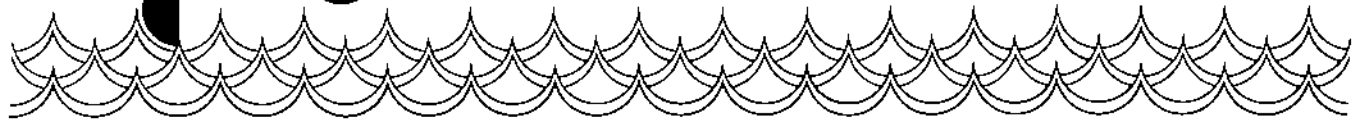


Region Two



Elkhart, Kosciusko, LaPorte, Marshall, and St. Joseph Counties, located in the north-central portion of Indiana, form Region Two. The region contains approximately 2,500 square miles and is bounded by Porter County on the west; Wabash and Fulton Counties on the south; Whitley, Noble, and Lagrange Counties on the east; and Lake Michigan and the State of Michigan to the north, as shown in Figure 75.

The population was 568,407 in 1975. Forty-two percent of the population resided in St. Joseph County. The official Indiana Population Projections for 1975 to 2000 estimate that the region may increase by twenty-one percent by the year 2000. The 1975 population and projection for each county are presented below.

Table 49
The 1975 and projected populations for Region Two.

County	1975	1980	1990	2000
Elkhart	131,900	148,900	175,100	201,600
Kosciusko	52,224	58,100	69,600	82,100
LaPorte	105,857	108,100	114,200	120,000
Marshall	37,941	42,000	49,000	55,700
St. Joseph	240,655	241,100	239,100	234,700
Total	568,407	598,200	647,000	694,100

The major population centers are Elkhart in Elkhart County, Warsaw in Kosciusko County, Michigan City in LaPorte County, Plymouth in Marshall County, and South Bend in St. Joseph County. These urban centers account for thirty-seven percent of the region's population.

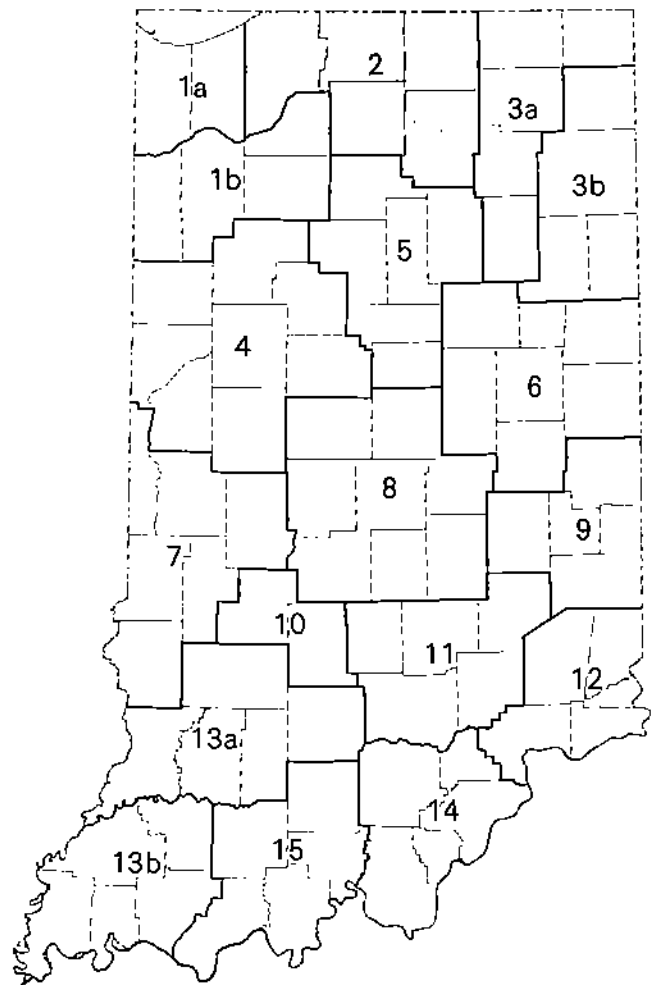


Figure 75
Map of Indiana showing the location of Region Two.

Agriculture is the dominant land use with more than seventy-two percent of the land area devoted to agricultural purposes. Approximately eight percent of the land is forested while the remaining twenty percent comprises urban and miscellaneous uses.

More than seventy percent of the region's work force is employed within Elkhart and St. Joseph Counties. Manufacturing employs approximately forty-seven percent of the total work force while agriculture employs approximately sixteen percent.

The topography of the region is a mixture of level prairie, some of which is former marshland, interspersed with moraines and hills.

The climate is directly influenced by Lake Michigan. The effect of Lake Michigan on the climate is most pronounced just inland from the shore, and it diminishes greatly with distance. Cold air passing over the warmer lake water produces precipitation leeward of the lake in the fall and winter. As a direct result of this phenomenon, winter precipitation, especially snowfall, is greatest in the extreme northwestern counties. Severe local snowstorms often occur just inland from Lake Michigan. In the spring daily maximum temperatures decrease in the immediate vicinity of the lake because of its cooling effect. Average daily minimum temperatures in the fall are higher in northwestern Indiana than further south in the state.

The region receives approximately 37.5 inches of precipitation annually. This varies from a high of 4.0 inches in July to a low of 1.75 inches in February. Approximately 12 inches of the annual precipitation appear as streamflow while 25.5 inches are consumed through evapotranspiration. The region has average temperatures ranging from 24°F. in January to 72.5°F. in July. The average annual temperature is 50°F. Data from South Bend Michiana Regional Airport indicates the annual prevailing wind is from the south-southwest at 10.6 miles per hour.

THE WATER RESOURCE

Ground Water

Of particular importance in this region are the glacially derived, unconsolidated deposits which contain the major sources of ground water. The deposits of Wisconsinan and Illinoian glacial stages consist of glacial till, inter-till sand and gravel, outwash-plain and valley-train sand and gravel, lake clays, dune sand, and ice-contact stratified drift. These materials range in thickness from about one hundred to five hundred feet. Significant outwash-plain and valley-train sand and gravel deposits are located adjacent to the Valparaiso Moraine and along the Kankakee, Elkhart, St. Joseph,

and Tippecanoe Rivers. Complex inter-till sand and gravel aquifer systems are present in the moraines that are in Kosciusko, Marshall, and Elkhart Counties. A sequence of lake clays and wind-blown dune sand are found along Lake Michigan in LaPorte County.

Beneath the thick cover of glacial materials are bedrock formations of Mississippian, Devonian, and Silurian ages. The Mississippian rocks are generally composed of siltstone and shales while the Devonian rocks contain black shale and dolomitic-limestone units. A small area of Silurian limestone and dolomite may be present in extreme southeastern Kosciusko County beneath the unconsolidated deposits. The bedrock aquifers are not considered to be an important source of water in this portion of Indiana because of their depth, low yielding character, and the general occurrence of good aquifers within a glacial drift.

Glacial deposition has been a major controlling factor in the availability of ground water in Region Two. Figure 76 indicates the maximum potential yield of the aquifers within the region. The area of lowest potential yield capability is located in northwestern LaPorte County where fine sand deposits are not likely to yield more than 50 gallons-per-minute (gpm). Southeast of this area conditions begin to improve as sand and gravel deposits become more prevalent and yields up to 400 gpm are possible. From LaPorte eastward ground-water availability increases substantially, and properly constructed, large diameter wells will yield from 400 to 2,000 gpm. Outwash plain deposits of sand and fine gravel occurring in western St. Joseph County and extending southwesterly into LaPorte County, constitute one of the major aquifer systems in the state. This system, the Kankakee Aquifer, is capable of producing 600 to 1,000 gpm to properly constructed wells. Further east, extensive outwash sand and gravel aquifers in St. Joseph, Elkhart, and Kosciusko Counties form another area of major ground-water availability. Estimated recharge rates of 500,000 gallons-per-day per square mile are applicable to much of the area. The recharge rate, when combined with the large, available storage and permeable nature of the Kankakee aquifer, indicates that tremendous quantities of ground water are available for development.

Ground-water quality is typical of most parts of Indiana. Ground water is generally hard and relatively high in iron content. Hardness ranges in concentration from 180 to 400 parts-per-million (ppm) with areas of softer waters of 180 to 200 ppm occurring in southern LaPorte County. The iron content of ground water averages between one and two ppm with locally low iron concentrations in the outwash sand and gravel of northern Elkhart and St. Joseph Counties.

Manganese is below recommended maximum levels (below 0.05 ppm) in areas of western Elkhart and

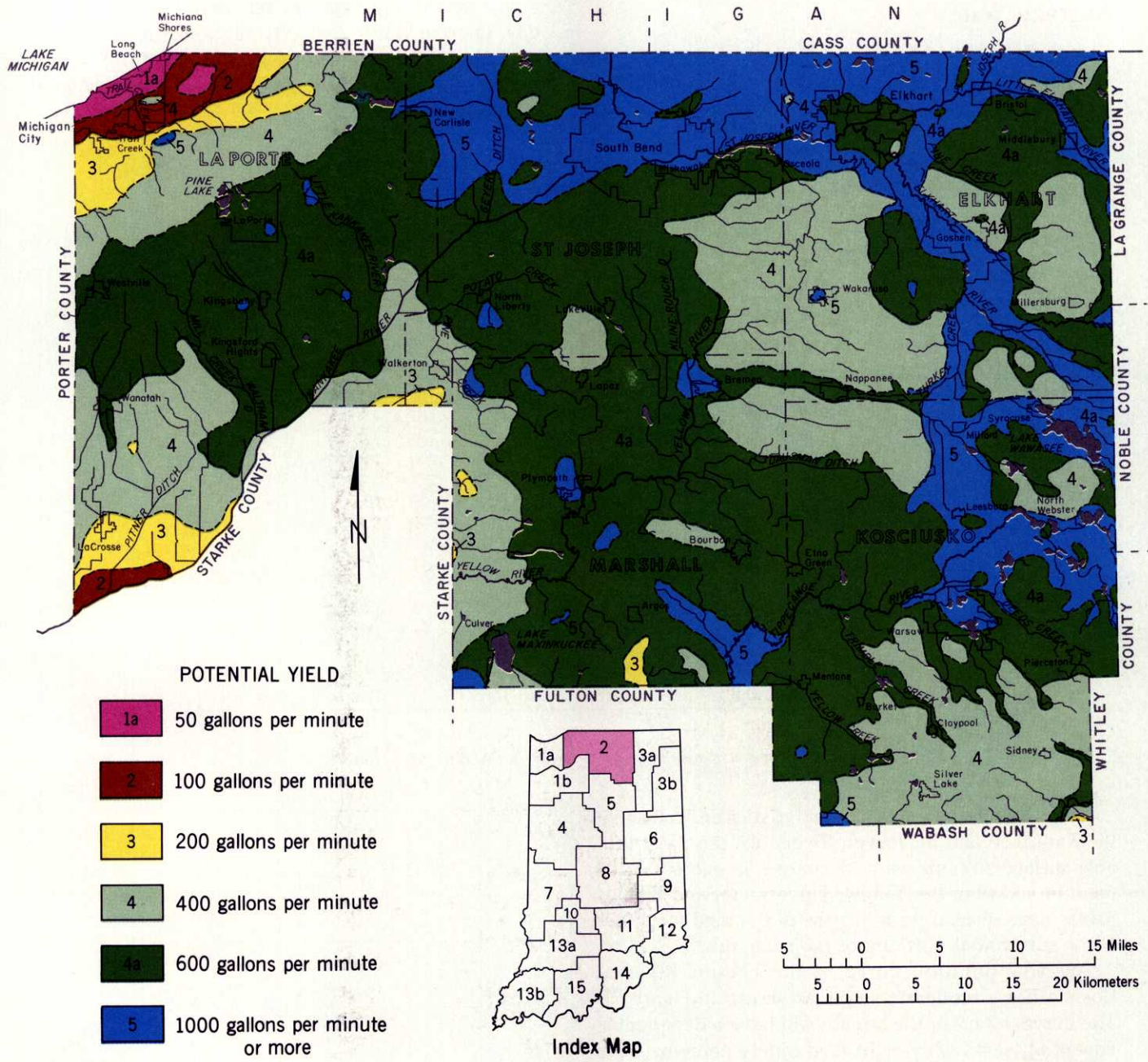


Figure 76

Map of Region Two showing the general location and potential yield of ground water from properly constructed large diameter wells.

northern Kosciusko and Marshall Counties. High manganese levels are present in various localities throughout the region. Fluoride, sulfate, and hydrogen sulfide are usually all within recommended levels.

Surface Water

Streamflow Three major river systems occur within Region Two. The major drainage systems include the St. Joseph River and its tributaries of Little Elkhart and

Elkhart Rivers, that drain into Lake Michigan; the Kankakee and Yellow Rivers, that discharge into the Upper Mississippi River basin; and the Tippecanoe River, that flows into the Wabash and Ohio Rivers. Stream drainage is usually in a westerly direction.

The seven day, once in ten year (Q7-10); the one day, once in thirty year (Q1-30); and the average annual flow in million-gallons-per-day (mgd) for streams with gaging stations in Region Two are indicated in the following table.

Table 50
Flow characteristics of streams.

Stream	Drainage Area (square miles)	Million-Gallons-Per-Day		
		Average Annual	Q7-10	Q1-30
Elkhart River at Goshen	594	320	51.0	10.0
Kankakee River at Davis	537	320	120.0	100.0
Kankakee River at North Liberty	174	94	36.0	29.0
Little Kankakee River at* Mill Creek	na	22	15.3	na
St. Joseph River at Elkhart	3,370	2,000	520.0	270.0
Tippecanoe River at Osweld	113	63	0.9	0.1
Trail Creek at* Michigan City	54	28	12.8	na
Turkey Creek at New Paris*	160	68	11.5	na
Yellow River at Bremen	na	67	4.1	3.6
Yellow River at Plymouth	294	160	12.0	9.7

na: not available

*Flow characteristics estimated from stream gaging stations with short periods of record.

Analysis of the low-flow characteristics indicates that the Kankakee and St. Joseph Rivers are the most reliable surface streams, with discharges in excess of 100 mgd. In addition, the Yellow, Tippecanoe, and Elkhart Rivers have discharges in excess of ten mgd for either all or substantial portions of their lengths.

The flow duration curve of the Elkhart River at Goshen has a moderate slope, as shown in Figure 77. The curve indicates the stream will have a dependable flow of at least eighty-eight mgd ninety percent of the time. The curve's moderate slope also indicates that the Elkhart River basin contains aquifers which provide significant ground-water contributions to streamflow. To verify this, the technique of hydrograph separation was applied to three annual hydrographs representing "dry," "average," and "wet" years. The results indicate that the ground-water contribution to streamflow amounts to forty-five, forty-six and twenty-nine percent for "dry," "average," and "wet"

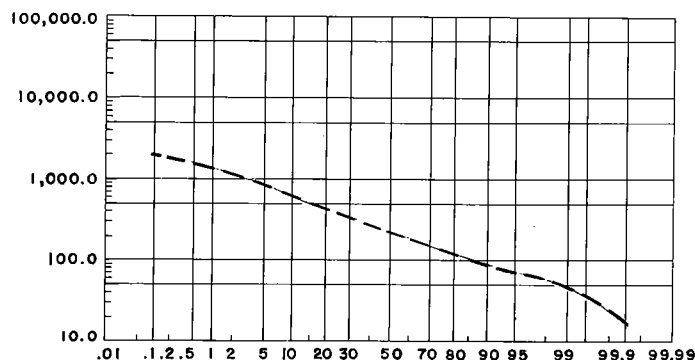


Figure 77
The flow duration curve for the Elkhart River at Goshen.

years respectively. Conversely, from forty-five to seventy-one percent of the flow, depending on the year, is due to direct surface runoff from runoff-producing precipitation events or from snowmelt.

Lakes Lake Michigan is the dominant surface-water feature in Region Two, and is the major water supply to Michigan City. Approximately 154,000 acres of Lake Michigan are included within Indiana. The remaining lakes within the region that are at least fifty acres in size or have a storage capacity of 32.5 million gallons

or more are listed in Table 51 and are located on Figure 78. These seventy-eight lakes have a combined surface area of approximately 16,875 acres with a gross storage capacity of approximately 92,900 million gallons.

Table 51
Lakes at least 50 acres in size or with a storage capacity of 32.5 million gallons or more.

<i>Lake Number</i>	<i>Lake Name</i>	<i>Drainage Area (square miles)</i>	<i>Surface Area (acres)</i>	<i>Gross Storage (million gallons)</i>
1	Clear Lake	0.65	106.0	247
2	Dingler Lake	na	na	39
3	Hog Lake	na	59.0	224
4	Hudson Lake	7.92	432.0	1,648
5	Lower Fish Lake	10.40	134.0	283
6	Pine Lake	10.70	564.0	na
7	Saugany Lake	2.34	74.0	713
8	Silver Lake	1.72	54.0	na
9	Stone Lake	10.70	140.0	na
10	Union Mills Lake	na	20.9	58
11	Upper Fish Lake	9.65	139.0	338
12	North Chain Lake	3.89	88.0	456
13	Riddles Lake	11.70	77.0	208
14	South Chain Lake	6.32	90.0	87
15	Goshen Pond	na	164.5	358
16	Heaton Lake	9.33	87.0	208
17	Hunter Lake	0.51	99.0	364
18	Indiana Lake	0.62	122.0	1,107
19	Simonton Lake	7.44	282.0	508
20	Wolf Lake	1.29	100.0	na
21	Cook Lake	na	93.0	537
22	Dixon Lake	na	33.0	156
23	Fiat Lake	na	26.0	68
24	Gilbert Lake	na	37.0	159
25	Holem Lake	na	40.0	127
26	Lake Latonka	5.77	100.0	159
27	Lake of the Woods	9.45	416.0	2,219
28	Lawrence Lake	na	69.0	514
29	Maxinkuckee Lake	13.70	1,864.0	14,858
30	Mill Pond	5.34	168.0	332
31	Myers Lake	1.41	96.0	651
32	Pretty Lake	0.85	97.0	697
33	Banning Lake	0.48	12.0	35
34	Beaver Dam Lake	2.83	146.0	1,068
35	Big Barbee Lake	44.70	304.0	1,837
36	Big Chapman Lake	4.17	581.0	1,981
37	Boner Lake	na	40.0	120
38	Caldwell Lake	na	45.0	260
39	Carr Lake	2.27	79.0	436
40	Center Lake	0.73	120.0	671
41	Crystal Lake	0.45	76.0	303
42	Dewart Lake	8.05	551.0	2,932
43	Diamond Lake	3.92	79.0	417
44	Flatbelly Lake	4.66	326.0	na
45	Hill Lake	0.85	67.0	423
46	Hoffman Lake	8.07	180.0	1,029
47	Irish Lake	50.90	182.0	759
48	James Lake	55.90	282.0	2,469
49	Kuhn Lake	3.85	137.0	420
50	Little Barbee Lake	49.00	74.0	312
51	Little Chapman Lake	7.13	177.0	648

Table 51 (continued)

Lake Number	Lake Name	Drainage Area (square miles)	Surface Area (acres)	Gross Storage (million gallons)
52	Little Pike Lake	na	25.0	45
53	Loon Lake	3.59	40.0	218
54	McClures Lake	1.29	32.0	97
55	Muskelonge Lake	11.80	32.0	97
56	North Little Lake	2.89	12.0	55
57	Oswego Lake	113.00	83.0	254
58	Palestine Lake	52.40	290.0	381
59	Papakeechee Lake	5.52	300.0	488
60	Pike Lake	41.50	203.0	922
61	Ridinger Lake	34.60	136.0	944
62	Robinson Lake	7.15	59.0	381
63	Rock Lake	2.74	56.0	117
64	Sawmill Lake	51.80	36.0	120
65	Sechrist Lake	0.58	105.0	811
66	Sellers Lake	na	32.0	110
67	Sherburn Lake	5.51	15.0	74
68	Shock Lake	na	37.0	394
69	Silver Lake	6.31	102.0	495
70	Syracuse Lake	38.20	414.0	1,746
71	Tippecanoe Lake	113.00	768.0	9,247
72	Wabsee Lake	14.60	187.0	1,547
73	Wawasee Lake	36.90	3,060.0	21,900
74	Webster Lake	49.20	774.0	1,906
75	Weimer-Black Lake	1.40	29.4	63
76	Winona Lake	32.10	562.0	5,435
77	Wyland Lake	na	6.0	32
78	Yellow Creek Lake	11.10	151.0	1541

na: not available.

UTILIZATION OF THE WATER RESOURCE

Instream Uses

The supply and demand analysis for recreational uses of water by the residents of Region Two is shown

in Table 52. The existing supply for recreational activities is expressed as a percentage of the demand. Therefore, when this percentage exceeds one hundred, the supply exceeds the demand. Conversely, when the supply as a percentage of demand is less than one hundred the supply is less than the projected demand.

Table 52
The outdoor recreation demand and supply analysis.

Activity	Percent of Population Participating	Density Guideline	Approximate Supply	Existing Supply as a Percentage of Projected Demand		
				1980	1990	2000
Boating	26	19.6 boats/acre/year	173,100 acres ^a	100+	100+	100+
Waterskiing	8	34.4 skiers/acre/year	28,000 acres ^b	100+	100+	100+
Canoeing	9	585 canoes/mile/year	134 miles	100+	100+	100+
Swimming	42	76,600 swimmers/acre/year	36 acres ^c	62	56	53
Ice-Skating	11	6,678 skaters/acre/year	15 acres	54	52	48
Fishing	37	66 persons/acre/year	172,100 acres ^d	100+	100+	100+

This table is based upon the 1979 Indiana State Outdoor Recreation Plan. Only the supply and recreational demands of residents of the region are displayed. The available recreational opportunities outside the region are not considered, nor are the recreational demands of nonresidents considered.

^aIncludes 154,000 acres of Lake Michigan and 19,000 acres of inland waters.

^bIncludes 18,400 acres of Lake Michigan (thirty square miles excluding the two hundred feet from the shoreline) and 9,600 acres of inland waters.

^cDoes not include Lake Michigan.

^dIncludes 154,000 acres of Lake Michigan and 18,100 acres of inland waters.

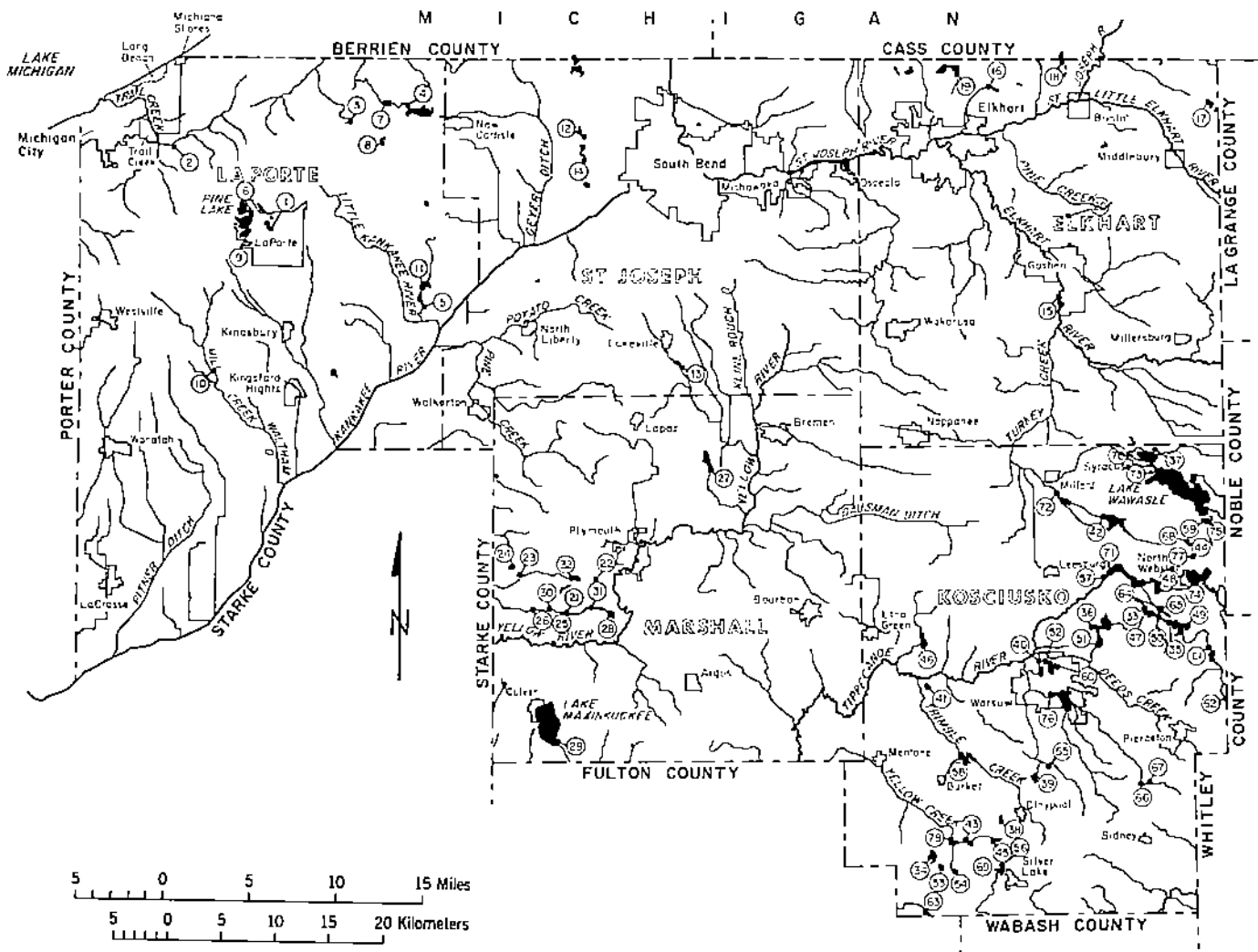


Figure 78
 Map of Region Two showing the location of lakes that are at least 50.0 acres in size or that have a storage capacity of 32.5 million gallons or more.

Boating and Waterskiing Portions of the St. Joseph River in St. Joseph and Elkhart Counties are used for waterskiing. The Tippecanoe and Kankakee Rivers are used for boating but not waterskiing, due to their size, depth, and number of obstacles.

There are several lakes available for boating and waterskiing, the majority being in Kosciusko County. Lakes Wawasee, Webster, and Tippecanoe are the most heavily used recreational lakes in Kosciusko County and provide the most waterskiing acreage within the region.

The additional supply provided by Lake Michigan guarantees adequate boating and waterskiing opportunities well into the future. Access is available in Michigan City at the Washington Park Marina, Sprague Marina, and three private marinas for both boat launching and storage, although considerable demand for boat storage has created waiting lists at all facilities.

Canoeing The Kankakee, Tippecanoe, St. Joseph, and Elkhart Rivers offer canoeing opportunities. Although some streams (St. Joseph River in particular) have sluggish currents, the rivers all flow freely enough to provide enjoyable trips. Other streams in the region may also occasionally be used by canoeists. Approximately thirty-three miles of the St. Joseph River, thirty miles of the Elkhart, and the entire Kankakee River may be canoed within Region Two. The current supply of canoeable streams will meet the demand by canoeists through the year 2000.

Swimming and Ice-Skating There is a deficit of water available both for swimming and ice-skating. The demand for swimming acreage may exceed the supply by fifty percent by the year 2000. Swimming areas include the Potato Creek State Park, the Indiana Dunes National Lakeshore, and the Indiana Dunes State Park.

Fishing The quality of the fisheries habitat is indicated on Figure 79. The Kankakee and the Tippecanoe Rivers sustain stable warmwater fish populations. Both rivers also contain northern pike which use their tributaries and backwaters for spawning in the spring. The Tippecanoe and Yellow Rivers are noted for smallmouth bass fishing. The aquatic habitat value is reduced in each of these rivers where pools and riffles are removed by dredging, and where vegetation is cleared from the stream banks and stream beds. Despite water quality problems, the St. Joseph River and Trail Creek attract annual migrations of trout and salmon from Lake Michigan. The Little Kankakee River, Potato Creek, Cobus Creek, Little Elkhart River, and Solomon's Creek have sufficient aquatic habitat and public usage to support a put-and-take trout fishery program.

The usual assortment of warmwater fish found in Indiana — sunfish, yellow perch, and catfish — are present in the lakes of this region. The many natural lakes of Kosciusko County attract fishermen year-round. The large areas of aquatic vegetation and bordering marshes found in many of the lakes are vital to the existence of desirable game fisheries. Wyland Lake, in the Tri-County Fish and Wildlife Area, is stocked with trout while other lakes have their fisheries supplemented with walleye and northern pike. Lake Michigan offers excellent habitat for many varieties of fish and is well known for coho and chinook salmon, steelhead, lake, and brown trout.

Access to the streams and lakes is available on many state-owned properties. Two public fishing sites are located on the St. Joseph River in Elkhart County. One public fishing site is located in St. Joseph County. The old Tip Town site in Marshall County and the Mollenhour site in Kosciusko County allow access to the Tippecanoe River. The Kingsbury and Kankakee Fish and Wildlife Areas, provide access to the Kankakee River. The Potato Creek State Park provides fishing access to Potato Creek. Public fishing sites are located on sixteen lakes scattered throughout the region.

Riparian Habitat The quality of riparian habitat is shown in Figure 80. Urban development along stretches of Trail Creek and the Elkhart and St. Joseph Rivers reduces suitable riparian habitat for many desirable species of wildlife. The wooded swamps and marshes along the Tippecanoe, Kankakee, and Elkhart Rivers and Turkey Creek are excellent habitat for waterfowl such as mallards, blue wing teal, woodduck, various shorebirds, beaver, muskrat, raccoon, and upland game. Many tributaries to these larger streams have little wildlife habitat as they pass through agricultural areas. However, those with grassy or vegetated banks may attract pheasants and bobwhite quails.

Most large lakes in the region, Lake Wawasee, Syracuse Lake, Winona Lake, and Lake Maxinkuckee, are heavily developed and provide sparse wildlife habitat except in wetland areas. Smaller, less developed lakes, such as Wyland Lake, Flat Lake, and Lake Lee, have more extensive riparian habitat. Deep water cattail and spatterdock marshes, such as those on Lake Wawasee, Syracuse Lake, and Simonton Lake, are valuable habitat, especially for waterfowl and muskrats. Deep water or shrub swamps occur on several lakes in northern St. Joseph County and central Elkhart County. The wetlands also support waterfowl, muskrats, and shorebirds.

Public hunting is allowed on the Kankakee, Kingsbury, and Tri-County Fish and Wildlife Areas. Hunting is also permitted on the Maxinkuckee Wetland Conservation Area in Marshall County.

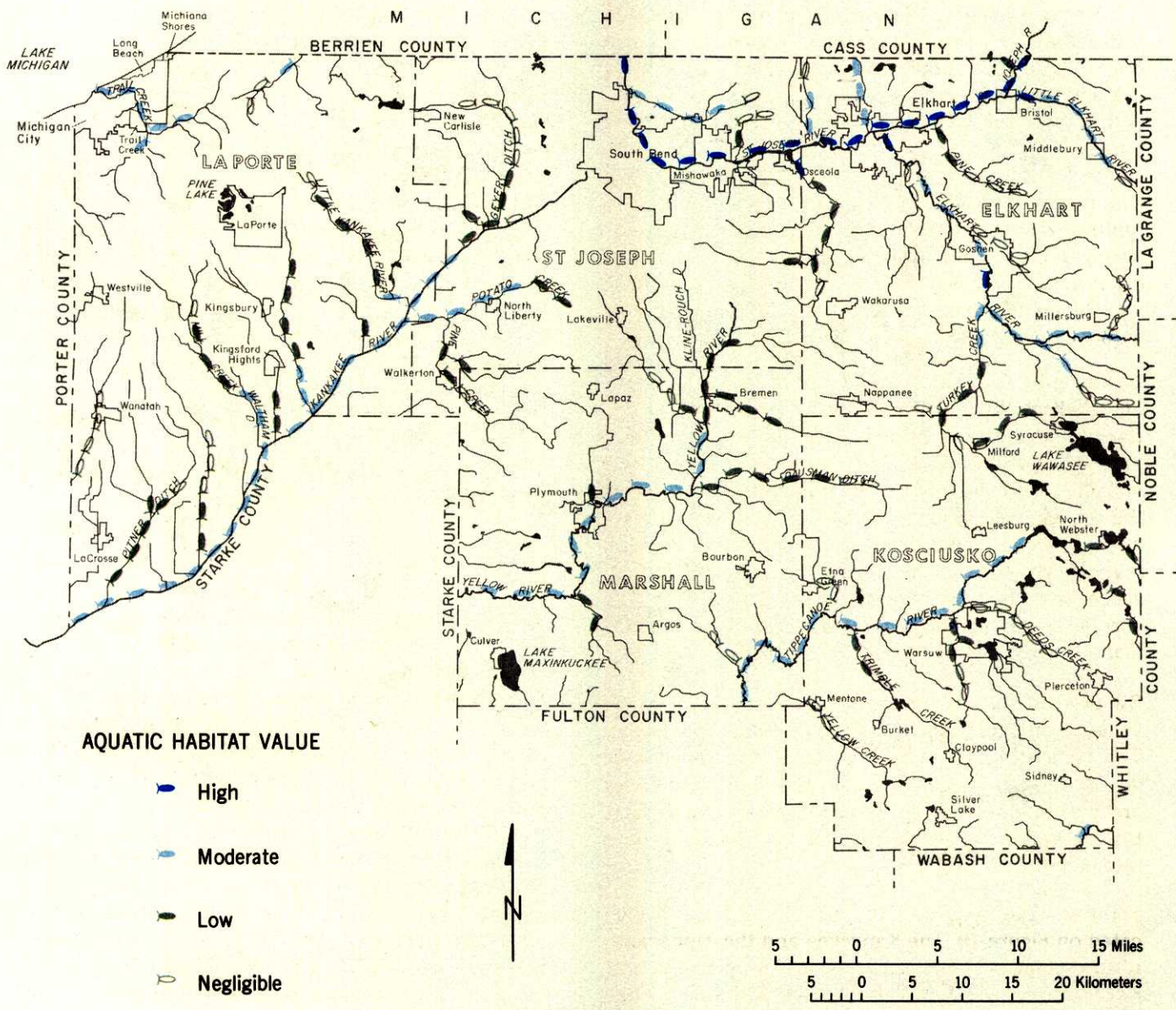


Figure 79
Map of Region Two showing the quality of the fisheries habitat.

Navigation Michigan City Harbor is a project constructed by the U.S. Corps of Engineers and operated by the Michigan City Port Authority. This harbor provides for limited commercial use and a considerable amount of recreational traffic. It also provides access to one of the most important inland waterways in the world, the Great Lakes– St. Lawrence system. Approximately 51,000 tons of cargo per year are transported through Michigan City Harbor.

Hydroelectric Power The two operating hydroelectric plants in Region Two are the Twin Branch Generating Station at South Bend and the Elkhart Generating Station at Elkhart. Both are owned by the Indiana and Michigan Electric Company. Twin Branch is rated at 7.3 megawatts (mw) and was completed in 1903. The Elkhart station was completed in 1913 and is rated at 3.4 mw.

There are no additional sites available in the region that could support substantial hydroelectric development. However, consideration is being given to increasing the capacity of Twin Branch to 14.8 mw and Elkhart to 9.2 mw.

Withdrawal Uses

Public Water Supplies Elkhart, Kosciusko, LaPorte, Marshall, and St. Joseph Counties are served by forty-four public water utilities. An estimated 345,800 persons, or sixty-one percent of the population, were served by a public utility in 1975.

The largest, single, water utility operating in the region is the South Bend Public Utility. This utility served approximately 117,000 persons in 1975. In 1977, the South Bend utility withdrew an average of 25.5 mgd. Other large utilities are located in Michigan City, Elkhart, and Mishawaka, all of which pump more than 5.0 mgd; and in LaPorte, Goshen, and Warsaw, which pump more than 2.0 mgd. Figure 81 shows the water service areas within Region Two.

Public utilities in this region generally serve only those customers living within their corporate boundaries; however, Mishawaka, Elkhart, Warsaw, Michigan City, and other utilities provide service to some customers outside their corporate limits.

These forty-four public water utilities withdrew an average of 61.3 mgd in 1975. St. Joseph County accounted for 31.7 mgd; LaPorte County, 13.4 mgd; Elkhart County, 10.6 mgd; Kosciusko County, 3.3 mgd; and Marshall County, 2.3 mgd. Approximately fifty-four mgd of the total public water supply is withdrawn from ground water. All of the public utilities in the region with the exception of those in the Michigan City and the Warsaw areas are supplied from ground water.

Withdrawals from Lake Michigan average 7.7 mgd while supplying 49,200 persons.

Projections of public water supplies indicate that the region's water withdrawals may increase to approximately 71.3 mgd by the year 2000. Consumptive use of this public water supply is expected to increase from approximately 7.0 mgd in 1975 to 8.2 mgd by 2000. The 1977 and projected water withdrawals and consumption rates by public water utilities by the year 2000 are presented in the following table.

Table 53

The 1977 and projected withdrawal and consumption rates of public water supplies by the year 2000, in million-gallons-per-day.

<i>Public Water Supply</i>	1977	1980	1990	2000
Withdrawal	61.3	63.0	8.0	71.3
Consumption	7.0	7.2	7.8	8.0

Industrial Water Industrial establishments had an estimated water intake averaging 102 mgd in 1977. Of this total intake, 53.1 mgd was self-supplied by the industries while 48.9 mgd was purchased from the region's public utilities. Approximately 12.3 mgd is consumed in the manufacturing process.

Most of the industries in the region purchase their water from local utilities. However, significant numbers, including all the large water users, are self-supplied from ground water. A few industries in Elkhart and St. Joseph Counties use significant amounts of water from the St. Joseph River.

The largest water-using industries in the region are rubber and plastics, fabricated metal products, chemicals and allied products, and transportation equipment.

Industrial production for the year 2000 is expected to increase eighty-seven percent above the 1977 value (United States Water Resources Council). Despite the predicted increase in industrial output, total industrial water intake is expected to decrease initially due to plant efficiency, and then increase slowly as output increases. The current and projected self-supplied water withdrawals and rates of consumption for industries located in Region Two are now presented.

Table 54

The 1977 and projected self-supplied withdrawal and consumption rates for industries, in million-gallons-per-day.

<i>Industrial Self-Supply</i>	1977	1980	1990	2000
Withdrawal	53.1	54.8	56.2	59.1
Consumption	6.4	7.2	9.3	11.8

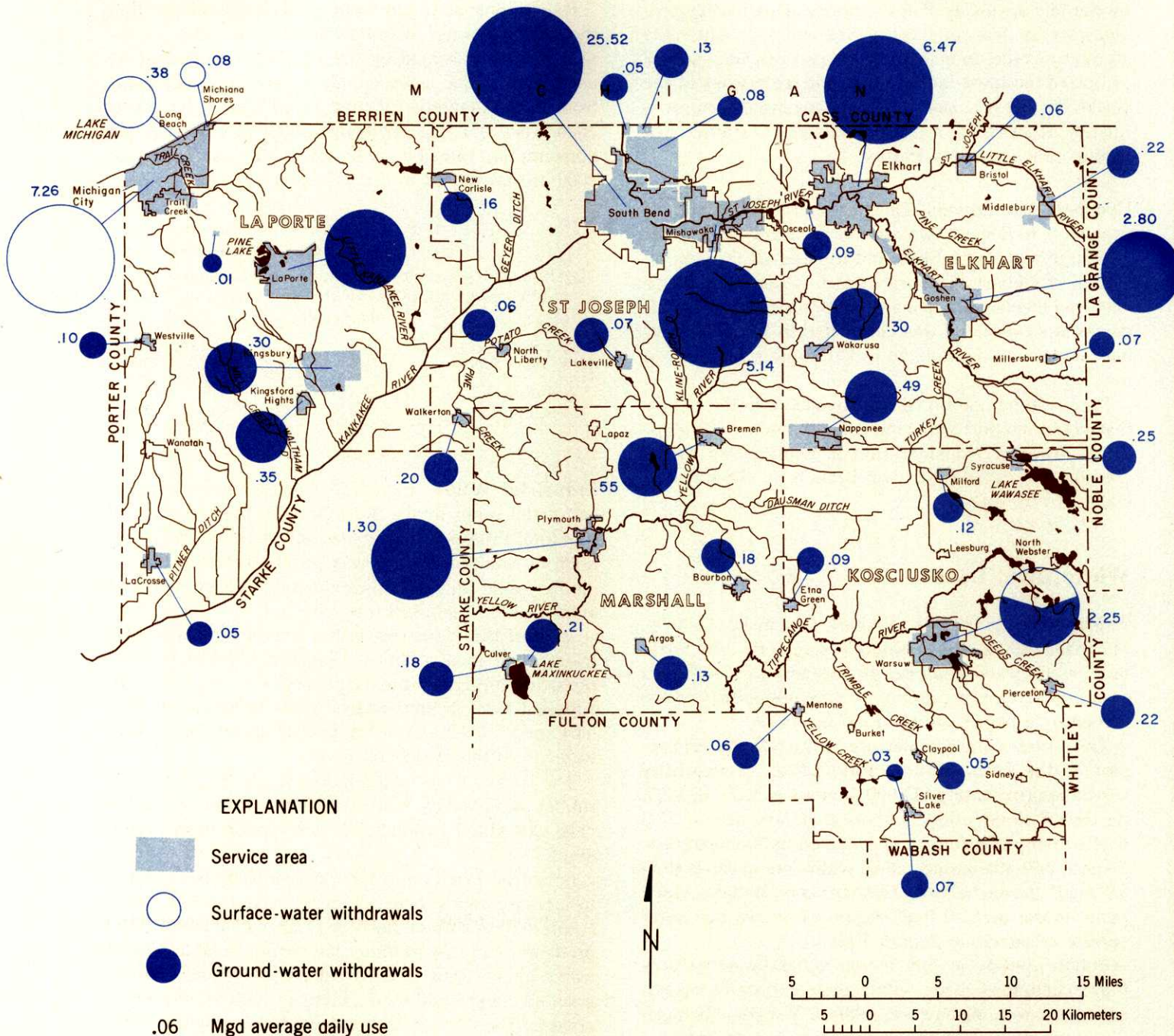


Figure 81
 Map of Region Two showing the service areas of the public water utilities and average daily use in million-gallons-per-day.