data developed by the U.S. Army Corps of Engineers. The Corps shipment data are presented in two parts: (1) for the Mississippi River from Minneapolis, Minnesota to the mouth of the Missouri River; and (2) from the mouth of the Missouri River to the mouth of the Ohio River. We combine these data, counting shipments that are transported on both reaches only once.

DEVELOPMENT OF THE UMR FOR COMMERCIAL NAVIGATION

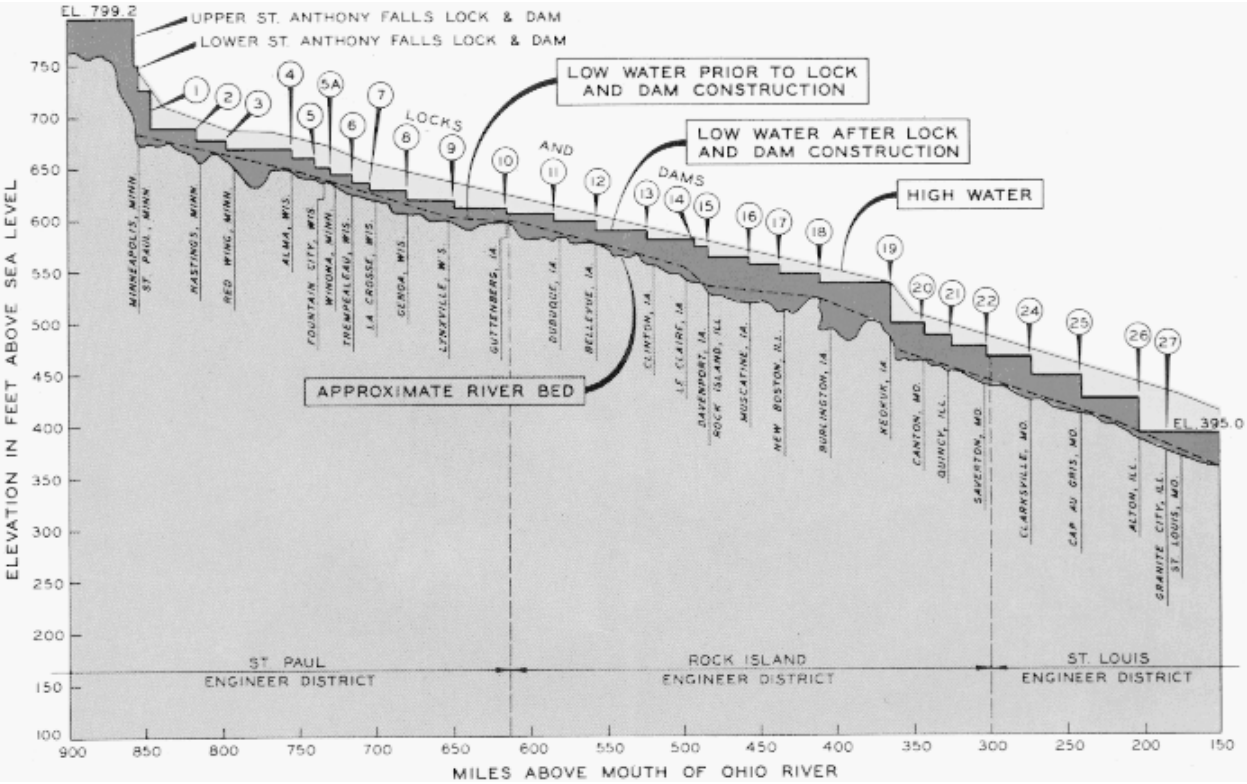
Before the UMR was developed for commercial navigation, it was characterized by a series of deep pools separated by shoals and rapids. The river's channel was often obstructed by sandbars and snags, and during the seasons of summer and fall water levels often dropped significantly. In the late 1800s, the Corps began developing a 4.5-foot channel from Minneapolis, Minnesota to the mouth of the Missouri River by removing channel obstructions, constructing reservoirs on headwater streams, and building wing dams to guide the river. This effort was only marginally successful, however, because the limited dimensions of the channel could not support larger waterway transportation vessels.[1]

To increase the reliability of navigation on the Mississippi, Congress approved plans for the Corps to construct a nine-foot channel in 1930. From 1930 to 1950, the Corps built a system of 29 locks and dams from Minneapolis to the mouth of the Illinois River that changed this reach of the river into a staircase-like series of slackwater pools (see Exhibit 2-1). The dams were constructed at intervals varying from 10 to 47 miles apart, with the average length of a pool measuring about 25 miles. The lock and dam system has made it possible for tows and other boats to climb or descend the pools as they travel the river. South of the lock and dam system, the nine-foot channel has been maintained by "open river" techniques, including the construction of dikes and dredging operations.[2]

[1] U.S. National Park Service, *Mississippi River Corridor Study. Volume 2: Inventory of Resources and Significance*, 1996, p. 32-35.

[2] U.S. National Park Service, Ibid.

Exhibit 2-1



Source: U.S. Army Corps of Engineers, obtained from " http://www.mvr.usace.army.mil/navdata/missprof.gif" on 12/14/98.

Today, the Mississippi River's commercial navigation system supports waterway transportation that has opened the nation's interior to worldwide commerce. The river is navigable from Minneapolis/St. Paul to the Gulf of Mexico. Commodities are shipped aboard barges wired together to form tows, which are pushed by towboats. The standard tow on the UMR consists of 15 barges configured in a five-long, three-wide rectangle — a size that allows for efficient passage through the locks of the UMR. These tows have the same capacity as 225 rail cars or 900 trucks.[3] Depending on the type of commodity and weight or volume measure, they can carry 22,500 tons, 787,500 bushels, or 6,804,000 gallons.

To support the loading and unloading of these shipments, the UMR is lined by close to 400 docks and terminals. Tows pay these port facilities rent, fleeting (parking), and port fees to load and unload cargo. In addition, ports provide services such as barge cleaning, repairing, boat refueling, and security services.

As a less expensive mode of transportation than rail or trucking, waterway transportation helps farmers, mining operations, and other producers of bulk commodities remain competitive. According to a Corps study of UMR

[3] U.S. Maritime Administration, "Domestic Shipping," obtained from "http://marad.dot.gov/publications/domestic_shipping.htm" on 12/8/98.

Exhibit 2-2
Inland Rivers—Navigable Waterways

Source: U.S. Army Corps of Engineers, obtained from "http://www.mvr.usace.army.mil/navdata/ww.gif" on 12/14/98.

transportation, producers save from $1.61 to $12.03 per ton by using barge transportation instead of the best possible all-land routing alternative.[4] The average savings of barge transportation are about $9.00 per ton.

While these savings are considerable, it should be noted that to a degree they are the result of taxpayer support of the barge industry. For example, taxpayers pay almost the entire cost of operating and maintaining the UMR waterway system, which includes dredging the channel and maintaining locks and dams. In addition, taxpayers support about half the cost of major waterway rehabilitation projects and system improvements, such as new or expanded locks. Towboat companies pay the other half of these costs through taxes on their fuel.[5]

The nation's inland waterway system extends over 25,000 miles, of which about 11,000 miles are generally considered to be significant for domestic commerce. The nation's navigable inland waterways includes the Mississippi River System — defined by the Corps to include the main channels and all tributaries of the Mississippi, Illinois, Missouri, and Ohio Rivers — as well as other rivers such as the Columbia/Snake River in the Pacific Northwest (see Exhibit 2-2). According to the Corps, a total of 620 million tons of commodities were shipped on the nation's inland waterways in 1995. Of this total, about 480 million tons (nearly 80 percent) were shipped on the Mississippi River System.[6] The major commodities shipped on the Mississippi River System in 1995 were coal, non-metallic minerals (primarily sand and gravel), farm products (primarily grains), and petroleum products. Exhibit 2-3 shows the Mississippi River System's shipments in tons for 1995.

SHIPMENTS ON THE UMR

Shipments on the UMR account for a significant share of the nation's total inland waterway shipments. In 1995, close to 125 million tons of commodities were shipped on the UMR, which represented about 20 percent of

[4] U.S. Army Corps of Engineers, *Transportation Rate Analysis: Upper Mississippi River Navigation Feasibility Study*, prepared by the Rock Island U.S. Army Corps of Engineers office and Tennessee Valley Authority, July 1996.

[5] The McKnight Foundation, *The Mississippi River in the Upper Midwest: Its Economy, Ecology, and Management*, 1996, p. 30-31. Also see Paul Hansen, "The Upper Mississippi River — At A Critical Juncture: The Izaak Walton League of America's Perspective," prepared for The Upper Mississippi River Conservation Committee, 52nd Annual Meeting, Cape Girardeau, MO, 1996. Bruce Uppin, "A river of subsidies," *Forbes*, vol. 161, no. 6, March 23, 1998, p. 86.

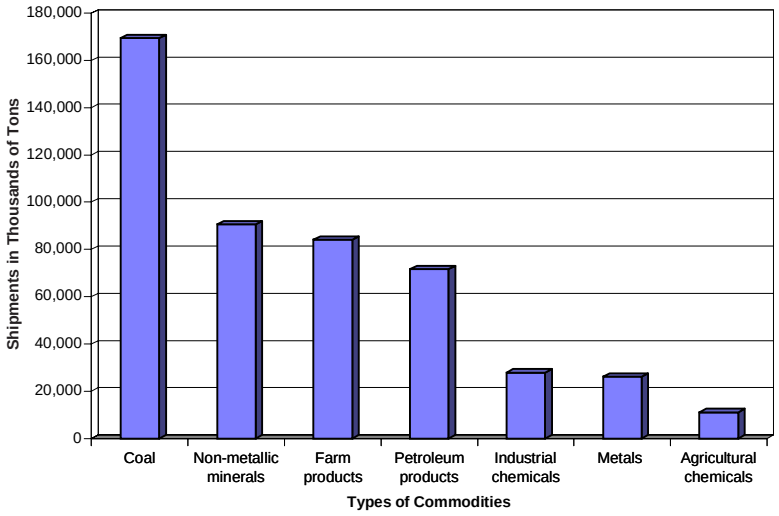
[6] U.S. Army Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1995*, Waterborne Commerce Statistics Center, 1997.

total inland waterway commerce.[7] As shown in Exhibit 2-4, farm products accounted for about 45 percent of the UMR's total shipments (55 million tons), followed by coal (24 million tons) and non-metallic minerals (21 million tons). Farm product shipments are dominated by grains — corn, soybeans, and wheat — while non-metallic mineral shipments consist primarily of sand and gravel, crushed stone, and cement and concrete products. Other major categories of commodities shipped on the UMR included petroleum products, metals (primarily iron and steel products), and industrial and agricultural chemicals.

About 70 percent of the UMR's commodity shipments are headed downstream for domestic consumption or export. In particular, about half the farm products shipped on the UMR are destined for export markets.[8] Returning tows often bring agricultural chemicals for the UMR region's farming sector. Other commodities, such as coal, petroleum products, minerals, and metals, are shipped up and down the UMR depending on markets. For instance, coal is primarily shipped to power plants located on the river.

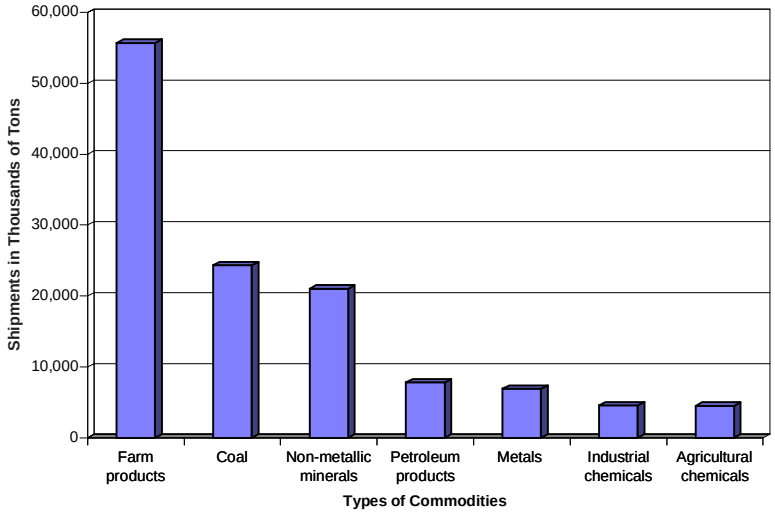
In addition to shipment tonnages, the *use* of a waterway is often measured in "ton-miles," calculated by multiplying the tons of waterborne commerce by the number of miles shipped. For example, shipping 50 tons a distance of 100 miles would yield 5,000 ton-miles. In 1995, the UMR supported about 36 billion ton-miles of commodity shipments, compared to 267 billion ton-miles for the overall Mississippi River System and 306 billion ton-miles for the nation's inland waterways (see Exhibit 2-5).[9] Farm prod-

Exhibit 2-3
Shipments on the Mississippi River System, 1995



Source: U.S. Army Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1995*, Waterborne Commerce Statistics Center, 1997.

Exhibit 2-4
Shipments on the UMR, 1995



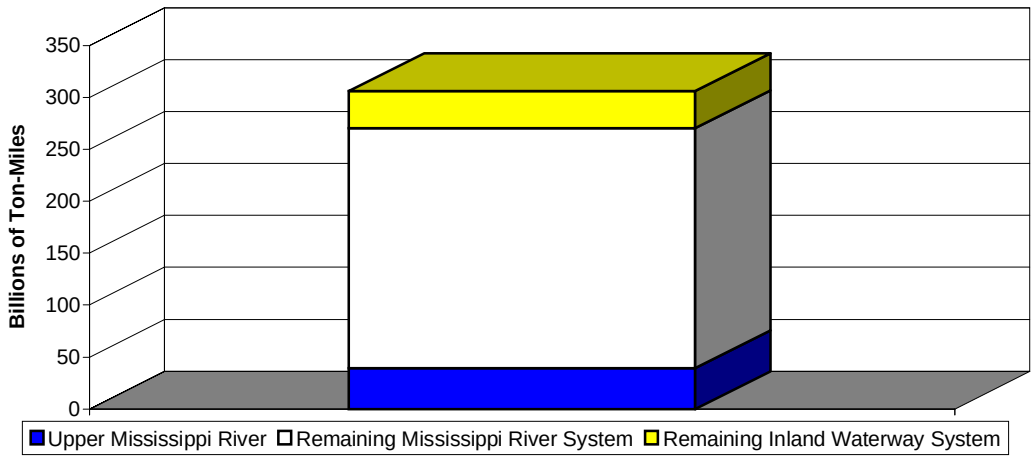
Source: U.S. Army Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1995*, Waterborne Commerce Statistics Center, 1997.

[7] This estimate reflects shipments that originate from, or are destined for, a UMR port, as well as shipments that pass through the UMR without loading or unloading cargo at a port. U.S. Army Corps of Engineers, *Waterborne Commerce of the United States*, op cit.

[8] U.S. Army Corps of Engineers, Ibid.

[9] U.S. Army Corps of Engineers, Ibid.

Exhibit 2-5
Ton Miles on the Nation's Inland Waterway System, 1995



Source: U.S. Army Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1995*, Waterborne Commerce Statistics Center, 1997.

uct shipments are the main reason the Mississippi River System accounts for close to 90 percent of the nation's ton-miles of inland waterway traffic. The average haul of farm products was over 1,000 miles in 1995, compared to about 350 miles for non-farm products.[10]

UMR WATERWAY TRANSPORTATION INDUSTRY: REVENUE AND EMPLOYMENT

The waterway transportation industry generated $4.7 billion in revenue in the ten states along the Mississippi River in 1992, according to a study by Price Waterhouse.[11] This revenue supported close to 36,000 full-time equivalent jobs. Of this total, the five states of the UMR region accounted for about $1.3 billion in revenue and 8,600 full-time equivalent jobs (see Exhibit 2-6). Because these estimates reflect the economic activity of the five-state region (including the Illinois River) rather than the UMR corridor alone, we view them as upper bound estimates.

We use IMPLAN model data to establish lower bound revenue and employment estimates. IMPLAN estimates are more conservative because they only reflect the economic activity of the waterway transportation industry in the 60-county UMR corridor; it is possible that some towing companies operating on the UMR are based outside of the corridor. According to IMPLAN data, the water transportation industry generated $800 million in revenues in 1994 and employed about 4,100 people.[12]

[10] U.S. Department of Commerce, *U.S. Industry and Trade Outlook 1998*, International Trade Administration, 1998, p. 43-6.

[11] Price Waterhouse, op cit.

[12] IMPLAN model data, 1994. Revenue estimates have been adjusted to 1997 dollars using the Gross Domestic Product deflator.

Using a mid-point of the two data sources provides a best estimate of about $1 billion in revenue and 6,300 people employed in the UMR water transportation industry. As a proportion of the corridor transportation industry, water transportation accounts for 9 to 15 percent of transportation revenue and 5 to 10 percent of transportation employment.[13]

Exhibit 2-6
Revenue and Employment of UMR's Waterway Transportation Industry

Data Sources	Revenue (millions)	Employment
IMPLAN model data (Lower bound estimate)	$812	4,07
Price Waterhouse Study (Upper bound estimate)	$1,324	8,61
Midpoint of IMPLAN-Price Waterhouse Range	$1,068	6,34

TRENDS

Over the past decade, shipments on the Mississippi River System have increased by about 1.8 percent per year, from 402 million tons in 1986 to 480 million tons in 1995.[14] This growth can be attributed primarily to increased shipments of farm products, minerals, and primary manufactured goods. However, at the same time that barge shipments have been increasing, the barge industry has been consolidating — down from nearly 2,000 towing companies to about 900 companies.[15] Many of the smaller towing companies have had difficulty competing with larger, multi-service waterway transportation firms. As of 1994, the top nine towing operations controlled more than 45 percent of the total industry capacity.[16]

The future of commercial navigation on the UMR will depend greatly on upcoming decisions about lock and dam rehabilitation and upgrades. The majority of locks on the UMR were constructed in the 1930s, and many may now be in need of repair. In addition, five of the UMR's locks (locks 20, 21, 22, 24, and 25) have been identified among those with the highest average transportation delays, highest total barge transit processing and lockage times, and highest rate of lock utilization in the nation.[17] Lock 22 was the most congested lock with average delays of about seven hours per tow. The Corps estimates that tows at locks 20-25 were delayed a total of 87,000 hours in 1992. Assuming a cost of $400 per hour of delay, the Corps estimates that the total cost of delays was $35 million.[18]

[13] These estimates compare revenue and employment for water transportation (SIC 4400) to total transportation revenue and employment for railroad transportation (SIC 4000), motor freight transportation and warehousing (SIC 4200), water transportation (SIC 4400), pipeline transportation—except natural gas (SIC 4600), and transportation services (SIC 4700). IMPLAN, op cit.

[14] U.S. Army Corps of Engineers, *Waterborne Commerce of the United States*, op cit.

[15] Price Waterhouse, op cit.

[16] Price Waterhouse, Ibid.

[17] U.S. Army Corps of Engineers, *Waterway Traffic Forecasts for the Upper Mississippi River Basin*, prepared by Jack Faucett Associates, Bethesda, MD, April 7, 1997.

[18] U.S. Army Corps of Engineers, *Waterway Traffic Forecasts*, op cit.

Delays are projected to become worse as barge traffic increases in the future. The Corps forecasts that shipments on the Mississippi River System will increase by over 90 percent from 1991-93 to 2050.[19] To manage the estimated growth in waterway traffic, the Corps is currently conducting a seven-year, $50 million study to evaluate the economic and environmental consequences of improving navigation structures on the UMR and Illinois River. In part, the Corps study is examining how expanding the length of locks from 600 feet to 1,200 feet would reduce traffic delays on the UMR. Currently, lock chambers on the UMR are not long enough to allow 15 barge tows to pass through on one trip. Instead tows must "lock through" in two steps, which can take about two hours. In contrast, a 1,200 foot lock would decrease "lock through" transit time to about 30 minutes.

The Corps' study and the possibility of new lock construction has generated considerable debate. While the UMR's waterway transportation industry and its users support new infrastructure investments, critics point out the significant subsidies already received by the waterway transportation industry and its users, as well as the high taxpayer costs associated with doubling the size of locks from 600 feet to 1,200 feet. The Corps estimates that expanding locks to 1,200 feet could cost from $115 to $150 million per lock, depending on the foundation of the lock structure.[20] Others estimate the cost could be higher.[21] In addition to these concerns, some critics have taken issue with the Corps' forecasted increase in UMR waterway traffic, particularly the projected doubling of grain shipments from 1991-93 to 2050. They argue that it is questionable whether this much additional grain could be grown in the Upper Midwest, or that export markets will expand at the Corps' projected rate.[22]

As the December 1999 scheduled deadline for the Corps' feasibility study nears, the debate on infrastructure improvements is likely to increase. To a large extent, the future of commercial navigation on the UMR will depend on how Congress ultimately resolves this debate.

[19] As a share of total UMR shipments, the Corps projects that corn and industrial chemicals will increase while agricultural chemicals, coal, and petroleum products will decrease. U.S. Army Corps of Engineers, *Waterway Traffic Forecasts,* op cit.

[20] Lambert, Dick, Office of Freight, Railroads, and Waterways, Minnesota Department of Transportation, "Comments on the Economic Profile of the Upper Mississippi River Region," March 4, 1999.

[21] Taxpayers for Common Sense, "River of Subsidy," obtained from "http://www.taxpayer.net/TCS/MS_River/summary.htm" on 12/14/98. Also see Bruce Uppin, op cit.

[22] See: (1) Paul Hansen, op cit; (2) Bruce Uppin, op cit; and (3) Taxpayers for Common Sense, op cit.

Commercial Harvest of Natural Resources

Chapter 3

The UMR supports a variety of fish and wildlife species, some of which are harvested for commercial purposes. While other chapters address the recreational and intrinsic value of fish and wildlife, this chapter focuses on their commercial value. The three primary commercial harvest activities in the UMR corridor are fishing, musseling, and trapping. This chapter profiles each of these activities, providing information on harvest size, economic value, and likely future trends.

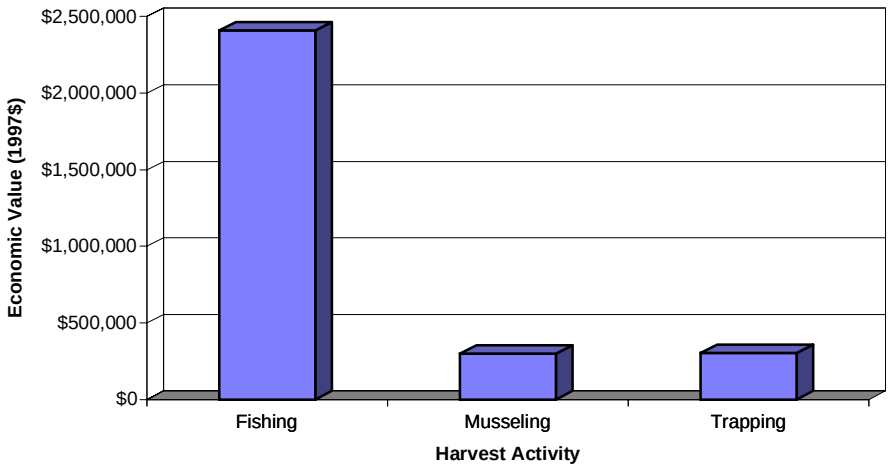
In the 1990s, about 1,200 to 4,000 people have been licensed each year to harvest fish or mussels, or trap animals, in the UMR corridor. These commercial harvests have ranged in value from about $3 million (1997) to about $9 million (1990), primarily due to the high variability in mussel harvests. For instance, while mussel harvests reached a value of over $6 million in 1990, only $300,000 worth of mussels were harvested in 1997. There has been almost no harvest of mussels in 1998. In contrast to this variability, fishing and trapping values have remained relatively stable in recent years, ranging from $2-$3 million and $200,000-$300,000, respectively.

Exhibit 3-1 shows the most recent and complete economic data available for fishing, musseling, and trapping. These values reflect harvests of over 11 million pounds of fish, 280,000 pounds of mussels, and 50,000 animals.

DATA SOURCES AND METHODOLOGY

Data on commercial harvests from the UMR were provided by the staff of the Upper Mississippi Conservation Committee (UMRCC), U.S. Fish and Wildlife Service, and state Departments of Natural Resources. We highlight the primary data sources for each commercial harvest activity below.

Exhibit 3-1
Value of Commercial Harvests of Fish (1995), Mussels (1997), and Wildlife (1996-97 season)



Sources: (1) "Upper Mississippi River Commercial Fisheries Statistics for 1995," in *Proceedings of the 52nd Annual Meeting of the Upper Mississippi River Conservation Committee*, Cape Girardeau, Missouri, 1996; (2) Information on UMR mussel harvests was obtained from Kurt Welke, Fisheries and Mussels Manager, Wisconsin Department of Natural Resources, 11/9/98; Bob Williamson, Illinois Department of Natural Resources, 11/17/98; and Travis Moore, Missouri Department of Conservation, 11/25/98; and (3) "Trapping Report 1996-97: Upper Mississippi River National Wildlife and Fish Refuge," February 3, 1998; and John F. Olson, "1997-98 Wisconsin Furbearer Status Report" obtained from "http://www.dnr.state.wi.us" on 11/11/98.

- **Commercial Fishing Data:** Commercial fishing harvest statistics for 1995 were drawn from "Upper Mississippi River Commercial Fisheries Statistics for 1995," in *Proceedings of the 52nd Annual Meeting of the Upper Mississippi River Conservation Committee*, Cape Girardeau, Missouri, 1996. Statistics were compiled from state Department of Natural Resources data by the UMRCC.

- **Commercial Musseling Data:** Information on mussel harvests along the UMR over the last 12 years was obtained from Kurt Welke, Fisheries and Mussels Manager, Wisconsin Department of Natural Resources, 11/9/98. Additional data on musseling activity was provided by Bob Williamson, Illinois Department of Natural Resources, 11/17/98, and Travis Moore, Missouri Department of Conservation, 11/25/98.

- **Trapping Data:** Data on trapping activity were available for the Upper Mississippi River National Wildlife and Fish Refuge, but not for all of the UMR corridor. According to several staff of the U.S. Fish and Wildlife Service and state Departments of Natural Resources, the majority of UMR trapping occurs within this refuge. Trapping data were provided by Eric Nelson, U.S. Fish and Wildlife Service, in "Trapping Report 1996-97: Upper Mississippi River National Wildlife and Fish Refuge," February 3, 1998. Pricing data for pelts were drawn from John F. Olson, "1997-98 Wisconsin Furbearer Status Report" obtained from "http://www.dnr.state.wi.us" on 11/11/98.

The value of fish and mussel harvests were estimated by multiplying the pounds of fish and mussels harvested by the average market price per pound. Similarly, trapping values were calculated by multiplying the number of animals trapped by the average price per pelt for each respective species.

COMMERCIAL FISHING

Fish monitoring over the last five years has identified the existence of 127 fish species in the UMR. The richness of fish species is greater in the UMR's northern reaches, which may be due to the greater physical complexity of this area (e.g., more abundant backwater areas). Commercial fishing harvests are typically dominated by six species: carp, buffalo, drum, and three species of catfish (channel, flathead, and blue).[1] These species represented about 95 percent of the commercial catch (in pounds) in 1995.

Commercial Fish Harvest

Roughly 900 commercial fishers harvested over 11 million pounds of fish from the UMR in 1995.[2] As shown in Exhibit 3-2, carp dominated the har-

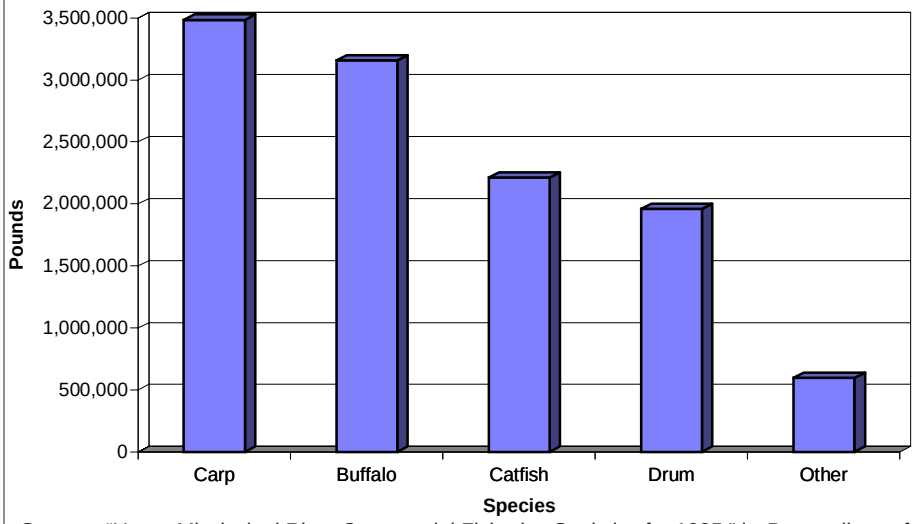
[1] We refer to the species of channel, flathead, and blue catfish collectively as "catfish."

[2] State agencies reported a total number of 923 commercial fishers on the UMR in 1995. Illinois reported 228 commercial fishers for *all* waters, but did not provide an estimate for the UMR alone. Therefore, the true number of total commercial fishers is somewhat less than the 923 fishers reported.

vest, followed by buffalo, catfish, and drum. These species are primarily sold for human consumption, rather than pet food or fertilizers. Markets for UMR fish include restaurants, grocery stores, and fish markets in the Midwest and major metropolitan areas, such as Chicago and New York.[3]

Commercial fishing on the UMR has been relatively stable over several decades. Throughout the 1960s and 1970s, the total commercial fishing catch fluctuated between about 11 million and 14 million pounds annually. Since the late 1970s, the catch has ranged from a low of 8.6 million pounds to a high of over 11 million pounds.[4]

Exhibit 3-2
Total Commercial Catch, by Species (1995)



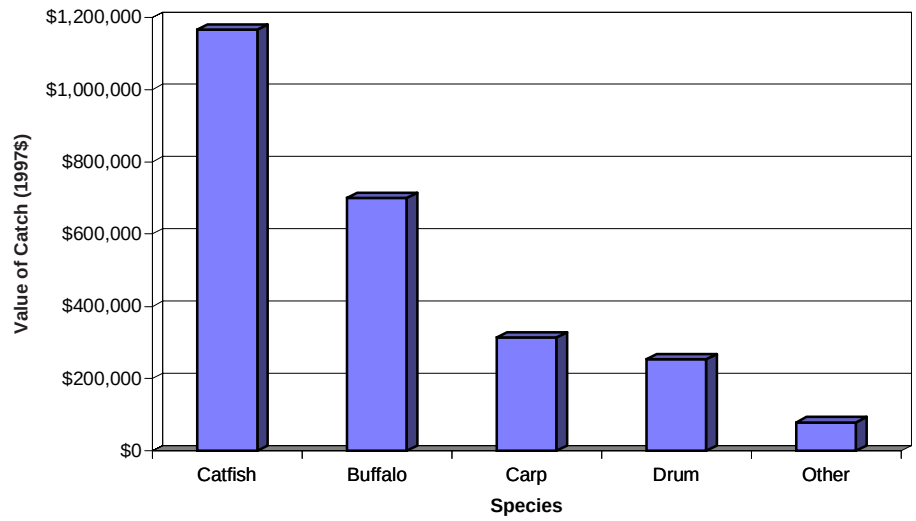
Source: "Upper Mississippi River Commercial Fisheries Statistics for 1995," in *Proceedings of the 52nd Annual Meeting of the Upper Mississippi River Conservation Committee*, Cape Girardeau, Missouri, 1996.

Economic Value of Fish Harvested

The total value of the UMR commercial fishing harvest was $2.4 million in 1995. According to staff at state Departments of Natural Resources, most people licensed to commercially fish the UMR view it as a means to supplement their income rather than as full-time employment. Indeed, the average licensed commercial fishermen harvested less than $3,000 worth of fish in 1995.

Exhibit 3-3 shows the economic value of major species caught on the UMR in 1995. At

Exhibit 3-3
Total Value of Commercial Fishing in 1995, by Species



Source: "Upper Mississippi River Commercial Fisheries Statistics for 1995," in *Proceedings of the 52nd Annual Meeting of the Upper Mississippi River Conservation Committee*, Cape Girardeau, Missouri, 1996.

[3] Personal communication with Jon Duyvejonck, U.S. Fish and Wildlife Service and UMR Conservation Committee coordinator, and Bill Bertrand, Illinois Department of Natural Resources, 12/21/98.

[4] Jon Duyvejonck, "Ecological Trends of Selected Fauna in the Upper Mississippi River," in David L. Galat and Ann G. Frazier, eds., *Overview of River-Floodplain Ecology in the Upper Mississippi River Basin*, vol. 3 of John A. Kemelis, ed., Science for Floodplain Management into the 21st Century, Washington, DC, U.S. Government Printing Office, 1996.

about $300,000 in value, carp accounted for only about 12 percent of the catch's total value despite representing more than 30 percent of the harvest in pounds. In contrast, catfish, which were caught in smaller quantities than carp but sold at higher prices, accounted for close to 50 percent of the harvest's total value. On average, carp sold for $.09 per pound while catfish sold for $.42 to $.51 per pound in 1995. Buffalo and drum sold for $.21 and $.12 per pound, respectively.

Trends

Although the total catch has remained stable, there has been a change in the abundance of some species. For example, lake sturgeon are much less abundant today than in the past. Competition from the common carp has been a significant factor in the decline of other species. Soon after its introduction to the UMR, the carp displaced native fish as the most common component of the commercial catch. Throughout the last two decades, carp has remained the most frequently harvested species, accounting for 30 percent or more of the annual harvest.[5]

COMMERCIAL MUSSELING

Commercial musseling on the UMR has a rich and varied history dating back to the 1800s. Unlike the relatively stable level of commercial fish harvests from the UMR, commercial musseling has gone through several boom and bust periods. These periods have been driven by the abundance/scarcity of mussels and by the rise and fall of two significant industry consumers of mussel products: (1) the pearl button industry from the later 1800s to the 1940s; and (2) the cultured pearl industry from the 1970s to the present.

Commercial Musseling, 1800s to 1940s

The first harvesters of freshwater mussels were Native Americans, who used mussels to construct utensils and jewelry. European settlers began harvesting mussels in the second half of the 19th century for their freshwater pearls and to make pearl buttons for the garment industry. By the turn of the century, 49 button-making plants in 13 cities along the UMR depended on the harvest of thousands of tons of mussels. The center of activity was Muscatine, Iowa—the "Pearl Button Capital of the World."[6]

With no harvest regulations, mussel beds were stripped without regard to mussel size or species, decimating the mussel populations. For instance, mussel harvests from Lake Pepin declined from 6 to 8 million pounds in 1914-15 to only 300,000 pounds by 1929.[7] Likewise, the pearl button industry, which manufactured $12.5 million of buttons and employed 20,000 people in 1916, decreased its output to $5.8 million and employment to 5,000 people by 1929.[8]

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[5] Duyvejonck, 1996, Ibid.

[6] Duyvejonck, 1996 op cit.

[7] P.V. Scarpino, *Great River — An environmental history of the upper Mississippi River 1890-1950*, Columbia: University of Missouri Press, 1985, as cited in Duyvejonck, 1996, p. 43.

[8] Ibid.

The pearl button industry became obsolete by the 1940s as a result of the invention of the plastic button. The last known pearl button plant in the UMR corridor closed in 1967.

Commercial Musseling, 1970s to the present

In the past two decades, mussel harvesting has been revived. Mussel shells are used for making seed pearl or nuclei for the cultured pearl industry. To create a cultured pearl, oysters are gathered from the sea at two or three years old. The oysters are then surgically implanted with a small round piece of polished mussel shell and returned to the sea in wire baskets. The oyster creates a cultured pearl by trying to "contain" the mussel shell irritant with coats of a pearly calcium carbonate substance known as nacre. Cultured pearls are harvested after three to six years. Only about 50 percent of the implanting operations are successful, of which about 15 percent will produce pearls of gem quality. Nevertheless, more than 90 percent of the pearls on the market are cultured.

The world's largest pearl-producing beds are in the coastal waters off Japan. However, the future of this industry is threatened by a virus that has killed millions of oysters—up to 70 percent of the pearl oyster population in Japan.[9] The collapse of Japanese oyster stocks, in combination with a depressed Japanese economy and an unfavorable exchange rate of yen to dollars, has resulted in severely reduced demand for mussel shells. In addition, the cultured pearl market is increasingly served by the Chinese cultured pearl industry, which does not use mussel shell bead nuclei for pearl production.

Mussel Harvests, 1987-1998

Mussel harvests from the UMR have fluctuated dramatically over the last 12 years (see Exhibit 3-4). From 1987 to 1991, annual mussel harvests ranged from 3 million to 7 million pounds. Since that period, mussel harvests have decreased significantly.[10] The dramatic decline of commercial musseling in the 1990s may be due to a combination of factors, including:

Mussel Biology and Conservation

Freshwater mussels are sedentary filter feeders that require good water quality and quantity (flow) for feeding, breathing, and reproducing. Mussels feed by straining phytoplankton and other microscopic organisms out of the water with their gills. As a group, native mussels, particularly freshwater mussels, are the most rapidly declining animal group in the U.S. and constitute the largest group of federally listed endangered or threatened invertebrates. The decline of freshwater mussels is attributed to several factors, including: sedimentation; toxic spills and pollution from point-discharge violations; dam construction; dredge, fill, and other channel modifications; over-harvesting; poaching; and most recently the introduction of the zebra mussel which out-competes native mussels for food.

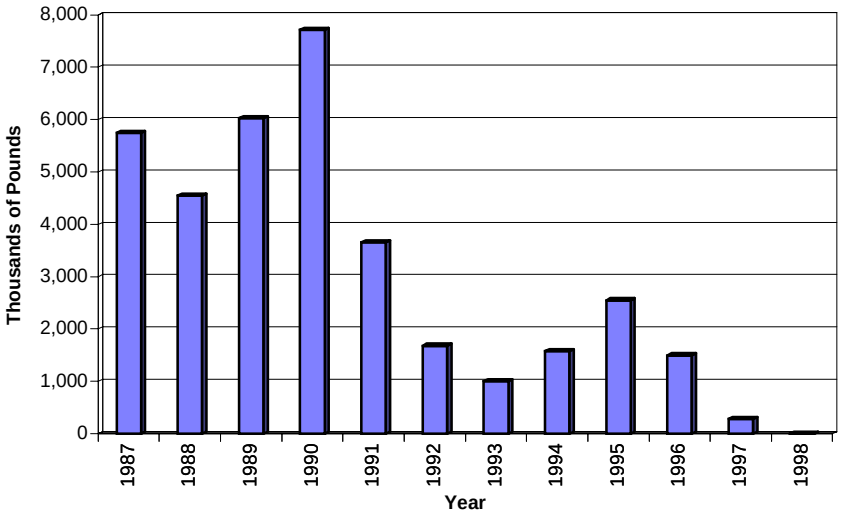
One of the most interesting aspects of mussel biology is their reproductive process. Male mussels release sperm into the water and rely on currents to carry it to females. The females filter the sperm from the water to fertilize their eggs. When the eggs are mature, the female releases the larvae mussels into the water. Incapable of surviving on their own, these larvae must attach themselves to a host fish or other aquatic species. They remain on the host until they develop into juvenile mussels, at which time they drop off onto the substrate where they typically will live for 30 to 80 years. It is important to recognize that without an appropriate host, the larvae mussels cannot survive. Therefore, efforts to conserve mussel resources must include the conservation of the required host species.

The Nature Conservancy, *Species at risk: annual report card*, Arlington, VA, 1996, as cited in The National Park Service, "Natural Resource Information Division Fact Sheet: Freshwater Mussels," 1997, obtained from "http://www.nature.nps.gov/facts/fmussel.htm" on 11/16/98.

[9] Tracey Wong Briggs, "Oyster virus is blamed for the shortage of pearls and their very high prices," USA Today, September 10, 1998. Also see Audrey Gillan, "Mystery virus devastates cultured pearl industry," The Telegraph, London, May 6, 1998.

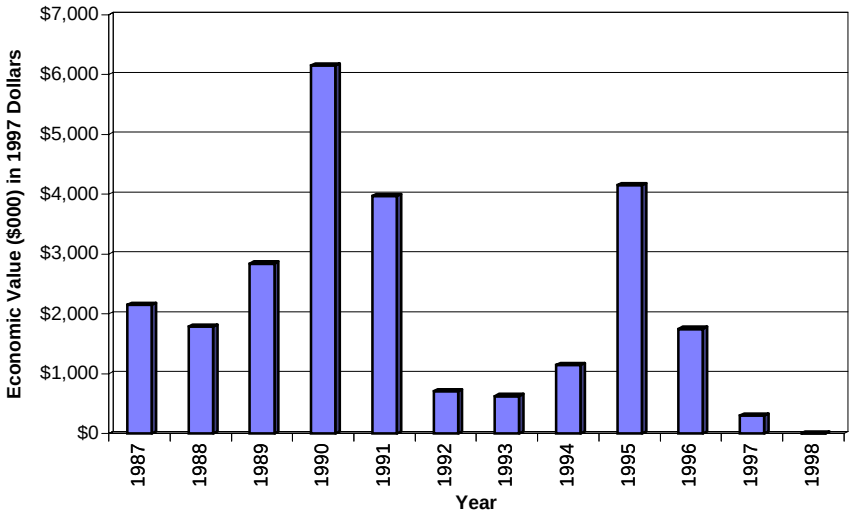
[10] It is important to note that mussel harvest estimates may be somewhat understated because they do not reflect illegal (unreported) harvests.

Exhibit 3-4
Pounds of Mussels Harvested from the UMR, 1987-1998



Kurt Welke, Fisheries and Mussels Manager, Wisconsin Department of Natural Resources, 11/9/98; Bob Williamson, Illinois Department of Natural Resources, 11/17/98; and Travis Moore, Missouri Department of Conservation, 11/25/98

Exhibit 3-5
Economic Value of Mussel Harvests, 1987-1998



Kurt Welke, Fisheries and Mussels Manager, Wisconsin Department of Natural Resources, 11/9/98; Bob Williamson, Illinois Department of Natural Resources, 11/17/98; and Travis Moore, Missouri Department of Conservation, 11/25/98

- Reduced supply of mussels due to over-harvesting;
- Reduced demand for mussels due to the collapse of the Japanese cultured pearl industry;
- Tighter state regulations on the size of mussels that can be harvested; and,
- Competition from zebra mussels.

Despite higher mussel prices for much of the 1990s, the total economic value of mussel harvests from the UMR has decreased due to smaller harvests (see Exhibit 3-5). State Department of Natural Resources officials point out that due to the collapse of the cultured pearl industry in 1998, there has been no demand for mussels and prices have fallen. Without a market to sell mussels, very few people have purchased a musseling license.[11]

For most commercial musselers, mussel harvesting provides a supplemental income rather than full-time employment. In 1990, the peak year for mussel harvests, over 2,500 people were licensed musselers.[12] Since that peak, the number of licensed musselers has dropped from 1,500 in 1992 to roughly 40 in 1998.

TRAPPING

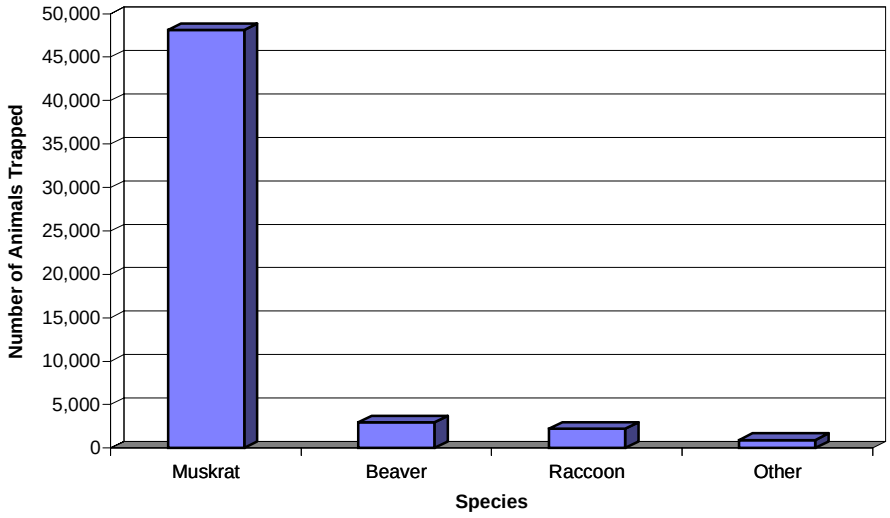
The majority of trapping activity on the UMR occurs within the UMR National Wildlife and Fish Refuge, which extends 261 miles

[11] Personal communications with: (1) Kurt Welke, Fisheries and Mussels Manager, Wisconsin Department of Natural Resources, 11/9/98; (2) Bob Williamson, Illinois Department of Natural Resources, 11/17/98; and (3) Travis Moore, Missouri Department of Conservation, 11/25/98.

[12] Depending on the state data collection method, the number of licensed musselers counted may include harvesters, helpers, and buyers.

along the river from north of Wabasha, Minnesota to near Rock Island, Illinois, and encompasses most of Pools 4 through 14. The refuge covers close to 200,000 acres of mostly open water, bottomland hardwoods, and aquatic vegetation. Although some trapping also takes place outside the refuge on state-managed land and other Fish and Wildlife Service refuges, no data are available on this trapping activity. According to Fish and Wildlife Service staff, little trapping occurs south of the National Wildlife and Fish Refuge because the channel narrows, providing less wildlife habitat.[13]

Exhibit 3-6
Number of Animals Trapped in the UMR National Wildlife and Fish Refuge, 1996-97 Season



Source: "1996-97 Trapping Report," Upper Mississippi River National Wildlife and Fish Refuge, 1998.

Trappers can obtain a permit to trap on the National Wildlife and Fish Refuge at a cost of $15 per season. The permit allows the trapper to set a maximum of 40 traps and requires the trapper to submit a fur catch report at the end of the season. Data from these reports have been collected in 1990 and 1992-96. Over these six years, the number of permits issued to trappers has ranged from 292 to 466, with about 87 percent of permit holders actively trapping.[14] Trapping is primarily viewed as a form of recreation and a means of supplementing income, rather than as full-time employment.[15]

Number of Animals Trapped

By far, muskrats are the most commonly trapped animal along the UMR, representing almost 90 percent of the animals trapped in the 1990s. As Exhibit 3-6 shows, Over 48,000 muskrats were trapped during the 1996-97 season. In comparison, only about 3,000 beavers and 2,200 raccoons were trapped. Other animals trapped during the 1996-97 season included mink (450), opossum (396), skunk (23), gray fox (17), otter (14), coyote (7), and red fox (5). Pools 7-10 and 13 accounted for about 80 percent of the muskrats trapped and close to two-thirds of the beavers and raccoons trapped. The highest number of muskrats (14,180) and beavers (556) were trapped around Pool 9.

[13] Personal communication with Eric Nelson, UMR National Wildlife and Fish Refuge, and Dick Steinbach, Mark Twain National Wildlife Refuge, 11/5/98.

[14] Joseph H. Wlosinski and Laurie B. Wlosinski, "Muskrat Harvests, Water Levels, and Aquatic Vegetation on the Upper Mississippi River National Wildlife and Fish Refuge," Project Status Report, Long Term Resource Monitoring Program, U.S. Geological Survey, June 1998.

[15] Personal communication with Eric Nelson, UMR National Wildlife and Fish Refuge, 11/5/98.

Exhibit 3-7
Economic Value of Pelts Trapped in the UMR National Wildlife and Fish Refuge, 1996-97 Season

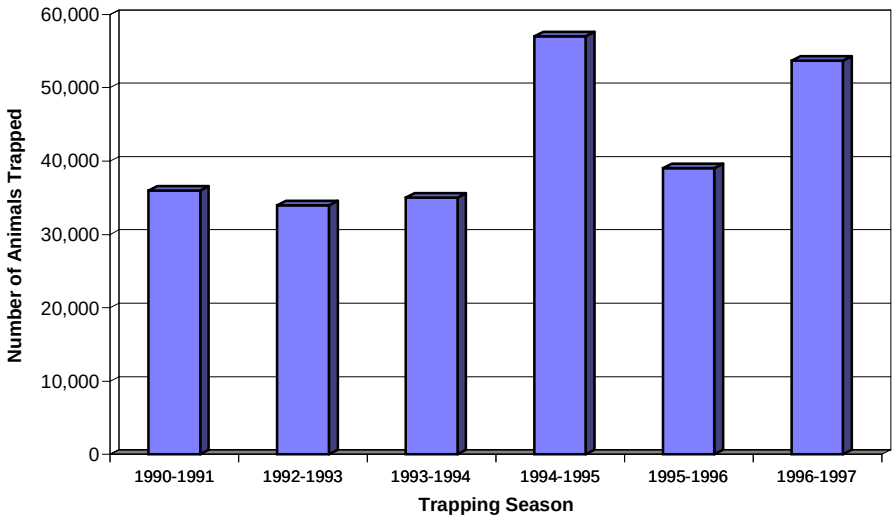
Species	Number of Animals Trapped	Average Price Per Pelt	Total Economic Value of Pelts
Muskrat	48,115	$4.15	$199,677
Beaver	2,966	$20.44	$60,62
Raccoon	2,203	$14.57	$32,09
Mink	450	$20.50	$9,225
Opossu	369	$1.40	$554
Skunk	23	$3.36	$77
Gray Fo	17	$9.37	$159
Otter	14	$45.66	$639
Coyote	7	$11.57	$81
Red Fox	5	$16.49	$82
All Animals	53,751	--	$303,218

Source: "Trapping Report 1996-97: Upper Mississippi River National Wildlife and Fish Refuge," February 3, 1998; and John F. Olson, "1997-98 Wisconsin Furbearer Status Report" obtained from "http://www.dnr.state.wi.us" on 11/11/98.

Economic Value of Pelts

Trappers sell animal pelts to fur buyers, who in turn sell them to the fur industry. Pelts are primarily used to make fur coats, but other fur products include hats, earmuffs, bags/purses, pillows, and toys (e.g., teddy bears). The total economic value of pelts, which eclipsed $300,000 for the 1996-97 season, reflects the number of animals trapped multiplied by the average price per pelt (see Exhibit 3-7). Muskrats accounted for 65 percent of the total pelt value, followed by beaver (20 percent) and raccoon (11 percent).

Exhibit 3-8
Number of Animals Trapped in the UMR National Wildlife and Fish Refuge, 1990-97 Trapping Seasons*



* No data are available for the 1991-92 season or for seasons prior to 1990-91.
Source: "1996-97 Trapping Report," Upper Mississippi River National Wildlife and Fish Refuge, 1998

Trends

The total number of animals trapped in the UMR National Wildlife and Fish Refuge has been relatively stable in the 1990s, with peak trapping activity occurring in the 1994-95 and 1996-97 seasons (see Exhibit 3-8). The higher numbers of animals trapped in these seasons primarily reflects the rise in trapping activity that occurred due to higher pelt prices.[16]

According to Fish and Wildlife Service staff, the number of animals trapped along the UMR is expected to remain stable in the future.[17] However, they note that in any given year the number of animals trapped may increase or decrease depending on changes in pelt prices and wildlife populations. Pelt prices vary due to changes in demand for fur by the garment industry, whereas wildlife populations may rise or fall due to changes in the quality of habitat, weather conditions, and trapping effort.

[16] Jeff Dankert, "Pelt Prices Increase," *Winona Daily News*, December 22, 1996.

[17] Personal communication with Eric Nelson, UMR National Wildlife and Fish Refuge, and Dick Steinbach, Mark Twain National Wildlife Refuge, 11/5/98.

Water Supply

Chapter 4

Water from the UMR is an essential input into industrial and commercial economic activity as well as the daily lives of residents of the UMR region. In this chapter, we examine the public water supply system in the corridor counties, focusing on the portion that relies on surface water sources such as the UMR. This system supplies over 550 million gallons of water each day, with the majority going to domestic users in cities such as Minneapolis, St. Louis, and Rock Island. Other major users include industrial and commercial facilities such as office buildings and hotels. We estimate that the relevant portion of the water supply sector employs between 650 and 1,300 people, generating annual revenues of between $87 million and $176 million.

The discussion below is divided into several sections. First, we review the data sources and methods used to estimate key figures. We then provide an overview of the water supply sector in the region that summarizes total quantities supplied and major users. Next, we discuss revenue and employment estimates. Finally, we close with a discussion of recent trends in water use in the UMR region.

DATA SOURCES AND METHODOLOGY

Water supply data provided in this chapter are based on the U.S. Geological Survey's *Water Use in the United States* county estimates for 1995. In the USGS data, public supply estimates include all public and private water systems that supply water to at least 25 people, or have a minimum of 15 connections. In this chapter, we report all surface water withdrawals in the 60-county study area. While the majority of these withdrawals are from the UMR main stem, a portion is likely associated with tributaries or other water bodies. As such, we likely overstate withdrawals from the main stem of the UMR.

Most of the water in the public supply system is delivered to domestic, commercial or industrial water users, although some is used for public purposes such as street washing and fire fighting. USGS estimates deliveries to specific sectors by gathering information from water supply authorities and through per-capita estimates (in the case of domestic users). Our estimates assume that 61 percent of the water used by each category of user is from surface water supplies; this estimate is based on the overall split of surface water and groundwater use in the corridor.

While this chapter focuses primarily on the public water supply sector, some businesses in the UMR corridor also use self-supplied surface water. For industrial and commercial businesses, USGS obtains its data on self-

supplied withdrawals from state agencies that permit withdrawals or require permits to operate drinking water supplies. For example, self-supplied water use estimates for the industrial sector are estimated using state permit programs that require industrial users to report withdrawals and returns. In some cases, USGS bases the total amount of self-supplied withdrawals on the population of facilities (i.e., workers in an office building, average occupancy of a hotel, or the number of students at a university).

We derive employment estimates using County Business Patterns data for Standard Industrial Classification (SIC) code 4940. Water supply includes establishments primarily engaged in distributing water for sale for domestic, commercial, and industrial use. It does not include systems that distribute water primarily for irrigation services. Because of confidential business information issues, the County Business Patterns data provide a range estimate of employment estimates when only a few establishments are located in a county.

We estimate revenue in the water supply sector based on the number of employees reported in the County Business Patterns data. To do so, we multiply the number of employees by an estimate of revenue per employee. The revenue per employee figure of $134,635 is based on national data reported in the *1992 Economic Census CD-ROM Report Series*.

The major data sources used in this chapter include the following:

- U.S. Geological Survey, *Water Use in the United States, 1995*, obtained from "http://water.usgs.gov/watuse/" on 11/12/98.
- U.S Department of Commerce, Bureau of the Census, C*ounty Business Patterns 1994 & 1995*, November 1997.
- Bureau of the Census, *1992 Economic Census CD-ROM Report Series*, November 1997.
- McKnight Foundation, *The Mississippi River in the Upper Midwest, Its Economy, Ecology, and Management*, 1996.

OVERVIEW OF WATER SUPPLY AND WATER USERS

Water Supply System

Public supply systems furnish 557 million gallons of surface water per day in the 60-county UMR corridor (see Exhibit 4-1). After surface water is withdrawn, it is generally transported to a publicly owned treatment facility. The treatment facility filters and disinfects the water and removes organic and inorganic contaminants. Water supplies that draw their water from surface water sources are required to test for some contaminants on a more routine basis than systems that draw from groundwater sources. To ensure that a water supply meets regulations, water is tested at various stages of the treatment

process. After treatment, the water is delivered to domestic, commercial, and industrial water users through transmission pipes.

In addition to deliveries from the public supply, many sectors using public water also use self-supplied surface water. During 1995, the total amount of self-supplied surface water withdrawals in the UMR corridor was 6.6 billion gallons per day. As shown in Exhibit 4-1, the vast majority (96 percent) of this water was used by thermoelectric power generators. Generally, self-supply is more common in industrial sectors using the water for cooling or other purposes that require little or no purification of the water.

Exhibit 4-1
Surface Water Use By Type in UMR Corridor (Millions of Gallons Per Day)

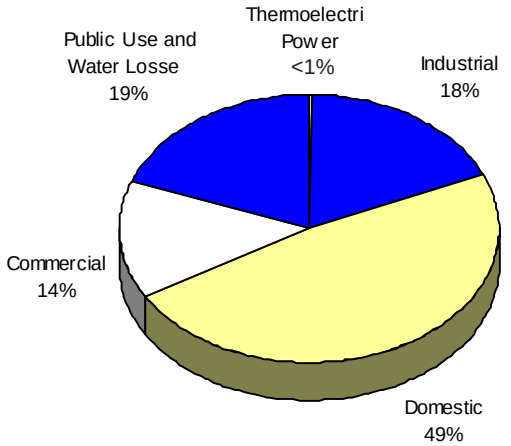
User Category	Public Water Deliveries from Surface Water	Self-Supplied Surface Water	Total Surface Water Use
Thermoelectric Power	2.3	6,388.2	6,390.5
Industrial	99.7	224.9	324.6
Domestic	269.2	0.0	269.2
Commercial	79.3	19.7	99.0
Mining	0.0	17.5	17.5
Agriculture	0.0	13.5	13.5
Public Use and Water Losses	106.7	0.0	106.7
Total	557.2	6,663.9	7,221.1

Source: U.S. Geological Survey, *Water Use in the United States, 1995*, obtained from "http://water.usgs.gov/watuse/" on 11/12/98.

Major Users of the Public Water Supply

Domestic users are the largest recipients of public surface water supply in the UMR corridor, accounting for approximately half of all deliveries (see Exhibit 4-2).[1] Total surface water deliveries to all domestic water supply systems in the UMR corridor were 269 million gallons per day during 1995. Domestic water use includes water for normal household purposes such as drinking, food preparation, bathing, flushing toilets, washing clothes and dishes, and watering lawns and gardens. As shown in Exhibit 4-3, 22 municipalities in the UMR corridor use the river as a source of household water. Additionally, some of these public water supply facilities, such as Minneapolis Water Works, serve surrounding communities (see text box).

Exhibit 4-2
Public Supply Deliveries from Surface Water, by User Sector (Corridor Counties)



Source: U.S. Geological Survey, *Water Use in the United States, 1995*, obtained from "http://water.usgs.gov/watuse/" on 11/12/98.

Industrial water users receive approximately 18 percent of all public supply surface water deliveries in the UMR corridor. Industrial water use includes processing, washing, and cooling water used in facilities that manufacture products. All industrial water users in the UMR corridor received approximately 100 million gallons per day in deliveries during 1995. Industrial facilities also used 225 million gallons per day in self-supplied surface water withdrawals.

Commercial users receive approximately 14 percent of all public supply surface water deliveries in the UMR cor-

[1] As noted, we use the 61/39 percent split of surface water to groundwater withdrawals to weight the deliveries to each sector.

Exhibit 4-3

Municipalities Using UMR Water as a Source For Their Public Water Supply

IOWA	
• Burlington	• Fort Madison
• Davenport	• Keokuk
ILLINOIS	
• Alton	• Moline
• Chester	• Nauvoo
• East Moline	• Quincy
• East St. Louis	• Rock Islan
• Granite City	• Warsaw
• Hamilto	
MINNESOTA	
• Brooklyn Center	• St. Paul
• Minneapolis	
MISSOURI	
• Cape Girardeau	• Louisian
• Hannibal	• St. Louis

Source: Barbara Naramore, Upper Mississippi River Basin Association, "Comments on the Draft Economic Profile of the Upper Mississippi Region," February 12, 1999.

UMR Water Use in Minneapolis

Minneapolis is a major user of UMR water, relying on the Minneapolis Water Works (MWW) facility in Anoka County for its water needs. The MWW services nearly 500,000 people in Minneapolis and seven surrounding suburbs. About 40 percent of the city's water is used by residents for drinking and household water, 45 percent is for commercial and industrial use, and the remaining 15 percent is for municipal and other uses. The MWW withdraws 25 billion gallons of water from the Mississippi River annually, averaging 70 million gallons per day with peak rates during the summer as high as 180 million gallons per day. Some of the largest users of the public water supply in Minneapolis are the University of Minnesota and the Metropolitan Airports Commission.

Source: City of Minneapolis Home Page, *Minneapolis Water Facts* obtained from http://www.ci.minneapolis.mn.us/citywork/public-works/water/facts.html on 3/8/99.

ridor. Commercial water use includes water for hotels, motels, restaurants, office buildings, other commercial facilities, and civilian and military institutions. Deliveries to golf courses are also included in commercial water use. Total surface water deliveries to commercial water users in the UMR were 79 million gallons per day during 1995. These facilities used an additional 20 million gallons per day in self-supplied surface water withdrawals.

The thermoelectric power category includes the generation of power with fossil fuel and nuclear energy. Total deliveries to this sector are less than one percent of all public supply surface water deliveries, as most of the water used to generate power is self-supplied. Most of the 6.4 billion gallons of water withdrawn per day by these plants is used for condenser and reactor cooling. In the UMR corridor, only a small percentage of all water withdrawn for thermoelectric power generation was consumed as a result of once-through, cooling tower, or pond cooling. Therefore, the vast majority of all water used in the UMR corridor by thermoelectric power producers is returned to the river or its tributaries.

Public use accounts for approximately 20 percent of all surface water deliveries from the public supply in the UMR corridor. Public water use includes water used for firefighting, street washing, municipal office buildings, parks and swimming pools, and water used to flush out filters at water treatment facilities. This category also includes water that is lost in the distribution system. In Minneapolis, these water losses are about five percent of all water used, or about one-quarter of all public use.[2] Losses in less modern systems may be as high as 10 percent of all water used.

REVENUES AND EMPLOYMENT IN THE WATER SUPPLY SECTOR

County Business Patterns data indicate that the overall water supply sector in the UMR corridor employs roughly 640 to 1,700 people. Because a portion of the supply activity is based on groundwater rather than surface water, we scale the employment figures to estimate the portion of employment associated with surface water sources. Specifically, we apportion 61 percent of the employment to surface water withdrawal. The resulting employment estimates are presented in Exhibit 4-4. As shown, between 650 and

[2] Personal communication with Paul Koski, Minneapolis Water Works, on 12/29/98.

1,300 people are employed at relevant water supply facilities, with Missouri having the largest estimated number of employees.

As noted, we estimate revenue based on the national average revenue per employee in the sector. Multiplying this figure ($134,635) by employment provides a rough estimate of revenue associated with surface water supply in the UMR corridor. As shown, the sector generates between $87 million and $176 million per year.

Exhibit 4-4
Employment and Revenue Associated With UMR Corridor Surface Water Supply

	Employment	Estimated Revenue
Minnesota	253[a]	$34,063,000
Wisconsin	0[b]	$0
Iowa	12 - 84	$1,616,000 - $11,309,000
Illinois	74 - 331	$9,963,000 - $44,564,000
Missouri	307 - 637	$41,333,000 - $85,762,000
Total	646 - 1,305	$86,975,000 - $175,698,000

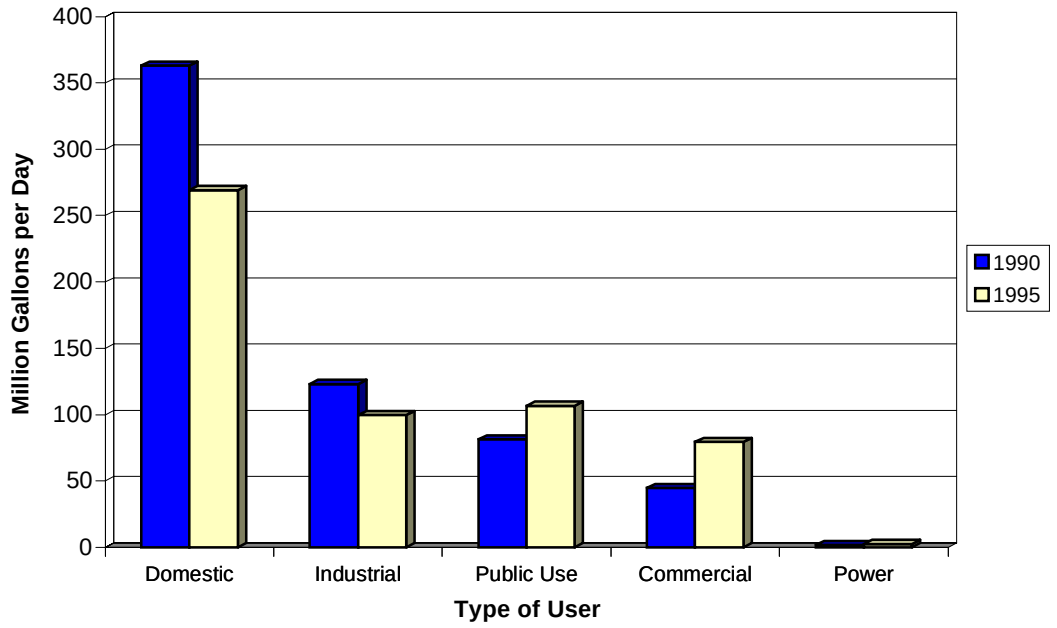
[a] *City of Minneapolis Home Page,* Minneapolis Water Facts *obtained from http://www.ci.minneapolis.mn.us/citywork/public-works/water/facts.html on 3/8/99. The Minnesota employment estimate may understate total employment because it only reflects employment at Minneapolis Water Works.*
[b] *Data indicate no surface water withdrawals in the Wisconsin corridor counties.*
Source: U.S Department of Commerce, Bureau of the Census, County Business Patterns 1994 & 1995, *November 1997; Bureau of the Census,* 1992 Economic Census CD-ROM Report Series, *November 1997.*

TRENDS IN THE WATER SUPPLY SECTOR

Total surface water use has declined by almost 10 percent in the UMR corridor, from 614 million gallons per day in 1990 to 557 million gallons per day in 1995. As shown in Exhibit 4-5, this change was driven by a domestic use decline of more than 25 percent during the period. While commercial and public water use rose, these sectors are relatively small and have less of an impact on total use.

The decline in domestic water use follows national trends that are attributed to conservation programs which have lowered per capita use from 184 gallons

Exhibit 4-5
Trends in Surface Water Deliveries in UMR Corridor Over Time



Source: U.S. Geological Survey, *Water Use in the United States, 1995*, and *Water Use in the United States, 1990,* obtained from "http://water.usgs.gov/watuse/" on 11/12/98.

per day in 1990 to 179 gallons per day in 1995.[3] As in other parts of the country, conservation has been prompted by increases in rates paid by users. For example, domestic water rates in Minneapolis have increased from $0.85 per 100 cubic feet in 1989 to $1.40 per 100 cubic feet in 1998.[4] Industrial water use is down as a result of new technologies that require less water, improved plant efficiency, and increased water recycling.

Future domestic water use trends are difficult to estimate because decreased use on a per capita basis due to higher water prices and active conservation programs may be offset by an increased demand for water due to a larger population. Industrial water use is expected to continue to decline as total water use per unit of production is expected to continue falling; however, forecasts suggest that this decline will not be as sharp as in the recent past.[5]

[3] U.S. Geological Survey, *Water Use in the United States, 1995*, obtained from "http://water.usgs.gov/watuse" on 11/12/98.

[4] Personal communication with Dave Moore, Minneapolis Water Works, on 12/21/98.

[5] USGS, op cit.

Recreation and Its Role in the Regional Economy

Chapter 5

The natural beauty and abundant wildlife of the Upper Mississippi River attract millions of boaters, anglers, hunters, and other individuals seeking recreation. The majority of recreational activity originates at over 500 developed recreational areas along the river, as well as at thousands of permitted docks and marina slips. Much of the forested area along the river is publicly owned and numerous public recreational resources exist throughout the study area, including state parks, state forests, wildlife refuges, and recreational centers. Exhibit 5-1 provides examples of major public recreational areas along the UMR.

Recreational spending fuels a wealth of economic activity in the region and nationwide. This chapter summarizes the linkages between recreation and economic activity. Available studies indicate that recreation creates over $200 million in direct revenue to businesses in the counties along the river (i.e., output before multiplier effects are considered), creating jobs for about 3,000 people. The economic impacts of recreation are even greater when we consider the effects on output and jobs in the five-state area and the nation as a whole.

In the sections below, we discuss:

- the primary sources of information on the economic impact of recreation in the UMR region;
- the estimated significance of recreation for the commercial economy of the region; and
- trends in recreational activity.

Exhibit 5-1

Examples Of Recreational Resources Along the UMR

State	Recreational Resources
Minnesota	• Seven state parks • Richard J. Dorer Memorial State Forest • Mississippi National River and Recreation Area
Wisconsin	• Great River State Trail • Five state parks • Grant River Recreational Area
Iowa	• Effigy Mounds National Monument • 20 state parks, forests, and refuges
Illinois	• 24 state natural areas and 13 state parks • Mark Twain National Wildlife Refuge
Missouri	• Eight state parks • Clarence Cannon National Wildlife Refuge • 26 Natural Areas (MO Department of Conservation)
Multi-State	• Upper Mississippi River National Wildlife and Fish Refuge • Municipal parks

Source: U.S. National Park Service, *Mississippi River Corridor Study, Vol.2: Inventory of Resources and Significance*, 1996; Missouri Department of Conservation website; Minnesota Department of Natural Resources website.

DATA SOURCES AND METHODOLOGY

Corps of Engineers Recreation Study

The most extensive survey of recreational activity in the UMR region was conducted by the U.S. Army Corps of Engineers and described in the report entitled *Economic Impacts of Recreation on the Upper Mississippi River*

System.[1] The central element of this study was a survey of over 1,300 individuals using various types of access points along the river. Relevant access points included developed recreational areas, marinas, permitted docks, and other sightseeing areas and visitor centers. Using a combination of on-site interviews and mailback questionnaires, the survey gathered information on two major topics:

- First, the survey examined the type of recreational activity pursued on the river and the number of trips and visitors associated with these activities. The authors then used statistical methods to infer the total extent of recreational activity on the UMR.

- Second, the survey characterized the recreational expenditures made by UMR visitors. These expenditure "profiles" were then combined with activity information to estimate total recreational expenditures. The study then applied a regional economic model to examine how recreational spending affects output by businesses at the local, state, and national levels.

The Upper Mississippi River National Wildlife And Fish Refuge

Established in 1924, Upper Mississippi River National Wildlife and Fish Refuge stretches 261 miles along the Mississippi River through parts of Minnesota, Wisconsin, Iowa, and Illinois. Nearly 200,000 acres of habitat serve approximately 270 species of birds, 57 species of mammals, 45 species of amphibians and reptiles, and 113 species of fish. Particularly noteworthy is the refuge's role in supporting bird migration. Key waterfowl species migrating through or nesting in the refuge include tundra swans, wood ducks, canvasback ducks, and other diving ducks. In addition, bald eagles winter in the refuge and water birds (e.g., herons, egrets) nest in bottomlands. This ecological diversity has led the American Bird Conservancy to designate the refuge as a *Globally Important Bird Area in the United States*.

The refuge is a popular recreational destination, attracting approximately 3.5 million visitors per year. Popular pursuits include wildlife viewing, hunting, fishing, camping, and boating.

Source: Upper Mississippi River National Wildlife and Fish Refuge web site (http://www.emtc.nbs.gov/umr.refuge.html on 3/2/99).

The geographic area addressed by the Corps survey included several areas not included in the study area for this report. Most significantly, the Corps study area includes 13 counties along the Illinois river. We exclude the economic impacts of expenditures from these counties to make the recreational expenditure information more consistent with the 60-county study area used in this report for other sectors. We do so by scaling the aggregate expenditure figures for the full Corps study area by the proportion of recreational activity that occurs in the relevant subregions. It is noteworthy that the Illinois River is more urbanized and generally less popular with recreationalists than the Mississippi. As a result, the adjustment to the Corps study estimates is relatively minor. Specifically, over 90 percent of recreational activity occurs on the UMR exclusive of the Illinois River.

The Corps study area also includes small portions of the St. Croix and Minnesota Rivers. As a result, it covers five other counties not included in our study area. Likewise, our study area includes one county (Anoka county in Minnesota) not included in the Corps study. While the available data do not allow us to adjust the Corps figures to account for these discrepancies, the net effect of these differences is likely to be minor.

[1] U.S. Army Corps of Engineers, *Economic Impacts of Recreation on the Upper Mississippi River System — Recreation Use and Activities Report and Recreation Expenditure Report*, March 1993.

Other Recreation Studies

While the Corps study represents the most complete examination of UMR recreation, a variety of other studies provide recreational information for specific pools, recreation facilities, or recreational activities. We use these studies to complement information from the Corps report.

It is also important to note that the UMR supports recreation beyond the river's boundaries and even the county corridor. Most notably, the UMR is a critical resource for millions of migratory birds during fall and spring migration. Below, we consider the economic impact of hunting and viewing of waterfowl throughout the five-state area, activity that at least indirectly depends on the UMR.

Exhibit 5-2
Recreational Activity in the UMR

Number of Recreational Visits	11.3 million
Numbers of People Engaging in Different Forms of Recreation*	
Fishing	2,021,000
Boating	1,969,000
Hiking and Sightseeing	1,318,000
Camping and Picnicking	510,000
Swimming	204,000
Hunting	149,000
Other	309,000

Source: U.S. Army Corps of Engineers, *Economic Impacts of Recreation on the Upper Mississippi River System -- Recreation Use and Activities Report and Recreation Expenditure Report*, March 1993. Figures adjusted t reflect differences in study area.
* Total does not sum because people may participate i more than one activity.

RECREATIONAL ACTIVITY AND ECONOMIC IMPORTANCE

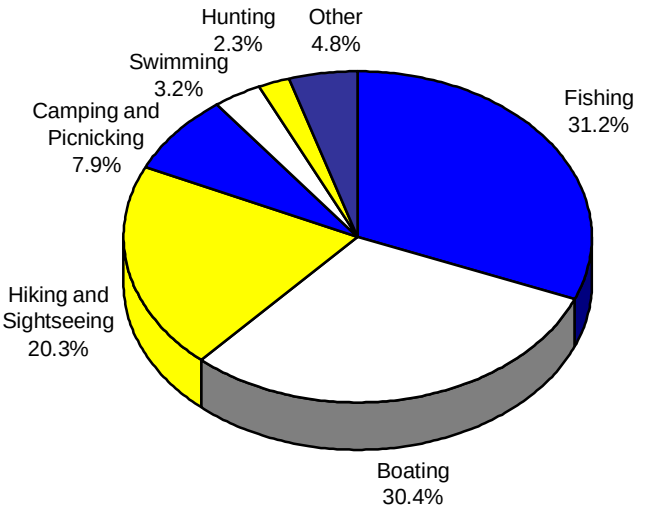
Economic Activity Associated with Developed Recreational Areas

The results of the Corps of Engineers survey clearly demonstrate the economic significance of recreation in the UMR region. As shown in Exhibit 5-2, recreational enthusiasts make over 11 million visits to the UMR each year. The data suggest that about three-quarters of those recreating on the UMR are residents of the counties bordering the river and that the majority of the usage occurs on the northern stretch of the UMR between the Twin Cities and Rock Island, Illinois.

Visitors engage in a variety of recreational activities. The responses offered in the survey suggest that fishing and boating are the most popular pursuits; about 31 percent of those surveyed fished during their visit while 30 percent engaged in recreational boating (see Exhibit 5-3). Hiking and sightseeing are also very popular. Camping, picnicking, swimming, and hunting represent other key pursuits.

Spending by visitors engaged in recreation fuels a significant amount of economic activity in the counties bordering the UMR. Expenditures by recreationalists generally fall into two categories:

Exhibit 5-3
Distribution of UMR Recreational Activities



Source: U.S. Army Corps of Engineers, *Economic Impacts of Recreation on the Upper Mississippi River System — Recreation Use and Activities Report and Recreation Expenditure Report*, March 1993.

- Trip-related expenditures are one-time expenses that vary with the number and length of trips taken. Examples include gas, food, lodging, boat rentals, and guide fees.

- Durable goods expenditures involve purchasing items with useful lives that extend beyond a single trip. Examples include boats, trailers, fishing equipment, and camping gear.

As shown in Exhibit 5-4, annual trip-related expenses by UMR recreationalists total about $216 million. In addition, recreationalists spend about $171 million each year on durable goods that they use when visiting the UMR.

Exhibit 5-4
Summary of UMR Recreational Expenditures

Total Annual Trip-Related Expenditures	$ 216 million
Total Annual Expenditures on Durable Goods	$ 171 million
Total Annual Expenditures (trip-related and durable goods)	$ 387 million

Source: Carlson, Bruce, et al., *Economic Impact of Recreation on the Upper Mississippi River System*, U.S. Army Corps of Engineers, April 1995. Figures adjusted to reflect study area.

The purchases that recreationalists make affect the economy at a number of levels. Many purchases are made locally, i.e., at establishments in counties along the UMR. Particularly significant are trip-related expenditures typically made in the immediate vicinity of recreational activity, such as food purchases and boat rentals. This spending supports a variety of local businesses in the UMR region. Recreationalists make other trip-related as well as durable goods expenditures that affect businesses outside the immediate UMR corridor.

The Corps study examined how recreational expenditures affect commercial activity in three regions: the counties along the UMR, the five-state area, and entire U.S. As shown in Exhibit 5-5, recreational spending at businesses in the immediate vicinity of the UMR accounts for more than $200 million in output (sales) and this economic activity supports approximately 3,000 jobs. Spending across larger geographic areas reveals an even greater economic impact. Nationally, spending by UMR recreationalists generates about $336 million in output, supporting over 4,800 jobs.

Exhibit 5-5
Direct Economic Impact of UMR Recreational Expenditures

	Output	Jobs
UMR Corridor Counties	$200 million	3,000
Five-State Area	$262 million	4,100
Entire U.S.	$336 million	4,800

Source: Carlson, Bruce, et al., *Economic Impact of Recreation on the Upper Mississippi River System*, U.S. Army Corps of Engineers, April 1995. Figures adjusted to reflect study area.

The full impact of recreational expenditures goes beyond the direct effects of spending at retail businesses supplying goods and services used in recreation. In any geographic area, businesses both purchase output from and supply input to other businesses in that region. As a result, when people purchase goods from a particular business, industries linked to that business are also affected. For example, anglers purchase fishing equipment at sporting goods stores. These purchases also affect manufacturers of fishing poles, wading gear, lures, and other equipment, which in turn affect suppliers of raw materials (e.g., rubber for wading boots). An increase in fishing equipment sales would spur increases in the output and employment of these secondary industries.

The Corps study used a computer-based regional economic modeling approach to characterize the full impact of recreational spending once the "multiplier effects" ripple through all sectors of the economy. The grand

tally of U.S. economic output that depends on UMR recreation is roughly $1.1 billion per year, supporting approximately 12,600 jobs.

Other Studies of UMR Recreation

While it accurately characterizes activity at developed recreational areas on the UMR, the Corps study did not attempt to evaluate certain other aspects of the economic relevance of recreational spending. Below, we discuss two important considerations: recreation at sites other than developed areas and the way in which the UMR supports recreation beyond its banks.

Recreation at Sites Not Addressed in the Corps Study

Recreational activity may originate from areas other than those surveyed by the Corps. Most notably, the study is not designed to capture recreation at dispersed, undeveloped locations along the river. Other recreational access points not included in the Corps survey include urban river corridor parks, private clubs, riverside households without permitted docks, and river festivals such as fishing tournaments. Overall, the economic significance of recreation may be greater than is reflected in the Corps study when the full set of recreational access points and activity is considered. For instance, Twin Cities riverside parks attract over 4 million people annually, many for activities not captured in the Corps study (e.g., bicycling).[2] Alternative data on the number of recreational fishing days on the UMR suggest the potential importance of considering all types of recreational access. For example, one study estimated 8.5 million fishing days for the region, exceeding the number estimated in the Corps study (roughly three or four million).[3]

Support of Recreational Activity Beyond the UMR Region

A major natural resource like the UMR affects ecological conditions, and human uses of the ecosystem, well beyond its immediate boundaries. Taking these broader ecological linkages into account suggests that restricting attention to recreational activity directly on the river (as is the case in the Corps study) may understate the actual significance of the river for recreation.

Hunting and wildlife viewing provide good examples of the broader reliance on the UMR ecosystem. The Corps survey examined hunting and viewing activity conducted or initiated at developed recreational areas on the UMR. However, the UMR supports hunting and viewing activity well beyond its banks. In all, about 40 percent of all waterfowl in North America rely on the Mississippi Flyway, the migration route through the central portion of the continent. Therefore, waterfowl hunting and viewing activity throughout the

[2] Ray, Dan, The McKnight Foundation, "Comments on the Economic Profile of the Upper Mississippi River Region," March 10, 1999.

[3] Fremling, C.R., et al., Mississippi River Fisheries: A Case History, 1989; as reported in USGS Environmental Management Technical Center, *Ecological Status and Trends Report of the Upper Mississippi River System*, forthcoming.

Exhibit 5-6

Economic Impact of Waterfowl-Related Recreation in Minnesota, Wisconsin, Iowa, Illinois, And Missouri

	Hunting	Viewing	Total
Direct Retail Sales	$ 127,317,000	$ 545,787,000	$ 673,104,000
Total Effect on Output (direct sales and multiplier effects)	$ 251,582,000	$ 1,148,772,000	$ 1,400,354,000
Jobs	2,770	14,07	16,84

Source: Southwick Associates, *The Economic Contribution of Bird and Waterfowl Recreation in the United States During 1991*, prepared for International Association of Fish and Wildlife Agencies and the U.S. FWS North American Waterfowl and Wetlands Office, March 1995.

central parts of the U.S. and Canada depend indirectly on the ability of the UMR to provide food and shelter to migrating populations as well as nesting habitat for some species.

As a result of these ecological connections, it is useful to consider hunting and viewing activity in a broader geographic area, rather than activity on the river alone. A study completed for the U.S. Fish and Wildlife Service highlights the economic importance of waterfowl hunting and viewing activity nationwide. As shown in Exhibit 5-6, the economic impact of waterfowl hunting and viewing in the five-state area alone is large. Direct retail sales associated with hunting and viewing expenditures are over $670 million. If we take into account the full economic impact (including multiplier effects), the significance of hunting and viewing in the region is well over $1 billion, with over 16,800 jobs supported in businesses such as sporting goods retail, restaurants, and lodging.

Caveats and Uncertainties

A number of issues and uncertainties should be considered when interpreting the above information on the economic impact of recreation. First, the Corps study of recreational activity is survey-based and therefore subject to uncertainties inherent in these types of data. For example, responses given in the survey year may have been affected by weather, water levels, and other factors, limiting the degree to which they are representative of recreational activity in other years.

Second, the economic impact estimates derived in both the Corps study as well as the national study of waterfowl-related recreation rely on regional economic modeling methods. The analyses reflect the economic activity generated by recreational expenditures. Many of the expenditures (e.g., bait, lodging) would likely be eliminated if recreation ceased. Some expenditures, however, would occur regardless of whether individuals fish, boat, etc. For example, individuals would still purchase food from stores if they do not fish. Therefore, the results likely overstate the change in economic activity that would occur if recreational activity were eliminated.

Similarly, 70 percent of respondents in the Corps survey indicated that they would have made a recreational trip if the UMR were not available; i.e., substitute recreation sites exist in the region. Therefore, the recreational activity and economic impacts attributed to the UMR may be overstated.

Finally, it is noteworthy that overlap likely exists between our estimates of the economic impacts of recreation and analogous estimates for tourism. In particular, the Corps survey included "sightseeing" as one of the activities contributing to economic output. Such activity is clearly captured in estimates of tourist activity and spending presented later in this report.

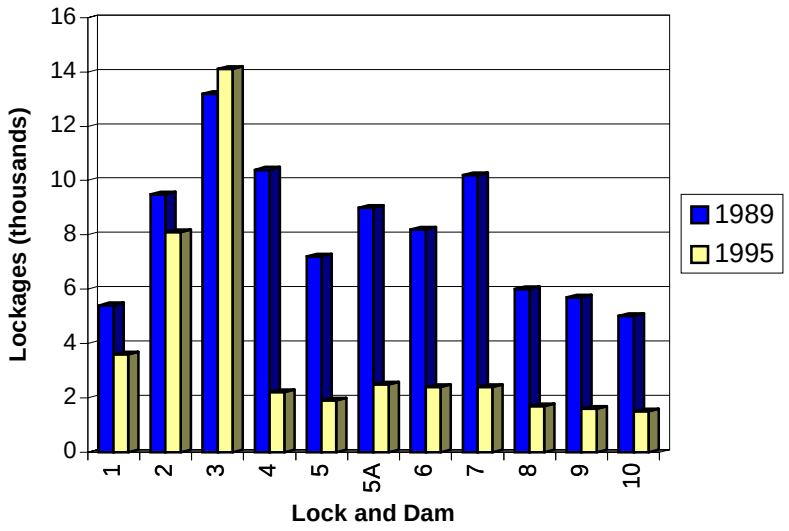
TRENDS IN RECREATIONAL ACTIVITY

No comprehensive data exist for assessing trends in recreational activity on the UMR. Data are available for specific activities on specific pool segments of the river, and the evidence paints a somewhat inconclusive picture of activity level trends.

On the one hand, some data suggest that fishing and boating activity may be decreasing. For example, a detailed survey of Iowa anglers found that those living in the counties along the Mississippi River fished less often relative to past years.[4] Specifically, the average number of days fished fell from 36 in 1986 to 27 in 1994. When asked to describe factors behind their decline in participation, anglers cited issues such as poor water quality and lack of free time. Such declines in participation would be expected based on fishing advisories and perceived declines in water quality on the UMR. Water quality studies performed by the states classify 75 percent of the UMR as impaired for fishing, according to a study examining the UMR from Lake Itasca (north of Minneapolis) to Muscatine, Iowa.[5] Fishing advisories are in place for large portions of the river, restricting consumption of fish of different sizes and species, and sometimes focusing on specific categories of consumers such as pregnant women or children. Overall, only 15 percent of the river is free of fish consumption advisories.

Available data also suggest that recreational boating on the UMR may have declined in recent years. In conjunction with the Minnesota-Wisconsin Boundary Area Commission, the Corps of Engineers conducts a bi-annual aerial photo survey of recreational boats passing through locks 1-10. This stretch of the river extends from the Twin Cities into Iowa and supports the majority of recreational boating on the UMR. As shown in Exhibit 5-7, recreational lockages have decreased at all locks except one (Lock and Dam 3) when considering 1989 relative to 1995. Total lockages decreased by roughly 45,000 lockages over this period. Reasons for the decrease are unclear, but potentially include congestion and competition with commercial craft.

Exhibit 5-7
Comparison of 1989 and 1995 Recreational Boat Lockages at Lock and Dam 1-10



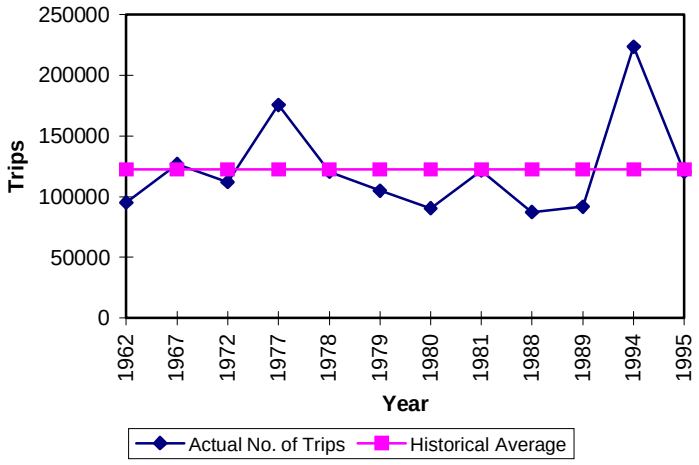
Source: U.S. Army Corps of Engineers, et al., *1993 Recreational Boating Study, Lower St. Croix National Scenic Riverway, Mississippi River Pools 2-10*, January 1995.

Other data suggest that recreational activity has increased or at least held steady in past years. For example, one

[4] Iowa Department of Natural Resources, *Fishing in Iowa: A Survey of 1994 Iowa Anglers*, 1995.

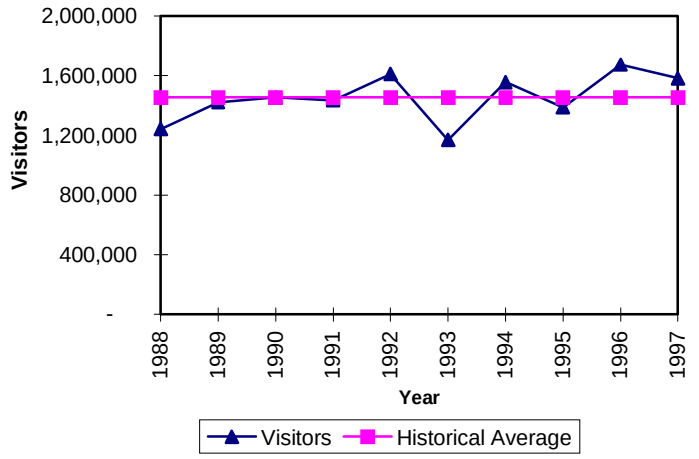
[5] McKnight Foundation, *Upper Mississippi River Resource Book*, February 1996.

Exhibit 5-8
Angler Trips on UMR Pool 4



Source: Stevens, Allen G., *Angler Survey of Pool 4, Mississippi River*, Minnesota Department of Natural Resources, September 1996.

Exhibit 5-9
Visitors to Minnesota State Parks in UMR Region



Source: Minnesota Department of Trade and Economic Development.

study found that, despite variations from year to year, the total number of fishing trips on Pool 4 has generally not changed in the last 30 years. As shown in Exhibit 5-8, the number of trips in 1995 is consistent with the historical average. Data on attendance at Minnesota state parks on or near the UMR shows similar stability. As shown in Exhibit 5-9, the number of visitors to UMR state parks has been relatively constant over the last decade.

Regional data also suggest that participation in key recreational activities has held steady in recent years. Data collected as part of a national Fish and Wildlife outdoor recreation survey examine the number of anglers and hunters by region. In the region that includes Wisconsin and Illinois, the percentage of the total population that engages in recreational fishing went from about 28 percent in 1980 to 30 percent in 1990; the percentage of hunters was essentially unchanged in the period. In the region that includes Minnesota, Iowa, and Missouri, the percentage of anglers went from 36 to 38 percent between 1980 and 1990 while the percentage of hunters was unchanged at 14 percent.[5]

Finally, projections of future recreational activity indicate the continued importance of the UMR as a recreational boating resource. A recent Corps of Engineers study projects recreational boating trips as a function of population growth in the areas surrounding the UMR. The analysis covers the length of the river (through Pool 27) and projects that the number of boating trips will grow from about 2.4 million trips in the year 2000 to about 2.9 million trips in 2050.[6]

Overall, data on recreational activity over time are sparse and show no clear trend. Nonetheless, recreation clearly is and will continue to be a major source of economic activity in the UMR region.

[5] U.S. Fish and Wildlife Service, *1991 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation*, Summary Volume, March 1993.

[6] U.S. Army Corps of Engineers, *Upper Mississippi River-Illinois Waterway System Navigation Study: Effects of Recreational Boating, Recreational Traffic Forecasting and Allocation Models*, Draft, February 1999.

Tourism and Cultural/ Historical Resources

Chapter 6

The history, scenic beauty, and tourist attractions of the Upper Mississippi River draw millions of visitors to the UMR corridor each year. Tourists come for the corridor's cultural and historical resources, riverfront festivals, and riverboat tours and gaming, as well as for recreation such as fishing, boating, and camping. This chapter focuses on the importance of tourism and cultural/ historical resources to the UMR's regional economy; the role of outdoor recreation in the regional economy is addressed in Chapter 5.

Leisure travelers to the UMR corridor spent about $6.6 billion in 1995. This money was spent primarily on lodging, food and drink, transportation, retail shopping, and entertainment. Travel expenditures in the corridor supported about 140,000 jobs, mostly in the hotel, restaurant, and retail industries.

In this chapter, we describe the corridor's cultural and historical resources, river towns and festivals, and other attractions, such as riverboat tours and casinos. In addition, we present travel expenditure and employment information for the corridor and discuss likely future tourism trends.

DATA SOURCES AND METHODOLOGY

As an economic sector, it is difficult to define "tourism" precisely. Unlike sectors such as mining and manufacturing, revenue and employment information for the tourism sector cannot be collected by surveying facilities in a specific industry category (i.e., there is no Standard Industrial Classification code for tourism). The tourism sector generates revenue and creates jobs for multiple types of businesses, such as hotels, restaurants, retail stores, and rental car agencies. Typically, the revenue and employment of these businesses is only partly dependent on tourism.

To estimate tourism-related revenue and employment, state tourism departments and economic development departments survey travelers, as well as major industries serving tourists (e.g., hotels). While these surveys provide useful information on travel expenditures and travel-generated employment, they tend to overestimate tourism benefits because not all travelers are tourists. For instance, people may be traveling on business or to visit friends and relatives.

For this chapter, we rely on county-level travel expenditure data provided by the Mississippi River Parkway Commission, state tourism departments, and state economic development departments. We exclude business travel from the expenditure and employment estimates by scaling the estimates according to state-level information on the number of person-trips by business and leisure travelers. This scaling process is explained in more detail below.

Exhibit 6-1
National Natural Landmarks in the UMR Corridor

Name of National Natural Landmark	County/ State	Description
Cedar Creek Natural History Area/ Allison Savanna	Anoka, MN	Consists of tall grass prairie, eastern deciduous forest, and boreal coniferous forest that support 61 species of mammals and 183 species of birds
Chippewa River Bottoms	Buffalo, WI	Contains a large stand of bottomland hardwood forest and a great blue heron rookery
Wyalusing Hardwood Forest	Grant, WI	Exhibits high biological diversity, including several rare plants and endangered wildlife species
Kickapoo River Natural Are	Vernon, WI	Contains the state's largest concentration of exposed seeping sandstone, as well as endangered flora species
Horseshoe Lak Nature Preserve	Alexander, IL	Migration corridor and overwintering area for Canadian geese and many other waterfowl
Mississippi Palisades	Carroll IL	Consists of deep V-shaped valleys, caves and sinks, and cliffs along the Mississippi River
Little Grand Canyo Area	Jackson, IL	Large box canyon with vertical overhanging walls supporting a diversity of ecosystems
Fults Hills Prairie Nature Preserve	Monroe, IL	Contains the largest complex o essentially undisturbed loess (i.e., yellowish-brown soil deposits) hill prairies along the Mississippi River in Illinois
Giant City Geologic Area	Union, IL	Consists of large sandston blocks of the Pennsylvanian Age as well as oak and hickory forests
Mark Twain Cave and Cameron Cav	Marion, MO	Provides excellent examples of maze-type cavern developmen
Big Oak Tree	Mississippi, MO	Contains a sizable tract of essentially virgin bottomlan hardwood forest
Pickle Springs	Ste. Genevieve MO	Consists of a deep, forested gorg containing one of the fines habitats in Missouri from the Pleistocene era

Source: U.S. National Park Service, *Mississippi River Corridor Study. Volume 2: Inventory of Resources and Significance*, 1996.

To describe the cultural and historic resources of the UMR corridor, we primarily used information from the U.S. National Park Service and the National Register of Historic Places. These sources provide an inventory of national landmarks, national historic places, and other historic sites located in the corridor. We relied on multiple sources for information on other corridor's festivals, riverboat tours, riverboat casinos and other attractions.

TOURIST ATTRACTIONS

Below we describe three categories of tourist attractions in the UMR corridor: (1) cultural/historic resources; (2) river towns and festivals; and (3) riverboat tours and gaming.

Cultural/Historical Resources

There are over 1,700 cultural landmarks and sites within the UMR corridor according to the National Register of Historic Places.[1] These sites include famous landmarks, such as the Jefferson National Expansion Memorial ("Gateway Arch") in St. Louis, and lesser known properties, such as historic homes and local cultural sites. Below we describe three types of cultural/historical properties in the UMR corridor: (1) national natural landmarks; (2) national historic landmarks; and (3) other national register properties.

National Natural Landmarks

National natural landmarks are geological and ecological features that have been identified as significant examples of the nation's natural heritage. They are designated by the Secretary of the Interior under the authority of the

[1] This estimate was developed from: National Park Service, "National Register Information System data," obtained from "http://www.nr.nps.gov" on 12/18/98. The National Register of Historic Places lists all historic areas in the national park system, all national historic landmarks, and properties considered significant for preservation by the nation, a state, or a community. Nationwide, there were more than 80,000 listings on the national register in 1998.

Historic Sites Act of 1935. Of the close to 600 national natural landmarks in the U.S., 12 are located within the UMR corridor. Exhibit 6-1 lists these landmarks and provides a brief description of their geological and ecological features. Although visitation records are not kept for many of the corridor's landmarks, available data suggest that hundreds of thousands of people visit the landmarks each year. For example, the Horseshoe Lake Nature Preserve alone received over 150,000 visitors in 1995.

National Historic Landmarks

In addition to national natural landmarks, the Secretary of the Interior (through the National Park Service) designates certain buildings, structures, sites, and objects to be nationally significant in American history and culture. This designation is the principal federal means of recognizing the national significance of historic properties. Nationwide, there are more than 2,000 national historic landmarks, of which 50 are located in the UMR corridor (see Exhibit 6-2). The most famous of these landmarks, Jefferson National Expansion Memorial (Gateway Arch) in St. Louis, received more than 3.4 million visitors in 1997 according to the National Park Service.[2]

To provide an illustration of national historic landmarks in the UMR corridor, a landmark from each of the five UMR states is described below.

- **Fort Snelling — Hennepin, Dakota, and Ramsey counties, MN.** Fort Snelling was established at the confluence of the Minnesota and Mississippi Rivers in 1819 as a frontier post and trading center. The fort consists of 14 stone buildings and two log structures that served as an important post of European-American settlement in the old Northwest. It was also used as a troop training center in the Civil War and in both World Wars. Today, the fort is maintained much as it was in the 1800s. The fort is manned by infantry in period

Exhibit 6-2
National Historic Landmarks in the UMR Corridor

Minnesota	*Illinois (continued)*
• Fort Snelling • Pillsbury A Mill • James J. Hill House • St. Croix Boom Site • Frank B. Kellogg Hous • Peavey-Haglin Experimental Concrete Grain Elevator	• Cahokia Mounds • Rock Island Arsenal • Church of the Holy Family • Pierre Menard Hous • Lyman Trumbull House • Principia College Historic District
Wisconsin	***Missouri***
• Second Fort Crawfor Military Hospital • Dousman Hotel • Villa Louis • Astor Fur Warehouse • Brisbois House • Hamlin Garland Hous	• Mark Twain Boyhood Home • Ste. Genevieve Historic District • Anheuser-Busch Brewery • Eads Bridge • Goldenrod (Showboat) • Wainwright Buildin • U.S. Customhouse and Post Office • Loui Bolduc House • Union Station • Missouri Botanical Garden • Tower Grove Park • "Champ" Clark Hous • Joseph Erlanger House • Scott Joplin Residence • White Haven (Building) • Shelley House • Washington University Hilltop Campus Historic District • Jefferson National Expansion Memorial (Gateway Arch) • Christ Church Cathedral • White Haven (Building)
Iowa	
• Toolesboro Mound Grou • Effigy Mounds National Monument • Dubuque County Jail • Van Allen and Company Department Store • William M. Black (Structure) • Julien Dubuque's Mines • George M. Verity (Maritime Vessel)	
Illinoi	
• Nauvoo Historic District • Ulysses S. Grant House • Modoc Rock Shelter • Fort De Chartes	

Source: U.S. National Park Service, "National Historic Landmarks -- Search NHLs by State," obtained from "http://www.cr.nps.gov/nhl" on 12/23/98.

[2] National Park Service, "Public Use Statistics," obtained from "http://www.nature.nps.gov/datasci" on 12/24/98.

costumes who demonstrate the use of cannons, muskets and other weaponry. In addition, craftspeople describe old methods of tool- and candle-making, printing, and other crafts.[3]

- **Astor Fur Warehouse — Crawford county, WI.** Europeans first came to this area for the fur trade. The Astor Fur Warehouse is a remnant of John Jacob Astor's vast fur trading empire. The stone building was one of the principal establishments of Astor's American Fur Company.[4]

- **Toolesboro Mound Group — Louisa county, IA.** Toolesboro Mound Group is the site of several ceremonial burial grounds of the Hopewell Native American culture of 200 B.C. to 400 A.D.[5]

- **Cahokia Mounds — St. Clair county, IL.** The Cahokia Mounds area was first inhabited by Native Americans of the Woodland culture around 700 A.D. This population eventually abandoned the area by 1500. The Cahokia tribe, after whom the site is named, came to the area in the late 1600s. However, it is the building accomplishments of the Woodland culture that make the site significant. They constructed a network of more than 100 earthen mounds, moving an estimated 50 million cubic feet in woven baskets to do so. Monk's Mound, for example, covers an area of 14 acres and rises in four terraces to a height of 100 feet. These mounds represent the largest prehistoric earthen construction in the Americas.[6]

- **Jefferson National Expansion Memorial (Gateway Arch), City of St. Louis, MO.** The Jefferson National Expansion Memorial commemorates the westward expansion of the U.S. in the 19th century. The memorial's uniquely designed Gateway Arch towers 630 feet above the banks of the Mississippi River. In addition to the Arch, the memorial includes the Museum of Westward Expansion, which provides a history of the opening of the West and tells the story of the Arch's construction.[7]

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[3] National Park Service, *Mississippi River Corridor Study. Volume 2: Inventory of Resources and Significance*, 1996, p. 59; and Pat Middleton, *Discover! America's Great River Road*, Heritage Press: Stoddard, Wisconsin, 1996, p. 13.

[4] National Park Service, Ibid.

[5] University of Iowa, "Iowa's Historic Sites — Toolesboro Indian Mounds," obtained from "http://www. uiowa.edu/~shsi/sites/tooles/htm" on 12/23/98.

[6] National Park Service, "World Heritage Sites — Cahokia Mounds," obtained from "www.cr.nps.gov/worldheritage/cahokia.htm" on 12/24/98.

[7] National Park Service, "Jefferson National Expansion Memorial" obtained from "www.nps.gov/jeff/default/htm" on 12/24/98.

Other National Register Properties

In addition to the 12 national natural landmarks and 50 national historic landmarks, more than 1,600 other properties are listed in the National Register of Historic Places as cultural resources worthy of preservation. Properties may be culturally significant for a variety of reasons, including their architecture; relationship to historic people or events; contribution to music, art, or literature; role in education, transportation, business, or the military; and religious significance. Exhibit 6-3 illustrates the diversity of UMR properties listed in the National Register of Historic Places.

Exhibit 6-3

Examples of UMR Properties Listed in the National Register of Historic Places

Minnesota (Hennepin county)
• John R. Cummins Farmhous
• Great Northern Railroad Depot
• Flour Exchange Buildin
Wisconsin (LaCrosse county)
• Christ Church of LaCrosse
• Sand Lake Archeological District
• Smith Valley School
Iowa (Scott county)
• Central Fire Station
• American Telegraph & Telephone Company Buildin
• Frick's Tavern
Illinois (Madison county)
• Haskell Playhouse
• Miners Institute Building
• Bethalto Village Hall
Missouri (City of St. Louis)
• Ambassador Theater Building
• International Fur Exchange Building
• Lennox Hotel

Source: U.S. National Park Service, "National Register Information System data," obtained from "http://www.nr.nps. gov" on 12/18/98.

River Towns and Festivals

In addition to the historic sites noted above, river towns provide a window into the UMR corridor's rich and diverse cultural heritage. For thousands of years, Native Americans lived along the UMR, sustaining themselves through hunting, gathering, and agriculture and using the river to conduct trade. Many signs of the Native American past remain, such as the Hopewell burial mounds. In addition, several river towns are named after Native Americans.

European settlers were drawn to the corridor by the fur trade and the promise of agricultural land, forests, and prairies. They included English, Spanish, French, Africans, Irish, Scots, Welsh, Scandinavians, Germans, and Italians.[8] As with Native Americans, the cultural representation of these ethnic groups can be seen in the names of river towns, such as La Crosse, Stockholm, De Soto, and Genoa.

Today, tourists are drawn to river towns by their rich history and well-preserved architecture, as well as other attractions such as river festivals. These festivals generally celebrate the river's history with food, music, and entertainment. For instance, Dubuque, Iowa's *Riverfest* includes a parade, arts and crafts, and other activities to honor the river's history. LaCrosse, Wisconsin celebrates the river with *Riverfest*, six continuous days of free family entertainment, as well as the *Great River Jazz Fest* and the *Great River Traditional Music and Crafts Festival*.

A popular way to visit river towns is via The Great River Road, a network of federal, state, and county roads covering 3,000 miles that parallel the river on both sides. It is the nation's longest scenic byway. Marked with roadside signs depicting a steamboat pilot's wheel, the Great River Road provides access to roadside parks, points of historical interest, scenic overlooks, and other river-oriented amenities.

[8] National Park Service, 1996, op cit., p. 4.

Exhibit 6-4

River Towns Along the UMR: Examples of Attractions

St. Paul, MN — St. Paul developed as the end point of steamboat navigation up the Mississippi River. Today, it is the state capital and a center for commerce. The downtown Riverfront includes parks, walkways, and entertainment facilities.

La Crosse, WI — La Crosse provides scenic views from bluffs overlooking the Mississippi River, as well as riverboat cruises, hiking and biking trails, and festivals. The historic district includes museums and specialty shops.

Dubuque, IA — Attractions include the Mississippi River Museum, National Rivers Hall of Fame, General Zebulon Pike Lock and Dam, Spirit of Dubuque riverboat, and riverboat gaming.

Rock Island/Moline, IL — Historical and cultural resources include: Arsenal Island, featuring historic buildings, a lock and dam, and a Confederate cemetery; Hauberg Indian Museum, providing a history of local Native American tribes; and the John Deere Headquarters, offering tours of the headquarters' architecture, art, and farm machinery displays.

Hannibal, MO — Hannibal offers stunning views of the Mississippi River from scenic bluffs as well as tours of Mark Twain's Boyhood Home and Mark Twain Cave. Other attractions include Hannibal's Historic district and riverboat cruises.

Source: "The Great River Road: Places to Visit Along the Upper Mississippi River, obtained from "www.amrivers.org/mm/map897.html" on 12/21/98.

Riverboat Tours and Gaming

Many tourists visit the UMR corridor to take riverboat tours and/or to gamble at riverboat casinos. More than thirty riverboats operate tours and cruises on the UMR, many of which evoke the Mississippi River's era of steamboats and paddlewheel boats. For example:

- *The Delta Queen* is the only fully restored overnight steamboat in the world.
- *The Spirit of Dubuque* is a replica of a century-old Mississippi River steamboat with decorative smokestacks.
- *The La Crosse Queen* is one of the few paddlewheel riverboats in operation in the country.

Riverboats offer sightseeing cruises, luncheon and dinner cruises, and overnight luxury cruises. While the majority of riverboats are smaller craft providing shorter excursions, some riverboats, such as the *Mississippi Queen* and *American Queen*, offer 3- to 12-night cruises and have the capacity to accommodate over 400 passengers.

One of the newest forms of recreation on the UMR is riverboat casino gambling. As shown in Exhibit 6-5, there are 11 riverboat casinos on the UMR, six operating out of Iowa, four operating out of Illinois, and one operating out of Missouri. These casinos have a combined capacity of over 10,000 passengers. One of the largest riverboats, *Lady Luck*, can accommodate up to 2,500 passengers.

Close to six million people visited the four riverboat casinos operating out of Illinois in 1997; these casinos generated about $180 million in total revenues.[9] *The Casino Queen*, which is docked in St. Louis, served 3.3 million of the six million casino visitors and accounted for $107 million of the total revenues.[10]

[9] Tourism Research Laboratory at the University of Illinois at Urbana-Champaign, "River Boat Casinos: 1997 Monthly Reports," obtained from "http://www. tourism.uiuc.edu" on 12/23/98.

[10] Revenue and attendance data were not available for the six casinos operating out of Iowa.

Visitors attracted to the river for gaming will frequently stay longer to experience other opportunities, such as touring historic, scenic, or recreation sites. Tour operators often package tours that include a number of river attractions and/or festivals in addition to the initial draw of riverboat gambling. The Quad Cities in Illinois and Iowa report that riverboat gaming has stimulated downtown businesses, including restaurants, shops, and hotels.[11]

Exhibit 6-5

Riverboat Gaming on the UMR

Riverboat (County/State)
• Alton Belle (Madison, IL)
• Casino Queen (St. Clair, IL)
• Jo Daviess Silver Eagle (Jo Daviess, IL)
• Rock Island Casino (Rock Island, IL)
• Diamond Jo Casino (Dubuque, IA)
• Catfish Bend Riverboat Casino (Lee, IA)
• Mississippi Belle II (Clinton, IA)
• President Riverboat Casino (Scott, IA)
• Lady Luck Casino (Scott, IA)
• Miss Marquette Riverboat Casino (Clayton, IA)
• Admiral-President Casino (St. Louis, MO)

Sources: (1) Tourism Research Laboratory at the University of Illinois at Urbana-Champaign, River Boat Casinos: 1997 Monthly Reports*, obtained from "http://www.tourism.uiuc.edu" on 12/23/98; (2)* Iowa Casino Profiles *obtained from "http://www.iowaalive.com/travel/casinos/index.htm"; and (3) Missouri Gaming Commission.*

TRAVEL EXPENDITURES AND TRAVEL-GENERATED EMPLOYMENT IN THE UMR CORRIDOR

Tourists traveling to visit the corridor's cultural/historical resources and other attractions spend money on goods and services, such as lodging, food, transportation, retail, and entertainment. Based on data provided by state tourism agencies and the Mississippi River Parkway Commission, traveler expenditures in the UMR corridor were close to $8.5 billion in 1995.[12] These expenditures supported about 180,000 jobs.[13]

It should be noted, however, that travel expenditures include leisure and *business* travel. Although data excluding business travel at the county level were not available, state and national travel data indicate that about one-quarter of travel is business-related. Scaling travel expenditures based on these estimates to exclude business travel suggests that leisure travel expenditures in the corridor are closer to $6.6 billion and that these expenditures support about 140,000 jobs.[14] Although

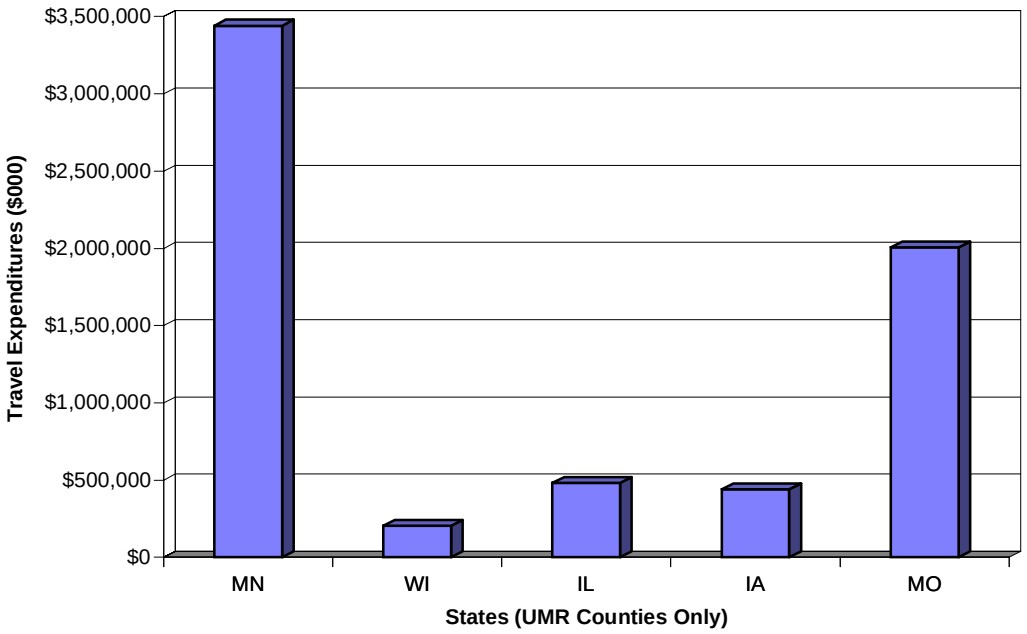
[11] National Park Service, op cit., p. 43.

[12] Revenue estimates for 1995 have been converted to 1997 dollars using the Gross Domestic Product deflator.

[13] Sources for revenue and employment estimates are: (1) Mississippi River Parkway Commission, *Economic Impact of Tourism and Travel in the Counties and Parishes Along the Great River Road in 1995*, 1997; and (2) Missouri Division of Tourism, "Sales of Selected Tourism SIC Codes, 1996," data provided by Herb C. Fallert on 12/4/98.

[14] We estimate business travel to the corridor based on travel data (in person-trips) for Illinois and Minnesota. About 33 percent of person-trips to Illinois were business-related (1997), while about 18 percent of person-trips to Minnesota were business-related (1996). For UMR counties in Illinois and Minnesota, we exclude business travel expenditures according to the state data. Since no data were available for Wisconsin, Iowa, and Missouri, we use an average based on Illinois and Minnesota (25 percent) to exclude business travel in these states. This estimate is consistent with national estimates, which indicate that 24 percent of person-trips in the U.S. are business-related. We used the following sources to develop these estimates: (1) Illinois Department of Tourism, "1997 Economic Impact of Illinois Tourism," obtained from "http://www.enjoyillinois.com/97tvlsum.htm"; (2) Minnesota Office of Tourism, *1998 Minnesota Travel and Tourism Report*, 1998; and (3) U.S. Bureau of the Census, *Statistical Abstract of the United States: 1997*, (117th edition), Washington DC, 1997.

Exhibit 6-6
Travel Expenditures in the UMR Corridor (Excluding Business Travel), 1995



Sources: (1) Mississippi River Parkway Commission, *Economic Impact of Tourism and Travel in the Counties and Parishes Along the Great River Road in 1995*, 1997; and (2) Missouri Division of Tourism, "Sales of Selected Tourism SIC Codes, 1996," data provided by Herb C. Fallert on 12/4/98.

these revised estimates exclude business travel, it is important to point out that many leisure travelers to the UMR corridor may come for reasons other than tourist attractions (e.g., visiting relatives). Therefore, the corridor's actual tourism expenditures and related employment are probably somewhat lower than the revised estimate. Finally, it should be noted that corridor travel expenditures include money spent on outdoor recreation (e.g., fishing, boating). This activity is discussed in more detail in Chapter 5.

As shown in Exhibit 6-6, the majority of travel expenditures occurred in the Minneapolis/St. Paul and St. Louis metropolitan areas (i.e., Hennepin, Ramsey, and St. Louis counties and the City of St. Louis). These areas accounted for approximately $4.6 billion in travel expenditures, or about 70 percent of all travel expenditures. According to traveler expenditure information for the states of Minnesota, Illinois, and Iowa, travelers primarily spend their money on lodging, food and beverages, and transportation, with smaller amounts spent on entertainment and retail shopping.[15]

[15] Sources: (1) Minnesota Office of Tourism, *1998 Minnesota Travel and Tourism Report*, 1998; (2) Illinois Department of Tourism, "1997 Economic Impact of Illinois Tourism," obtained from "http://www.enjoyillinois.com/97tvlsum.htm"; and (3) Division of Tourism, Iowa Department of Economic Development, *Iowa Welcome Centers: 1997 Survey Results*, 1998.

TRENDS

Tourism in the UMR corridor appears to be on the rise. The most popular attraction, Jefferson National Expansion Memorial (Gateway Arch), received about 3.4 million visitors in 1997 — roughly one million more visitors than toured the site ten years earlier in 1988.[16] Similarly, smaller historic sites, such as the Ulysses S. Grant National Historic Site in Missouri, have enjoyed greater numbers of visitors; close to 15,000 people visited the site in 1997 compared to 1,400 visitors in 1992.[17] However, visitor counts have declined for some corridor attractions. For example, visitors to Effigy Mounds National Monument in Iowa dropped from roughly 100,000 people in 1988 to about 76,000 people in 1997.[18]

Travel expenditures in the corridor have increased by about three to six percent per year from 1993 to 1997 based on data from UMR counties in Illinois, Wisconsin, and Minnesota.

- **Illinois counties:** Travel expenditures grew by a total of 25 percent from 1993 to 1997.[19] Travel-generated employment increased by 30 percent over this same period. Madison and St. Clair counties enjoyed above-average growth in travel expenditures (36 percent and 27 percent, respectively). In part, this growth may be due to the two riverboat casinos operating out of these counties — *Alton Belle* (Madison county) and *Casino Queen* (St. Clair county). For instance, the Casino Queen's revenues have increased from approximately $46 million in 1993 to about $107 million in 1997.[20]

- **Wisconsin counties:** Travel expenditures increased by about 16 percent from 1993 to 1997. Pepin county, which contains one of the UMR's most scenic pools, enjoyed the greatest growth (35 percent) over this period. La Crosse, the largest Wisconsin county on the UMR, also enjoyed an above-average increase in travel expenditures (22 percent).[21]

[16] National Park Service, "Public Use Statistics," op cit.

[17] Ibid.

[18] Ibid.

[19] Tourism Research Laboratory at the University of Illinois at Urbana-Champaign, "Economic Impacts, 1993-1997," obtained from "http://www.tourism.uiuc.edu" on 12/23/98.

[20] Tourism Research Laboratory at the University of Illinois at Urbana-Champaign, "River Boat Casinos: Yearly Reports From 1993-1997," obtained from "http://www.tourism.uiuc.edu" on 12/23/98.

[21] Wisconsin Department of Tourism, "Wisconsin's Economic Impact Study: Traveler Expenditures," 1998.

- **Minnesota counties:** Only limited travel expenditure data were available for Minnesota. We used Metro and Southeast Regional data to approximate travel expenditures for Minnesota's UMR counties from 1994 to 1995. Over this period, travel expenditures grew by about six percent.[22]

[22] Minnesota Trade and Economic Development, Office of Tourism, "Economic Impact of Travel and Tourism in Minnesota," February 1997.

Mineral Resources

Chapter 7

A significant amount of mining activity takes place along the Upper Mississippi River. In 1994, the UMR corridor's mining operations and cement and lime producers generated over $1.2 billion in revenues and employed over 6,500 people. Many of the mining operations in the corridor and five-state region depend on the river as a cost-effective means of transporting raw materials and products. About 24 million tons of coal and 21 million tons of minerals were shipped on the UMR in 1995, which represents over one-third of the tonnage of all materials and goods shipped on the river that year. In addition to transportation, some mining operations benefit from the UMR's resource deposits. Specifically, many of the sand and gravel operations located along the UMR extract sand and gravel directly from the river bed and/or floodplain.

In this chapter we provide an overview of the UMR corridor's primary mining activities, including crushed stone, sand and gravel, and coal mining, as well as cement and lime production. We also present information on revenues and employment for the UMR's mining sector and discuss likely future trends.

DATA SOURCES AND METHODOLOGY

We have defined the mining sector broadly to include the extraction of minerals and the manufacture of some mineral-based products. As is common in studies of the mining sector, we examine the mineral extraction and processing activities defined as "Mining" under Standard Industrial Classification (SIC) codes 1000-1499. We focus primarily on mining activities that are prevalent in the UMR corridor, including crushed stone (SIC 1420), sand and gravel (SIC 1440) and coal mining (SIC 1200).

In addition to traditional mining activities (SIC 1000-1499), we include the production of cement and lime manufacturers. A significant number of cement and lime plants have "vertically integrated" mining and manufacturing operations, i.e., they mine raw materials and use them to manufacture cement and lime products. To capture this activity, we include cement manufacturing (SIC 3241) and lime production (SIC 3274) as part of the mining sector.

We relied on several data sources for information on the number of mining operations in the UMR corridor, their revenue and employment, and their shipments on the UMR. The most significant sources used in this chapter are:

- IMPLAN model data, 1994.

- U.S. Department of Commerce, Bureau of the Census, *County Business Patterns, 1994-1995*, November 1997.

- Stephen D. Smith, *NonFuel Minerals Statistical Summary*, U.S. Geological Survey, Minerals Information, 1996, obtained from "http://minerals.er.usgs.gov/minerals/" on 11/4/98.

- U.S. Geological Survey, "The Mineral Industry of [Illinois, Iowa, Minnesota, Missouri, and Wisconsin]," obtained from "http://minerals.er.usgs.gov/minerals/" on 10/30/98.

- Energy Information Administration, *Coal Data: A Reference*, U.S. Department of Energy, 1995; and "Coal Production and Number of Mines by State, County, and Mine Type, 1996," obtained from "http://ww.eia.doe.gov" on 10/30/98.

- Personal communications with officials at state Departments of Natural Resources.

Due to confidential business information issues, county-level data on the tons of minerals extracted by mining operations in the UMR corridor were not available. IMPLAN model data (1994) were used to estimate the UMR mining sector's revenue and employment. Available data for crushed stone mining revenue reflect revenue from both crushed stone (SIC 1420) and dimension stone (SIC 1410) mining. Based on employment estimates for each of these types of mining, it appears that crushed stone is by far the more dominant mining activity. Therefore the inclusion of dimension stone revenues should not bias the crushed stone estimate upward by a significant amount.

OVERVIEW OF MAJOR MINING ACTIVITIES

The primary mining activities within the UMR corridor are crushed stone, sand and gravel, coal, cement, and lime production. Along the UMR there are over 100 quarries for mining crushed stone, about 40 sand and gravel operations, two coal mines (in southwestern Illinois), five cement plants, and three lime plants.[1] A profile of each type of activity is provided below.[2]

[1] U.S. Department of Commerce, Bureau of the Census, *County Business Patterns, 1994-1995*, November 1997; personal communication with Ardel Rueff, Missouri Department of Natural Resources, Division of Geology and Land Survey, 11/5/98.

[2] In addition to sources noted in the "Data Sources and Methodology" section, profile information was drawn from: (1) U.S. Environmental Protection Agency, *Profile of the Non-Fuel, Non-Metal Mining Industry*, EPA Office of Compliance Sector Notebook Project, September 1995; (2) Portland Cement Association, *The U.S. Cement Industry*, 1984; and (3) Portland Cement Association, *U.S. and Canadian Portland Cement Industry: Plant Information Summary*, 1992.

Crushed Stone

Crushed stone is the most common mineral commodity mined in the U.S. Crushed stone is usually mined from deposits of relatively solid rock such as limestone and dolomite. Stone that breaks into cubical fragments and is free of both surface alteration from weathering and impurities is preferred for crushed stone. Crushed stone is most commonly used as aggregate in the construction industry, with the majority being applied in road construction and maintenance. In addition, crushed stone may be used in chemical and metallurgical processes, including cement and lime manufacturing, for agricultural purposes, and in water and sewer filtration systems. Nationwide, the average price of a metric ton of crushed stone was about $5.40 in 1996.

Sand and Gravel

Sand and gravel are the granular materials resulting from the natural disintegration of rock or stone. Deposits of sand and gravel are commonly found adjacent to or within rivers, or in areas with glaciated or weathered rock (see text box). There are two main types of sand and gravel materials—construction and industrial. Construction sand and gravel are used primarily by the construction industry for aggregate to be mixed into concrete, asphalt aggregate and roadbase materials, and construction fill. About 97 percent of the sand and gravel mined in the U.S. in 1996 was construction sand and gravel. Industrial sand and gravel, which is mainly used in manufacturing glass, ceramics, and chemicals, must meet strict chemical and physical criteria. It is a higher value product than construction sand and gravel, selling for about $18 per metric ton compared to about $4.40 per metric ton for construction sand and gravel in 1996.

In-Stream Sand and Gravel Extraction

Since most sand and gravel resources were deposited by rivers, sand and gravel operations are commonly located in former or current river valleys. Sand and gravel materials excavated by dredge and dragline operations from a river bed are typically more cost-effective than operations mining sand and gravel from a former stream valley. River-bed sand and gravel tends to occur as finely grained, nearly uniform-sized particles that are suitable for concrete aggregate. However, in-stream extraction and riparian mining of sand and gravel can cause significant environmental damage. First, extraction from a river bed or banks removes river-bottom plants and riparian vegetation, which damages habitat for fish and wildlife and leaves the river bed prone to further erosion. Mining-induced erosion has been known to result in property damages, reduced fish and wildlife resources, and the extirpation and extinction of stream fauna. Second, suspended sediments increase turbidity and reduce light penetration, which harms aquatic habitat. Similarly, stockpiled sand and gravel on the floodplain may produce turbid discharges during storm events.

[3] Timothy J. Kemmis and Deborah J. Quade, "Sand and Gravel Resources of Iowa," Iowa Department of Natural Resources, obtained from "http://www.igsb.uiowa.edu/browse/sandgrav/sandgrav.htm" on 11/23/98.

Coal

Of all mineral commodities mined in the U.S., coal mining currently ranks second only to crushed stone in terms of tonnage mined. The different varieties of coal include: lignite, subbituminous, bituminous, and anthracite. Of these varieties, bituminous coal is the most abundant and widespread in the U.S. Coal's most obvious and useful characteristic is that it can be burned for energy. More than eight out of every ten tons of coal used in the U.S. are for

electricity generation; coal is burned to produce high-pressure steam that drives an electrical generator. Coal is also often used to fuel manufacturing processes, such as cement, steel, and food processing. Nationwide, the average price of coal was $18.50 per ton in 1996.

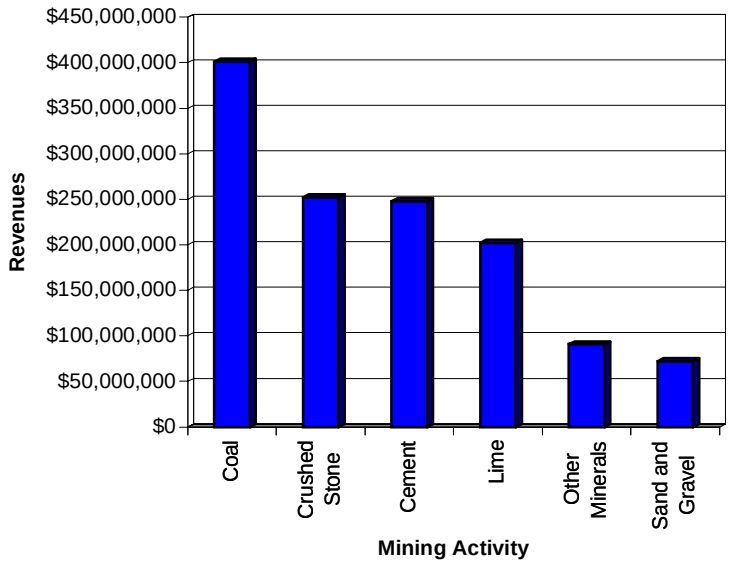
Cement

Cement is a chemical combination of limestone, silica, alumina, iron ore, and small amounts of other materials. It is made by quarrying, crushing, and grinding these raw materials, burning them in large rotary kilns at high temperatures, and grinding the resulting marble-sized pellets (called clinker) into a very fine powder. Cement is most often mixed with water and sand, gravel, crushed stone, or other aggregates to form concrete, the most widely used construction material in the world. Nationwide, the average price of cement was about $70 per ton in 1996.

Lime

Lime is manufactured by burning high quality limestone in a kiln at high temperatures, forming lime. Before burning, limestone is crushed and sized and often washed to remove impurities. Lime is used in various industries, including steelmaking, water purification, alkalies, and pulp and paper. The average price of lime in the U.S. was about $60 per ton in 1996.

Exhibit 7-1
Mining Revenues in the UMR Corridor, 1994



Source: IMPLAN model data, 1994.

Other Mining Operations

Other mining operations that may be active along the UMR include metals mining, oil and gas extraction, clay, ceramic, and refractory mineral mining, and chemical and fertilizer mineral mining. However, these operations represent only a small fraction of mining activity and revenue in the UMR corridor.

MINING REVENUES

The revenues generated by crushed stone, sand and gravel, coal, cement, and lime production account for more than 90 percent of the UMR corridor's $1.2 billion in total mining revenues (see Exhibit 7-1).

The higher value commodities—cement, lime, and coal—account for about two-thirds of the UMR corridor's mining revenues. Crushed stone and sand and gravel, while produced in greater quantities

than cement, lime, and coal, represent only about one quarter of mining revenues due to their lower value per ton. The remaining revenues ("other minerals") are generated by several types of mining including metals mining, clay, ceramic, and refractory mineral mining, oil and gas extraction, chemical and fertilizer mineral mining, and other miscellaneous mining.

UMR Corridor vs. UMR's Five-State Region

Comparing mining revenues in the UMR's five-state region to those of the UMR corridor in 1994 shows the importance of mining along the UMR, especially production of cement, lime, and crushed stone.

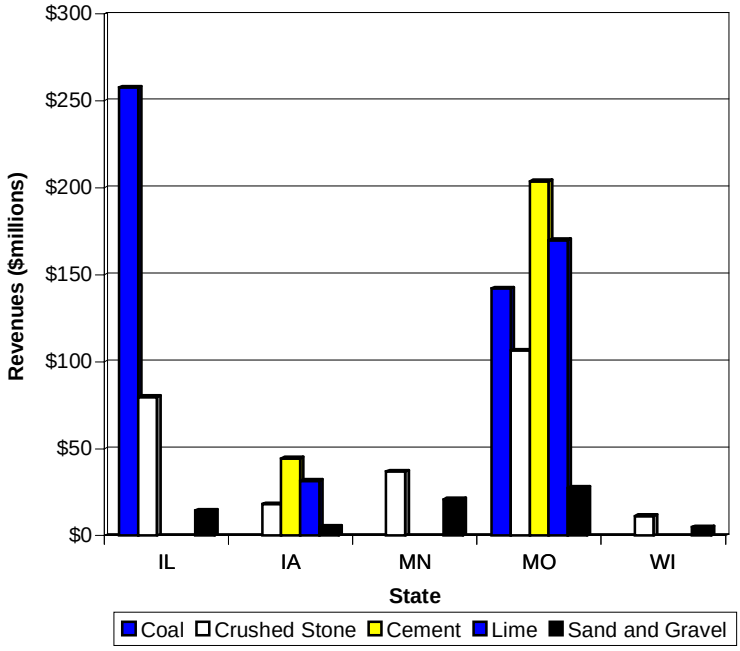
- Revenues from cement production along the UMR were about $250 million, representing close to 40 percent of the five-state region's total cement production revenues.
- Revenues from lime production along the UMR were approximately $200 million, accounting for more than one-quarter of revenues from lime production in the five-state region.
- Crushed stone mining revenues in the UMR corridor were about $250 million, accounting for almost one-quarter of the crushed stone revenues in the five-state region.

Due to the high-level of coal mining in Illinois, coal mining revenues along the UMR are only a small fraction (about two percent) of the five-state region's total coal revenues.

Areas of High Mining Activity

The distribution of mining activity along the UMR is uneven. Mining revenues generated along the southern reach of the UMR, particularly in Missouri and Illinois, are much greater than the mining revenues of counties in Iowa, Wisconsin, and Minnesota (see Exhibit 7-2). In 1994, more than half of the UMR's total mining revenues were generated in Missouri counties, which led in the production of crushed stone, cement, lime, and sand and gravel. Revenues from coal and crushed stone production in Illinois counties accounted for most of the UMR's remaining mining revenues.

Exhibit 7-2
Mining Revenues by Mining Activity and State (UMR Counties Only), 1994

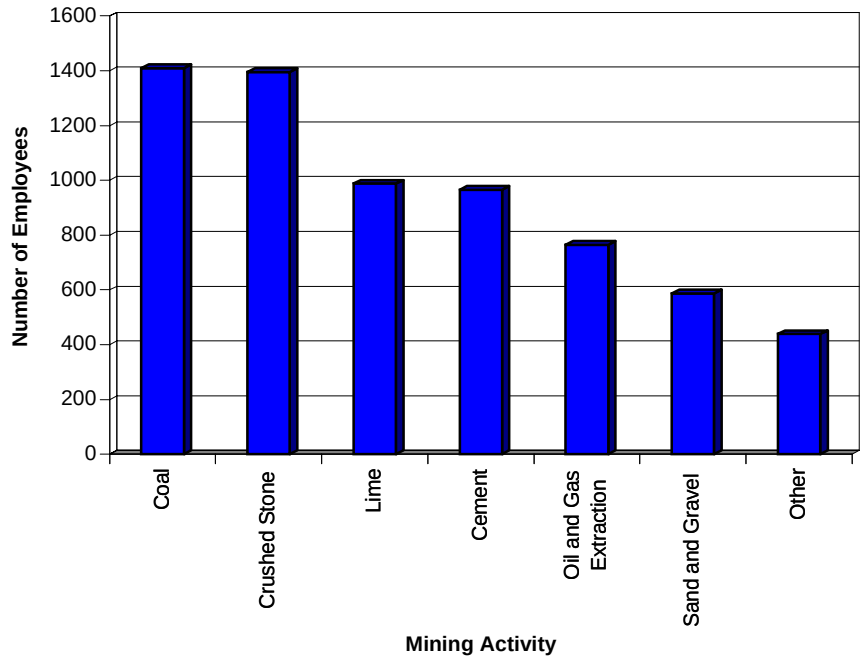


Source: IMPLAN model data, 1994.

MINING EMPLOYMENT

The mining sector employs over 6,500 people in the UMR corridor. As shown in Exhibit 7-3, coal and crushed stone are the leading employers with each employing about 1,400 people. Lime and cement production each support about 1,000 employees, while the oil and gas extraction sector employs about 750 people and sand and gravel operations provide close to 600 jobs. The remaining jobs are distributed across several mining areas including metals mining, clay, ceramic, and refractory mineral mining, chemical and fertilizer mineral mining, and other miscellaneous mining.

Exhibit 7-3
Mining Sector Employment in the UMR Corridor, 1994



Sources: (1) IMPLAN model data, 1994; and (2) County Business Patterns data, 1994-1995.

TRENDS

The primary factor driving trends in mining operations along the UMR is changes in demand for construction materials. In recent years the construction industry's strong demand for aggregate and cement has resulted in increased mining output. For instance, Missouri cement producers reported running out of product at times during 1997 due to demand. Although the cement industry expects some "flattening" of demand in the next several years, at least one plant in Pike County is planning to modernize and expand.[3] Sand and gravel operations along the UMR are expected to continue to benefit from strong residential construction and ready mix concrete markets. Likewise, the crushed stone industry has had near record production levels in recent years. The demand for crushed stone also appears to have triggered a movement toward consolidation, particularly in Missouri, where national and multinational companies have purchased several small operations.

[3] U.S. Geological Survey, "The Mineral Industry of Missouri," obtained from "http://minerals.er.usgs.gov/minerals" on 10/30/98.

Agriculture

Chapter 8

Agriculture plays a major role in the economy of the Upper Mississippi River corridor. The agricultural sector employed more than 94,000 people and generated more than $5 billion in total revenue in the UMR corridor in 1997 — $2.8 billion from the production of crops and $2.2 billion from the production of livestock and livestock products.[1] The majority of crops produced in the UMR corridor are grains, particularly corn and soybeans. In addition to crop production, farmers in the corridor raise cattle and hogs, and produce other dairy products such as milk and eggs.

Farmers along the UMR and in the five-state region depend on the river as an important means of shipping farm products, especially grain. Farm products accounted for close to half of all goods shipped on the UMR in 1995, or about 55 million tons, most of which were shipped downstream for domestic consumption or export. Returning barges bring agricultural chemicals upstream to farmers for use in crop production.

The UMR is also important to agriculture as a source of water for crops and livestock. Farmers in the UMR corridor used more than 10 million gallons of fresh surface water per day in 1995 for livestock watering, feed lots, dairy operations, and other farm needs. In addition to this use, the UMR supports irrigated agriculture on close to 300,000 acres of farmland, or about two percent of the total number of acres farmed in the corridor; farmers in the corridor use more than three million gallons of irrigation water per day. These irrigation rates tend to vary from year to year depending on annual rainfall, farm commodity prices, application technologies, and conservation practices.[2]

The significance of the agriculture sector to the UMR corridor is illustrated in the following statistics:

- Over 70 percent of all land in the corridor is used for agricultural purposes.
- More than 52,600 farms are located in counties along the UMR, averaging in size from 230 acres in Wisconsin counties to 350 acres in Illinois counties. These farms represent approximately 13 percent of the farms in the UMR five-state region and account for about 12 percent of the five-state region's farm acreage.

[1] The estimate of employment in the agricultural sector reflects full-time and part-time employees.

[2] U.S. Geological Survey, *Water Use in the United States, 1995*, obtained from "http://water.usgs.gov/watuse/" on 11/12/98.

- The $5 billion in revenue generated by the UMR's agricultural sector was approximately 1.4 percent of the total revenue for all enterprises in the corridor in 1997. Total employment in the agricultural sector (94,000 people) represented about 2.3 percent of all workers in the corridor.

This chapter provides an overview of the UMR corridor's agricultural sector, including information on the major crops and livestock produced, number of farms and acres harvested, revenues and employment, and likely future trends.

DATA SOURCES AND METHODOLOGY

We define the agriculture sector by activities captured under Standard Industrial Classification (SIC) codes 0100-0799, which includes crop production, livestock production, and agricultural services. Crop production reflects the major crops produced in the UMR corridor — corn and soybeans. Although the corridor produces other crops, such as sugarbeets and potatoes, total output for these crops is significantly smaller and, therefore, data are not maintained at a county level. Livestock production refers to establishments engaged in the keeping, grazing or feeding of livestock for the sale of livestock or livestock products. Livestock includes cattle, hogs, sheep, goats, and poultry of all kinds. Establishments primarily engaged in the production of dairy products such as milk and eggs are also included in the agriculture sector. Livestock also includes "animal specialties" — the production of more specialized animals such as horses, fur-bearing animals, and aquaculture. Finally, agricultural services include activities such as crop services performed to prepare crops for market or further processing, and farm labor and management services. Revenue and employment associated with food processing and preparation activities (e.g., milling grain) are not included in this chapter; they are captured under Manufacturing (see Chapter 10).

We estimate the total value of crop production in the UMR corridor by multiplying crop production by the state-specific average price per bushel or ton. In addition to revenues generated from the sale of crops on the open market, this approach captures the total value of crops used by farmers as inputs to other production (e.g., grain produced for cattle feed). Crop production and price information were provided through the following state agricultural statistics reports:

- Minnesota Agricultural Statistics Service, *Minnesota Agricultural Statistics 1998*, U.S. Department of Agriculture and Minnesota Department of Agriculture, 1998.

- Iowa Agricultural Statistics, *1998 Iowa Agricultural Statistics*, U.S. Department of Agriculture and Iowa Farm Bureau, August 1998.

- Missouri Agricultural Statistics Service, *1998 Missouri Farm Facts*, U.S. Department of Agriculture and Missouri Department of Agriculture, September 1998.

- U.S. Department of Agriculture, National Agricultural Statistics Service, State Offices Home Page, obtained from "http://www2.hqnet.usda.gov/nass/sso-rpts.htm" on 11/20/98.

- U.S. Department of Agriculture, *USDA Agricultural Baseline Projections to 2007*, obtained from "http://usda.mannlib.cornell.edu/usda" on 12/23/98.

- Connor, John M. and William A. Schiek, *Food Processing: An Industrial Powerhouse in Transition*, John Wiley & Sons, Inc., 1997.

- U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census, *USA Counties 1996: A Statistical Abstract Supplement*, August 1996.

- Minnesota Corn Growers Association, *Corn Talk*, obtained from "http://www.mncorn.org/corntalk" on 12/16/98.

Statistical data provided by state Departments of Agriculture and Farm Bureaus were developed through surveys of farmers and other agribusinesses.

We derived the total value of livestock production using IMPLAN model data. The IMPLAN data include the value of all livestock products sold or used as inputs to other products. These data are based on U.S. Department of Agriculture and National Agricultural Statistics Service estimates.

We obtained employment information for livestock and crop production from the IMPLAN county database. It is important to note that IMPLAN does not make a distinction between full-time and part-time employment. Given the large demand for part-time and seasonal workers in agriculture, the IMPLAN employment estimate is likely to be significantly higher than the estimate of full-time equivalent employees for the sector.

OVERVIEW OF THE UMR CORRIDOR'S AGRICULTURAL SECTOR

Land in the UMR corridor is highly compatible with the production of both crops and livestock. Several factors influence the type of crop and livestock production practiced, including climate, terrain, and soil quality. The UMR corridor receives more rainfall than the arid southwestern states, but less than the more humid northwestern and southeastern states. This climate contributes to a long growing season for grains as well as native grass found in livestock pastures. In addition, the soil quality and relatively flat terrain in the UMR floodplain is ideal for planting large fields of grains.[3]

[3] Missouri Agricultural Statistics Service, *1998 Missouri Farm Facts*, U.S. Department of Agriculture and Missouri Department of Agriculture, September 1998.

Exhibit 8-1
Overview of Agriculture in UMR Corridor

	Total Agricultura Land in Acres (1992)	Average Value of Land Per Acre (1997)	Total Agriculture Land Valu (Million $)	Major Products
Minnesota	1,653,00	$1,04	$1,71	Dairy Products, Corn
Wisconsin	2,476,00	$1,25	$3,09	Dairy Products, Corn
Iowa	2,940,00	$1,65	$4,85	Corn, Hogs
Illinois	4,639,00	$2,21	$10,252	Corn, Soybeans
Missouri	3,012,00	$1,01	$3,04	Soybeans, Cor
Total	14,720,000		$22,959	

Sources: (1) U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census, *USA Counties 1996: A Statistical Abstract Supplement*, August 1996; (2) U.S. Department of Agriculture, National Agricultural Statistics Service, State Offices Home Page, obtained from "http://www2.hqnet.usda.gov/nass/sso-rpts.htm" on 12/8/98; (3) Minnesota Agricultural Statistics Service, *Minnesota Agricultural Statistics 1998*, U.S. Department of Agriculture and Minnesota Department of Agriculture, 1998; (4) Iowa Agricultural Statistics, *1998 Iowa Agricultural Statistics*, U.S. Department of Agriculture and Iowa Farm Bureau, August 1998; and (5) Missouri Agricultural Statistics Service, *1998 Missouri Farm Facts*, U.S. Department of Agriculture and Missouri Department of Agriculture, September 1998.

More than 14.7 million acres were used for agricultural activities in the UMR corridor in 1992 (see Exhibit 8-1). Almost one-third of this land is located in Illinois counties bordering the river. Based on state-specific estimates for the average value per acre, the total value of all farm land in the corridor was nearly $23 billion in 1997.

Crop production in the UMR corridor is dominated by corn, soybeans, and hay. Farmers in the corridor produced 547 million bushels of corn, 133 million bushels of soybeans, and 4.4 million tons of hay in 1997. Of the grains grown in the corridor, Illinois counties produced more than one-third of all corn and close to half of all soybeans. Iowa counties accounted for more than 40 percent of total hog production. Moving north, UMR counties in Minnesota and Wisconsin play a significant role in dairy farming, accounting for about two-thirds of all dairy production in the UMR corridor.

As we discuss below, agricultural production fuels a great deal of other economic activity in the region. Inputs to production include seeds, fertilizers, and farm equipment. Most of the commodities produced in the UMR corridor are used as inputs in food processing industries such as the production of soybean oil, flour, corn oil and other corn by-products, cheese, butter, processed milk, and meat processing and packaging. Companies in the food processing industry are typically located near their major sources of inputs because the inputs can be expensive to transport or may be perishable.

Corn

Corn grown in the UMR corridor is processed within the five-state region or shipped out of the region as a raw product for processing in other parts of the country. The U.S. corn milling industry has been the fastest growing industry selling bulk foodstuffs in the nation, growing about 11 percent per year from 1972 through 1992. Outputs of this industry include fructose, corn oil, corn starch, corn gluten, and other corn by-products. In 1992, corn milling

companies in Iowa and Illinois represented more than 60 percent of all corn milling in the nation. Much of this production is exported to other countries, such as Japan, Taiwan, and South Korea. The geographic distribution of corn milling plants is expected to change in the future because high fructose corn syrup, the major sweetener in the highly dispersed soft-drink industry, is difficult to transport because it must be kept warm to avoid crystallization. Most new plants are being built on the eastern or western edge of the traditional milling areas (Iowa, Illinois, Indiana and Tennessee).

Corn grown in the UMR corridor is also used to produce ethanol, an automobile fuel that is designed to improve air quality. Ethanol is mixed in small quantities with gasoline and then distributed at gas stations, mostly in the Upper Midwest. Since late 1997, Minnesota has been able to provide ten percent of its own vehicle fuel needs with ethanol. On a national scale, the total number of bushels of corn used for ethanol production in 1997 (500 million bushels) is more than 16 times greater than the number of bushels used for ethanol production in 1977.

Soybeans

Like corn, soybeans are processed within the UMR corridor and also shipped to other parts of the country for processing. Most of the revenue in the soybean industry is derived from its by-products, including soybean cake, meal, and oil. Soybean cake and meal are sold as high-protein ingredients to the prepared animal feeds industry. High protein animal feed is used predominantly by the poultry and hog sectors. Raw soybeans and soybean meal are also exported to meet foreign demand for high protein feed. When soybeans are crushed into meal, soybean oil is also produced. Crude soybean oil is typically sold to the cooking oil industry where it is then refined into edible products. Almost 50 percent of the nation's soybean oil processing occurs in Illinois, Iowa, and Minnesota.

Livestock

Most UMR livestock are processed in the UMR five-state region due to the perishable nature of the products. Meat packing plants typically obtain live cattle, hogs, or carcasses from within 150 to 200 miles of the plant. Therefore, it is not surprising that Iowa ranks third in the nation with 12 percent of the nation's meat packing output. Meat processing companies, which typically obtain their meat by buying carcasses or boned meat from meat packing houses, make a wide variety of products including bacon, ham, cold cuts, canned meats, and beef patties. Wisconsin, Illinois, and Iowa rank in the top five meat processing states in the nation in terms of output. Wisconsin and Minnesota are the largest producers of manufactured dairy products in the nation, representing more than 60 percent of all butter and 40 percent of all cheese produced in the nation.

REVENUE AND EMPLOYMENT IN THE AGRICULTURAL SECTOR

As shown in Exhibit 8-2, UMR crop and livestock production generated more than $5 billion in revenues in 1997 — $2.8 billion in crop revenues and $2.2 billion in livestock revenues. Compared to crop production in the five-state region, corridor crop revenues represented 12 percent of corn revenues and 10 percent of soybean revenues. While other crops were produced in the UMR corridor, such as oats, sorghum, rice, apples, and potatoes, the level of production and corresponding revenues of these crops was minimal. Oats, for example, contributed $14 million in revenue to the corridor's total agricultural output in 1997.

Exhibit 8-2
Agricultural Revenue By Activity in the UMR Corridor in 1997 (Millions $)

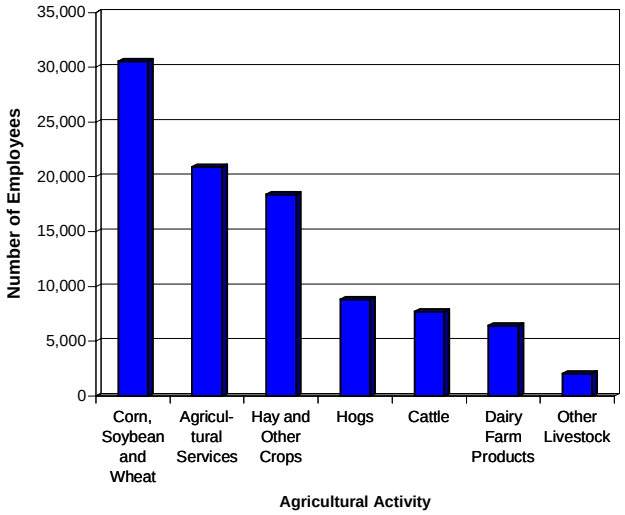
	Corn	Soybeans	Hay	Wheat	Dairy Products	Hogs	Cattle	Other Livestock	All Crops and Livestock
Illinois	$543	$381	$88	$60	$71	$215	$186	$11	$1,555
Iowa	$370	$182	$121	$1	$173	$291	$174	$19	$1,330
Wisconsin	$151	$27	$88	$1	$357	$50	$99	$38	$810
Minnesota	$164	$69	$78	$1	$180	$46	$99	$36	$673
Missouri	$175	$200	$36	$41	$22	$78	$75	$14	$642
UMR Corridor	**$1,403**	**$859**	**$412**	**$103**	**$803**	**$680**	**$633**	**$117**	**$5,010**

Notes: The total crops and livestock estimate for the UMR corridor does not reflect minor crops produced because data on crops produced in smaller quantities are not available at the county level.
Sources: (1) IMPLAN model data, 1994; (2) Minnesota Agricultural Statistics Service, Minnesota Agricultural Statistics 1998*, U.S. Department of Agriculture and Minnesota Department of Agriculture, 1998; (3) Iowa Agricultural Statistics,* 1998 Iowa Agricultural Statistics*, U.S. Department of Agriculture and Iowa Farm Bureau, August 1998; (4) Missouri Agricultural Statistics Service,* 1998 Missouri Farm Facts*, U.S. Department of Agriculture and Missouri Department of Agriculture, September 1998; and (5) U.S. Department of Agriculture, National Agricultural Statistics Service, State Offices Home Page, obtained from "http://www2.hqnet.usda.gov/ nass/sso-rpts.htm" on 11/20/98.*

Of the $2.2 billion in revenues generated by UMR corridor livestock production in 1997, dairy farm products, cattle, and hogs each contributed close to one-third of the total revenue. Poultry and egg production generate the majority of "other livestock" revenues.

The agriculture sector employed more than 94,000 people in the UMR corridor in 1994. Approximately half of all those employed in the sector worked as field labor in the production of grains (corn, soybeans, and wheat) and hay and other crops (see Exhibit 8-3). The production of livestock and livestock products employed approximately one quarter of all farm workers in the UMR corridor. The remaining workers were employed in agricultural services including establishments primarily engaged in soil preparation services, veterinary services, and farm labor and management services.

Exhibit 8-3
Employment in the UMR Corridor's Agricultural Sector, 1994



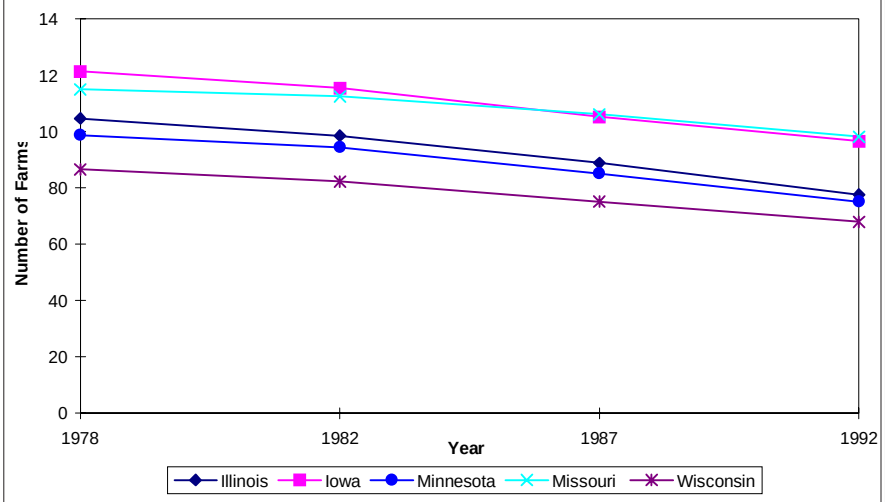
Source: IMPLAN model data, 1994.

It is important to note that the agricultural sector's employment estimate reflects total full-time and part-time employment. Because agriculture employs a high number of part-time and seasonal workers, the number of *full-time equivalent* employees in agriculture is likely to be significantly less than 94,000 people.

TRENDS

Agricultural trends in the UMR region reflect nationwide trends toward fewer, larger farms. The total number of farms in the UMR five-state region has decreased by more than 100,000 farms since 1978, or one-fifth of all farms in the region (see Exhibit 8-4). Illinois has experienced the largest decline, losing more than 27,000 farms over the 14 year period.

Exhibit 8-4
Total Number of Farms in the UMR Five-State Area



Source: U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census, *USA Counties 1996: A Statistical Abstract Supplement*, August 1996.

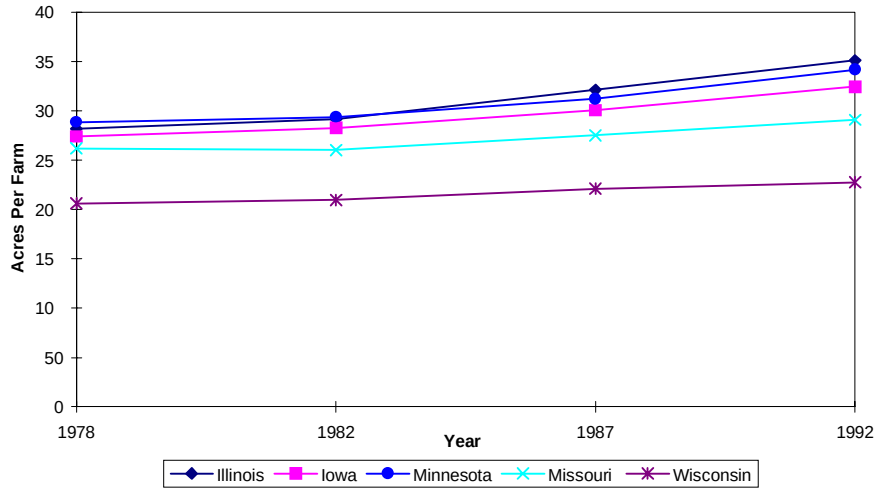
In general, family-owned farms with relatively little acreage are being consolidated into larger, more mechanized farms. As evidence, consider that while the total number of farms has declined by about 20 percent, total farm acreage has declined only slightly (about seven percent) and even remained constant in some states such as Minnesota. Therefore, the average number of *acres per farm* has increased in the five-state region (see Exhibit 8-5). The average size of Illinois farms increased by more than 25 percent from 1978 to 1992, while the average size of Wisconsin farms increased by about 10 percent during the same period. This trend toward larger, more mechanized farms is expected to continue in the future.

Domestic demand for the UMR region's grain is expected to remain strong in the near future. Nationwide, the total production of corn is expected to grow because of strong demand for corn as a sweetener and for ethanol. Demand for soybeans is also forecasted to remain strong due to continued growth in the poultry sector and the related need for soybean meal.[4]

In the livestock sector, total cattle production is expected to decline through 2000 due to the high feed costs experienced during 1995 and 1996. Although grain prices have since fallen, allowing pork and poultry production to rebound,

[4] U.S. Department of Agriculture, *USDA Agricultural Baseline Projections to 2008*, obtained from "http://www.econ.ag.gov/epubs/pdf/baseline/waob991.PDF" on 3/8/99, p. 5.

Exhibit 8-5
Average Number of Acres Per Farm in the UMR Five-State Area



Source: U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census, *USA Counties 1996: A Statistical Abstract Supplement*, August 1996.

tight food supplies and cattle's longer biological production lags indicate that beef production will continue to decline through 2000. While the production of cattle is expected to rebound by 2007, per capita consumption of poultry is expected to exceed per capita consumption of red meat by 2004, suggesting that poultry may have a greater role in the livestock sector of the future. Milk production is expected to grow slowly as higher hay prices will likely deter herd expansions. In addition, the removal of price supports due to the 1996 Farm Act suggests that diary prices will fall. As a result, milk sales are forecast to remain stagnant in the near term.[5]

Growth in U.S. agricultural exports is expected to be slow during the next two to three years reflecting decreased demand in Asian and former Soviet Union markets, as well as increased competition from South American producers. Increased demand for South American exports stems from gains in productivity, currency realignment, privatization of key economic sectors, and other market-oriented reforms. However, long term prospects for U.S. agricultural exports are good due to decreased trade barriers, and higher income in developing countries leading to increased demand for U.S. agricultural commodities.[6]

[5] U.S. Department of Agriculture, Ibid, p. 66-71.

[6] U.S. Department of Agriculture, Ibid, pp. 84, 103.

Chapter 9

Energy Production

Energy production in the UMR corridor depends on the Mississippi River in several ways. First, the river supports waterway transportation, which is an important means of shipping coal to power plants. About 24 million tons of coal were shipped on the UMR in 1995, much of it destined for power plants in the corridor.[1] Second, the river provides a source of cooling water for fossil fuel and nuclear power plants. Cooling water is drawn from the UMR, used to dissipate heat created in the process of generating energy, and discharged back to the river. According to the U.S. Geological Survey, power plants in the UMR corridor used 6.4 billion gallons of cooling water per day in 1995.[2] Power plants also use UMR water in the generation process to create steam that turns power-generating turbines. Finally, the Mississippi River serves as a direct fuel source for hydroelectric power generation. Seven hydroelectric plants in the UMR corridor generate approximately 125 megawatts (MW) of power annually.[3]

In 1996, 49 power plants located in the UMR corridor generated close to 7,500 MW of electricity. This represents about 20 percent of the total power generated in the UMR's five-state region.[4] The generating capacity of the corridor's plants ranges from small generators with capacities of less than 1 MW to larger generators with capacities close to 1,900 MW. Many of the larger generators are located near significant power-consuming areas, such as St. Louis and Minneapolis.

The remainder of this chapter provides an overview of the different types of power plants along the UMR, presents facility generation and capacity data, examines revenue and employment associated with power generation, and discusses potential trends for the industry.

DATA SOURCES AND METHODOLOGY

We defined the energy sector as industries classified by Standard Industrial Classification (SIC) code 4910—establishments engaged in the generation,

[1] U.S. Army Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1995*, Waterborne Commerce Statistics Center, 1997.

[2] U.S. Geological Survey, *Water Use in the United States*, 1995, obtained from "http://water.usgs.gov/watuse/" on 11/12/98.

[3] Energy Information Administration (EIA), database file 759, *Monthly Power Plant Report*, fiscal year 1996, obtained from "http://www.eia.doe.gov/cneaf/electricity/page/eia759.html" on 11/2/98.

[4] EIA, Ibid.

transmission, and/or distribution of electric energy for sale—and SIC code 4930—establishments providing electric or gas services in combination with other services. We relied on several sources for information on the UMR corridor's energy sector:

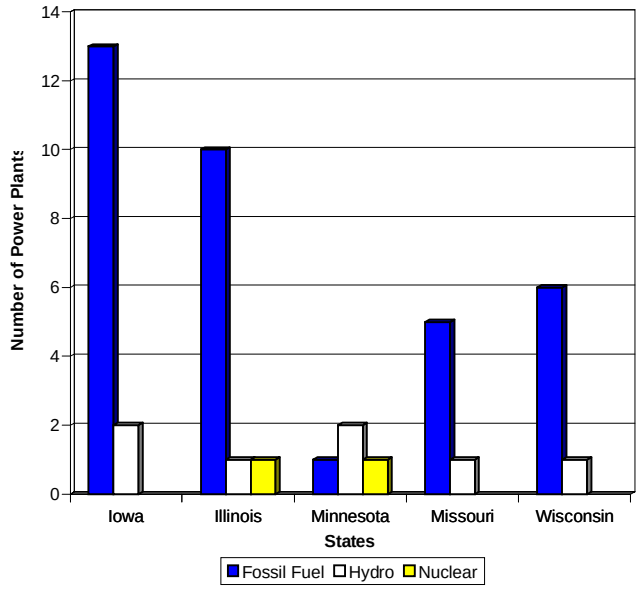
- Generation and capacity estimates were developed using data from the U.S. Department of Energy's Energy Information Administration (http://www. eia.doe.gov).
- Estimates of surface water used as cooling water by the energy sector were obtained from the 1995 U.S. Geological Survey, *Water Use in the United States* (http://water.usgs.gov/watuse).
- Revenue and employment estimates were developed based on IMPLAN model data, 1994.

Generation estimates reflect net generation, which is gross generation minus electricity used by the plant. All generation data provided in megawatt hours were converted to megawatts by dividing megawatt hours by 8,760 hours (i.e., the number of hours per year).

OVERVIEW OF POWER PLANTS

Three types of power plants generate energy in the UMR corridor: fossil fuel plants, nuclear facilities, and hydroelectric dams. The most common type of power production facility in the UMR corridor is fossil fuel generation (40 plants), followed by hydropower (seven plants), and nuclear power (two plants).[5] Exhibit 9-1 shows the number of power plants by state, for UMR corridor counties only. Each type of power production is described in more detail below.

Exhibit 9-1
Number Of Electric Power Plants in UMR Corridor, 1996



Source: EIA, database file 759, *Monthly Power Plant Report*, fiscal year 1996, obtained from "http://www.eia.doe.gov/dneaf/ electricity/ page/eia759.html" on 11/2/98.

- **Fossil Fuel Plants:** Fossil fuel plants produce energy by burning coal, gas, or petroleum to power steam turbines, gas turbines, or internal combustion engines. Coal is by far the leading energy source for fossil fuel plants in the UMR five-state region, fueling approximately 96 percent of their electricity generation. Gas and petroleum fuel the remaining four percent of fossil fuel plant generation.[6] Fossil fuel plants also use a significant amount of cooling water, almost five billion gallons per day in 1995.[7]

[5] EIA, database file 759, op cit.

[6] Data obtained from "http://www.eia.doe.gov/emeu/ sep.states.html" on 11/30/98.

[7] U.S. Geological Survey data, op cit.

- **Nuclear Power:** Nuclear power plants operate by initiating a controlled reaction of fissionable materials to produce heat that is used to drive turbines and generate power. As with fossil fuel plants, nuclear facilities use a large amount of cooling water. The corridor's two nuclear plants used a total of 1.4 billion gallons of cooling water per day in 1995.[8]

- **Hydroelectric Power:** Water is the most common renewable energy source for generating electricity. While the construction and operation of hydroelectric dams may significantly impact a river's ecology and surrounding wildlife habitat, hydroelectric plants take advantage of an inexpensive and "clean" energy source, in that it does not require fuel combustion. UMR hydropower production depends on seasonal changes that affect river flow because the majority of hydroelectric plants function in a "run of the river" mode to generate power. That is, these facilities use the force of the river's natural current to turn turbines and produce electricity, rather than storing water for future release.[9]

Importance of UMR Cooling Water

Most power plants locate on lakes or rivers because they provide an abundant source of water that can be used for cooling purposes in the energy production process. The level of intake and outflow of cooling water depends on the plant's location on the river and seasonal constraints, such as fish spawning periods. Temperature and quantity of discharges are regulated through NPDES (National Pollutant Discharge Elimination System) permits under the Clean Water Act. The specifications for permits are unique for each facility and depend on the quality of the receiving body of water and local habitat, such as the plant's proximity to mussel beds.

Source: (1) Personal communication with Mike Coffey, U.S. Fish and Wildlife Service, 12/11/98; and (2) information obtained from The Prairie Island nuclear power plant website at "http://www.cannon.net/~gonyeau/nuclear/ prairie.htm" on 11/30/98.

Overall, the UMR's water has proven to be a dependable and integral part of the energy production process. Droughts have only occasionally impacted energy production in the corridor. For example, the Mississippi River dropped to about 10 percent of its normal flow in 1988 due to an especially dry spring and summer. This drought, however, caused only one power plant, a nuclear facility in Monticello, MN to interrupt its operations because of low flow.[10]

POWER GENERATION AND CAPACITY

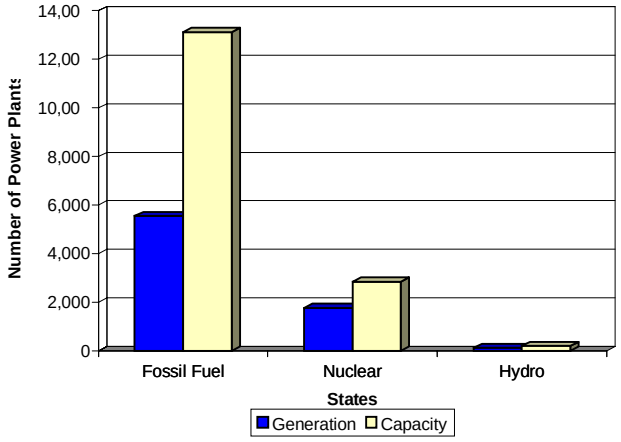
Power plants in the UMR corridor generated close to 7,500 MW of electricity in 1996 and had the capacity to generate over 16,000 MW. Capacity refers to the amount of electric power a generator is capable of producing according to the manufacturer's specifications for the generation equipment

[8] U.S. Geological Survey data, Ibid.

[9] EIA, *Primer for Electric Power Industry, Chapter 2*, from "http://www.eia.doe. gov/cneaf/electricity/page/prim2/chapter2.html" on 11/30/98.

[10] It should be noted that the Monticello plant is located upstream of Hennepin county in Wright county, which is outside the UMR corridor. The McKnight Foundation, *The Mississippi River in the Upper Midwest: It's Economy, Ecology, and Management,* p. 26.

Exhibit 9-2
Total Generation And Capacity in the UMR Corridor, 1996



Sources: EIA, database file 759, *Monthly Power Plant Report*, fiscal year 1996, obtained from "http://www.eia.doe.gov/dneaf/electricity/page/eia759.html," and EIA, *Table 20, Existing Generating Units at U.S. Electric Utilities by State, Company, and Plant, as of January 1, 1997,* obtained from "http://www.eia.doe.gov/cneaf/electricity/ipp/h20p01.txt" on 11/16/98.

being used, while generation reflects the actual power produced. Capacity estimates are important to a region because they indicate the amount of power that could be made available during peak periods of energy demand.

Fossil fuel plants are the dominant source of power in the UMR region. As shown in Exhibit 9-2, fossil fuel plants generated over 5,500 MW of power in 1996, or about 75 percent of the UMR corridor's total power production. Illinois Power Company's Baldwin facility was the largest generator in the UMR corridor in 1996, generating over 1,100 MW. The Baldwin plant is located in southwestern Illinois, in close proximity to several coal mines. It supplies power to the surrounding St. Louis, MO metropolitan area, serving over 242,000 residential and industrial consumers.[11] In comparison to fossil fuel generation, nuclear facilities generated 1,800 MW, while hydropower accounted for only 125 MW. Although all the dams located along the UMR were constructed primarily for commercial navigation purposes, some dams also generate small amounts of power.

Power plants in the UMR corridor account for about 20 percent of energy generation and capacity in the five-state region (see Exhibit 9-3). Geographically, power generation in the corridor is centered near cities. Illinois is the leading generator in the UMR corridor, driven by the abundance of coal mines in the area and energy demands from Chicago. Power plants along the UMR in Minnesota and Missouri account for significant portions of their states' power production and capacity. These plants serve the power needs of the large metropolitan areas of Minneapolis/St. Paul and St. Louis.

Exhibit 9-3
Generation and Capacity in UMR Corridor and UMR's Five-State Region

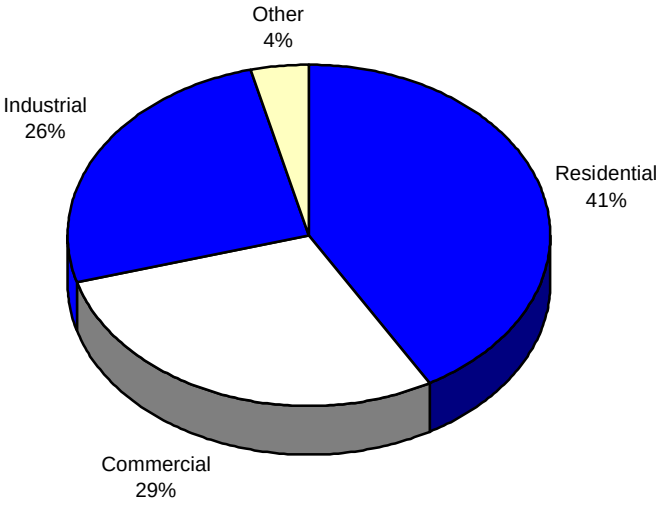
	Generation (MW)			Capacity (MW)		
	UMR Corridor	UMR Five-State Region	UMR Corridor Generation as a % of Five-State Region	UMR Corridor	UMR Five-State Region	UMR Corridor Capacity as a % of Five-State Region
Illinois	2,41	16,452	15%	5,19	37,018	14%
Iowa	1,13	3,81	30%	2,36	9,07	26%
Minnesot	1,83	4,77	38%	3,50	9,57	37%
Missouri	1,60	7,74	21%	3,77	17,247	22%
Wisconsi	505	5,89	9%	1,32	11,987	11%
Total	**7,49**	**38,673**	**20%**	**16,159**	**84,900**	**19%**

Sources: EIA, database file 759, *Monthly Power Plant Report*, fiscal year 1996, obtained from "http://www.eia.doe.gov/cneaf/electricity/page/eia759.html" on 11/2/98, and EIA, Table 20, *Existing Generating Units at U.S. Electric Utilities by State, Company, and Plant, as of January 1, 1997*, obtained from "http://www.eia.doe.gov/ cneaf/electricity/ipp/h20p01.txt" on 11/16/98.

[11] Data obtained from "http://www.nrdc.org/nrdc/nrdc/nrdcpro/utilprof/utilhtml/il.html" on 12/10/98.

Exhibit 9-4 shows the distribution of power in the UMR five-state region based on revenue generated by residential, commercial, industrial, and other users such as public authorities for street lighting and railroad operators.[12] Residential users account for the largest share of revenue (41 percent). Commercial sector consumers represent 29 percent of revenues, using electricity for the lighting, heating, and cooling of commercial buildings (e.g., offices). Industrial users (26 percent of revenue) include food processors, chemical manufacturers, and transportation equipment producers, among the largest manufacturers in the UMR.

Exhibit 9-4
Power Consumers By Sector Based on Revenue Generation in the UMR Five-State Region



Source: EIA, *Table 7. Revenue from Sales to Ultimate Consumers by Sector, Census Division, and State,* 1997, obtained from "http://www.eia.doe.gov/cneaf/electricity/esr/t07.txt" on 11/18/98.

REVENUE AND EMPLOYMENT

Power facilities in the UMR corridor employ over 13,000 workers and generate over $4.7 billion in revenues (see Exhibit 9-5). It should be noted that these estimates reflect revenue and employment from the generation, transmission, and distribution of electricity. Revenue and employment from transmission and distribution activities tend to be higher in highly populated areas, such as Minneapolis/St. Paul and St. Louis, which helps to explain why Minnesota and Missouri UMR counties rank highest in terms of revenue and employment even though Illinois counties generate more power. An additional reason for lower revenue and employment in Illinois counties is that the headquarters for Illinois Power Company, the owner of many of the generators along the UMR in Illinois, is located outside the corridor.

Exhibit 9-5
Revenue and Employment in 60-County UMR Corridor

	Revenue (in $ millions)	Employment
Illinois	$1,028	2,630
Iowa	$335	1,176
Minnesota	$1,720	4,842
Missouri	$1,403	3,669
Wisconsin	$257	872
Total	**$4,743**	**13,189**

Source: IMPLAN, 1994 model data.

[12] EIA, *Table 7. Revenue from Sales to Ultimate Consumers by Sector, Census Division, and State,* 1997, obtained from "http://www.eia.doe.gov/cneaf/electricity/esr/t07.txt" on 11/18/98.

TRENDS

The nation's power industry is facing an uncertain period as deregulation forces the industry into a new era of competition. This transition may result in significant restructuring of the power industry, but it is not yet clear how power producers in the UMR corridor will be affected.

- If power plants in the UMR region are low-cost generators compared to generators nationwide, they may see an increase in interregional transfers of power as electricity is transmitted and distributed to larger geographical areas.

- Greater competition may also motivate generators to reduce their levels of capacity reserved for emergencies or periods of peak demand. Therefore, only a small amount of new generating capacity is expected to be necessary in the near-term, which will most likely be fulfilled by smaller oil or gas burning units rather than coal burning or nuclear facilities.[13]

Over the next eight years, power plant construction in the UMR corridor and five-state region is expected to comprise largely of fossil fuel generating units, mainly natural gas burning facilities. These new plants will likely add 6,700 megawatts of generating capacity to the five-state region's existing capacity of 84,900 megawatts.[14] Few, if any, plants are expected to close.[15]

[13] International Trade Administration, *U.S. Industry & Trade Outlook '98,* Department of Commerce, 1998.

[14] EIA, *Table 23. Planned Generating Unit Additions at U.S. Electric Utilities by State, Company, and Plant, 1997 through 2006, as of January 1, 1997*, obtained from "http://www.eia. doe.gov/cneaf/electricity/ipp/b2301p01.txt" on 12/16/98.

[15] The McKnight Foundation, op. cit.

Manufacturing

Chapter 10

The UMR corridor's manufacturing sector is large and diverse, encompassing operations such as food processing and production of industrial machinery, transportation equipment, and chemicals. These and other manufacturers in the corridor generated $126 billion in revenue and employed over 600,000 people in 1994, with most of this activity concentrated in the Minneapolis/St. Paul and St. Louis metropolitan areas.

The UMR serves the manufacturing sector in three main ways. First, manufacturers draw water directly from the river for use in production processing, washing, and cooling. Corridor manufacturers withdraw about 325 million gallons of surface water per day.[1] Some water-intensive industries along the UMR include steel, chemical and allied products, paper and allied products, and petroleum refining. Second, several manufacturers discharge wastewater from production processes into the UMR. Properly treated waste can be assimilated and treated by the river more safely and at a lower cost than if wastes were disposed of by other means. Finally, the river provides a means of transporting crops and raw materials to food processing facilities and industrial plants. In turn, these manufacturers ship primary and finished products from production sites to distributors.

This chapter presents an overview of the UMR corridor's major manufacturing activities, provides revenue and employment estimates, and discusses potential future trends.

DATA SOURCES AND METHODOLOGY

We define the manufacturing sector as those operations that fall within Standard Industrial Classification (SIC) codes 2000 through 3999.[2] Generically, manufacturing refers to the transformation of materials into new products. This process can occur at a variety of levels, from taking raw materials and making intermediate products, to creating finished products. As a result, we include activities in the manufacturing sector that span from primary processing, such as mixing fertilizer, to high technology manufacturing, such as building computers.[3]

[1] U.S. Geological Survey, *Water Use in the United States*, 1995, obtained from "http://water.usgs.gov/watuse/" on 11/12/98.

[2] Cement and lime manufacturing (SIC codes 3241 and 3274, respectively) are excluded from this chapter. The revenue and employment of these activities are captured in Chapter 7, Mineral Resources.

[3] Office of Management and Budget, Standard *Industrial Classification Manual*, Executive Office of the President, 1987.

We rely on a variety of information sources to characterize manufacturing in the UMR corridor, such as: (1) The McKnight Foundation, *The Mississippi River in the Upper Midwest: It's Economy, Ecology, and Management*, 1996; and (2) Minnesota Department of Trade and Economic Development, *Compare Minnesota: An Economic and Statistical Fact Book 1998/1999*, 1998. To develop revenue and employment estimates, we use: (1) IMPLAN model data, 1994; (2) County Business Patterns, 1994-1995; and (3) Dun & Bradstreet reports.

MANUFACTURING REVENUE AND EMPLOYMENT

As shown in Exhibit 10-1, a variety of manufacturers contribute to the UMR corridor's economy. As a whole, the manufacturing sector generated $126 billion in revenue and employed about 600,000 people in 1994, led by four industrial sectors: (1) food and kindred products; (2) industrial and commercial machinery (including computer equipment); (3) transportation equipment; and (4) chemicals and allied products. Corridor manufacturing is centered around the Minneapolis/St. Paul and St. Louis metropolitan areas. These areas accounted for about $90 billion in manufacturing revenues, or about 70 percent of the corridor's total manufacturing revenue.

Exhibit 10-1
Revenue and Employment of Manufacturing Sectors in the UMR Corridor

SIC Code	Industrial Categor	Industry Revenu ($ millions)	Employment
20	Food and kindred products	23,378	63,539
35	Industrial and commercial machinery and computer equipment	16,905	90,614
37	Transportation equipment	14,371	48,419
28	Chemicals and allied products	11,619	31,087
27	Printing, publishing, and allied industries	7,88	68,353
26	Paper and allied products	7,81	35,343
33	Primary metal industries	7,49	29,851
34	Fabricated metal products, except machinery and transportation equipment	7,08	49,307
38	Measuring, analyzing, and controlling instruments; photographic, medical and optical goods; watches and clocks	6,16	41,873
29	Petroleum refining and related industries	6,01	5,67
36	Electronic and other electrical equipment and components, except computer equipment	5,87	38,980
30	Rubber and miscellaneous plastics products	4,08	27,705
24	Lumber and wood products, except furniture	1,91	16,126
25	Furniture and fixtures	1,53	13,294
39	Miscellaneous manufacturing industries	1,48	14,998
32	Stone, clay, glass, and concrete products	1,22	8,74
23	Apparel and other finished products made from fabrics and similar materials	988	11,491
31	Leather and leather products	465	4,56
22	Textile mill products	177	1,55
	TOTAL	**126,469**	**601,523**

Source: IMPLAN model data, 1994.

MAJOR MANUFACTURING ACTIVITIES IN THE UMR CORRIDOR

Below we describe the corridor's major manufacturing categories (i.e., food and kindred products, industrial and commercial machinery, transportation equipment, and chemicals and allied products) in more detail and discuss their role in the UMR corridor. For each category, we examine significant subsectors and provide examples of firms operating in the corridor.

Food and Kindred Products

Manufacturers of food and kindred products process food and beverages for human and animal consumption. Food processors in the UMR corridor mainly concentrate in meat, grain, and beverage products. The processing industries are supported by the five-state region's extensive production of grain crops and livestock. Key subsectors include the following:

- *Meat products.* Concentrated in the city of St. Louis, meat packing plants slaughter cattle, sheep, lambs, and hogs for freezing or processing into other products, such as sausage.
- *Grain products.* Manufacturers mill corn to make starch, syrup, and other by-products. In addition, manufacturers mill grain into flour and cereal and prepare flour mixes and doughs.
- *Beverages.* The beverage industry, located primarily in and around St. Louis, is dominated by malt beverage manufacturing, including beer and malt liquors.

Exhibit 10-2
Major Manufacturing Activities: Food and Kindred Products

Significant Manufacturing Activities	Number of Establishments	Examples of Firms Operating in the Corridor (more than 200 employees)
Meat Products	82	• Kraft Foods, Inc. • Long Prairie Packing Company, Inc. • GFI America, Inc.
Grain Products	96	• General Mills, Inc.; Yoplait USA and JF Research Center • Archer Daniels Midland Milling Co. • The Pillsbury Company, Inc.
Beverages	57	• The Stroh Brewery Company, Inc. • Minnesota Brewing Company, Inc. • Anheuser-Busch, Inc.

Sources: (1) IMPLAN model data, 1994; (2) 1996 County Business Patterns; (3) 1998 Dun & Bradstreet reports.

Industrial and Commercial Machinery

Many companies in the UMR corridor produce industrial and commercial machinery. Major industries include computer and office equipment, refrigeration and service industry machinery, and farm and garden equipment.

- *Computer and office equipment.* This sector manufactures various electronic computers ranging from personal computers to mainframes. The majority of computer firms in the corridor are located in Minneapolis/St. Paul.
- *Refrigeration and service industry machinery.* Air-conditioning and heating equipment comprise the majority of products made by this sector. Over 25 manufacturers in this industry are located in Hennepin County, MN.

Exhibit 10-3
Major Manufacturing Activities: Industrial and Commercial Machinery

Significant Manufacturing Activities	Number of Establishments	Examples of Firms Operating in the Corridor (more than 200 employees)
Computer and office equipment	77	• General Dynamics Corporation • Siemens Energy and Automation, Inc. • Lockheed Martin Corporation
Refrigeration and service industry machinery	89	• Johnson Heater Corp. - Marcraft Division • Weather-Rite, Inc. • American Standard Inc. - The Trane Company
Farm and garden equipment	68	• John Deere • Carter Day, Inc. • The Toro Company, Inc.

Sources: (1) IMPLAN model data, 1994; (2) 1996 County Business Patterns; (3) 1998 Dun & Bradstreet reports.

Exhibit 10-4
Major Manufacturing Activities: Transportation Equipment

Significant Manufacturing Activities	Number of Establishments	Examples of Firms Operating in the Corridor (more than 200 employees)
Motor vehicles	108	• The Ford Motor Company • Chrysler Corporation • Minnesota Mining and Manufacturing Company
Aircraft	33	• McDonnell Douglas Corporation • Honeywell, Inc. • United Technologies Corporation

Sources: (1) IMPLAN model data, 1994; (2) 1996 County Business Patterns; (3) 1998 Dun & Bradstreet reports.

Exhibit 10-5
Major Manufacturing Activities: Chemicals and Allied Products

Significant Manufacturing Activities	Number of Establishments	Examples of Manufacturers Operating in the Corridor (more than 200 employees)
Medicinal chemicals and pharmaceutical products	52	• Mallinckrodt Chemical Inc. • Research and Diagnostic Systems, Inc. • SmithKline Beecham Corporation
Soaps, detergents, and cleaning preparations	95	• The Lamaur Corporation • A-Veda Corporation • Happy Dragon, Inc.

Sources: (1) IMPLAN model data, 1994; (2) 1996 County Business Patterns; (3) 1998 Dun & Bradstreet reports.

- *Farm and garden equipment.* Farm machinery, such as combines and rotary tillers, supports the corridor's agricultural activity. John Deere operates four facilities along the UMR in Illinois.

Transportation Equipment

The transportation equipment sector is dominated by two industries: motor vehicle and aircraft production.

- *Motor vehicles.* These companies manufacture or assemble complete passenger automobiles, trucks, and commercial vehicles, as well as produce certain car parts and accessories. Forty-nine plants produce car parts or accessories in St. Louis and Minneapolis/St. Paul alone.

- *Aircraft.* Aircraft manufacturers produce or assemble complete aircraft or parts and auxiliary equipment. One-third of these producers are located in St. Louis city or county.

Chemicals and Allied Products

Chemical manufacturers in the corridor primarily produce finished chemical products, including:

- *Medicinal chemicals and pharmaceutical products.* A significant portion of the chemicals sector is comprised of manufacturing finished medicinal chemicals and pharmaceutical products. Over half of these facilities are located in the St. Louis area.

- *Soaps, detergents, and cleaning preparations.* This sector manufactures skin and hair products (e.g., suntan lotion, soap, and shampoo) and specialty cleaning, polishing, and sanitation products (e.g., ammonia, disinfectant, and floor wax).

Other Significant Manufacturers

In addition to the four largest manufacturing sectors, several other manufacturers play a significant role in the UMR corridor's economy. The following industries each generated over $7 billion in revenues in 1994 and employed more than 30,000 workers.

Exhibit 10-6
Major Manufacturing Activities:
Other Significant Manufacturers

Significant Manufacturing Activities	Number of Establishments	Examples of Firms Operating in the Corridor (more than 200 employees)
Printing, publishing, and allied industries	1,543	• Nordic Press, Inc. • Creative Publishing International, Inc. • The Star Tribune Company, Inc.
Paper and allied products	93	• National Envelope Corporation • Wright Packing, Inc. • Weyerhaeuser Company, Inc.
Primary metal industries.	42	• Alumax Foils, Inc. • Heidtmans Steel Products, Inc. • ALCOA
Fabricated metal products	365	• Federal Cartridge Company, Inc. • Crown Diversified Industries Corporation • American Magnetite, Inc.

Sources: (1) IMPLAN model data, 1994; (2) 1996 County Business Patterns; (3) 1998 Dun & Bradstreet reports.

- *Printing, publishing, and allied industries.* This sector engages in various forms of printing, and performs services related to printing such as bookbinding and publishing newspapers, books, and periodicals. St. Louis and Minneapolis/St. Paul house the majority of these producers.

- *Paper and allied products.* These manufacturers produce pulp, paper and paperboard, and finished products such as boxes and envelopes. The largest concentration of these manufacturers is in Hennepin County, MN.

- *Primary metal industries.* In the UMR metropolitan areas, this sector is comprised of establishments that smelt and refine ferrous and nonferrous metals into basic products such as pipes, bars, and rods.

- *Fabricated metal products.* Companies in this sector manufacture intermediate and finished metal products. Businesses near corridor cities primarily produce ammunitions and structural products such as door frames and trim.

MANUFACTURERS' USE OF THE UMR

Manufacturing enterprises rely on the UMR for a variety of services. Specifically, manufacturers use water from the UMR in production processing, as a sink for discharge of wastewater, and for transportation of goods.

- *Processing.* A variety of industries use river water as a key part of their manufacturing process. Collectively, UMR manufacturers used 937 million gallons per day, down five percent from 1990.[4] This reduction is largely due to water conservation and recycling practices.

[5] U.S. Geological Survey, op cit.

- *Discharge.* The UMR receives discharges from manufacturers located along the river. For example, Marathon Ashland Petroleum LLC in St. Paul, MN discharged an average daily flow of two million gallons of wastewater into the UMR in 1998.[5]

- *Transportation.* Many manufacturers ship their products to distribution points along the river. For example, the John Deere Dubuque Works plant in Dubuque, Iowa ships finished tractors, while Archer Daniels Midland in Clinton, Iowa ships corn derivative products, such as corn sweetners and corn oil.[6]

In addition, manufacturers are also interested in the quality of the UMR water. Water that is too turbid can impair the efficiency of industrial processes such as heat exchange and filtration. Poor water quality may force manufacturers to perform expensive treatment on water before it can be used. In addition, degraded water quality limits the river's ability to absorb and treat additional wastewater discharged from factories. As a result, business interruptions and increased costs can result from unreliable water supplies or degraded water quality.[7]

TRENDS

It is difficult to predict broad future trends in manufacturing in the UMR corridor given the large variety of goods produced in the region. In general, though, as industries expand, they are locating outside the corridor to take advantage of less expensive land and a plentiful trained workforce.[8] Employment trends for manufacturing in the UMR states are provided in Exhibit 10-7. Employment appears relatively stable for the next decade. Minnesota shows the largest potential change with about 16,000 more jobs likely to be generated by 2010, mainly by printers and publishers and rubber and plastics manufacturers. Other states are projected to experience minor changes in manufacturing activity.

Exhibit 10-7
Employment Data For Manufacturers in the URM Corridor

	Manufacturing Sector	1998	2000	2005	2010	Percent Change, 1998-2010
Illinois	Employment (000's jobs)	956	962	956	949	-0.7%
Iowa	Employment (000's jobs)	248	247	248	248	0%
Minnesota	Employment (000's jobs)	435	438	445	451	3.7%
Missouri	Employment (000's jobs)	430	430	430	430	0%
Wisconsin	Employment (000's jobs)	597	595	602	607	1.7%
TOTAL FIVE-STATE AREA	**Employment (000's jobs)**	**2,666**	**2,672**	**2,681**	**2,685**	**0.7%**

Source: Bureau of Economic Analysis, Department of Commerce, obtained from "http://www.bea.doc.gov/gsp/projlist.htm" on 12/31/98.

[5] Minnesota Pollution Control Agency- Permit Compliance System, *Permitted Discharges to the Mississippi River Table*, 11/12/98.

[6] The McKnight Foundation , *The Mississippi River in the Upper Midwest: It's Economy, Ecology, and Management*, 1996.

[7] The McKnight Foundation, op cit.

[8] The McKnight Foundation, p. 28, op cit.

Natural Resource Services Not Directly Reflected in the Commercial Economy

Chapter 11

Other chapters in this report characterize how the UMR contributes to commercial activity such as navigation, recreational spending, or energy production. However, natural resources such as the UMR frequently provide services not reflected in the commercial economy but which are nonetheless valuable to society. An economic profile of the UMR must recognize these services. In the sections below, we consider the following:

- Use of the river as a site for discharging wastewater;
- Services provided by wetlands in the UMR study area; and
- The UMR as habitat for wildlife, irrespective of human use of the wildlife.

WASTEWATER TREATMENT

Major waterbodies such as the UMR commonly serve as "sinks" for receiving and treating wastewater from factories, municipal sewage treatment plants, and other facilities. Environmental regulations require that concentrations of harmful pollutants be reduced before wastewater is discharged to surface waters such as the UMR. However, residual amounts of bacteria, nutrients, metals, and other pollutants typically remain in the effluent that facilities discharge. Natural biological processes in the river help break some residual pollutants down while more persistent pollutants settle to sediments or are carried downstream.

The UMR's ability to treat and store wastewater represents a key service that is not directly

Exhibit 11-1
Facilities With Permits to Discharge Wastewater to the UMR

State	Number of Permitted Direct Dischargers	Example Facilities		
		Name	Location	Products
Minnesota	45	Ford Motor Co.	St. Paul	Pickup trucks
		3M	Cottage Grove	Films, adhesives, tapes
Wisconsin	50	Metallics	LaCrosse	Metal name plates
		Various groundwater remediation projects	Various	Discharges from groundwater pump and treat operations
Iowa	≈85	Archer Daniels Midland	Clinton	Corn-derived products
		Aluminum Corporation of America	Davenport	Aluminum for planes and autos
Illinois	60	John Deere Harvester Works	Moline and East Moline	Farm equipment
		Rock Island Sewage Treatment Plant	Rock Island	Sewage treatment services
Missouri	38	Continental Cement	Hannibal	Cement
		Cape Girardeau Sewage Treatment Plant	Cape Girardeau	Sewage treatment services

Sources: Minnesota Pollution Control Agency, Permit Compliance System; Wisconsin Department of Natural Resources, data summarized by John Sullivan; Iowa Department of Natural Resources, Natural Resources Geographic Information System; Illinois Environmental Protection Agency, Bureau of Water, Compliance Assurance Section; McKnight Foundation, *The Mississippi River in the Upper Midwest: Its Economy, Ecology, and Management*, 1996.

reflected in the commercial economy. While no one "buys" the service, precluding wastewater discharges would require that facilities find other ways to treat and dispose of wastewater. These alternative methods would likely be costly. Therefore, the cost savings associated with being able to discharge wastewater can be thought of as a benefit provided by the UMR.

As shown in Exhibit 11-1, the operations that discharge wastewater to the UMR and its nearby tributaries are numerous and diverse. In all, approximately 278 facilities hold permits to discharge wastewater. They include large and small industrial facilities, groundwater treatment operations, and municipal sewage treatment plants.

WETLAND SERVICES

Wetlands are essential to ecological quality in many areas, providing habitat, flood control and other services (see below). Exhibit 11-2 summarizes wetland acreage around the UMR. As shown, the portion of the total UMR drainage basin included in the five-state area has over 2.7 million acres of wetlands, with the vast majority found in Wisconsin and Minnesota. The corridor counties themselves have over 400,000 acres of wetlands.

Consistent with national patterns, much of the wetland acreage that historically surrounded the UMR has been drained and developed. In the region from the Twin Cities to the Quad Cities alone, 45 percent of historic wetlands have been converted to either farmland or urban land.[1]

While development of wetlands benefits agriculture and other forms of economic development, such development has its costs as well. Wetlands provide a number of crucial ecological services that must be replaced or forsaken when wetlands are lost. Examples include the following:

Exhibit 11-2
Wetland Acreage in UMR Region

State	Wetland Acreage in UMR Basin	Wetland Acreage in UMR Corridor Counties
Minnesota	1,086,760	151,112
Wisconsin	1,347,582	112,322
Iowa	168,522	70,204
Illinois	140,354	67,393
Missouri*	3,967	3,967
TOTAL	2,747,185	404,998

Source: GIRAS Spatial Data, U.S. Environmental Protection Agency, 1994; county data prepared by USGS, Environmental Management Technical Center.
* County data available only for counties entirely located in UMR drainage basin. Therefore, acreage estimates exclude seven counties in the southernmost portion of the study area, near the confluence with the Ohio River. The excluded counties are Cape Girardeau, Mississippi, Scott, St. Charles, St. Louis, St. Louis (city), and Ste. Genevieve. As a result, wetland acreage for Missouri is understated. Alternative county-based data were not available.

- **Flood Control**: Wetlands provide a variety of flood protection services. They store runoff during precipitation events, avoiding rapid releases to rivers and streams and the flooding that occurs when the carrying capacity of the river is exceeded. Delivery of large amounts of runoff to rivers also makes the rivers move faster, eroding streambanks.

- **Protection of Water Quality**: Plants growing in wetlands absorb dissolved nutrients, such as nitrogen and phosphorus. Particulate matter, toxic pollutants, and heavy metals present in wastewater settle to the bottom of wetland areas. Because of these functions, wetlands can play an important role in treating municipal and industrial wastewater discharged to rivers and streamside areas.

[1] McKnight Foundation, *The Mississippi River in the Upper Midwest: Its Economy, Ecology, and Management,* 1996.

- **Water Supply**: Some types of wetlands supplement groundwater through percolation of surface water to groundwater aquifers. These aquifers may be used for drinking water or other types of water supply.

Wetland services are not traded in markets, so placing a value on them can be difficult. One way that economists estimate the value of wetlands is to consider the cost of constructing man-made alternatives. For example, we can consider the cost of constructing a wastewater treatment plant that filters wastewater in a manner similar to wetlands. Likewise, the value of wetlands is reflected in the cost of building flood control structures such as levees. Some or all of these costs could be avoided if wetland areas were preserved or restored. Although the results are highly site-specific, estimates of the annual per-acre value of wetlands ranges from about $100 to over $1,000, based on the avoided cost of providing lost services through engineered means.[2]

Wetlands also play a critical role as habitat for wildlife and thereby support wildlife-associated recreation such as fishing and hunting. The importance of recreation to the commercial economy is discussed elsewhere in this report. Below, we discuss the intrinsic value of wildlife habitat.

A variety of efforts are underway to stem the loss of wetlands around the UMR and throughout the U.S. For example, under the 1990 Farm Bill, the U.S. Department of Agriculture introduced the Wetland Reserve Program. The program allows owners of farm land to receive payments for the establishment of permanent or long-term conservation easements. The purpose of the program is to restore hydrology and vegetation on wetlands converted to farm land and to provide for other compatible uses of the land such as leasing of hunting rights, timber production, and flood water retention.[3] These and similar efforts may not halt wetlands loss, but will likely slow its pace.

WILDLIFE SPECIES AND HABITAT

As we note elsewhere in this report, the fish and wildlife supported by the UMR ecosystem are the foundation for diverse economic activity such as recreation and commercial harvests. Separate from these human-centered considerations, however, it is useful to characterize the intrinsic importance of the UMR as habitat for wildlife species. While the health of the UMR ecosystem may not be directly reflected in the commercial economy, surveys have shown that people intrinsically value environmental quality and the health of habitat and species that they do not directly use.[4]

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[2] Barataria-Terrebonne National Estuary Program, *Economic Value Assessment for the Barataria-Terrebonne Estuarine System*, prepared by Industrial Economics, Incorporated, March 1996.

[3] North Carolina State University, "Restoration of Wetlands Under the Wetlands Reserve Program," Woodland Owner Note No. 24, February, 1994, obtained from http://www.ces.ncsu.edu.

[4] Walsh, R.G., et al., *Public Benefits of Programs to Protect Endangered Wildlife in Colorado*, Symposium on Issues and Technology in Management of Impacted Western Wildlife, Thorne Ecological Institute, 1985; Boyle, K.J., and R.C. Bishop, "Valuing Wildlife in Benefit-Cost Analyses: A Case Study Involving Endangered Species," *Water Resources Research*, Vol. 23, No. 5, 1991, pp. 943-950.

Economists have conducted numerous studies of individuals' willingness to pay for environmental amenities such as endangered species, free flowing rivers, and wetland habitat. These studies generally estimate the amount of money an average household in a given geographic area would be willing to pay each year for protection or maintenance of the environmental amenity. Exhibit 11-3 provides a sampling of results from several studies. While the methodologies used in these studies are subject to a variety of uncertainties, economists generally accept the notion that the public intrinsically values environmental quality when unique or regionally distinct resources are at issue.

Exhibit 11-3
Willingness To Pay for Ecological Quality: Sample Studies and Findings

Study	Resource Valued	Annual Willingness to Pay per Household
Sanders, et al. (1990)	Preserving the three most valuable rivers in the state of Colorado	$49
Sutherland and Walsh (1985)	Value of protecting water quality in Flathead River and Flathead Lake in Montana	$79
Loomis (1996)	Restoration of Washington's Elwah River and native salmon through removal of two dams	$60-$74
Boyle and Bishop (1987)	Preservation of bald eagle and striped shiner populations in Wisconsin	$6-$8
Whitehead and Blomquist (1991)	Preservation of Clear Creek wetlands in Kentucky through decreased development	$9-13

Below, we discuss the status and trends of key species in the UMR and the habitat on which these species depend.

Migratory Birds

Nearly 300 bird species migrate through or nest in the UMR. Diving ducks, swans, pelicans and cormorants rely on open water areas while dabbling ducks, geese, herons, egrets, and various songbirds rely on shallow wetland areas. Overall, the UMR is the migration corridor for about 40 percent of the waterfowl in North America.[5]

The number of some migratory bird species have dwindled while others have grown. Scaup populations have declined steadily over the last ten years, decreasing from about six million to about four million. Likewise, the number of great blue herons and double-crested cormorants has declined in recent years. In contrast, canvasback populations are higher than the historical average and the population of breeding bald eagles nesting along the UMR has increased from two to five pairs in the 1970s to 43 to 44 pairs in 1994.

Trends in food sources and habitat are the primary factors affecting the wide fluctuations observed in UMR bird populations. For instance, changes in canvasback populations are directly linked to the abundance of key food sources such as wildcelery and bottom-dwelling worms. Other important habitat influences include draining and development of wetlands, maintenance of navigation channels, and pollution from various sources including industrial effluent, municipal effluent, and runoff from agricultural and urban land.[6]

[5] Hansen, Paul, in *Proceedings of the Fifty-Second Annual Meeting of the Upper Mississippi River Conservation Committee*, March 1996.

[6] USGS Environmental Management Technical Center, *Ecological Status and Trends Report of the Upper Mississippi River System*, forthcoming.

Fish

Recent monitoring efforts indicate that the UMR is home to at least 127 species of fish. This biological diversity stands in contrast to other surface water bodies in the Upper Midwest and distinguishes the UMR as a major ecological resource. The richness of fish species is attributable to unique habitat features of the river. First, the physical structure of the UMR provides an array of habitats, including channels and backwater lakes where species can thrive. In addition, the north-south orientation of the river historically provided a migration corridor for some species.

Available data indicate that the number of species present in the UMR has changed little since the 1800s. The abundance of fish in the UMR, however, is complex and shows no simple trend. For example, populations of key commercial and recreational species such as sauger and catfish have remained steady throughout the UMR region. Other species have been adversely affected by human activities such as navigation improvements, flood control, wastewater discharge, and agricultural runoff. Effects vary across different pools. For example, because of their dependence on backwater habitats, bluegill populations have increased in some pools and decreased in others.[7]

Habitat Preservation and Restoration

The value that humans place on the maintenance of wildlife habitat and species is partly reflected in past and ongoing conservation efforts. First, federal and state authorities have established a vast network of conservation areas. In all, more than 267,000 acres of national wildlife refuge land are located on the UMR between the Twin Cities and St. Louis, the largest of which is the Upper Mississippi River National Wildlife Refuge. Exhibit 11-4 shows the total acreage for major national wildlife refuges in the study area. In addition, the national refuges are supplemented by over 60 state conservation areas.[8]

Exhibit 11-4
National Wildlife Refuges Along the UMR

Refuge	Acreag
Upper Mississippi River National Wildlife Refuge	200,000 acres
Mark Twain National Wildlife Refug	25,300 acres
Trempealeau National Wildlife Refug	5,617 acres
Clarence Cannon National Wildlife Refug	3,747 acres

Source: U.S. National Park Service, Mississippi River Corridor Study, *Vol. 2, Inventory of Resources and Significance*, 1996.

In addition to land set aside for conservation, federal and state resource managers are implementing a variety of habitat rehabilitation projects in the UMR region under the Environmental Management Program (EMP). The U.S. Congress established the EMP in 1986 as a means for improving environmental conditions on the Upper Mississippi River System. As of Spring 1998, 24 habitat rehabilitation and enhancement projects (HREPs) had been designed, constructed, and monitored under the EMP, affecting 28,000 acres of river and floodplain habitat. In addition, 26 more HREPs are underway that are expected to improve 69,000 acres of river and floodplain habitat. From 1986 to 1998, about $160 million has been invested in the Environmental Management Program.[9]

[7] USGS, Ibid.

[8] Hansen, Paul, 1996, op cit.

[9] Carlson, Bruce, "Upper Mississippi River System Environmental Management Program," U.S. Army Corps of Engineers, Spring 1998.

Habitat Restoration in Pool 7

Barrier islands recently constructed in Lake Onalaska (Pool 7) provide a good example of habitat rehabilitation efforts in the UMR. Barrier islands are typically constructed from dredged material or rock. They are designed to redirect river currents and sediment transport, creating sheltered areas for aquatic plants and wildlife and providing nesting and resting habitat for waterfowl. Studies of the Lake Onalaska project have documented several successes, including growth of extensive aquatic vegetation beds, increased density of clam populations, and increased waterfowl reproduction.

Source: U.S. Army Corps of Engineers, Report to Congress: An Evaluation of the Upper Mississippi River System Environmental Management Program*, December 1997.*

Exhibit 11-5
Eligible HREP Types and Their Primary Purposes

Project Types	Primary Purposes of Projects
Backwater dredging	Increase overwintering fish habitat; add depth diversity
Water level management (dikes and water control structures)	Reduce sediment deposition in backwater and wetland areas; promote aquatic plant and invertebrate production; restore waterfowl resting and feeding habitat
Island construction	Provide physical conditions for reestablishment of aquatic plant growth; reduce wind and wave action
Shoreline stabilization	Prevent bank erosion; create fish habitat
Side channel openings or closures	Preserve aquatic habitat by reducing sedimentation in backwaters
Aeration	Restore aquatic habitat through improved water quality
Other (notched wing dams, potholes, land acquisition, planting, etc.)	Complementary to above actions

Source: U.S. Army Corps of Engineers, *Report to Congress: An Evaluatio of the Upper Mississippi River System Environmental Management Program*, U.S. Army Corps of Engineers, Rock Island District, December 1997, as cited in Carlson, Bruce, "Upper Mississippi River Syste Environmental Management Program," U.S. Army Corps of Engineers, Spring 1998.

The EMP was established as a partnership among various federal agencies and the UMR states. The EMP Coordinating Committee, which is co-chaired by the U.S. Army Corps of Engineers and U.S. Fish and Wildlife Service, provides policy and budgetary oversight for the program. Other members include the U.S. Geological Survey, each of the five State conservation agencies, the Environmental Protection Agency, and the National Park Service. Corps district offices in St. Paul, Rock Island, and St. Louis are responsible for implementing the program.[10]

HREPs are being constructed to counteract adverse ecological impacts and restore ecosystem integrity. One of the main objectives of HREPs is to reverse buildup of sediments in side-channel and backwater areas. Common techniques for addressing this problem include: (1) introducing flow to enhance oxygen levels in isolated backwaters; (2) isolating backwaters to reduce the incoming flow of sediments; and (3) constructing islands to reduce wave action and resuspension of sediment.[11] These approaches and other eligible habitat restoration and enhancement project types are described in Exhibit 11-5.

[10] Carlson, Bruce, Ibid.

[11] Theiling, Charles H., "Habitat Rehabilitation on the Upper Mississippi River," *Regulated Rivers: Research and Management*, Vol. II, pp. 227-238, 1995.

Counties in the UMR Corridor

Appendix

A

COUNTIES LISTED BY STATE

Illinois	Iowa	Minnesota	Missouri	Wisconsin
Adams	Allamakee	Anoka	Cape Girardeau	Buffalo
Alexander	Clayton	Dakota	Clark	Crawford
Calhoun	Clinton	Goodhue	Jefferson	Grant
Carroll	Des Moines	Hennepin	Lewis	La Crosse
Hancock	Dubuque	Houston	Lincoln	Pepin
Henderson	Jackson	Ramsey	Marion	Pierce
Jackson	Lee	Wabasha	Mississippi	Trempealeau
Jersey	Louisa	Washington	Perry	Vernon
Jo Daviess	Muscatine	Winona	Pike	
Madison	Scott		Ralls	
Mercer			Scott	
Monroe			St. Charles	
Pike			St. Louis (incl. city)	
Randolph			Ste. Genevieve	
Rock Island				
St. Clair				
Union				
Whiteside				

IMPLAN Model and Data

Appendix

B

IMPLAN MODEL AND DATA

Portions of our analysis rely on data from MicroIMPLAN (IMpact Analysis for PLANning), an input/output model originally designed by the U.S. Forest Service.[1] Many state and federal planning agencies use IMPLAN to evaluate the economic impact of policy choices. Like other regional economic models, IMPLAN allows the user to specify changes in output in key industries and examine how these changes affect the larger regional economy. The primary component of the model is an input/output matrix that describes how much of each sector's input needs are met by the outputs of all other sectors in the specified geographic area. To group industries for purposes of developing the input-output matrix, IMPLAN uses the categories defined by the U.S. Office of Management and Budget's Standard Industrial Classification (SIC) code.

While this report does not rely on IMPLAN modeling, it does use the underlying data from the IMPLAN input/output matrix. Specifically, we rely on the County-level Database component of the IMPLAN model. For our purposes, the advantage of this data base is that it includes county-level estimates of revenues of key industries. While other regional economic data sources (e.g., the Census Department's County Business Patterns) provide county-level estimates of employment and salaries, none provide revenue estimates at this geographic level. The data reflect economic activity in 1994, the most recent year for which data are available.

IMPLAN's County-level Database estimates employment using data from the Department of Labor's ES202 employment security data, supplemented by County Business Patterns data and data from the Bureau of Economic Analysis's Regional Economic Information System (REIS). Employment figures include all employees of an industry, regardless of function (e.g., administrative staff at a steel plant are counted the same way as production floor workers). The data include both full- and part-time workers, so that the number of full-time equivalent jobs is less than the total employment reported.

IMPLAN's County-level Database also provides estimates of output (i.e., revenue) in different industries. This output is simply the value of production by the industry for a given year. County-level output is based on county-level employment information. The data base uses state-level estimates of revenue per worker (based on Bureau of Census economic census data and other federal industry surveys) in combination with the employment data to arrive at county-level revenue for each industry. It is important to recognize, therefore, that the county-level revenue figures are estimates, and are not reported as part of economic censuses. As such, they are subject to a moderate degree of uncertainty.

All IMPLAN data used in this report were obtained from the U.S. Fish and Wildlife Service's Division of Economics, a licensed owner of the data.

[1] The IMPLAN model is now owned and maintained by the Minnesota IMPLAN Group, Inc. (MIG), in Stillwater, Minnesota. Information in this appendix is taken from IMPLAN Professional: User's Guide, Analysis Guide, and Data Guide, February 1997.

Appendix

C

Individuals and Organizations Contacted for Information

Exhibit C-1

Individuals and Organizations Contacted For Information

Person	Organization
Craig Allison	Minneapolis Public Works
Bill Bertrand	Illinois Department of Natural Resources
Linda Brooks	Minnesota Pollution Control Agency
John Conners	U.S. Fish and Wildlife Service
Hank DeHaan	U.S. Geological Survey, Environmental Management Technical Center
Jon Duyvejonck	U.S. Fish and Wildlife Service and Upper Mississippi River Conservation Committee
Dan East	Missouri Department of Natural Resources
John Edman	Carlson Destination Marketing Services, Mississippi River Parkway Commission
Doug Eiken	Missouri Department of Natural Resources
Herb Fallert	Missouri Division of Tourism
Dan First	Iowa Utility Board
Chuck Furrey	Iowa Department of Natural Resources
Mike Green	Illinois Agricultural Statistics Service
Mike Hunst	Minnesota Agricultural Statistics Service
Betsy Johnson	Iowa Agricultural Statistics
Paul Koski	Minneapolis Water Works
Linda Lembeck	Minnesota Trade & Economic Development
Ken Lubinski	U.S. Geological Survey, Environmental Management Technical Center
Eric Macbeth	Minnesota-Wisconsin Boundary Area Commission
Jeff McGrath	U.S. Army Corps of Engineers
Dave Moore	Minneapolis Water Works
Travis Moore	Missouri Department of Conservation
Eric Nelson	U.S. Fish and Wildlife Service
John Noller	Missouri Division of Energy
John F. Olson	Wisconsin Department of Natural Resources
Valerie Olson	Minneapolis Water Works
George Rafael	Missouri Department of Economic Development
Connie Reimer	Minnesota Department of Trade and Economic Development
LuAnn Reinders	Iowa Department of Economic Development
Ardel Rueff	Missouri Department of Natural Resources
David Scheler	Wisconsin Department of Tourism
Matt Short	Illinois Environmental Protection Agency, Bureau of Water
Phil Smith	Minnesota Department of Public Service
Dick Steinbach	Mark Twain National Wildlife Refuge
John Sullivan	Wisconsin Department of Natural Resources
Chuck Theiling	U.S. Geological Survey, Environmental Management Technical Center
Kyle Vickers	Missouri Department of Agriculture
Kurt Welke	Wisconsin Department of Natural Resources
Heather Westra	Prairie Island Indian Community
James Wiener	National Biological Service (LaCrosse)
Bob Williamson	Illinois Department of Natural Resources
Bill Zillmer	Wisconsin Department of Commerce

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