

Region Eight

Boone, Hamilton, Hancock, Hendricks, Johnson, Marion, Morgan, and Shelby Counties, located in central Indiana, form Region Eight. The region contains approximately 3,081 square miles and is bounded by Clinton, Tipton, and Madison Counties to the north; Henry, Rush, and Decatur Counties to the east; Bartholomew, Brown, and Monroe Counties to the south; and Owen, Putnam, and Montgomery Counties to the west, as shown in Figure 158.

The 1975 population of Region Eight was 1,138,753 of which sixty-four percent resided in Indianapolis. The official Indiana Population Projections indicate that the region's population will increase to 1,531,100 by the year 2000, with the major growth in Marion County. The 1975 population and the population projections for each county are tabulated below.

Table 125
The 1975 and projected populations for Region Eight.

County	1975	1980	1990	2000
Boone	32,618	33,700	37,500	41,900
Hamilton	68,260	81,300	118,300	170,000
Hancock	40,294	48,300	65,500	86,100
Hendricks	61,290	68,800	88,100	110,700
Johnson	66,880	78,800	103,500	132,100
Marion	782,139	804,400	843,700	863,800
Morgan	48,480	52,200	62,800	74,800
Shelby	38,792	41,300	45,500	49,700
Total	1,138,753	1,208,800	1,364,900	1,531,100

Agriculture is the dominant land use within the region with more than seventy-one percent of the area devoted to farming. Approximately nine percent of the

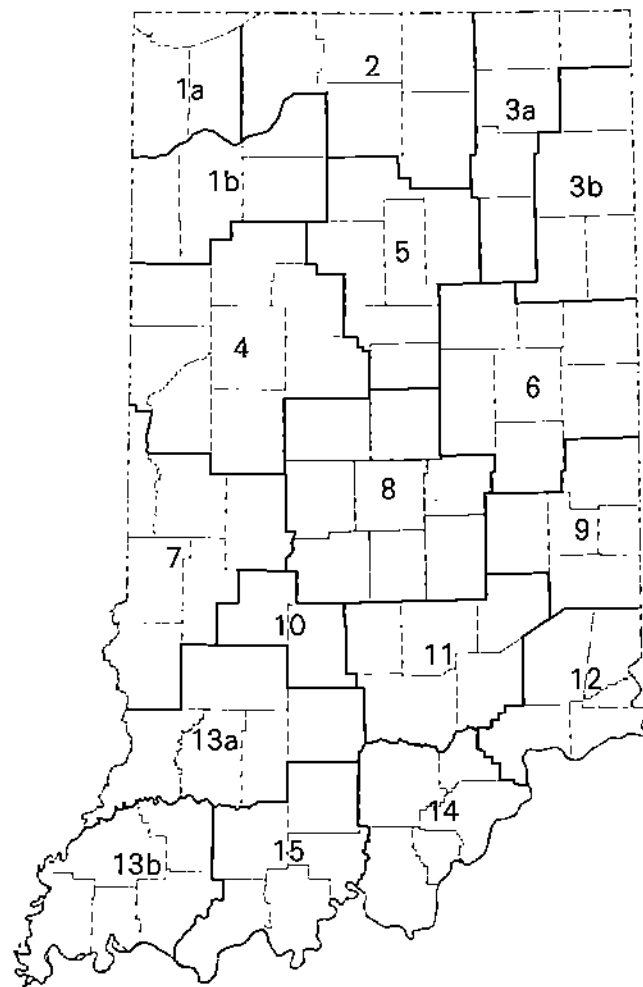


Figure 158
Map of Indiana showing the location of Region Eight.

land is forested while the remaining twenty percent comprises urban and miscellaneous uses.

Approximately thirty-six percent of the work force is employed within the region. The transportation equipment, electrical machinery, and nonelectrical machinery industries employ sixteen percent of the work force. Eighty-five percent of the entire work force is employed in Indianapolis.

The region is characterized by gently rolling to nearly flat topography. However, portions of Morgan County are characterized by steep ridges and relatively rugged topography.

Average annual precipitation for the region is approximately 39.5 inches. This varies from a high of 4.3 inches in May to a low of 2.4 inches in February. Of the 39.5 inches falling annually, approximately 13.0 inches appear as streamflow while 26.5 inches are consumed through evapotranspiration.

The area has moderate temperatures with averages ranging from 28°F. in January to 75°F. in July. The average annual temperature is 53°F. The annual prevailing wind at the Indianapolis International Airport is from the southwest at 9.7 miles per hour.

THE WATER RESOURCE

Ground Water

Virtually all of Region Eight was covered by the Wisconsin continental glaciers that advanced through Indiana some 20,000 years ago. The deposits left by these ice sheets consist predominantly of glacial till, scattered deposits of ice contact sand and gravel, silt, lake clays, outwash sand and gravel, and alluvial materials. Of particular importance are the permeable sand and gravel deposits found in the valleys of the West Fork White River, Fall Creek, Eagle Creek, White Lick Creek, Blue River, and Brandywine Creek. Also contained within the glacial drift are numerous, thin, intertill sand and gravel zones.

Beneath the glacial and alluvial materials are sedimentary rock formations of Mississippian, Devonian, Silurian, and Ordovician ages. In the extreme southwestern portion of the region, middle Mississippian limestone is present. Further eastward, siltstone, shale, and lenses of limestone of the Borden Group occur beneath about one-third of the region. The New Albany shale, a black carbonaceous formation, underlies the cities of Franklin, western Indianapolis, and Zionsville. The remaining eastern portion of the region is underlaid by limestone and dolomite of Silurian and Devonian ages and thin, interbedded shale and limestone of Ordovician age.

The availability of ground water is associated with the nature and type of aquifer materials present in a given area. The availability of ground water in Region

Eight is shown in Figure 159. Well yields are usually limited to ten to one hundred gallons-per-minute (gpm) in much of the western portion of the region, particularly in areas underlaid by Mississippian bedrock formations. However, well yields from 250 to 1500 gpm are obtained from aquifer systems in the valleys of White Lick Creek, West Fork of the White River and Eagle Creek, and in the vicinities of Brownsburg and Thorntown.

In the central portion of the region, an area running northwest to southeast has good ground-water conditions, and anticipated maximum well yields range from 100 to 400 gpm. Major ground-water sources occur in the West Fork of the White River valley sand and gravel aquifer system and the underlying limestone and dolomite bedrock aquifers.

Groundwater potential in the eastern portion of Region Eight is good, and except for a small area in extreme southeastern Shelby County, well yields from 200 to 400 gpm are generally available. In some portions of Hancock and Shelby Counties, well yields of 600 to 1000 gpm can be developed from thick sand and gravel aquifers.

The easily recharged aquifers of the West Fork of the White River, Fall Creek, and Blue River valleys contain an estimated 125 billion gallons of water in storage and offer the best potential for ground-water development in Region Eight. However, because of physical constraints only a portion of this amount could be removed without creating adverse impacts. A 1975 study by the U.S. Geological Survey estimated that, depending on hydraulic characteristics, the sand and gravel aquifers in Marion County are capable of producing 59 to 103 million-gallons-per-day (mgd) from a system of wells.

Surface Water

Streamflow The greatest area of Region Eight is drained in a northeast to southwest direction by portions of Big Blue River and the West Fork of the White River. Other major streams include Sugar Creek, located in the Driftwood River drainage basin, Sugar Creek located in Boone County, Flatrock River and Big Walnut Creek. Of these larger streams, only Sugar Creek, located in the Driftwood drainage basin, and Big Walnut Creek originate within the region.

The seven day, once in ten year (Q7-10); one day once in thirty year (Q1-30); and the average annual flow for streams with gaging stations within Region Eight are shown in Table 126.

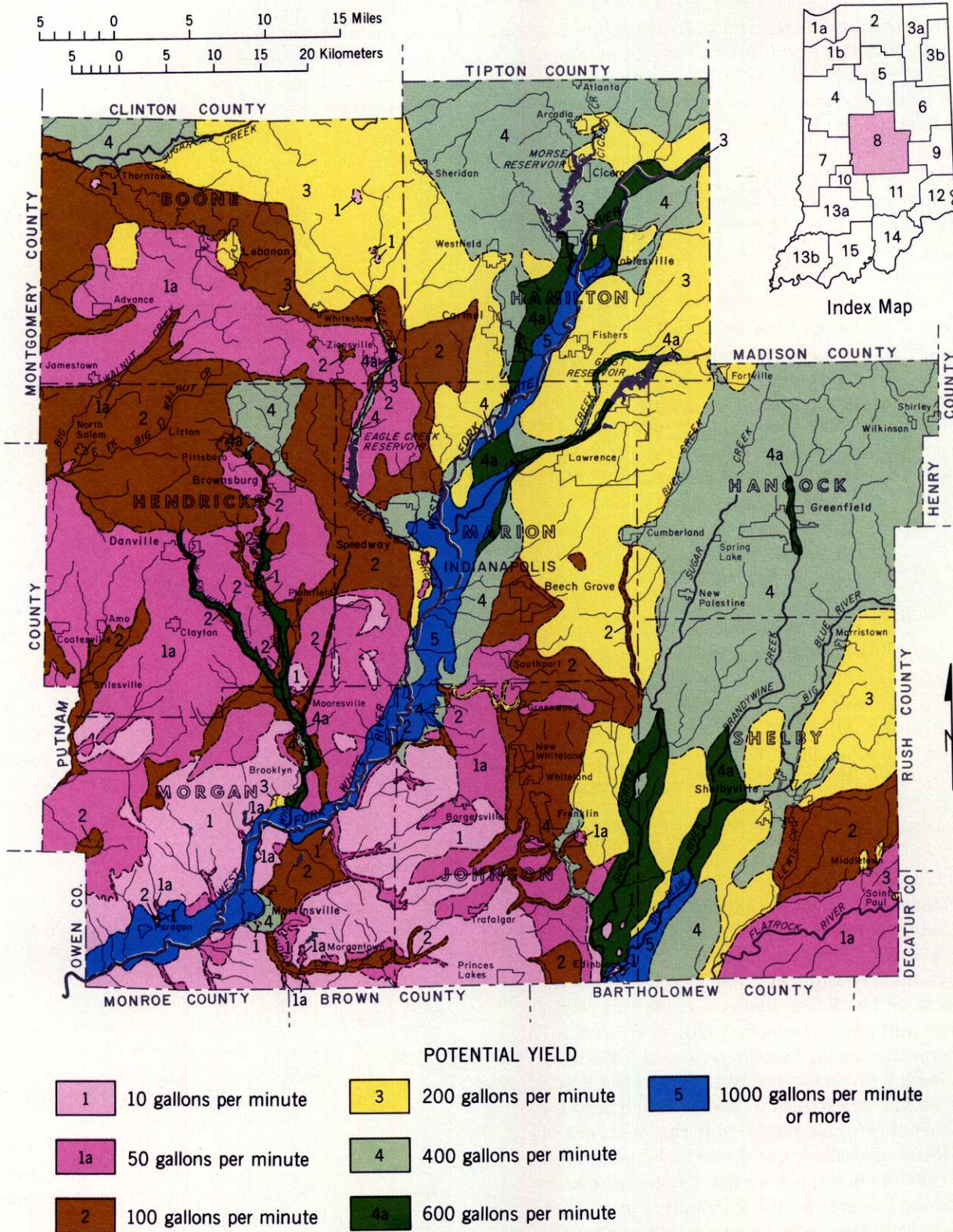


Figure 159
 Map of Region Eight showing the general location and potential yield of ground water from properly constructed large diameter wells.

Table 126
Flow characteristics of streams.

Stream	Drainage Area (square miles)	Million-Gallons-Per-Day		
		Average Annual	Q7-10	Q1-30
Big Blue River at Shelbyville	421	295	26.2	21.7
Eagle Creek at Indianapolis ^{a b}	162	96	2.6	2.6
Eagle Creek at Zionsville	103	60	0	0
Fall Creek near Fortville	169	105	10.1	7.6
Fall Creek at Millersville ^a	298	178	24.6	19.7
Flatrock River at St. Paul	303	202	1.3	0.5
Pleasant Run at Arlington Avenue	7.6	4	0	0
Pleasant Run at Brookville Road	10	6	0	0
West Fork of the White Lick Creek at Danville	29	18	0	0
West Fork of the White River near Centerton	2,444	1,550	145.4	107.3
West Fork of the White River at Indianapolis ^b	1,635	885	34.8	14.2
West Fork of the White River at Noblesville	858	530	49.9	34.9
West Fork of the White River near Noblesville	828	510	42.5	31.0
West Fork of the White River near Nora ^a	1,219	690	73.0	56.9
White Lick Creek at Mooreville	212	130	2.3	1.1

^aFlow characteristics include low-flow augmentation from reservoirs.

^bFlows reduced by water supply withdrawals upstream from gaging stations.

The *low-flow* characteristics indicate that the largest and most reliable streamflows are those in the West Fork of the White River in southwestern Morgan County. The one day, once in thirty year low flows for the West Fork of the White River at Centerton reveal that the river will have a sustained flow of at least 107 mgd, while the average annual flow exceeds 1,500 mgd. Both the Big Blue River and the West Fork of the White River have stream discharges in excess of ten mgd for their entire lengths in the region. Only the West Fork of the White River downstream of White Lick Creek has a yield in excess of one hundred mgd. Eagle Creek Lake has a required release of approximately 2.6 mgd for low-flow augmentation. Some augmentation also occurs in Cicero and Fall Creeks from Morse and Geist Lakes.

The flow duration curve for Eagle Creek at Indianapolis, as shown by Figure 160, indicates the

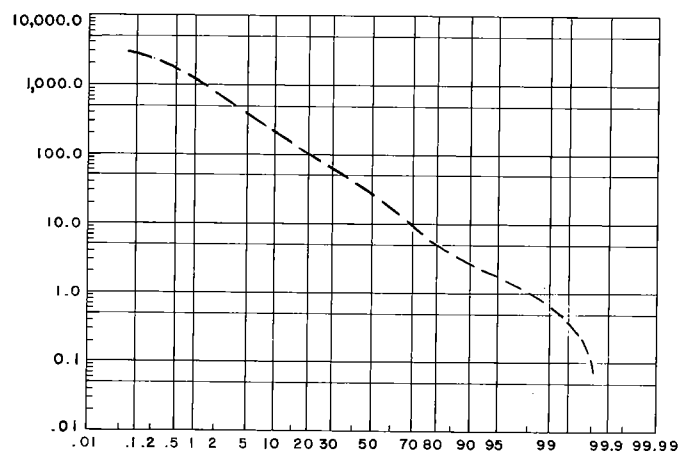


Figure 160
The flow duration curve for Eagle Creek at Indianapolis.

stream will have a dependable flow of at least 2.5 mgd ninety percent of the time.

The slope of the curve also indicates that the Eagle Creek basin contains aquifers which provide significant ground-water contribution to streamflow. To verify this, the technique of hydrograph separation was applied to three annual hydrographs at the Indianapolis gaging station, representing "dry," "average," and "wet" years. The results indicate that the ground-water contribution to streamflow amounts to forty-nine, thirty-four, and nineteen percent for dry, average, and wet years, respectively. Conversely, from fifty-one to eighty-one percent of the flow, depending on the year, is due directly to surface runoff from runoff-producing precipitation events or from snow-melt. Ground-water contribution to streamflow pro-

vides a moderate supplement to most streams in the region with the exception of those in Boone and Hendricks Counties.

Lakes The lakes within the region which are at least 50.0 acres in size or have a storage capacity of 32.5 million or more gallons are presented in Table 127, and are located on Figure 161. These forty-nine lakes have a combined surface area of approximately 5,840 acres and a gross storage capacity of approximately 30,150 million gallons. Region Eight contains three major supply structures: Eagle Creek and Geist and Morse Lakes. They possess storages of 7,820, 6,902, and 6,901 million gallons respectively, and are used as a source of water for the Marion County area.

Table 127
Lakes at least 50.0 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	Russel Lake	na	6.7	32
2	Wurster Lake	1.01	35.0	51
3	Morse Reservoir	214.00	1,375.0	6,900
4	Valley Forge Lake	0.33	19.0	54
5	Beck Lake	na	7.0	39
6	Danville Conservation Club Lake	na	na	32
7	Je-To Lake	na	10.1	48
8	Manor Lake	na	na	32
9	Stout Lake	na	15.6	52
10	College Park Lake	1.33	12.0	35
11	Eagle Creek Reservoir	168.00	1,350.0	7,820
12	Geist Reservoir	215.00	1,776.0	6,901
13	Indian Lake	25.40	53.6	136
14	Traders Point Lake	na	14.0	48
15	Sugar Hills Lake	na	77.1	100
16	Dalton Lake	na	10.9	58
17	Echo Lake	na	7.8	52
18	Fish Hatchery Lake	na	30.8	104
19	Foxcliff Lake	0.60	42.0	161
20	Hart Lake	na	22.6	58
21	Lahr Lake	na	10.4	58
22	Lake Bodona	na	14.0	45
23	Lake Edgewood	na	50.0	217
24	Lake Holiday	na	na	619
25	Lake Maxine	na	8.2	35
26	Little Nebo Lake	0.36	48.0	288
27	Lower Spring Lake	na	7.1	52
28	North Lake Dillman	na	10.1	48
29	Ole Swimming Hole Lake	na	105.6	391
30	Patton Lake Dam	15.10	94.7	651
31	South Lake Dillman	na	8.2	45
32	Twin Oaks Lake	na	7.0	91
33	Upper Spring Lake	na	6.6	48
34	Vandenbark Lake	na	32.5	260
35	Whip-Poor-Will Lake	na	9.4	32
36	Whip-Poor-Will Lake	na	25.0	202
37	Whispering Wind Lake	na	12.0	39
38	Wildwood Lake	na	na	78

Table 127 (Continued)

<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>
39	Bell Lake	na	8.8	391
40	Earlham Lake	na	20.8	169
41	Earth Lake, West	na	na	44
42	Hants Lake	na	9.4	58
43	Hood Lake	na	11.4	117
44	Lamb Lake	2.98	60.9	521
45	Lamb Lake Estates	9.10	309.0	2,362
46	Peoga Lake	na	14.6	97
47	Princes East Lake	2.61	63.0	332
48	Princes North Lake	na	20.3	78
49	White Lake	0.19	10.9	71

na: not available.

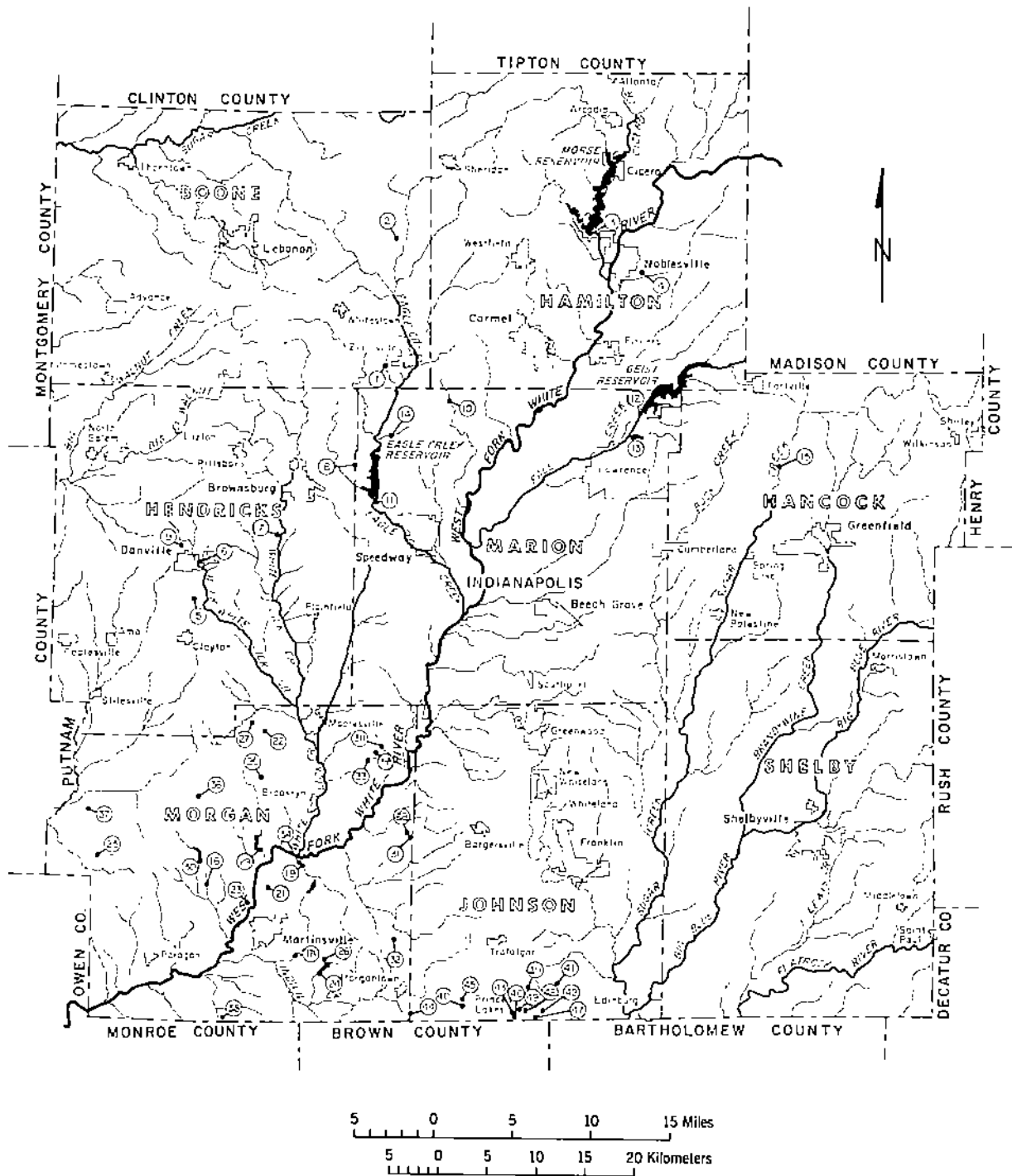


Figure 161
 Map of Region Eight showing the location of lakes that are at least 50.0 acres in size or have a storage capacity of 32.5 million gallons or more.

UTILIZATION OF THE WATER RESOURCE

Instream Uses

The supply and demand analysis for recreational uses of water by the residents of Region Eight is presented in Table 128. The existing supply for recreational activity is expressed as a percentage of the demand. Therefore, when this percentage exceeds one hundred the supply exceeds the demand. Conversely, when the percentage is less than one hundred the supply is less than the projected demand.

Boating and Waterskiing Eagle Creek Reservoir and Geist and Morse Lakes are the only lakes in the region that provide boating. Morse Lake is used extensively for waterskiing. Waterskiing is prohibited on the Eagle Creek Reservoir and Geist Lake.

The available supply of open water meets only sixteen percent of the demand for boating generated by residents of Region Eight. The demand for boating may exceed the supply through the year 2000. Waterskiing opportunities are more scarce than those for boating. The current demand exceeds the supply by ninety-six percent, a trend that is expected to continue through the year 2000.

Table 128
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	29	19.6 boats/acre/year	7,700 acres	16	14	14
Waterskiing	15	34.4 skiers/acre/year	600 acres	4	4	4
Canoeing	12	585 canoes/mile/year	123 miles	71	68	63
Swimming	43	76,600 swimmers/acre/year	39 acres	41	35	34
Ice-Skating	8	6,678 skaters/acre/year	8 acres	14	13	13
Fishing	41	66 persons/acre/year	13,500 acres	8	8	8

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.

Canoeing The major canoeing streams in the region are Flatrock River and the West Fork of the White River. A total of 123 miles is available to the canoeist, passing through both highly developed and rural areas. However, this stream mileage falls short of the estimated demand within the region. Approximately seventy-one percent of the demand for canoeing opportunities will be met in 1980, declining to sixty-three percent by the year 2000.

Swimming and Ice-Skating The demand for swimming opportunities exceeds the supply. It is estimated that only forty-one percent of the needed public pools and beaches will be available by 1980, and only thirty-four percent will be supplied by the year 2000.

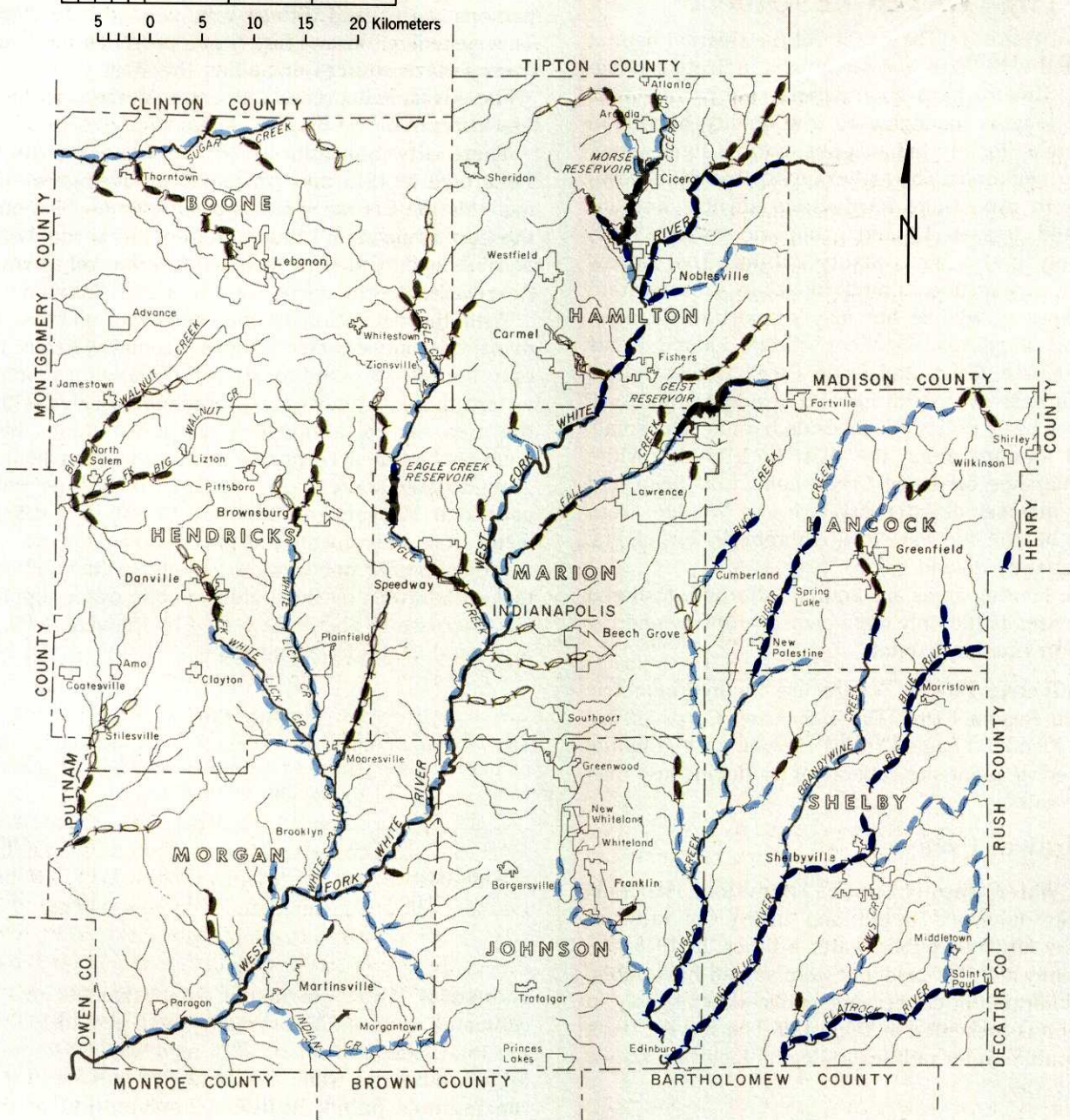
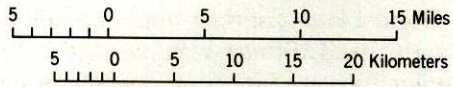
There is a deficiency of ice-skating facilities as well. Estimates reveal that only fourteen percent of the demanded ice-skating opportunities will be available by 1980, and thirteen percent by the year 2000.

Fishing The quality of the fisheries habitat in Region Eight is indicated on Figure 162. Larger streams, such as the West Fork of the White River, the Big Blue River, Flatrock River, and both Sugar Creeks have the best

overall aquatic habitat. The West Fork of the White River has an excellent fisheries habitat in Hamilton County but it decreases slightly downstream in Marion County. A lower quality aquatic habitat is found in the smaller tributaries to the West Fork of the White River, especially in Marion County, and in smaller streams in agricultural areas that are affected by siltation. Warm-water game fish, such as sunfish and catfish, are found in most of the streams. More stable populations of desirable game fish occur in streams with a better quality habitat. Sugar Creek in Boone County is an example of a good fishing stream and is recommended for its sunfish, catfish, and sauger.

Lake Clare, Morse Lake, Eagle Creek Lake, and Geist Lake, all man-made impoundments, offer the best lake fishing opportunities. They all have excellent aquatic habitat and support a variety of sunfishes and catfish. Some of the lakes at the Atterbury Fish and Wildlife Area also provide excellent aquatic habitat for warm-water game fish.

State-owned public access for fishing is available at Atterbury Fish and Wildlife Area, Boone's Pond State Fishing Area, West Fork of the White River in Morgan County, and the Big Blue River at Shelbyville.



AQUATIC HABITAT VALUE





-  High
-  Moderate
-  Low
-  Negligible

Figure 162
Map of Region Eight showing the quality of the fisheries habitat.

Estimates indicate that only eight percent of the region's fishing demand will be met by the year 2000.

Riparian Habitat The quality of the riparian habitat associated with lakes and streams is indicated in Figure 163. Streams have good riparian habitat for most of their lengths, changing to low quality habitat in urban areas, mainly Indianapolis, and in some intensively farmed areas. The higher quality habitat is vegetated with mixed-age hardwoods shrubs, and interspersed grasses. Upland game and various birds commonly prefer high quality habitat. The narrow strips of streamside habitat in urban areas attract fewer types of wildlife but may support small mammals and songbirds. Excellent wildlife habitat exists around Morse, Geist, and Eagle Creek Lakes. Upland game, furbearers, migratory and resident waterfowl, and other birds utilize the lakeside habitat. The small, wooded swamps along the West Fork of the White River, marshes on Eagle Creek Lake, and deep and shallow marshes at Atterbury Fish and Wildlife Areas provide habitat for waterfowl, shorebirds, furbearers, and frequently upland game.

Public hunting areas are limited. Atterbury Fish and Wildlife Area is the only state-owned property offering hunting in riparian habitat.

Hydroelectric Power There are no hydroelectric plants in Region Eight. The U.S. Army Corps of Engineers identified Eagle Creek Reservoir as a potential hydroelectric plant site capable of producing less than 100 kilowatts.

Withdrawal Uses

Public Water Supply Boone, Hamilton, Hancock, Hendricks, Johnson, Marion, and Shelby Counties are served by fifty-four public water utilities. In 1975, approximately 883,500 residents were served by a public utility. Information concerning public water supply in the region is presented in Table 129. The service areas for the public water utilities in Region Eight are shown in Figure 164.

Table 129
The public water supply systems as of 1975.

Counties	Number of Systems	Service Population	Average Daily Withdrawals in Million-Gallons-Per-day
Boone	6	15,300	1.33
Hamilton	10	35,270	4.99
Hancock	4	15,300	2.69
Hendricks	7	23,940	2.08
Johnson	8	40,590	7.17
Marion	4	715,510	97.81
Morgan	11	21,680	2.15
Shelby	4	15,900	2.02
Total	54	883,500	120.24

The Indianapolis Water Company, the largest water utility in Region Eight, served approximately 676,000 persons in 1975 and withdrew an average of 93.3 mgd. This system withdraws ninety-five percent of its water from surface sources, including the West Fork of the White River, Fall Creek, and Geist, Morse, and Eagle Creek Reservoirs.

These fifty-four utilities withdrew an average of 120.2 mgd in 1975 and consumed an average of 12.6 mgd. Marion County systems accounted for 99.0 mgd; those in Johnson and Hamilton Counties withdrew 7.2 and 5.0 mgd, respectively. In each of the other counties, average withdrawals were less than 3.0 mgd.

With the exception of the Speedway and the Indianapolis public water utilities, ground water is the only source of withdrawals for the region's public water utilities. In most cases, wells are located within the area served, although a few communities have gone beyond their corporate limits to locate adequate ground-water sources. In addition, rural water companies in Morgan and Johnson Counties withdraw water from wells located in major stream valleys.

Projections of public water supply utilities indicate that withdrawals by the region's public water supplies may increase to about 178.6 mgd by the year 2000, as presented in the following table.

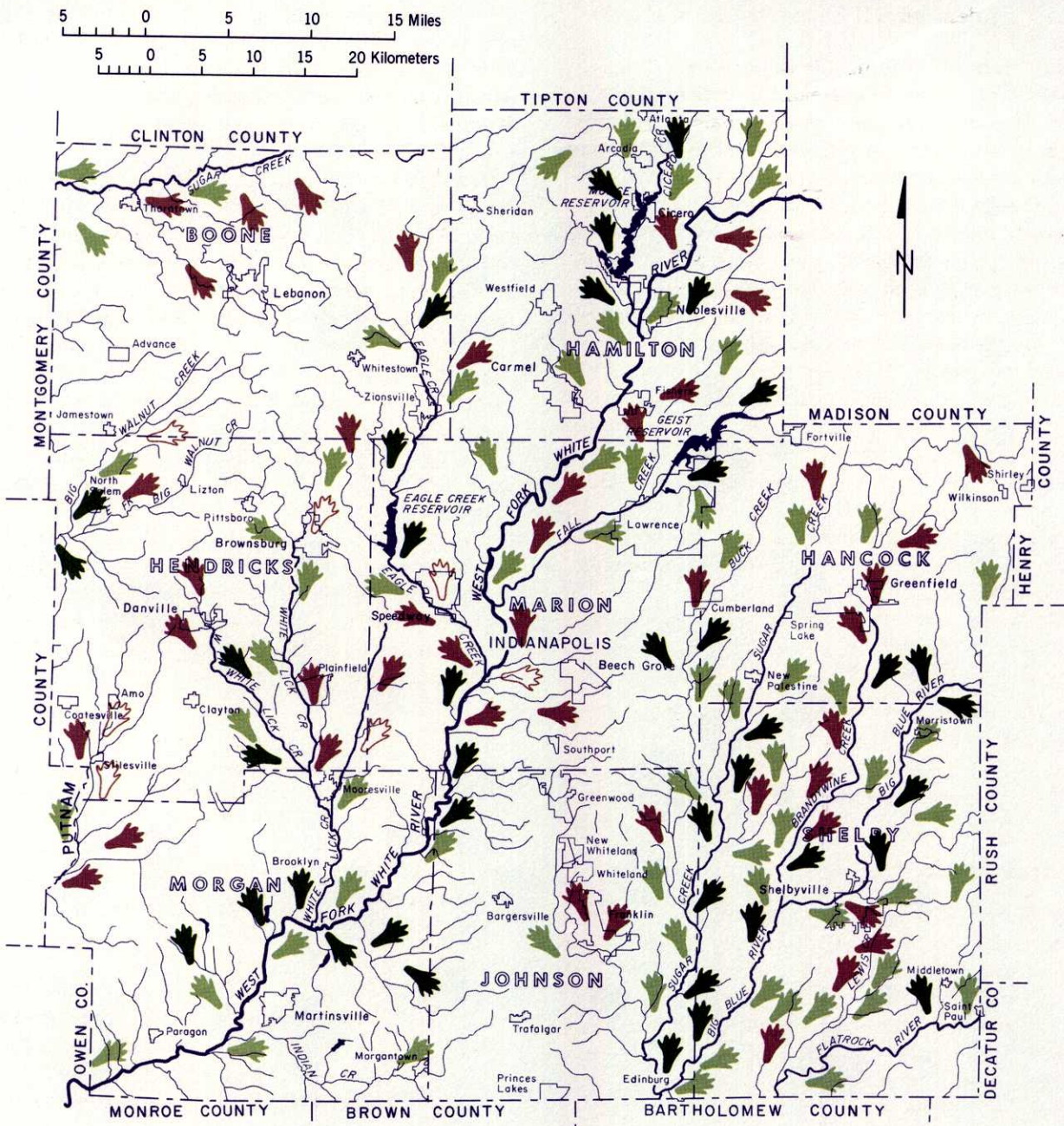
Table 130
The 1977 and projected withdrawal and consumption rates of public water supplies by the year 2000, in million-gallons-per-day.

Public Water Supplies	1977	1980	1990	2000
Withdrawal	120.2	126.8	151.9	178.6
Consumption	12.6	13.3	15.9	18.7

Industrial Water Industrial establishments had an estimated water intake averaging 149.0 mgd in 1977. Of the total industrial intake, 93.0 mgd was self-supplied by the industries while 56.0 mgd was purchased from the region's public utilities. Consumption of self-supplied water amounts to approximately 16.7 mgd. Ground water is currently the main source of water for the region's self-supplied industries, although surface water is important to selected industries.

The largest water-using group is comprised of small industries, which as a whole withdraw over 47.0 mgd. Manufacturers of chemicals, transportation equipment, stone, clay, and glass also use large amounts of water.

Although industrial output is expected to increase, total industrial water intake is expected to decrease initially due to plant efficiency and then rise slowly as output increases. Data for industrial self-supplied withdrawals is presented in Table 131.



RIPARIAN HABITAT VALUE





-  High
-  Moderate
-  Low
-  Negligible

Figure 163
Map of Region Eight showing the quality of the riparian habitat.

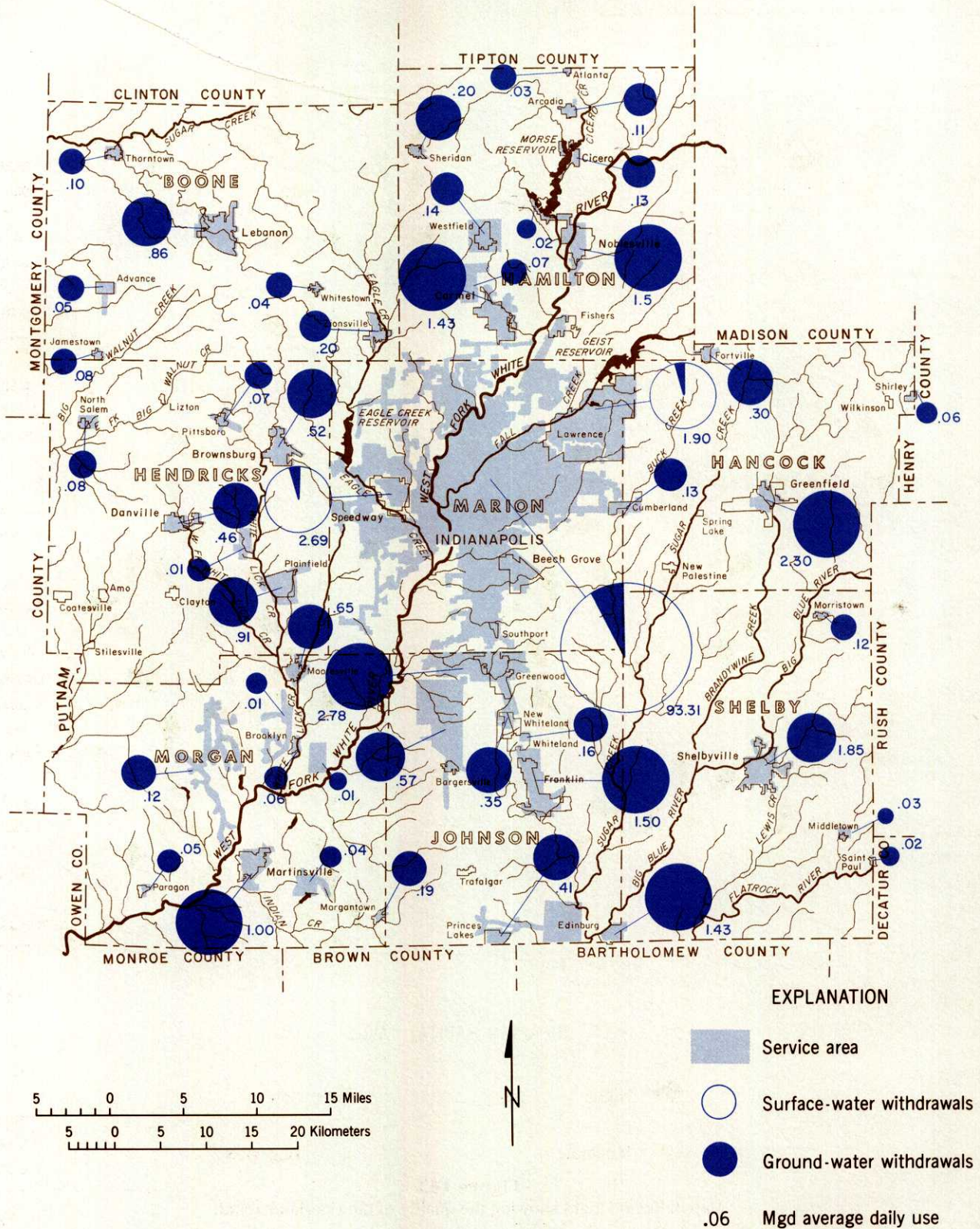


Figure 164
 Map of Region Eight showing the service areas of the public water utilities and average daily use in million-gallons-per-day.