



Region Ten



Monroe and Owen Counties, located in south-central Indiana, form Region Ten. The region contains approximately 770 square miles and is bounded by Putnam and Morgan Counties to the north; Brown and Jackson Counties to the east; Lawrence and Greene Counties to the south; and Clay County to the west, as shown in Figure 182.

The 1975 population of the region was 102,214, of which forty-eight percent resided in Bloomington. The official Indiana Population Projections indicate that by the year 2000 the region's population may increase to 133,000. The 1975 population of each county and the projections for future growth are indicated in the following table.

Table 147

The 1975 and projected populations of Region Ten.

County	1975	1980	1990	2000
Monroe	88,925	94,100	104,800	113,100
Owen	13,289	14,400	16,900	19,900
Total	102,214	108,500	121,700	133,000

Approximately fifty percent of the region is forested, forty-five percent is agricultural, while five percent represents urban and miscellaneous land uses.

Approximately thirty-six percent of the population is employed within the region. The three largest employers are electrical machinery, primary metals, and education (Indiana University). The region is known nationally for high quality limestone. The mining industry, including limestone and gravel, contributes significantly to the area's economy.

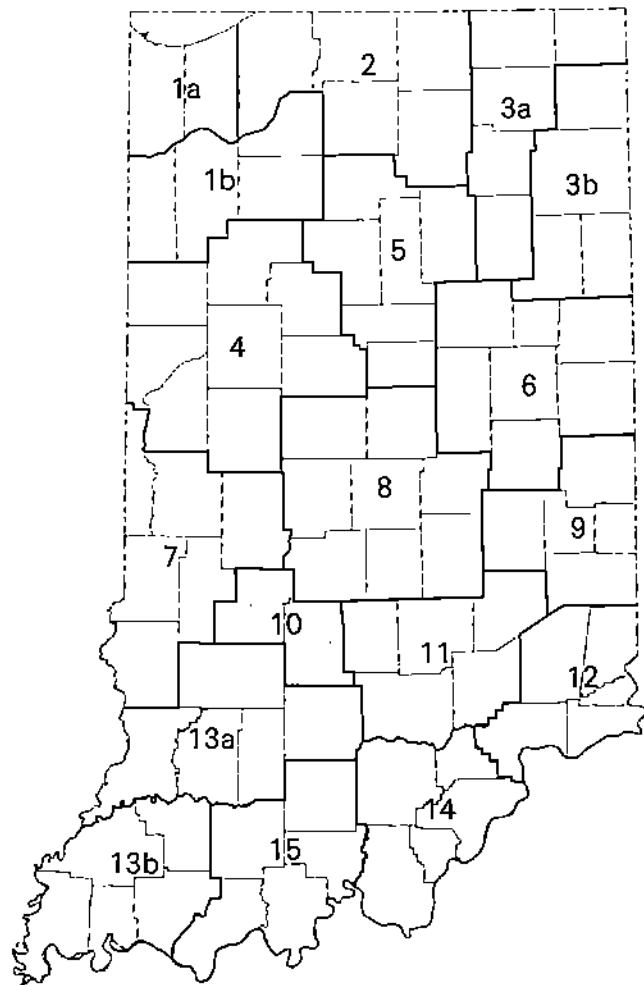


Figure 182

Map of Indiana showing the location of Region Ten.

Average annual precipitation is approximately 43.0 inches. This varies from a high of 4.9 inches in June to a low of 2.5 in October. Of the 43.0 inches falling annually, approximately 14.5 inches appear as streamflow while 28.5 inches are consumed through evapotranspiration. Temperatures are moderate with monthly averages ranging from 30.5°F. in January to 75.5°F. in July. The average annual temperature is 54°F. The annual prevailing wind at Indianapolis International Airport is from the southwest at 9.7 miles per hour.

THE WATER RESOURCE

Ground Water

Owen County was almost completely covered by the Illinoian glacial advance, while Monroe County received almost no glacial deposits. The unconsolidated deposits in this region include lake clays, glacial till, and valley train sand and gravel.

Beneath the cover of glacial and surficial deposits are bedrock deposits which range in age from Mississippian to Pennsylvanian. The Mississippian age rocks of Monroe County and eastern Owen County consist of shales, limestones, and sandstones. In western Owen County the Pennsylvanian bedrock includes shale and sandstone primarily, with some minor amounts of limestone and coal.

The availability of ground water is associated with the nature and type of aquifer materials present in a given area. In this region, there is a pronounced variability in ground-water occurrence, as shown in Figure 183.

Ground-water conditions are generally poor, with Monroe County having very limited ground-water resources. Except for a very small area adjacent to the West Fork of the White River in the northwestern portion of the county, where well yields of 1,000 gallons-per-minute (gpm) are possible, wells can normally produce only 10 gpm or less. In nearly all of Monroe County the Mississippian shales and limestones can be expected to supply only meager amounts of water.

In Owen County the potential for higher yielding wells is much improved because of the presence of glacial deposits, particularly sand and gravel. The West Fork of the White River valley contains thick sand and gravel aquifers which can yield in excess of 1,000 gpm. Another area of higher well yields occurs adjacent to Jordan Creek near Cagles Mill Lake where sand and gravel deposits are located. Wells can produce 50 to 400 gpm from these materials. Most upland areas in Owen County have limited ground-water resources, although the incidence of dry holes is much less than in Monroe County.

Water hardness is usually quite high, ranging between 300 to 400 parts-per-million (ppm) due largely to the presence of limestone in much of the area. Softer waters are possible locally in northwestern Owen County. Iron concentrations range from a low of 0.1 ppm in Owen County to around 0.9 ppm along the West Fork of the White River in northwestern Monroe County. The sand and gravel deposits along the West Fork of the White River also contain objectionable amounts of manganese. In general, ground-water quality is good and, exclusive of the need for iron and possible manganese removal in some areas, is satisfactory for most purposes.

Surface Water

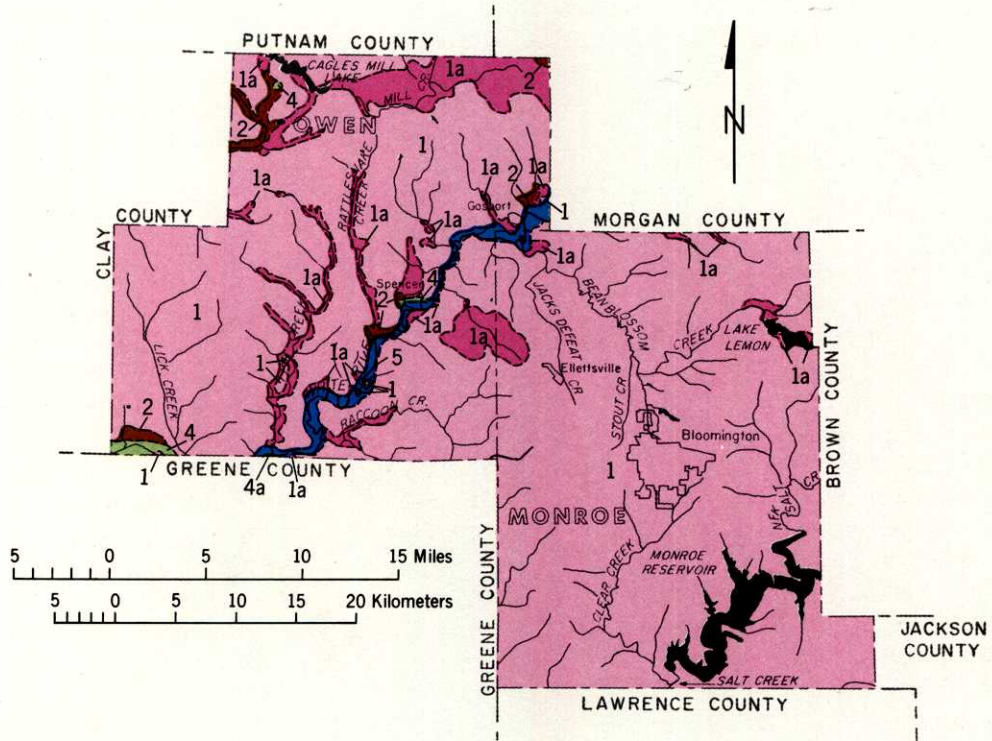
Streamflow Most of the region is drained by a collection of small and medium sized stream systems which eventually contribute to the West Fork of the White River. The only notable exception is the northwest corner of Owen County which drains into the Eel River system before contributing to the West Fork of the White River. Some of the river systems draining the region are Salt Creek, Bean Blossom Creek, Raccoon Creek, Fish Creek, Lick Creek, and Mill Creek.

The seven day, once in ten year (Q7-10), one day, once in thirty year (Q1-30) and the average annual flow in million-gallons-per-day (mgd) for streams with gaging stations within Region Ten are presented in Table 148.

Analysis of the low-flow characteristics of streams indicates that the largest and most reliable streamflows are those in the West Fork of the White River. The one day, once in thirty year low flows for the West Fork of the White River at Spencer reveal that the river will have a sustained flow of at least 110 mgd while the average annual flow will be 1,900 mgd.

Ground-water contribution to streamflow in the region is generally quite poor and, hence, significant annual variability in streamflow occurs in most streams. Only the West Fork of the White River, because of a better ground-water contribution in its upstream reaches, exhibits reasonably good low-flow characteristics.

Lakes The lakes within the region that are at least 50.0 acres in size or have a storage capacity of 32.5 million gallons or more are listed in Table 149, and are located on Figure 184. These eighteen lakes have a combined surface area of approximately 12,630 acres and a gross storage capacity of approximately 66,000 million gallons. Lake Monroe has a surface area of approximately 10,750 acres with a gross storage capacity of nearly 59,400 million gallons.



POTENTIAL YIELD

1	10 gallons per minute
1a	50 gallons per minute
2	100 gallons per minute
4	400 gallons per minute
4a	600 gallons per minute
5	1000 gallons per minute or more



Figure 183
Map of Region Ten showing the location and potential yield of ground water from properly constructed large diameter wells.

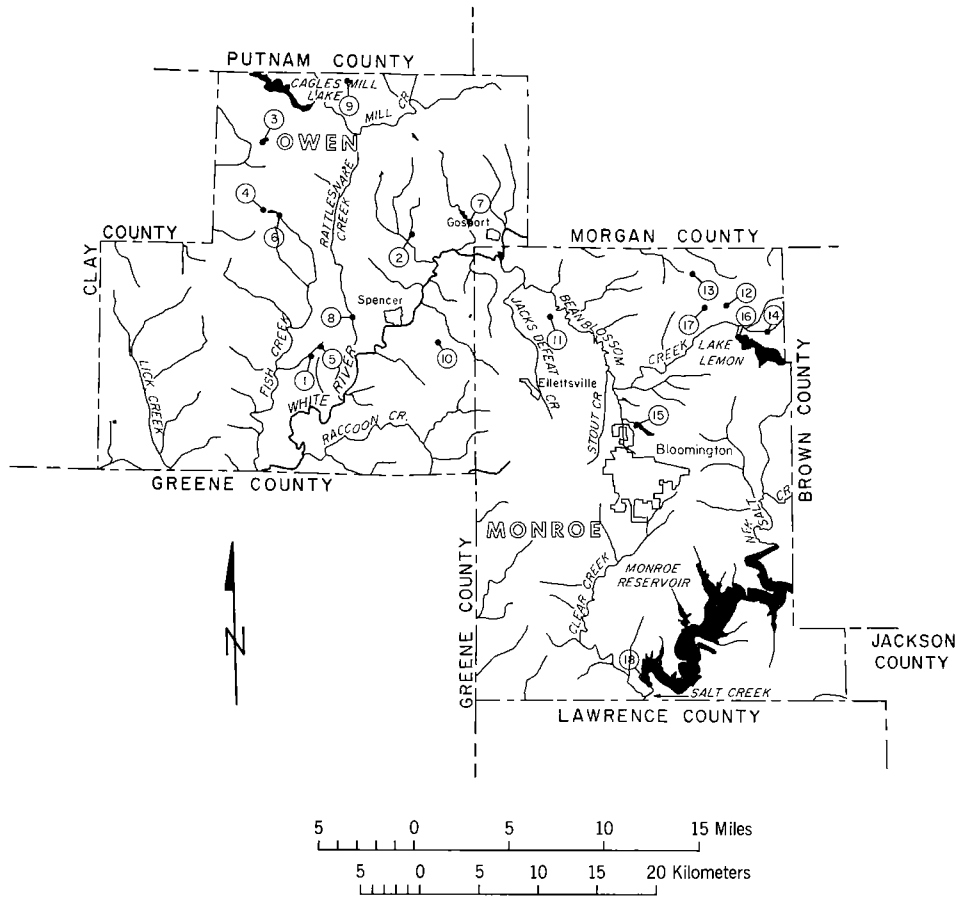


Figure 184
 Map of Region Ten showing the location of lakes that are at least 50.0 acres in size or have a storage capacity of 32.5 million gallons or more.

Table 148
Flow characteristics of streams.

Stream	Drainage Area (square miles)	Million-Gallons-Per-Day		
		Average Annual	Q7-10	Q1-30
Salt Creek near Harrodsburg ^a	432	153	0.1	na
West Fork White River at Spencer	2,988	1,900	150.0	110.0
Mill Creek near Cataract ^b	245	78	0.3	na

^aThese flows recorded prior to the construction of Lake Monroe.

^bFlow characteristics estimated from stream gaging stations with short periods of record.
na: not available.

Table 149
Lakes at least 50.0 acres in size or having a storage capacity of 32.5 million gallons or more.

Lake Number	Lake Name	Drainage Area (square miles)	Surface Area (acres)	Gross Storage (million gallons)
1	A.M. Thomas Lake	na	10.0	35
2	Amazon Lake	2.85	44.1	203
3	Barnes Lake	na	30.4	101
4	Clifton E. Barnes Lake	na	na	65
5	Cottons Little Pine Lake	na	11.5	35
6	Greybrook Lake	na	33.3	130
7	Hollybrook Lake	na	29.1	123
8	Mills Pond	0.92	21.0	70
9	Paradise Lake	na	3.6	78
10	Unnamed	na	na	32
11	Baughner Lake	na	7.8	52
12	Bean Blossom Lake	na	14.6	83
13	Bryant Creek Lake	na	11.4	45
14	Egenolf Lake	1.35	26.0	76
15	Griffy Reservoir	8.02	115.5	762
16	Lake Lemon	70.90	1,506.0	4,698
17	Lazy Lake	na	17.2	65
18	Monroe Lake	432.00	10,750.0	59,386

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 Ten are presented in Table 150. 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 supply is less than one hundred the supply is less than the projected demand.

Boating and Waterskiing The three large man-made lakes provide an ample supply of surface water to meet local demands for boating and waterskiing. Lake Monroe is the largest inland body of water in the state. The pool of Cagles Mill Reservoir, although its control structure is in Putnam County, provides open water for recreation. Lake Lemon also provides space for boating and waterskiing, and Griffy Reservoir supplies boating acreage.

The demand of resident recreationists for boating and waterskiing is projected to be satisfied by the existing supply into the year 2000. However, the data

does not reflect recreationists from outside the region that migrate to use the recreation facilities. According to the *Origin-Destination and Out-of-State Visitor Study* (Department of Natural Resources), fifty-four percent of the visitation to Paynetown Recreation Area on Lake

Monroe is generated from outside Region Ten. This migration will cause a much greater demand of the region's water resources than is indicated in the supply and demand analysis.

Table 150
The outdoor recreation demand and supply analysis for Region Ten.

Activity	Percent of Population Participating	Density Guideline	Approximate Supply	Existing Supply as a Percentage of Projected Demand		
				1980	1990	2000
Boating	27	19.6 boats/acre/year	12,300 acres	100+	100+	100+
Waterskiing	9	34.4 skiers/acre/year	8,100 acres	100+	100+	100+
Canoeing	6	585 canoes/mile/year	32 miles	100+	100+	100+
Swimming	45	76,600 swimmers/acre/year	12 acres	100	86	80
Ice-Skating	10	6,678 skaters/acre/year	3 acres	38	33	33
Fishing	34	66 persons/acre/year	7,700 acres	90	75	69

This table is based upon the 1979 Indiana State Outdoor Recreation Plan. Only the supply and recreational demands by 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 Thirty-two miles of the West Fork of the White River is the only canoeable stream in the region. This supply will fulfill the canoeing demand through the year 2000.

Swimming and Ice-Skating It is estimated that the current swimming needs are being met by the existing combination of municipal pools and public swimming beaches at Monroe and Cagles Mill Lakes. However, only eighty percent of the needed facilities may be available by the year 2000. Public ice-skating facilities currently meet only thirty-eight percent of the demand and are projected to satisfy only thirty-three percent of the demand by the year 2000.

Fishing The quality of the fisheries habitat is indicated on Figure 185. The streams contain sunfish, bass, and catfish, the typical mixture of warmwater fish in Indiana. Beanblossom Creek, Mill Creek, Raccoon Creek, North Fork Salt Creek, Clear Creek, and the West Fork of the White River have good to excellent aquatic habitat. The last two streams occasionally experience water quality problems which reduce the value of their fisheries habitat. Some small streams, such as Fish Creek, support seasonal game fisheries due to low flow in dry seasons. South Mill Creek is known for good smallmouth bass fishing. Walleye are available on the Eel River during the spawning run.

All of the public lakes have good aquatic habitat for warmwater game fish. Monroe Lake and Hill Lake contain sunfish, white and yellow bass, northern and wall-eye pike, and channel catfish as well as a variety of rough and forage fish.

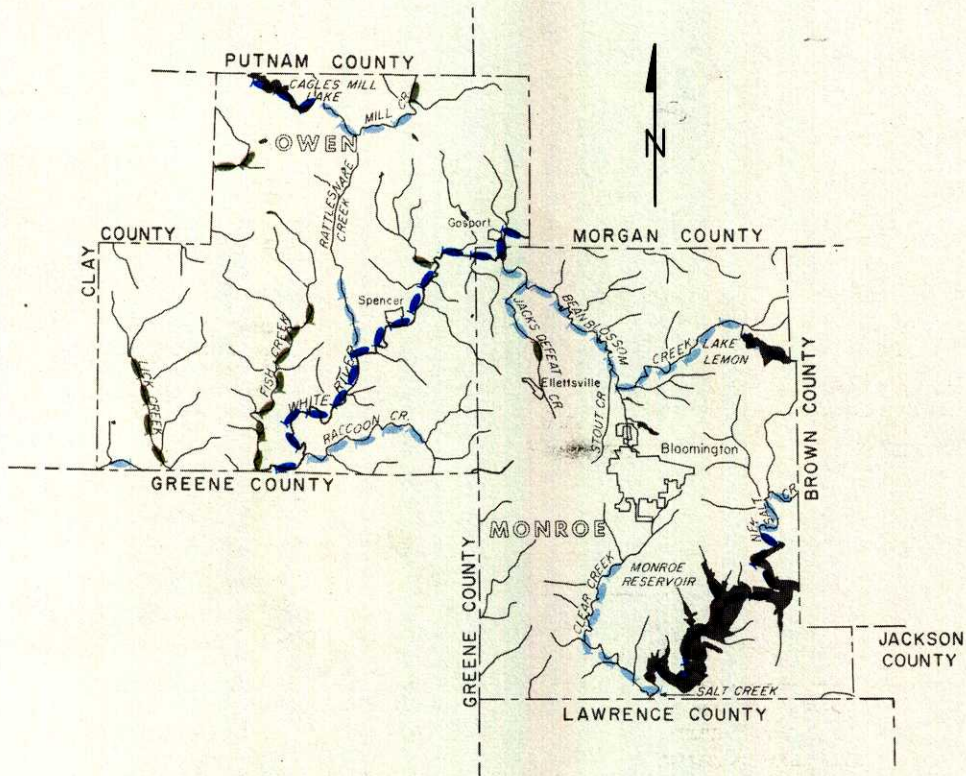
Public access for fishing is available on all the lakes except Lazy Lake. A state-owned fishing site is located on the West Fork of the White River in Spencer.

The demand for fishing acreage by residents of Region Ten currently exceeds the supply by ten percent. Use of the region's waters by fishermen from outside the region is extensive.

Riparian Habitat The quality of the riparian habitat associated with lakes and streams is indicated on Figure 186. Most of the streams offer good riparian habitat. Hardwoods and shrubs line the streambanks and provide suitable habitat for upland game, songbirds, shorebirds, waterfowl (especially wood ducks), furbearers, and other wildlife. The environment around the lakes is similar to that along the streams and is used by many of the same wildlife. The most extensive wetlands in the region have been developed on Monroe Lake along the North Fork of Salt Creek. Wetlands occur in the upper end of Cagles Mill Lake and seasonally along the West Fork of the White River. These wetlands are used by various types of wildlife especially migratory and resident waterfowl. Public hunting is available on state and federal lands.

Withdrawal Uses

Public Water Supplies Monroe and Owen Counties are served by eleven public water utilities. An estimated 67,000 persons were served by public utilities in 1975. Monroe County had approximately 61,000 while Owen County had 5,800 residents served by public water utilities. Figure 187 shows the service areas and withdrawals of public water utilities in Region Ten.



AQUATIC HABITAT VALUE

- High
- Moderate
- Low

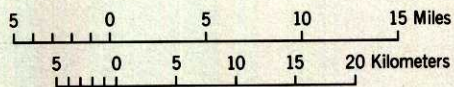
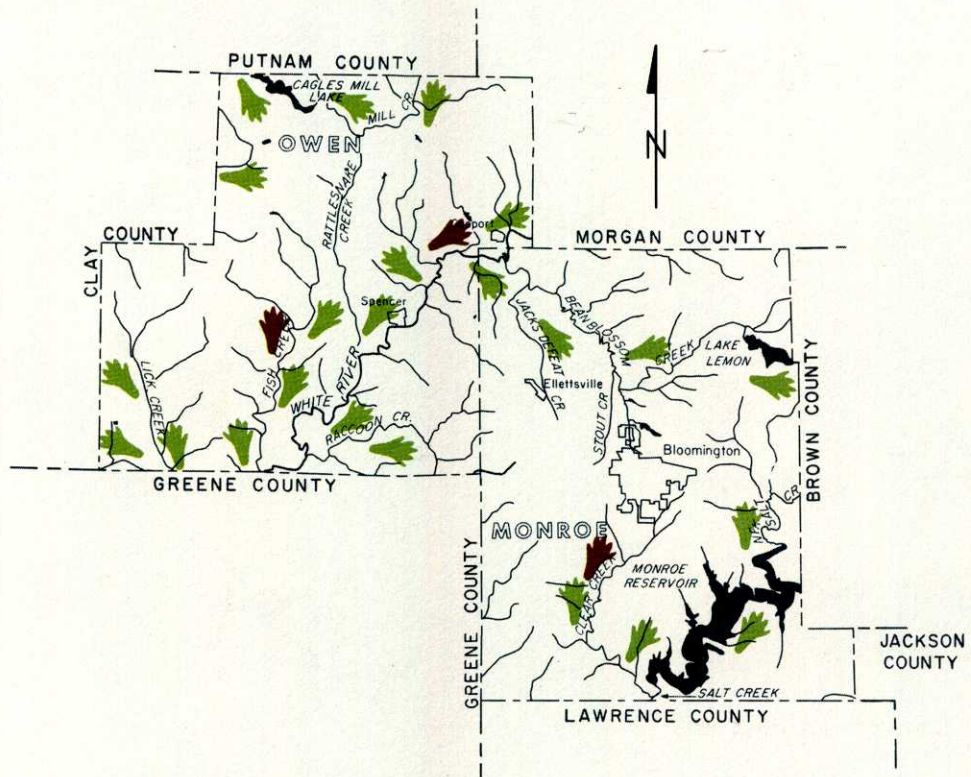




Figure 185
 Map of Region Ten showing the quality of the fisheries habitat.



RIPARIAN HABITAT VALUE

-  Moderate
-  Low

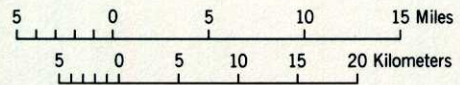


Figure 186
Map of Region Ten showing the quality of the riparian habitat.

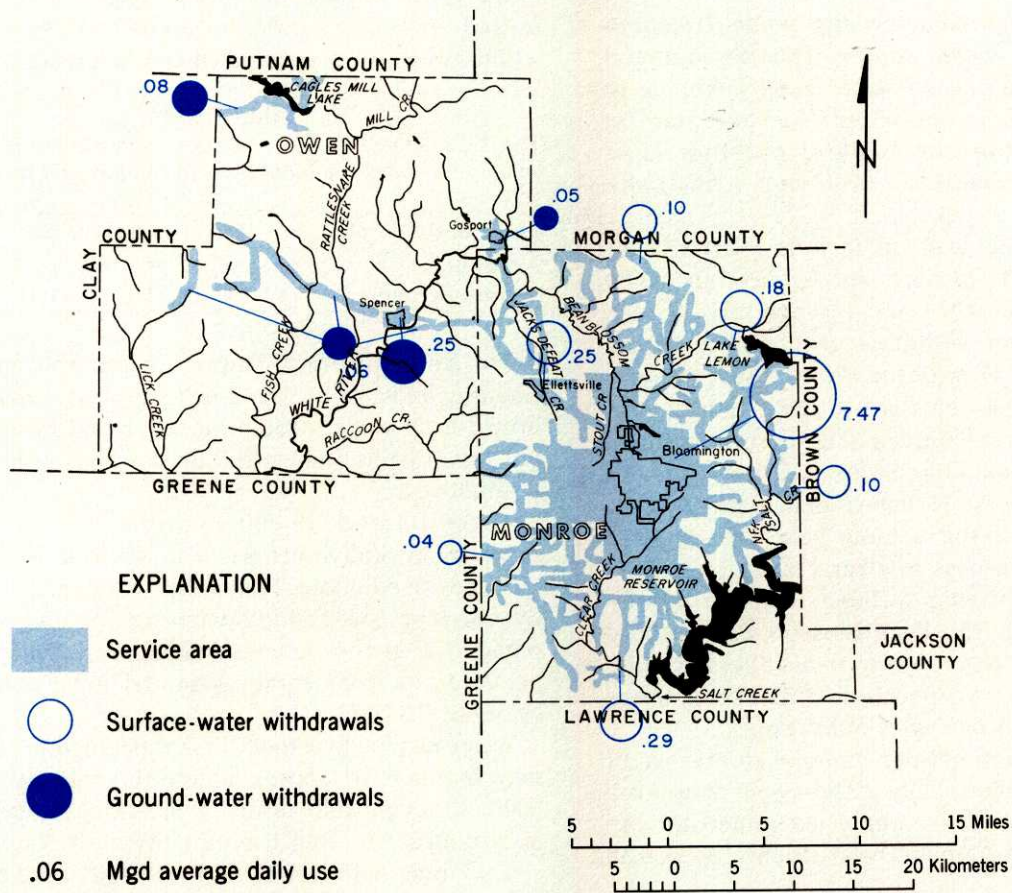


Figure 187
 Map of Region Ten showing the service areas of the public water utilities and average daily use in million-gallons-per-day.

Four of the utilities in the region are municipal systems, and the remainder are rural water systems. The Bloomington Municipal System, the largest single water utility operating in the region, served about 50,000 residents in 1975. It withdraws an average of 11.6 mgd and sells approximately 1.3 mgd to six rural water systems in Monroe County. The Bloomington system withdraws approximately eighty-one percent of the region's public water supply. The Bloomington utility depends primarily on water supply storage in Monroe Lake, which is purchased from the State of Indiana. Bloomington and Bedford together have guaranteed withdrawals of 17.0 mgd from Lake Monroe.

Additional municipal systems include Ellettsville in Monroe County and Gosport and Spencer in Owen County which withdraw 0.4 and 1.0 mgd respectively. Gosport and Spencer withdraw ground water from aquifers in the West Fork of the White River valley.

Seven rural water systems serve this region of generally limited water resources. These rural utilities have been rapidly expanding in the past few years. An estimated 12,000 persons have been connected to rural water systems in the last four years. Nearly all of Monroe County has access to a rural water line. Many of these rural utilities purchase water from the Bloomington system. The Bean Blossom-Patrickburg Water Corporation buys water from Spencer. The Cataract Lake Water Corporation obtains its water from wells southwest of Cagles Mill Lake.

In 1975, these eleven utilities pumped an average of 12.1 mgd, with maximum daily withdrawals of approximately 15.8 mgd. Monroe County accounted for approximately 11.7 mgd while Owen County used 0.38 mgd.

Projections of public water utilities indicate that water withdrawals may increase to approximately 20.5 mgd by the year 2000, as presented here.

Table 151

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

<i>Public Water Supplies</i>	1977	1980	1990	2000
Withdrawal	12.1	13.1	16.8	20.5
Consumption	2.3	2.5	3.3	4.0

Industrial Water Industrial establishments had an estimated water intake averaging 7.8 mgd in 1977. Of the total industrial intake, 6.0 mgd was developed by the industries themselves while approximately 1.7 mgd was purchased from the region's public utilities. About 1.6 mgd was consumed in the manufacturing process, 1.3 mgd of which was self-supplied.

The largest water-using industry group is comprised of smaller industries, which together use approximately 4.4 mgd. The region's limestone quarries withdraw a significant amount of the self-supplied 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 are presented in the following table.

Table 152

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

<i>Industrial Self-Supplied</i>	1977	1980	1990	2000
Withdrawal	6.0	6.2	6.7	7.2
Consumption	1.3	1.4	1.9	2.5

Rural Self-Supplied Water In Monroe and Owen Counties most of the rural self-supplied water is withdrawn from wells located on farms and rural residential lots. Cisterns are often used where wells are not productive.

An estimated 35,000 persons lived in homes supplied by individual wells in 1975. It is estimated that they used about 2.1 mgd for residential purposes. By the year 2000, additional residents and an anticipated use in the general standard of living are expected to increase rural residential water withdrawals to about 2.3 mgd.

Water use for livestock totaled 0.6 mgd in 1975. This may increase to approximately 0.7 mgd by the year 2000. Although wells furnish residential water supplies, farm ponds are often used for livestock watering.

The total withdrawal of rural self-supplied water may increase to approximately 3.0 mgd by the year 2000 as presented below.

Table 153

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

<i>Rural Self-Supplied Water</i>	1977	1980	1990	2000
Withdrawal	2.7	2.7	2.9	3.0
Consumption	2.7	2.7	2.9	3.0

Irrigation Water Soil associations with irrigation potential are located primarily in the valley adjacent to the West Fork of the White River in Owen County. Based upon the survey of irrigated lands, approximately 130 acres of cropland were irrigated in the region. Assuming 1977 as a normal growing year, this agricultural land would have required about 0.3 mgd during the peak irrigation period of July–August.

It is estimated that about 1,000 acres in the region could be profitably irrigated. An estimated 300 acres of

croplands may be irrigated by the year 2000. All of the additional acreage is expected to occur in Owen County. This expansion of irrigation acreage for agricultural land is expected to increase the peak July–August irrigation demand in an “average” year to about 0.8 mgd. The average year increase in ground-water withdrawal is expected to increase to 0.3 mgd by the year 2000.

In addition to the irrigation for agricultural use, fairways and greens on the region’s golf courses are irrigated. About 0.5 mgd, is applied to these areas during the peak July–August irrigation period. During average year conditions the amount of water used by golf courses exceeds that used to irrigate crops. This is projected to continue until 1990 when the irrigation demand for golf courses will be approximately 0.7 mgd.

The total withdrawal for irrigation of croplands and golf courses during the “average” irrigation season of 1977 was approximately 0.9 mgd. These withdrawals may increase to 1.5 mgd during the “average” growing season by the year 2000, as presented in the following table.

Table 154

The 1977 and projected withdrawals of irrigation water for croplands and golf courses, in million-gallons-per-day.

<i>Irrigation</i>	<i>1977</i>	<i>1980</i>	<i>1990</i>	<i>2000</i>
Withdrawal	0.9	1.0	1.2	1.5
Consumption	0.9	1.0	1.2	1.5

Electric Energy Region Ten contains no electrical generating plants of any type. There are, however, fossil-fueled plants just outside the boundaries of the region at Centerton and Edwardsport.

EXCESS WATER

Flooding

Approximately 28,000 acres of the region are subject to flooding. The major flood plains are shown in Figure 188. The most extensive flood plains are found along the West Fork of the White River. Virtually all of the streams are subject to flooding, and some may be subject to flash flooding. Figure 189 delineates the average annual flood damages along selected streams within the region.

Flood Control The two flood control projects are Lake Monroe and Cagles Mill Lake. Both projects are designed and operated to provide flood control to downstream reaches of the East and West Forks of the White River, the Wabash and the Ohio Rivers. Lake Monroe also provides flood control benefits to Salt Creek in southern Monroe County.

Flood control is afforded by thirty-three of the thirty-six dams in the region. There are no small watershed projects.

Flood Plain Management Participants in the emergency phase of the National Flood Insurance Program include Ellettsville in Monroe County and Spencer in Owen County. Bloomington is participating in the regular phase of the National Flood Insurance Program.

Agricultural Drainage

Approximately four percent of the soil associations have “severe” wetness characteristics, five percent have “moderate” wetness characteristics, while ninety-one percent have “slight” wetness characteristics. The general location of the soil associations with these wetness characteristics are shown in Figure 190.

Because of the well-developed natural drainage in the region, neither Monroe nor Owen Counties have a system of legal drains.

Soil Erosion

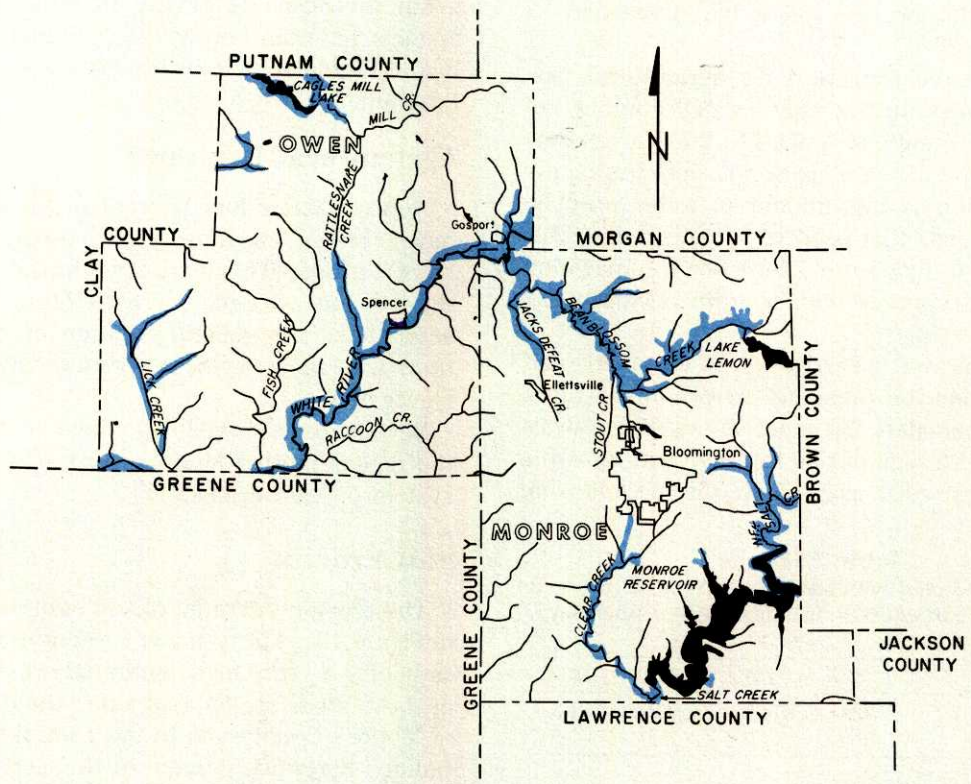
The erosion potential of soil associations are shown in Figure 191. Thirty-seven percent of the land is rated as having a “very high” potential erosion hazard. Most of these areas are located along the eastern boundary of Monroe County and in the central portion of Owen County. Forty-five percent of the land is rated as having a “high” potential erosion hazard. These areas are located centrally within the region and along the western border of Owen County. The remaining eighteen percent is rated as having a “low” potential erosion hazard for land left in a fallow state.

WATER QUALITY

The surface streams routinely surveyed for water quality by the Indiana State Board of Health are the West Fork of the White River and Clear and Salt Creeks. Water quality standards for the region are established by the Stream Pollution Control Board regulation SPC IR-4, the Water Quality Standards for the State of Indiana.

Water samples of the White River indicated that the dissolved oxygen, temperature, and nitrate levels were within acceptable limits. Although the White River is designated for partial body contact recreation, the level of fecal coliform bacteria was too high to permit this use on a year-round basis.

An investigation of Clear Creek south of Bloomington and of Salt Creek below its confluence with Clear Creek indicated high levels of PCB’s in fish, water, and sediments.



MAJOR FLOOD PLAINS

- Urban
- Rural

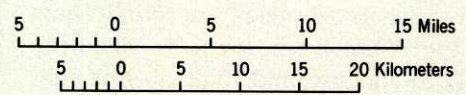
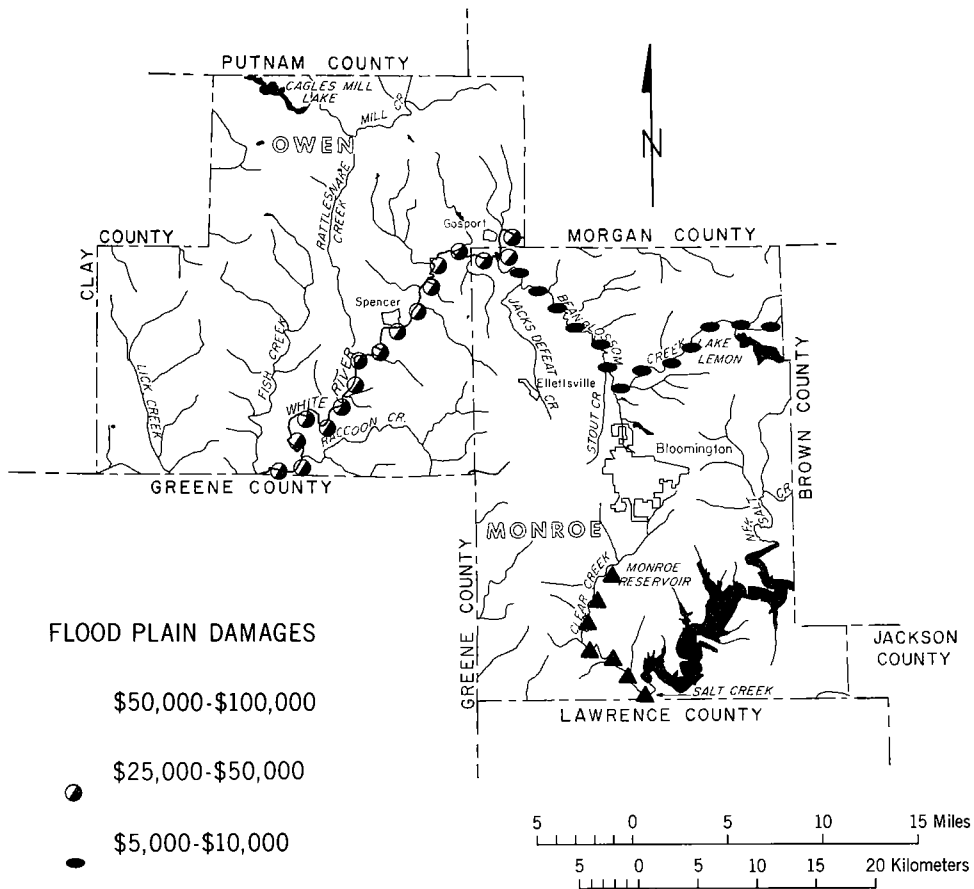
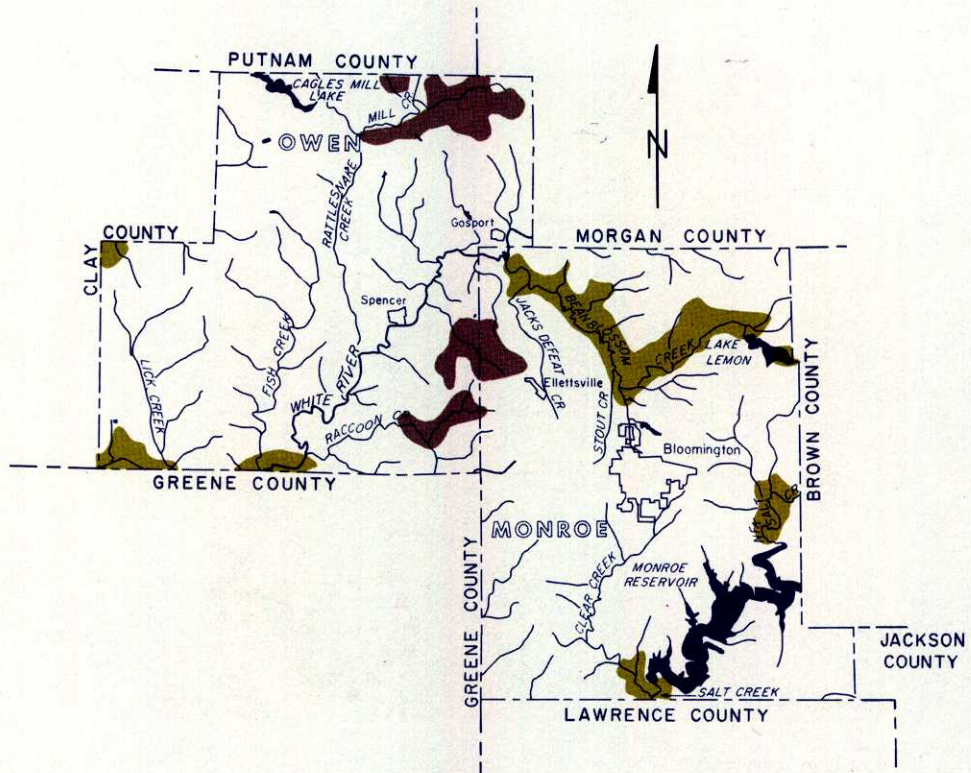


Figure 188
Map of Region Ten showing the major flood plains.





SOIL WETNESS CHARACTERISTICS

- Slight
- Moderate
- Severe

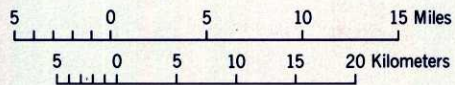
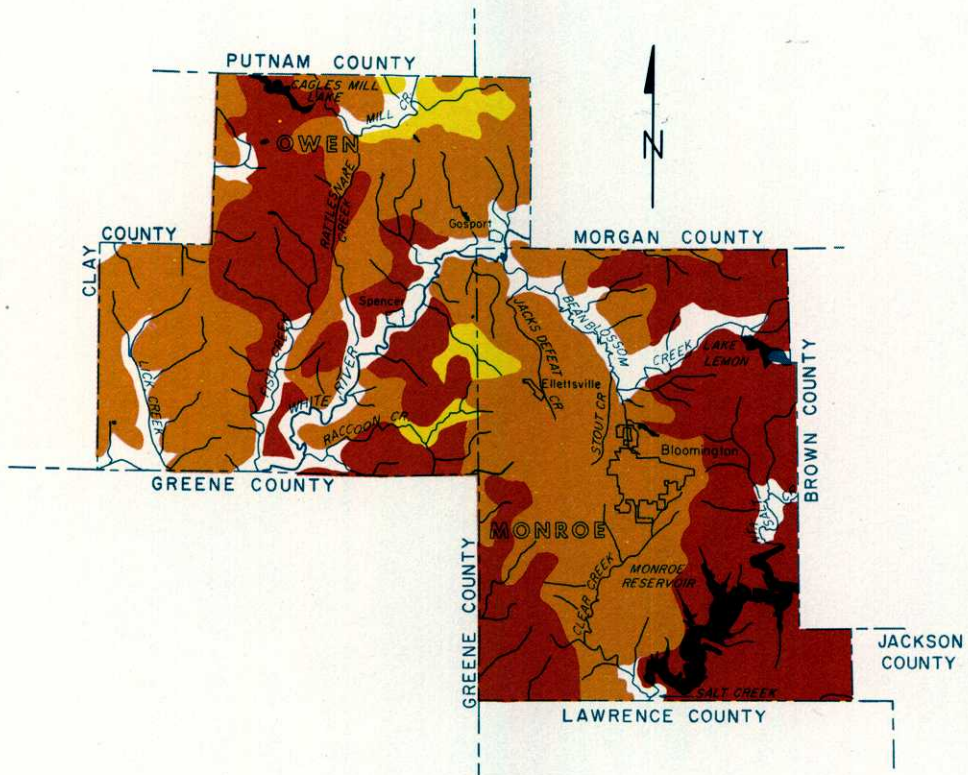


Figure 190
 Map of Region Ten showing the location of the wetness characteristics of soil associations.



SOIL EROSION POTENTIAL

- Low
- Medium
- High
- Very high

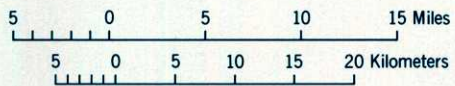


Figure 191
Map of Region Ten showing the erosion potential of the soil associations.