SOCIOECONOMIC SETTING

The demand for water in the Lake Michigan Region is directly linked to the area's population, economy and land use. Industrial processes create the greatest total demand for water in the Region. Water requirements also are high for energy production. Moreover, large quantities of water are needed in and near highly-populated urban centers for public supply. In rural areas, water is needed primarily for domestic and agricultural uses.

POPULATION

In 1990, the estimated population of the Lake Michigan Region (607,424) constituted nearly 11 percent of Indiana's total population (5,544,159). The in-basin portions of Lake, LaPorte and Porter Counties each had at least 65,000 residents in 1990, with Lake County accounting for almost 72 percent of the Region's population.

About 86 percent of the Region's total population in 1990 lived in urban areas of at least 2,500 persons. Fifteen of the 21 urban areas in the Region had population totals of 10,000 persons or greater. Gary and Hammond, the Region's largest cities, had populations of 116,646 and 84,236, respectively. The remainder of the Region's residents in 1990 lived in rural areas, which are defined by the U.S. Bureau of the Census as non-urban farm and non-farm areas of less than 2,500 persons.

Historic and projected population

Historic and projected population totals for in-basin portions of the four counties comprising the Lake Michigan Region are presented in appendix 1. The appendix also includes population values for entire counties and for urban areas within the Region. In-basin population values were derived by using county,

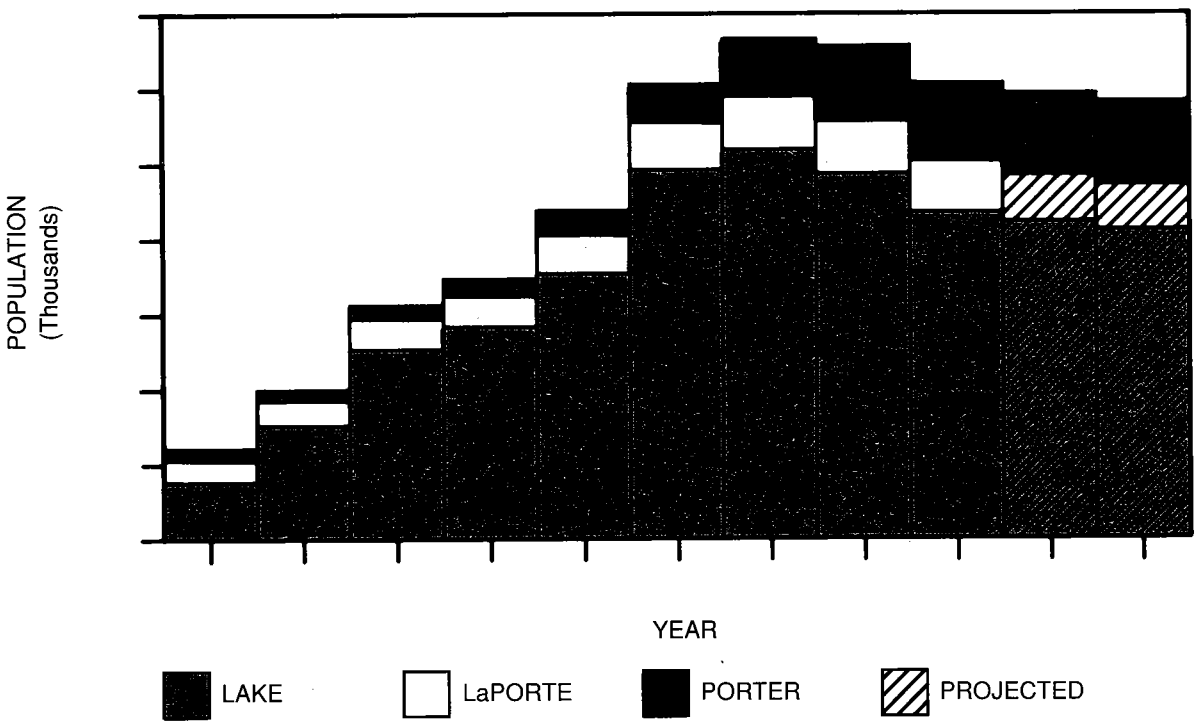

Figure 5. Historic and projected in-basin population of the three most populous counties

township, and urban area U.S. Bureau of Census data. Figure 5 illustrates the historic and projected population changes for the in-basin portions of the Region's three most populous counties Lake, LaPorte, and Porter. These three counties comprise 99.98 percent of the population for the Region.

Since 1910, there has been a 5-fold increase in total population for the Lake Michigan Region (figure 5 and appendix 1). The most rapid increases in population for the Region occurred during the 1950's and 1960's. After reaching a peak in the early 1970's, the total population in the Region began to decline and is expected to continue to decline for the next two decades. Of the three most populous counties in the Region, only Porter County has a population which continues to grow, while Lake County experiences the greatest decline in population (10 percent) since 1980. The primary loss of population in the Region has been in the urban areas in northern Lake County (appendix 1). Of the 21 urban areas in the Region, more than one-half of the towns or cities have experienced population declines since 1980, with New Chicago, Gary and East Chicago experiencing the greatest percentage of decline in population. Schererville, St. John, Dyer and Valparaiso had the greatest percentage increases in population for the same time period. Figure 6 illustrates the historic and projected population changes for selected cities.

The contrasting projections for communities within Lake County primarily reflect the southward shift of

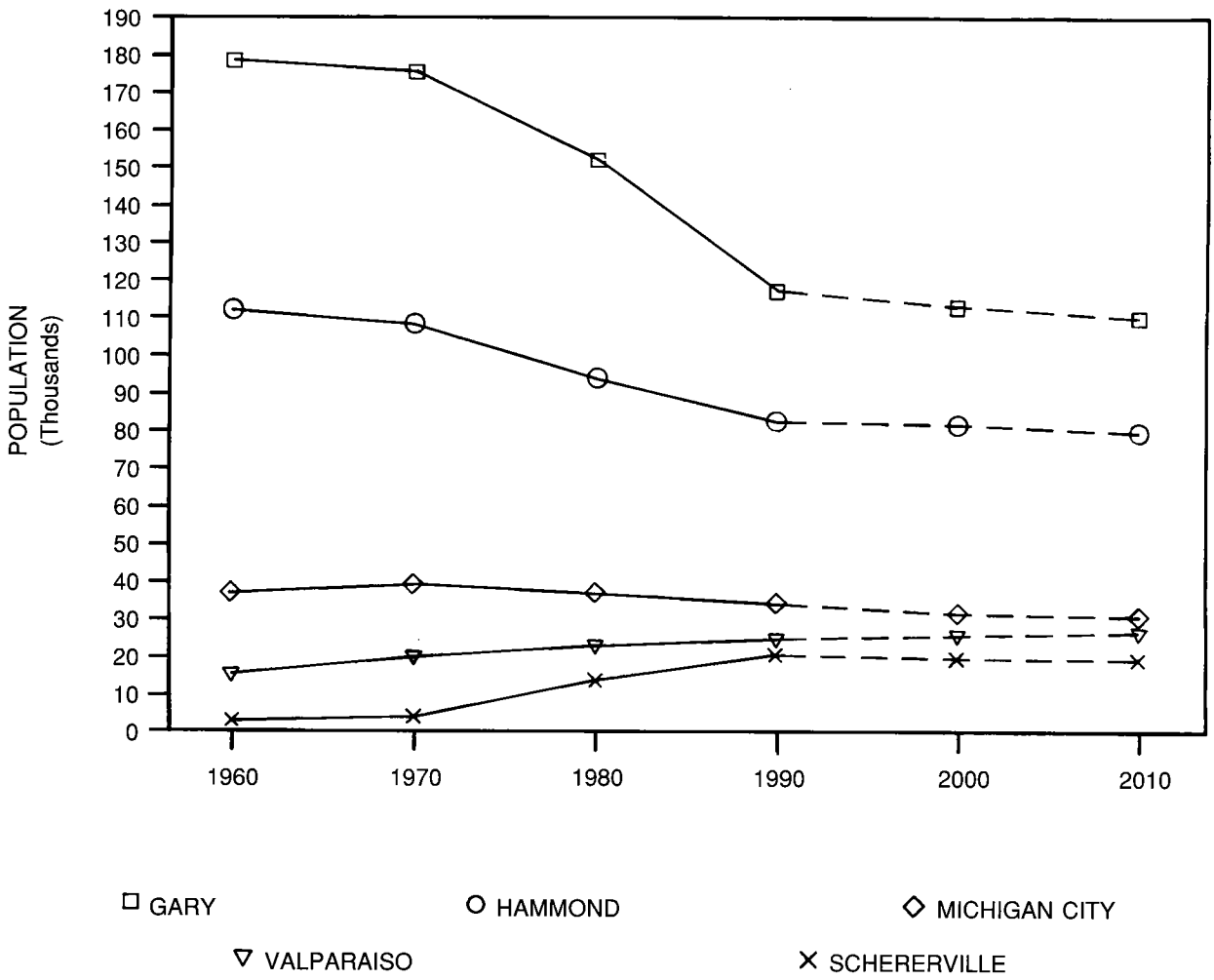

Figure 6. Recent and projected population of selected cities and towns

population from highly urbanized areas near Lake Michigan to urban and suburban areas lying near the southern boundary of the Lake Michigan Region.

ECONOMY

Economic activity within the Lake Michigan Region is an important factor determining water use because different types of industry have specific water resource requirements. In turn, the availability of water resources partially determines the type of industries that can be located in an area.

The lakeshore areas of the Lake Michigan Region form one of the largest industrial and commercial complexes in the world. The lake provides a plentiful supply of water and invaluable transportation for this industrial complex.

Lake Michigan is also part of the St. Lawrence navigation system, one of the most important inland waterway systems in the world. Four deep-draft commercial harbors in the Lake Michigan Region of Indiana provide access to this waterway: Indiana Harbor, Gary Harbor, Buffington Harbor and Burns International Harbor.

The following discussion on the economy of Lake, LaPorte and Porter Counties is based on data that were obtained from a computerized database (STATIS) which is maintained by the Indiana Business Research Center, Indiana University. The economic data refer to entire counties, and thus include areas lying outside the Lake Michigan Region.

Unemployment rates in Lake, LaPorte and Porter Counties were above the state average for most of the 1980's (figure 7). During the decade, unemployment rates in the Lake Michigan Region were highest in Lake County, peaking at 16.3 percent in 1982. LaPorte and Porter Counties experienced peak unemployment during 1983 when the rates were about 14.8 percent in both counties (figure 7). Toward the end of the 1980's unemployment rates were above the state average in Lake and LaPorte Counties but were below the state average in Porter County.

During the 1980's, the estimated per capita income in the Lake Michigan Region was highest in Porter County, staying above the state average during the entire decade (figure 8). Per capita income in Lake and LaPorte Counties was above the state average during the early 1980's. However, from 1984 to 1989 per capita income in Lake County was lower than the state

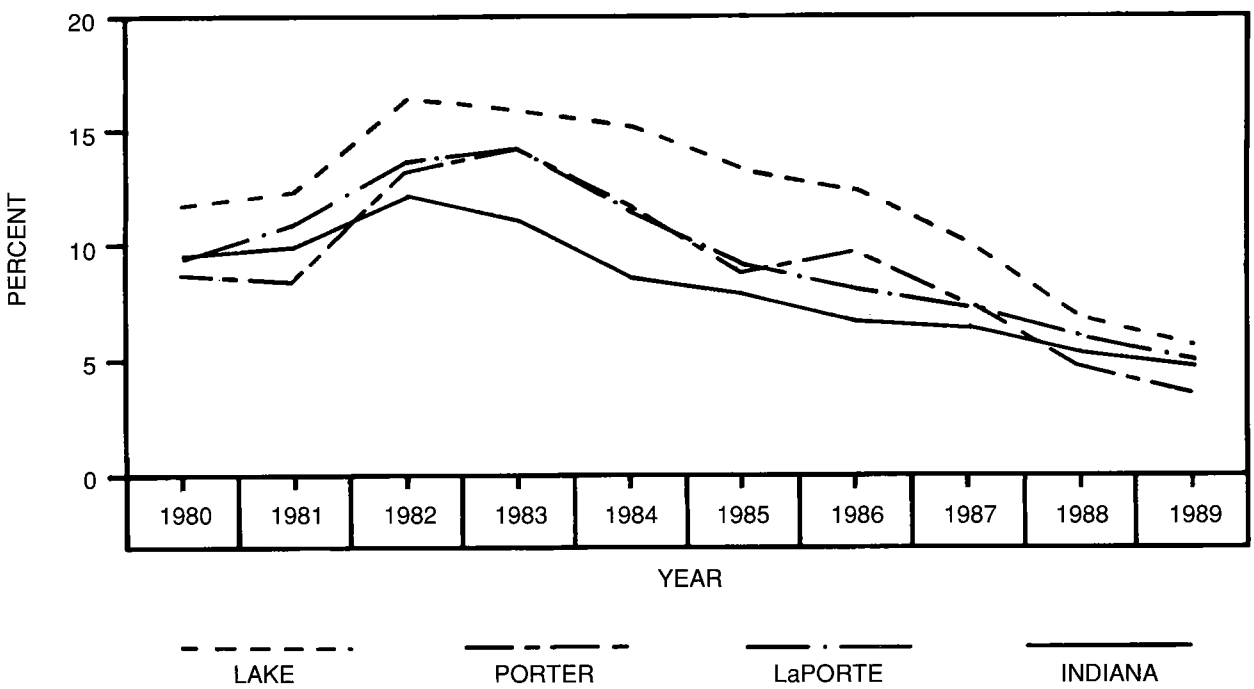

Figure 7. Unemployment rate

average, whereas income in LaPorte County was very close to the state average (figure 8).

Employment and earnings by industry in Lake, LaPorte and Porter Counties are based to a large extent on manufacturing, trade, services and government (figure 9). In 1988, these economic sectors employed more than 253,000 people or about 81 percent of the total workforce, and had a total payroll of $5.9 billion or almost 81 percent of the total earnings in the three counties (figure 9).

Manufacturing had the largest payroll among the economic sectors of Lake, LaPorte and Porter Counties during the period 1980-88 (figure 9). In 1988, the manufacturing sector employed only 22.4 percent of the total workforce, but had a payroll of about 36 percent of total earnings in the three counties (figure 9).

Steel manufacturing plants which dominate the industrial complex of the Lake Michigan Region utilize inexpensive and abundant surface water from Lake Michigan. Many of the steel mills in Lake and Porter Counties are operated by four of the nation's largest steel makers: Bethlehem Steel Corporation, Inland Steel Company, LTV Steel Company and the USS Division of USX. A $100 million steel finishing mill is being built by the Beta Steel Corporation at Burns International Harbor, and if it is successful, a second production facility will be built on an adjacent parcel of land (Indiana Port Commission, 1990b).

Indiana is currently the leading steel-producing state in the country with more than 20 percent of the nation's production in 1988. Although employment has stabilized in the steel industry, the installation of labor-saving machinery in the steel plants has resulted in an increase in steel production over the last few years.

The service and trade sectors of the economy of Lake, LaPorte and Porter Counties have experienced steady growth in employment and earnings since 1984 (figure 9). Since 1986, the service sector has had the largest workforce among the economic sectors in the combined area of Lake, LaPorte and Porter Counties. The shifting or restructuring of the regional economy from a manufacturing base to a service and trade base is the result of expansion in transfer economy (relief, pensions and social security payments), health care, personal care, financial services, legal services and insurance, many of which are financed from external sources (Singer, 1989)

In addition, retail trade and service expansion along U.S. Highway 30 in Lake and Porter Counties are drawing shoppers from a large geographic area. The lakeshore community of Michigan City, the retail hub of LaPorte County, continues to attract numerous shoppers from the eastern part of the Lake Michigan Region. Investments in restaurants, retail shops and

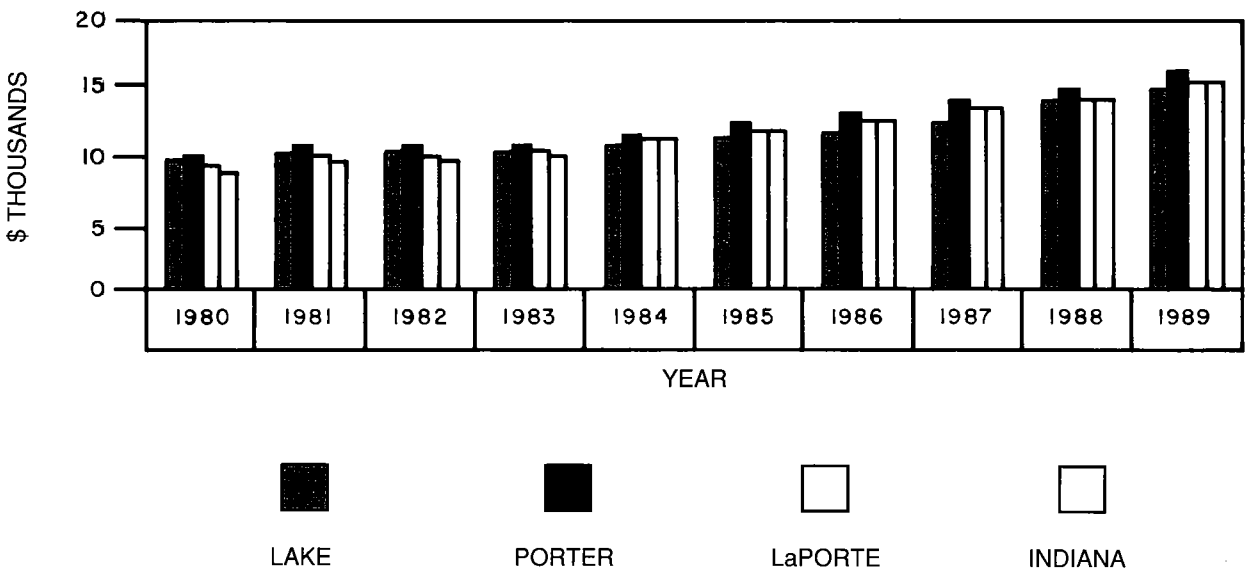

Figure 8. Per capita income

recreational facilities in the tourist areas of northern LaPorte County and the marina districts in Lake, LaPorte, and Porter Counties are expected to stimulate local economic growth. Like the regional trade and service industries, government activities are also concentrated in the urban areas.

The transportation network in the Lake Michigan Region is vital to the economic sectors of the Region. Harbors in the Lake Michigan Region link Indiana to other ports in the Great Lakes and the world. Cargo shipped through the ports in the Lake Michigan Region includes coal/coke, iron ore, steel and steel related products, fertilizer, grain, salt, limestone and petroleum. Burns International Harbor handled more than 8.6 million tons of cargo in 1989, which accounted for more than $46 million in sales and purchases. Counties in northern, central, and even southern Indiana (figure 10) benefit directly or indirectly from Burns International Harbor (Indiana Port Commission, 1990a).

The major industries and communities within the Lake Michigan Region are linked together by the Chicago South Shore and South Bend Railroad, Interstates 80/90 and 94, and U.S. Highways 12, 20 and 30. Studies by the Northern Indiana Commuter Transportation District (NICTD) show that the South Shore trains helped Indiana residents bring in $120 million a year in wages and salaries (in 1987 dollars) from jobs in Chicago (Smerk, 1990).

The smaller economic sectors of Lake, LaPorte and Porter Counties include construction, finance, agriculture, agricultural services, and mining. However, these economic sectors may be important to individual communities that lie within the Region. In 1988 agriculture in Lake, LaPorte and Porter Counties employed about 0.3 percent of the total workforce and had almost one percent of the total earnings, despite being the predominant land use in Lake, LaPorte and Porter Counties and in the Lake Michigan Region.

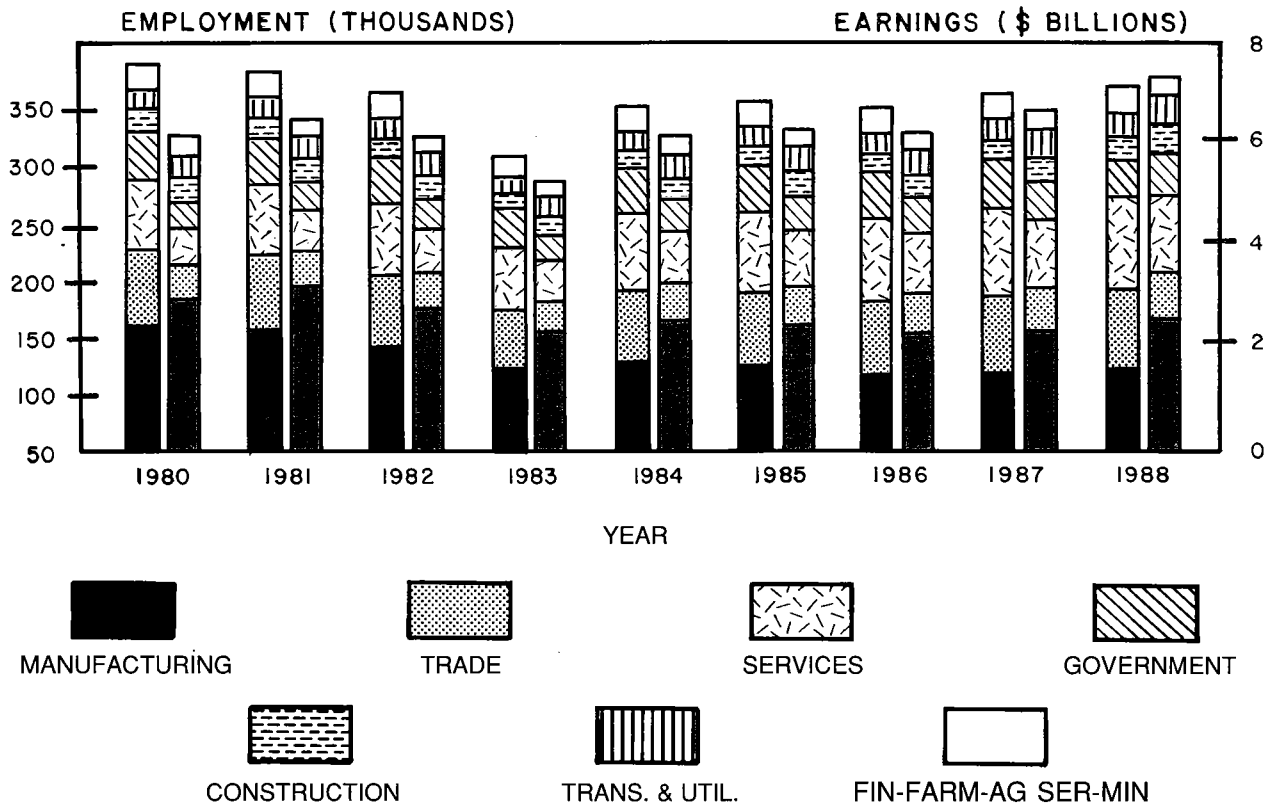

Figure 9. Employment and earnings

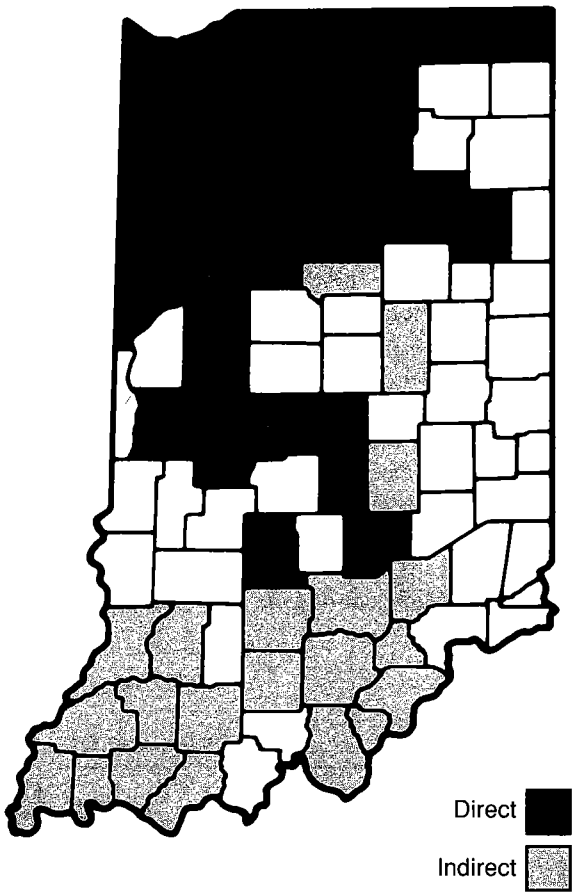

Figure 10. Counties which benefit directly or indirectly from Burns International Harbor in 1989
(adapted from Indiana Port Commission, 1989)

LAND USE

The landscape of the Lake Michigan Region today bears little resemblance to the natural landscape of pre-settlement times. Until the early 1800's, most of the area north of the Valparaiso Moraine was covered by a vast marsh and wooded swamp. Many areas in the Region were characterized by prairie grasses, and oak *savannas*, with hardwood forests common on the *morainal* uplands.

The current landscape of the Lake Michigan Region is dominated by urban and industrial areas in northern Lake County, and agricultural land in LaPorte and Porter Counties. Remnants of the natural prairie and wetland landscape occur only in isolated parcels in the Region. The Indiana Dunes National Lakeshore and the Indiana Dunes State Park in northern LaPorte and Porter Counties contain the largest expanse of natural forest in the Lake Michigan Region.

The U.S. Geological Survey has produced a series of land-use and land-cover maps by using aerial photographs and other remotely sensed data (Anderson and others, 1976). Land use refers to man's activities which are directly related to the land. Land cover describes the vegetation, water, natural surface and artificial constructions at the land surface (U.S. Geological Survey, 1982). It should be noted that only urban areas, bodies of water, gravel pits and certain agricultural areas of at least 10 acres are mapped. For other land use categories, the minimum mapping unit is 40 acres.

Figure 11 was produced from digital files of the U.S. Geological Survey land-use and land-cover maps using ARC/INFO geographic information system. The date of the aerial photography for the Lake Michigan Region was 1979. Land uses in the Region were grouped into five general categories for illustrative purposes. Tabular data of acreage for each general category and numerous subcategories were also generated from the digital files (appendix 2).

Figure 11 provides a general picture of land use for the Region. Higher resolution data on different types of land use may be obtained from other federal, state and local agencies.

In the Lake Michigan Region, agricultural land constitutes almost one-half of the land. Urban or built-up land accounts for about 29 percent of the Region's land area; forest land for about 17 percent; and water, wetlands and barren land for the remaining 5 percent.

Agricultural land

The U.S. Bureau of the Census compiles and publishes land use data for agricultural land, which is designated as "land in farms". A farm is defined by the bureau as any place from which the sale of agricultural products normally amounts to at least $1,000 during the census year.

Of the five agricultural land use categories defined by the bureau, the following four are mutually exclusive: cropland, woodland, other land, and land set aside in federal farm programs. The fifth category, total pastureland, is the sum of cropland, woodland, and other land used for pasture or grazing.

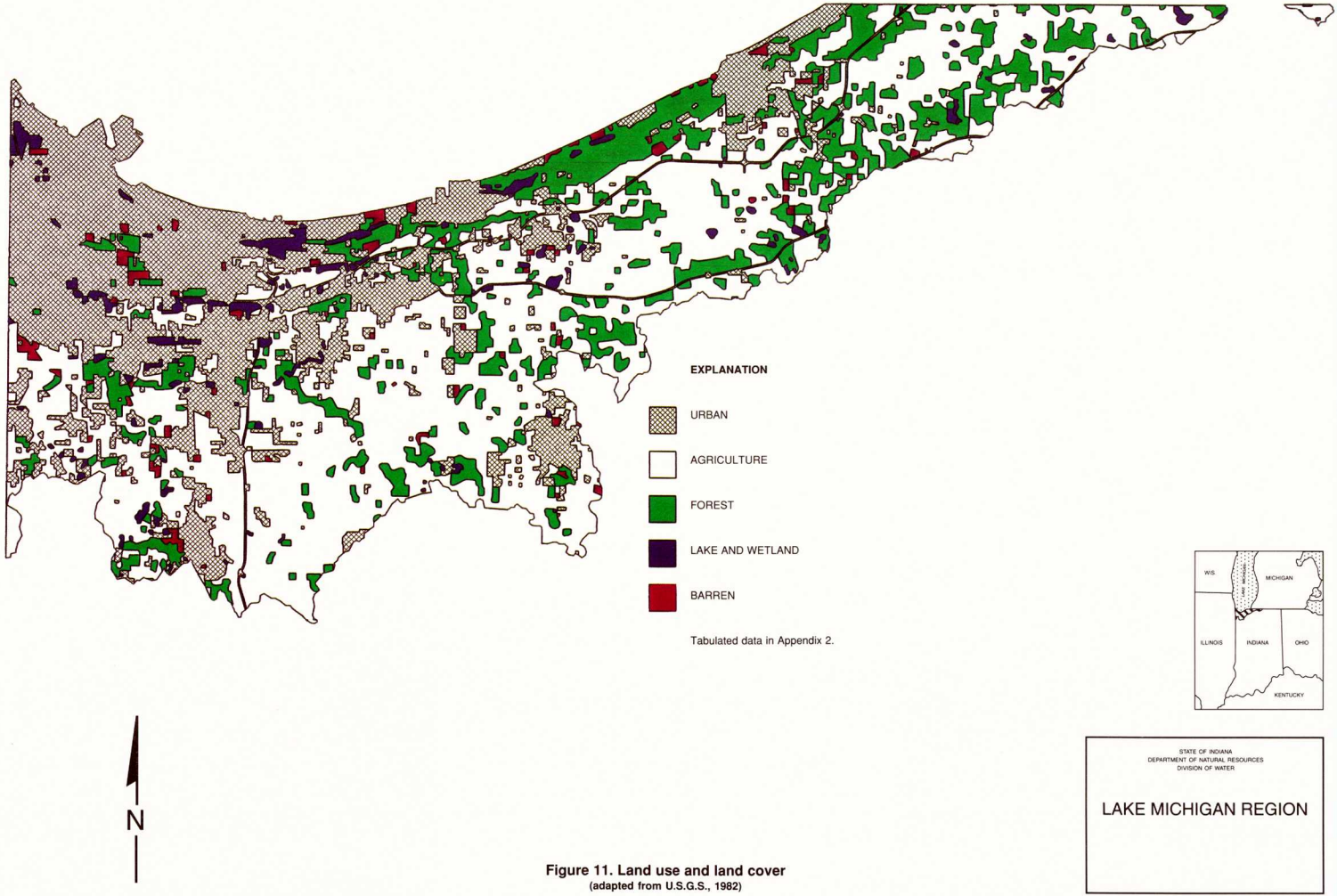

Figure 11. Land use and land cover
(adapted from U.S.G.S., 1982)

Agricultural statistics published by the U.S. Bureau of the Census are available on a county basis, and thus include areas lying outside the Lake Michigan Region boundary. However, the data available for the three major counties lying partially within the Lake Michigan Region nonetheless provide a general overview of agricultural land use.

Table 2 presents county data for the three major land uses on farmland. Cropland accounts for an average of about 90 percent of total farmland in Lake, LaPorte and Porter Counties. Most of the cropland in the Region is classified as harvested cropland, which includes not only land for field crops but also for orchards, vineyards, nurseries and greenhouses. Some small tracts of cropland are used for pasture, grazing, cultivated summer fallow, idle cropland or soil improvement crops. During the 10-year period 1978-87, cropland acreage showed a net increase in Lake County, but a decrease in LaPorte and Porter Counties.

Woodland accounts for an average of about 4 percent of all farmland in Lake, LaPorte and Porter Counties (table 2). Most woodland is used for woodlots, timber production and Christmas tree production.

Farmland designated as "other land" (table 2) constitutes about 6 percent of all farmland, and includes primarily land in house and barn lots, ponds, roads and wasteland. Only small tracts are used solely for pasture or are considered barren land. It should be noted that some of the barren land and land in lots or roads which the U.S. Bureau of the Census considers as agricultural land may be classified and mapped as barren, non-agricultural land by the U.S. Geological Survey.

Land used solely for pasture decreased in most of the counties that comprise the Lake Michigan Region during the period 1978-87. Land set aside in federal farm programs probably has increased since the establishment of the Conservation Reserve Program, which was created following enactment of the 1985 Food Security Act.

Other land

Urban or built-up areas occupy about 29 percent of the land area in the Lake Michigan Region (figure 11). Most of the urban land is concentrated in the northwestern part of the Region. The built-up areas near the shoreline of Lake Michigan form an almost continuous complex across northern Lake County and northwestern Porter County.

Other large tracts of built-up lands in the Lake Michigan Region are found in and near the communities of Crown Point in Lake County, Michigan City in LaPorte County, and Valparaiso, Portage, Chesterton, Burns Harbor and Ogden Dunes in Porter County.

Forest land, about 17 percent of the land in the Lake Michigan Region, generally occurs as small parcels scattered among cropland (figure 11). The predominant forest types in the Region are oak-hickory, elm-ash-soft maple, maple-beech, and cherry-ash-yellow poplar (Smith and Golditz, 1988).

The largest tracts of forested land are located just

Table 2. Selected land use data for farmland

{Values are for entire counties.}

Total area: Acreages are from county land areas listed in Marcus (1985).

Land in farms, total cropland, total woodland, other land: Upper numbers are for 1987 (U.S. Bureau of the Census, 1989); lower numbers are for 1978 (U.S. Bureau of the Census, 1984a).

County	Total area (acres)	Land in farms		Total cropland		Total woodland		Other land	
		Acres	Percent of total area	Acres	Percent of farmland	Acres	Percent of farmland	Acres	Percent of farmland
Lake	320,640	145,566	45	133,998	92	4,826	3	6,742	5
		146,177		130,919		4,561		10,697	
LaPorte	384,000	258,506	67	230,944	89	13,011	5	14,551	6
		276,416		239,903		16,375		20,138	
Porter	268,160	162,544	61	147,170	90	6,233	4	9,141	6
		170,470		150,786		9,031		10,653	

south of the Lake Michigan shoreline, particularly within the Indiana Dunes National Lakeshore and Indiana Dunes State Park. It should be noted that forest on these properties and other parts of the Region may also be classified as forested wetlands by the U.S. Fish and Wildlife Service.

Data on timberland are available on a county basis from the U. S. Forest Service (Smith and Golitz, 1988). Timberland is defined as commercial forest land producing or capable of producing crops of industrial wood and not withdrawn from timber utilization.

Table 3 presents timberland data for Lake, LaPorte and Porter Counties. Because the tabulated values include not only forest land held for non-agricultural uses but also woodland in farms, there is some overlap between timberland values in table 2 and total woodland values in table 3.

The area of timberland reported in the U. S. Forest Service's 1986 inventory is greater than the area reported in a 1967 inventory (Smith and Golditz,1988). One factor in timberland acreage increase may be procedural changes between the two surveys, including the reclassification as forest land of some areas previously classified as range, pasture and other land (U.S. Department of Agriculture, 1989). The large increase in LaPorte County, and to a lesser extent Lake and Porter Counties, may reflect both changes in agricultural land use within the Kankakee River Basin to the south, and increases in timberland near the Lake Michigan shoreline.

Wetlands, and areas categorized by the U.S. Geological Survey as water, including lakes, reservoirs and rivers, and barren land account for less than 5 percent of the land area in the Region (figure 11). However, the figure is not appropriate for all purposes because agencies may use significantly different classification schemes for wetlands.

Some areas mapped as cropland in figure 11 may be classified by the U.S. Fish and Wildlife Service as wetlands. Other areas mapped as forested wetlands may be classified by the U.S. Forest Service as riparian forest, or by the U.S. Bureau of the Census as wooded farmland. A discussion of wetlands and wetland classification used by the U.S. Fish and Wildlife Service is found in the **Surface Water Hydrology** chapter of this report under the subheading **Wetlands**. A discussion of the major lakes is found in the **Surface Water Hydrology** chapter of this report under the subheading **Lakes**.

Table 3. Area of timberland

{Values, for entire counties, are from a 1986 inventory report by Smith and Golitz, 1988.}

County	Acres	Percent of county area
Lake	17,800	6
LaPorte	41,700	11
Porter	30,600	11

WATER USE OVERVIEW

The demand for water in the Lake Michigan Region is influenced by a variety of factors including the level of urban and industrial development, the physical environment, and the hydrologic systems. A brief overview of current water use in the Region is presented below as a prelude to discussions of climate, geology, soils and hydrology. Details of current and projected water use are presented in the last chapter of this report.

Withdrawal uses

Withdrawals involve the physical removal of water from its surface-water or ground-water source, and conveyance to its place of use. The water withdrawn can be used in either a consumptive or non-consumptive manner.

Water applied for irrigation, incorporated into a manufactured product, lost to evapotranspiration, or otherwise removed from the immediate water supply is considered to be consumed if it is unavailable for reuse in a short period of time. Other applications, such as public water supply, energy production and many industrial uses, typically return most of the withdrawn water to the surface-water or ground-water systems.

Water-use data in Indiana historically has been obtained by combining limited data for public water supplies with various estimation techniques and voluntary responses to mailed questionnaires. Recent water-use summaries include those by the Indiana Department of Natural Resources (1982a, 1982b) and Solley and others (1983, 1988).

Since 1985, annual water-use data for large withdrawal facilities in Indiana have been compiled as mandated in the 1983 Water Resource Management

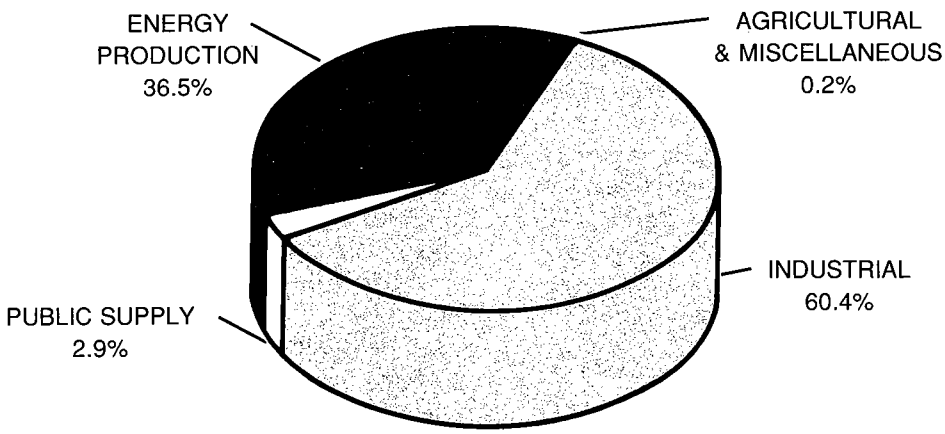

Figure 12. Percentage of registered water use by category
(Total 1990 Registered water use averaged 3089 million gallons per day)

Act (I.C. 13-2-6.1). This legislation requires owners of significant water withdrawal facilities to register these facilities and report annual water use to the Natural Resources Commission through the Indiana Department of Natural Resources, Division of Water. Significant water withdrawal facilities are defined as facilities capable of withdrawing at least 100,000 gallons per day of surface water, ground water, or surface water and ground water combined.

Reported water use for registered facilities typically is determined by metering devices, the multiplication of pump capacity and total time of pumpage, or by other methods approved by the Division of Water. Total non-registered water withdrawals generally are estimated using approximated values for population and per capita water use.

Although water withdrawals from a single well or surface-water intake may serve several purposes, each registered water withdrawal facility is grouped by the Division of Water into one of the following six categories: industrial, energy production, public supply, rural, agricultural, and miscellaneous. These categories differ slightly from those used in the 1980 report by the Governor's Water Resources Study Commission.

Facilities capable of withdrawing less than 100,000 gallons of water per day are not required to be registered with the Division of Water or to be monitored for annual pumpage. However, some types of non-registered facilities can create a large aggregate demand for water. It is estimated that non-registered facilities in the Lake Michigan Region withdrew approximately 2.4 billion gallons of water in 1990.

Registered withdrawals in the Lake Michigan Region totaled almost 1128 billion gallons during 1990. More than 99.8 percent of the withdrawals by the 80 facilities in the Region were used for industrial, energy production and public supply purposes (figure 12).

Industrial self-supplied water uses accounted for about 60 percent (682 billion gallons) of the total registered water use in the Lake Michigan Region in 1990 (figure 12). The 19 significant water withdrawal facilities used for industrial supplies represent about 24 percent of all registered facilities in the Region.

Energy production was the second highest water-use category in the Lake Michigan Region (figure 12). The four facilities grouped into this category withdrew about 412 billion gallons of water from Lake Michigan, or more than 36 percent of the total water withdrawals in the Region.

Public supply water-use was less than 3 percent of the total water use in the Lake Michigan Region (figure 12). The 25 facilities grouped into the public supply category withdrew more than 32 billion gallons of water. Surface water from Lake Michigan is the primary public supply source for communities in the northern parts of the Region, and ground water is the predominant public supply source for the communities in the interior parts of the Region.

About 14 percent of the Region's residents obtain their water from non-registered, privately owned domestic wells rather than from public supply systems. Non-registered, domestic self-supplied withdrawals account for about 0.2 percent (2.4 billion gallons) of all water withdrawals.

There were no registered rural withdrawal facilities in the Lake Michigan Region. Water withdrawals by fish hatcheries and large-scale livestock operations are categorized as rural usage.

Registered water withdrawals for agricultural and miscellaneous purposes constituted approximately 0.2 percent of the total water withdrawals in the Lake Michigan Region. However, the number of facilities grouped into either category represent 40 percent of all registered facilities in the Lake Michigan Region.

Instream uses

Instream uses are defined as non-withdrawal uses taking place within a stream, lake or reservoir. Instream uses in Lake Michigan, the primary surface-water body in northwestern Indiana, and the surface drainage networks primarily include commercial transportation, recreation activities, fish and wetland flora and fauna habitat, and waste assimilation.

Commercial transportation in the northern parts of Lake, LaPorte and Porter Counties is enhanced by the linkage of canals, waterways and dredged channels to Lake Michigan. Several harbors along Indiana's shoreline of the lake serve as transportation hubs for both regional and global cargo.

Water-based recreation activities, which include fishing, swimming, boating (including motorboating and sailing), and water skiing also occur on Lake Michigan. Hunting, camping, nature study, birdwatching, photography, walking, jogging, running and bicycling are among the activities that are strongly associated with or enhanced by the presence of water.

Popular recreation opportunities available at both the Indiana Dunes National Lakeshore and the Indiana Dunes State Park include camping, hiking, swimming, fishing and nature study. Activities permitted at the Langelutting Conservation Area in Porter County and the Galena Conservation Area in LaPorte County include fishing, hiking and nature study.

Water-dependent wildlife habitat in the Lake Michigan Region is composed primarily of the wetlands that lie between the relict dune and beach ridges in northern Lake, LaPorte and Porter Counties. Furbearers, wood ducks, waterfowl and deer are common in these areas.

Many of the wetlands in the Region have been drained or filled as a consequence of development, but some high-quality wetlands still remain as remnants of former wetland complexes. Exotic species of flora can be studied at Pinhook Bog in northwestern LaPorte County and Great Marsh (including Cowles Bog) in northern Porter County. In addition to these wetland areas, there are presently eight nature preserves in the Lake Michigan Region that are managed by the state. The conservation of these areas is discussed in the **Surface-Water Hydrology** chapter of this report under the subheading **Wetlands.**

Fisheries are present in the streams and lakes in the Lake Michigan Region. Because the type of fish population found in streams and lakes largely depend on ambient water quality, fisheries are summarized in the **Surface-Water Hydrology** chapter of this report in the section entitled **Surface-Water Quality.**

The treated effluents of waste-water treatment plants in the Lake Michigan Region are discharged directly into Trail Creek, the Grand Calumet River, the Little Calumet River and some of its tributaries. Wastewater discharges are discussed in the **Surface-Water Quality** section of this report.