Region Nine

Fayette, Franklin, Rush, Union, and Wayne Counties, located in eastern central Indiana, form Region Nine. The region contains approximately 1,595 square miles and is bounded by Henry and Randolph Counties to the north; the State of Ohio to the east; Dearborn and Ripley Counties to the south; and Decatur, Shelby and Hancock Counties to the west; as shown in Figure 170.

The 1975 population of Region Nine was 149,971, of which forty-five percent resided in Richmond, Connersville, and Rushville. The official Indiana Population Projections indicate the region's population may increase to 170,000 by the year 2000. The population and projections for each county are tabulated below.

Table 136
Existing 1975 and projected populations for Region Nine.

County	*1975*	*1980*	*1990*	*2000*
Fayette	27,604	29,100	32,000	34,600
Franklin	17,679	18,300	19,800	21,400
Rush	20,596	21,800	27,300	24,900
Union	6,741	6,800	7,100	7,400
Wayne	77,351	80,100	82,100	82,400
Total	149,971	156,100	168,300	170,700

Approximately thirty-three percent of the region's population is employed within Region Nine. The electrical machinery, nonelectrical machinery, and fabricated metal industries employ nearly thirty percent of the work force.

Agriculture is the dominant land use with more than eighty percent devoted to that purpose. Approximately fourteen percent of the land is forested while the

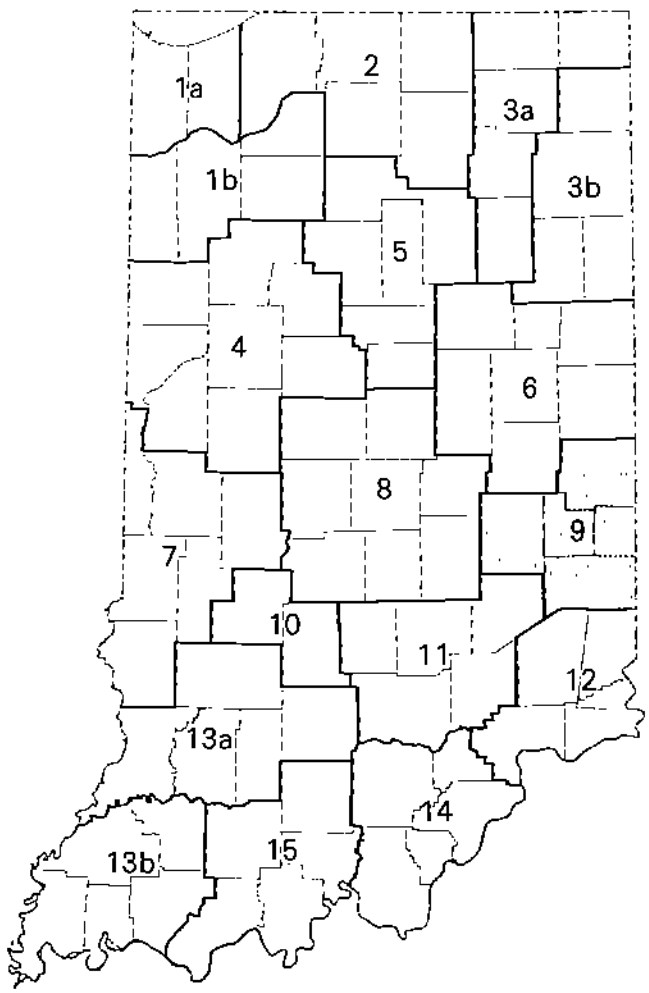


Figure 170
Map of Indiana showing the location of Region Nine.

remaining six percent represents urban and miscellaneous uses.

Average annual precipitation for the region is approximately 40.0 inches. This varies from a high of 4.3 inches in May to a low of 2.5 inches in February. Of the 40.0 inches falling annually, approximately 13.5 inches appear as streamflow while 26.5 inches are consumed through evapotranspiration. The region experiences moderate temperatures with monthly averages ranging from 28°F. in January to 74°F. in July. The average annual temperature is 52°F. The annual prevailing winds appear to be from the southwest at 8.4 miles per hour.

THE WATER RESOURCE

Ground Water

The Wisconsinan glacial advance extended as far south as the Whitewater River in Franklin County. The area southwest of the Whitewater River was unglaciated during the Wisconsinan period. The thickness of glacial deposits ranges from less than ten feet in parts of Franklin, Union, and southeastern Wayne Counties to cover 350 feet in a buried preglacial valley in western Wayne County. The types of deposits include glacial till, valley train outwash sand and gravel, ice contact sand and gravel, and alluvium. The most important glacial deposits in evaluating ground-water occurrence are the outwash sand and gravels deposited by glacial meltwaters in numerous stream courses. The entire Whitewater River valley and its major tributaries contain thick and permeable deposits of sand and gravel which constitute the major groundwater source in the region. Elsewhere, sand and gravel units occur as scattered deposits contained within the glacial till.

Underlying the unconsolidated materials are bedrock formations ranging in age from upper Ordovician through middle Devonian. The Ordovician rocks consist of shales and interbedded limestones. These rocks are essentially impermeable, and well yields are nearly always poor, with "dry holes" common in southern Franklin County. Elsewhere limestone and dolomite rocks constitute the Silurian and Devonian aquifers. The carbonate rocks generally yield moderate amounts of water depending on the nature of the overlying glacial drift.

The availability of ground water is associated with the nature and type of aquifer materials present in a given area. There is a pronounced variability in ground-water occurrence in Region Nine, as shown in Figure 171.

Well yields within the region are quite variable, and in some parts of the area, dry holes can be found within a mile of wells producing 1,000 gallons-per-minute (gpm). In upland areas of Franklin, Fayette, and Union Counties, wells can be expected to yield between 10 and 50 gpm with yields of less than 10 gpm common. However, in these same counties, properly constructed wells in the East Fork, West Fork, and the main stem of the Whitewater River valleys produce 400 to 1,000 gpm. In Rush County, well yields are, in general, best in the northern one-half of the county where 100 to 400 gpm can be developed. In the southern portion of the county, yields range from 10 to 100 gpm. Wayne County contains the best ground-water resources in the region due to the nature of the Wisconsinan glacial deposits. The only limited groundwater areas of Wayne County are the southeastern and extreme southwestern sections. From 400 to 1,000 gpm is available in sand and gravel deposits in the valleys of the East Fork, West Fork, and main stem of the Whitewater River, Martindale Creek, Greens Fork, and Nolands Fork.

The quality of ground water in the region is generally good with hardness levels of 300 to 400 parts-per-million (ppm) and iron contents of 0.1 to 3.0 ppm. Iron removal is often required to alleviate staining problems. Water from deep wells drilled into the Ordovician shales and limestones can be of poor quality with high levels of chlorides and mineralized water often reported.

Surface Water

Streamflow The streams in Fayette, Franklin, Union, and Wayne Counties flow predominantly in a north to south direction through the Whitewater River system, most of whose headwaters are contained within the region. The Flatrock and Big Blue River systems flow to the southwest, draining most of Rush County and part of Fayette County.

The seven day, once in ten year (Q7-10); one day, once in thiry year (Q1-30); and the average annual flow for streams with gaging stations within Region Nine are shown in Table 137.

Analysis of the low-flow characteristics of surface streams within the region indicates that the largest and most reliable streamflows are those in the West Fork of the Whitewater River. Brookville Lake has a required low flow release of approximately 25.8 million-gallons-per-day (mgd) for low-flow augmentation of the Whitewater River.

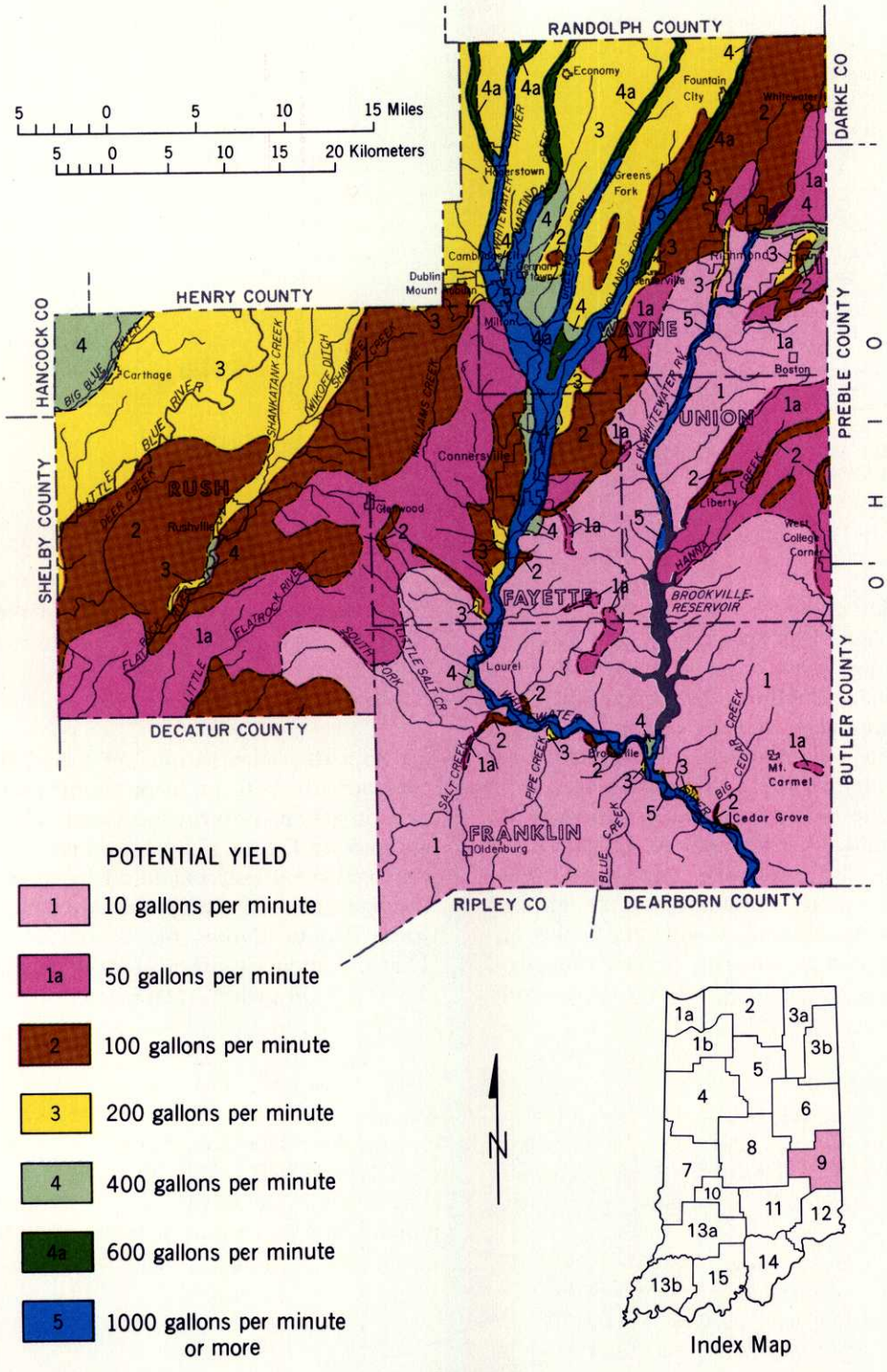


Figure 171

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

Table 137
Flow characteristics of streams.

Stream	Drainage Area (square miles)	Million-Gallons-Per-Day		
		Average Annual	Q7-10	Q1-30
Big Blue River at Carthage	184	130	17.0	13.0
West Fork Whitewater River near Alpine	529	350	32.0	22.0
East Fork Whitewater River at Abington	200	150	15.0	12.0
Martindale Creek near Cambridge City*	58	na	0.8	na
East Fork Whitewater River at Richmond*	121	75	2.2	na
Salt Creek near Metamora*	115	na	0.2	na

*Flow characteristics estimated from a stream gaging station with a short period of record.
na: not available.

The flow duration curve for the West Fork of Whitewater River near Alpine, as shown by Figure 172, indicates the stream will have a dependable flow of 50 mgd ninety percent of the time. The slope of the curve also indicates that the West Fork of the Whitewater River 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 gaging station, representing "dry," "average," and "wet," years, respectively. The results indicate that the ground-water contribution to streamflow amounts to seventy-four, thirty-seven, and twenty-two percent for "dry," "average," and "wet" years, respectively. Conversely, from twenty-six to seventy-eight percent of the flow, depending on the year, is due to direct surface runoff from runoff-producing precipitation events or from snowmelt.

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 138, and are located on Figure 173. These lakes have a combined surface area of approximately 5,740 acres and a gross storage capacity of approximately 63,400 million gallons. Two reservoirs, the Brookville and Whitewater Lakes, contain storages of 29,100 million gallons and 1,190 million gallons, respectively.

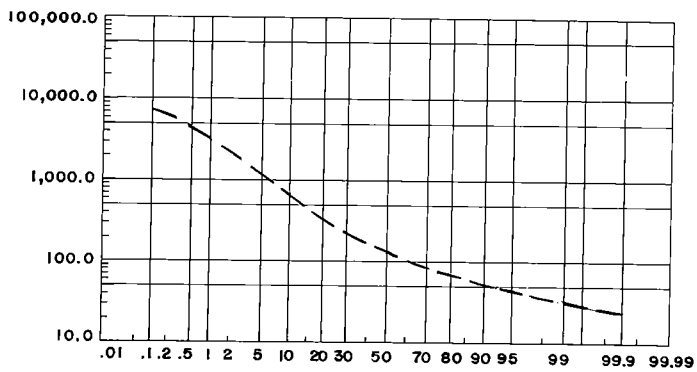


Figure 172
The flow duration curve for the Whitewater River near Alpine.

Table 138
Lakes at least 50 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	Middle Fork Reservoir	na	195.1	2,017
2	Big Blue River Structure No. 2	5.03	25.3	50
3	Big Blue River Structure No. 3	11.40	44.0	115
4	Manlove Lake	na	16.4	65
5	Whitewater Lake	19.20	199.0	1,189
6	Brookville Lake	379.00	5,260.0	59,959

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 Nine is presented in Table 139. 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 current demand for boating and waterskiing is being met by Brookville Lake. A surplus of water available for boating and waterskiing is expected to exceed the demand through the year 2000.

Canoeing Canoeing is available primarily on the West Fork of the White River. A total of 79 miles of canoeing is available in the region, which meets the current and projected demand by the year 2000.

Table 139
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	5,900 acres	100+	100+	100+
Waterskiing	8	34.4 skiers/acre/year	2,500 acres	100+	100+	100+
Canoeing	11	585 canoes/mile/year	79 miles	100+	100+	100+
Swimming	35	76,600 swimmers/acre/year	6 acres	60	60	60
Ice-Skating	3	6,678 skaters/acre/year	1 acres	20	20	20
Fishing	41	66 persons/acre/year	6,700 acres	53	50	50

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.

Swimming and Ice-Skating The demand for swimming and ice-skating opportunities exceeds the available supply. This shortage of supply is expected to continue through the year 2000.

Fishing The quality of the fisheries habitat is indicated on Figure 174. The Flatrock River, East and West Forks of the Whitewater River, Greens Fork, and Nolands Fork are the major waterways and have good to excellent aquatic habitat. Various stretches of smaller streams have been more adversely affected by agricultural practices and have lower quality aquatic habitat. Most streams in the region have warmwater fisheries typical to Indiana, with sunfish, bass, catfish, and various rough and forage fish. The East Fork of the Whitewater River, downstream of Brookville Lake, is also stocked with trout. This stream has spawning runs of white bass and walleye above the reservoir.

Brookville Lake, the largest man-made lake in the region, has excellent aquatic habitat. It is noted for its populations of white and striped bass, sunfish, walleye, channel catfish, and bullheads. Good aquatic habitat is

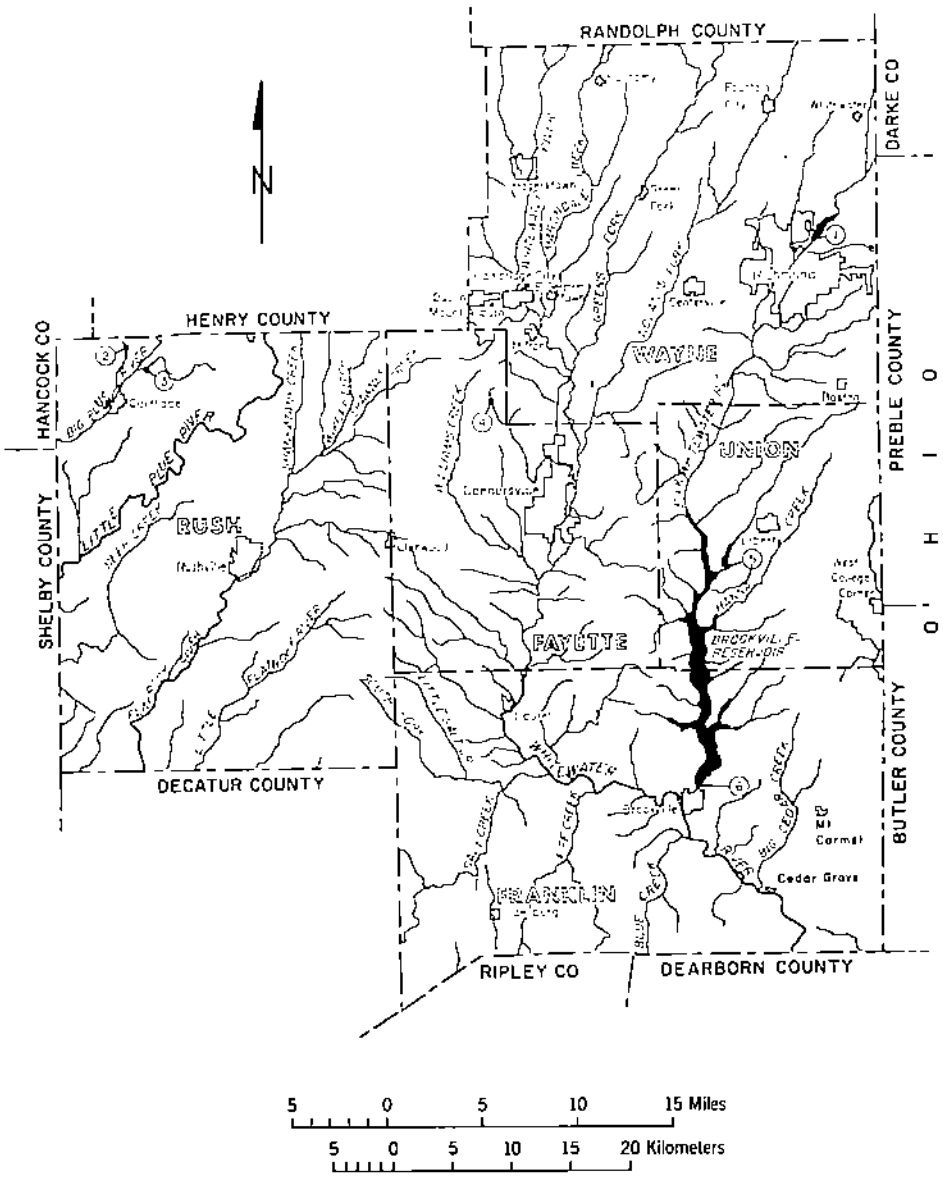
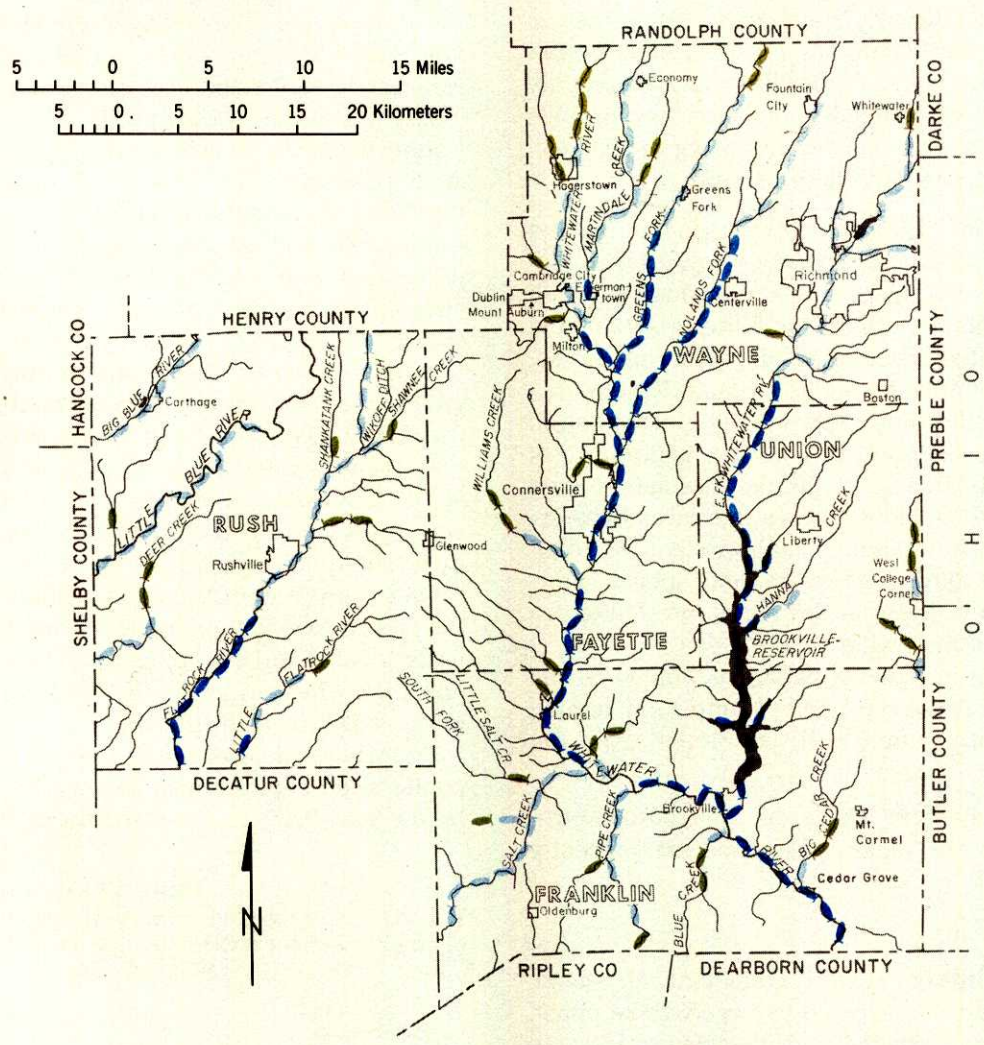


Figure 173
Map of Region Nine showing the location of lakes that are at least 50.0 acres in size or have a storage capacity of 32.5 million gallons or more.



AQUATIC HABITAT VALUE

- High
- Moderate
- Low
- Negligible

Figure 174
Map of Region Nine showing the quality of the fisheries habitat.

also found in Manlove Park Lake in Fayette County and in Whitewater Lake in Union County. Middle Fork Lake and the Martindale State Fishing Area are not so highly rated for their fisheries.

Fishing access through state-owned properties is available at the Martindale State Fishing Area, Brookville Lake, and Whitewater State Park. City and county parks, bridges, and roadside pullovers may provide additional access. The demand for fishing in 1980 will exceed the supply by fifty-three percent.

Riparian Habitat The quality of the riparian habitat associated with lakes and streams is indicated on Figure 175. Highly rated riparian habitat is found along all the larger streams in Region Nine. Hardwoods line the streambanks that are used by upland game, furbearers, and birds commonly found in Indiana. Recent discoveries of colonies of the endangered Indiana bat, in Rush and Wayne Counties, indicate the importance of the riparian habitat. Except for the Martindale State Fishing Area and Middle Fork Lake, the lakes have excellent riparian habitat for migratory and resident waterfowl, other birds, furbearers, and upland game. Significant wetland areas in the region are limited to the upper end of Brookville Lake.

Public hunting in riparian habitat is limited to the public lands of Brookville Lake. Hunting on private property is available only with permission from the landowners.

Hydroelectric Power There are no hydroelectric power plants in the region, and none are presently envisioned.

Withdrawal Uses

Public Water Supply Fayette, Franklin, Rush, Union, and Wayne Counties are served by twenty-three public water utilities. An estimated 91,000 residents of Region Nine were served by a public utility in 1975. Three of these systems — Everton Water Corporation, Franklin County Rural Water Corporation, and the North Dearborn Water Corporation — primarily serve rural areas. Information on public water utilities is presented in Table 140. Service areas for the public water utilities are shown in Figure 176.

Table 140
The public water supply systems as of 1975.

Counties	*Number of Systems*	*Service Population*	*Average Daily Withdrawals in Million-Gallons-Per-Day*
Fayette	5	19,460	4.82
Franklin	5	7,383	.89
Rush	4	8,476	1.07
Union	2	2,531	.22
Wayne	7	53,333	10.31
Total	23	91,183	17.31

The largest single water utility in this region is the American Water Works in Richmond. This utility serves more than 44,000 persons. In 1977, it withdrew an average of 8.7 mgd. Sixty percent of Richmond's water withdrawals are obtained from the Middle Fork Reservoir, and the remainder is withdrawn from groundwater sources located in sand and gravel aquifers.

The Batesville – Oldenburg system in Franklin County withdrew an estimated 0.1 mgd from a series of small reservoirs. The system also provides 0.1 mgd to the town of Oldenburg. In 1975, these twenty-three utilities pumped an average of 17.3 mgd. About thirty percent of this total is supplied from surface water sources while seventy percent is derived from ground water.

Ground water is the exclusive source for the region's public water systems, with the exception of Richmond, Batesville, and Oldenburg. For the most part, the well fields are in or adjacent to the area they serve. However, sometimes it is necessary to place well fields outside the area served in order to withdraw adequate quantities of water. The Franklin County Rural Water Corporation, which serves much of the eastern one-half of Franklin County, is supplied by wells located on the Fairfield Causeway over Brookville Lake. These wells tap the sand and gravel aquifers in the valley beneath the lake.

Projections of withdrawals indicate that the region's public water supplies may increase to about 22.4 mgd by the year 2000, as indicated below.

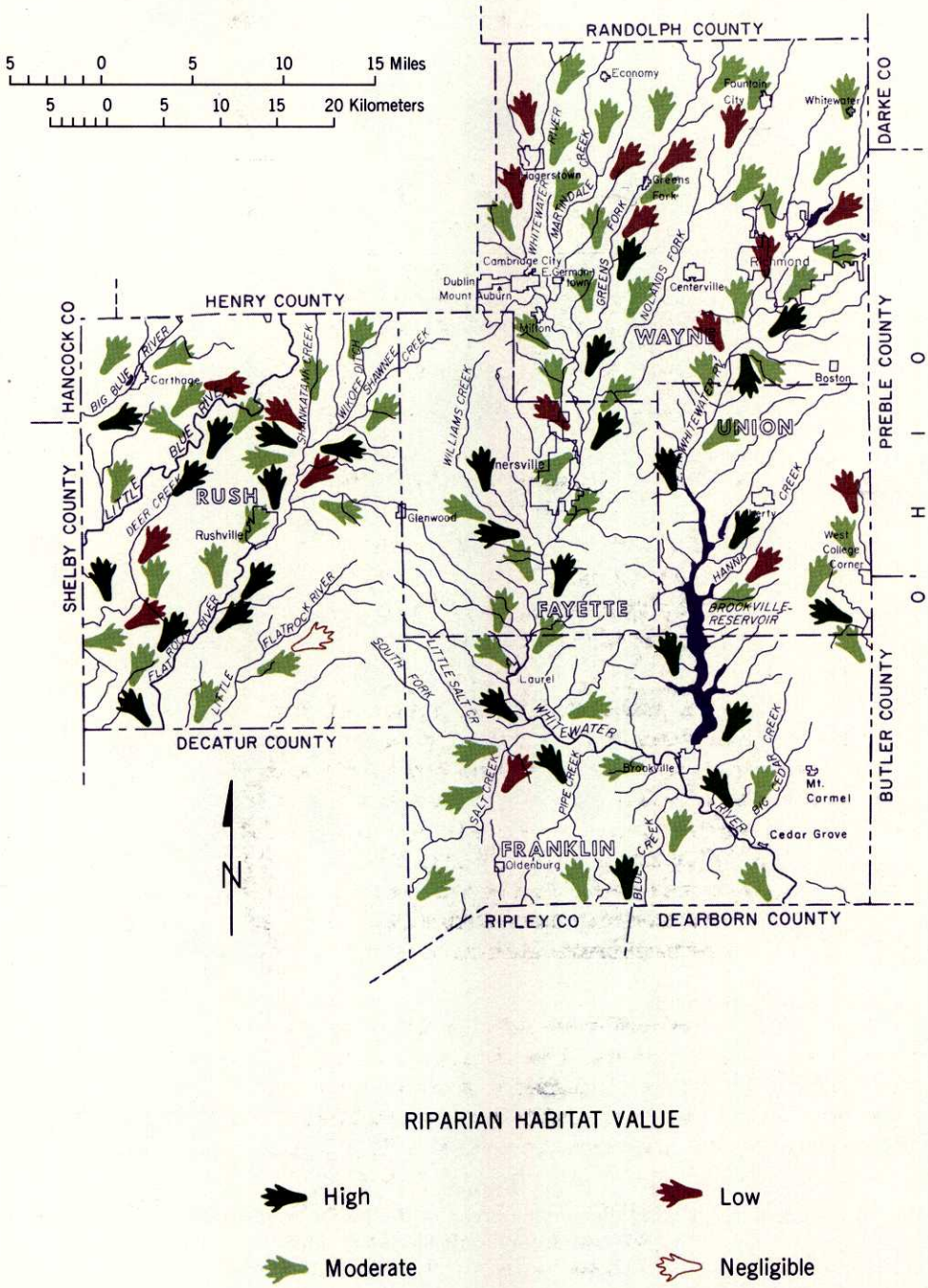
Table 141
The 1977 and projected withdrawal and consumption rates of public water supplies by the year 2000, in million-gallons-per-day.

Public Water	*1977*	*1980*	*1990*	*2000*
Withdrawal	17.3	18.1	20.8	22.4
Consumption	1.9	2.0	2.3	2.5

Industrial Water Industrial establishments had a water intake averaging 17.9 mgd in 1977. Of the total industrial intake, 8.1 mgd was withdrawn by the industries themselves while 9.8 mgd was purchased from the region's public utilities. About 1.2 mgd was consumed during the manufacturing process. The majority of self-supplied water is derived from ground-water sources located on plant property.

The largest water-using industry group is comprised of small industries which as a whole use approximately 8.6 mgd. Machinery industries account for 3.8 mgd and metal fabricators use 1.5 mgd.

Although industrial output is expected to increase, the total water intake is expected to decrease initially due to plant efficiency and then rise slowly as output



RIPARIAN HABITAT VALUE

High

Low

Moderate

Negligible

Figure 175
Map of Region Nine showing the quality of the riparian habitat.

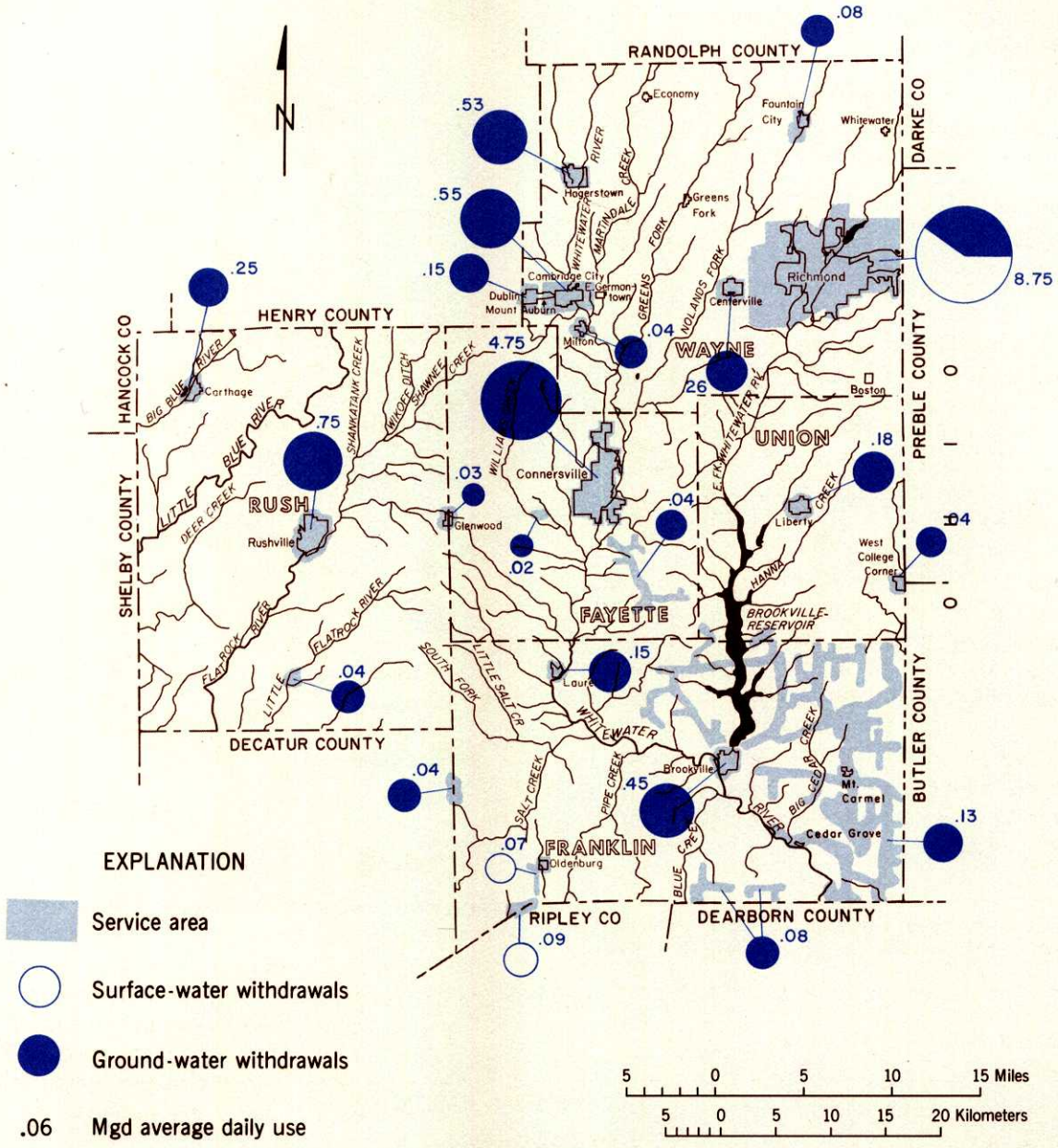


Figure 176

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

increases. Industrial water use is expected to increase to 17.9 mgd by the year 2000. The self-supplied component may increase to approximately 8.5 mgd. Data for industrial self-supplied withdrawals are presented in the following table.

Table 142
The 1977 and projected water withdrawal and consumption rates for industries, in million-gallons-per-day.

Industrial Self-Supplied	*1977*	*1980*	*1990*	*2000*
Withdrawal	8.1	8.0	8.2	8.5
Consumption	0.5	0.6	0.8	1.0

Rural Self-Supplied Water An estimated 58,000 persons lived in homes supplied by individual wells in 1975. It is estimated that these people used about 3.4 mgd for residential purposes in that year. As additional numbers become dependent on their own wells for water, and as the standards of living rise, rural residential water use is expected to increase to 4.9 mgd by the year 2000.

In 1975 there were an estimated 497,000 head of livestock and about 108,000 chickens. Collectively, these animals used just about 2.8 mgd. By the year 2000, increases in the animal population should raise water usage to 3.8 mgd. Most rural livestock needs are met by wells located on the farm property, although cisterns and ponds are used in some areas.

The total withdrawal of rural self-supplied water may increase from the current 6.4 mgd to 8.7 by the year 2000, as shown below.

Table 143
The 1977 and projected withdrawals and consumption rates for rural self-supplied water, in million-gallons-per-day.

Rural Self-Supplied	*1977*	*1980*	*1990*	*2000*
Withdrawal	6.4	6.7	7.8	8.7
Consumption	6.4	6.7	7.8	8.7

Irrigation Water Soil associations with irrigation potential are located mainly in the major stream valleys. Figure 177 shows the potential irrigation areas within the region.

It is estimated that 3,300 acres may be irrigated by the year 2000. The increase of irrigation acreage is expected to increase the peak July–August irrigation demand in an "average" year to about 8.7 mgd by the year 2000. The average year increase in ground-water withdrawals is expected to increase to 5.1 mgd. Irrigation of golf courses currently requires the withdrawal of approximately 0.7 mgd.

The total withdrawal for irrigation of croplands and golf courses during the "average" irrigation season of 1977 was approximately 0.7 mgd. These withdrawals may increase to 9.4 mgd during the average growing season by the year 2000, as shown in the following table.

Table 144
The 1977 and projected withdrawals of irrigation water for croplands and golf courses, in million-gallons-per-day.

Irrigation	*1977*	*1980*	*1990*	*2000*
Withdrawal	0.7	1.8	5.6	9.4
Consumption	0.7	1.8	5.6	9.4

Electric Energy Region Nine contains one electrical generating facility, operated by the city of Richmond. This plant withdraws 3.3 mgd, of which 2.6 mgd is consumed through the cooling process. Expansion of this facility is planned and may result in a net increase in water withdrawals by the year 2000 as shown below.

Table 145
The 1977 and projected water withdrawal and consumption rates for the production of energy, in million-gallons-per-day.

Energy	*1977*	*1980*	*1990*	*2000*
Withdrawal	3.3	3.3	5.3	3.8
Consumption	2.6	2.6	3.2	2.0

EXCESS WATER

Flooding

Approximately 41,100 acres of the region are subject to flooding. The major flood plains are shown in Figure 178. Figure 179 delineates the average annual flood damages along selected streams within the region. These damages were estimated in 1977 to be $1,644,800, of which some eighty percent occurred in rural areas. Most flooding in the region is caused by excessive rainfall occurring between the months of December and May.

Flood Control Brookville Lake, the only major flood control project in the region, was completed in 1974 by the U.S. Army Corps of Engineers in cooperation with the State of Indiana. It is located in Franklin and Union Counties and controls runoff from a drainage area of 379 square miles. Brookville Lake is designed to provide flood control, water supply, and recreational facilities.

The East Fork of the Whitewater River Project, authorized for construction under the U.S. Soil Conservation Service, is the only small watershed project within the region. The project will consist of the

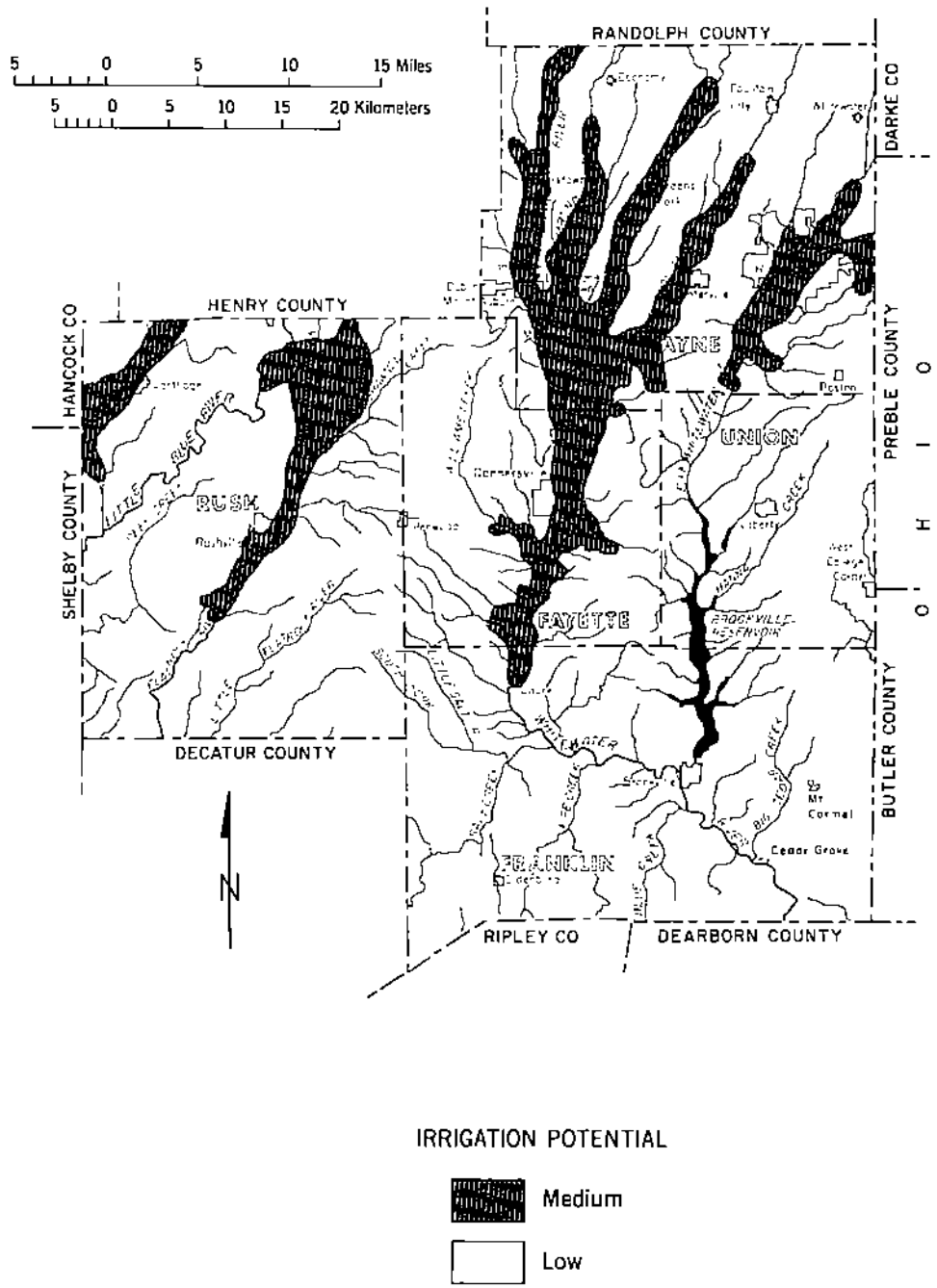
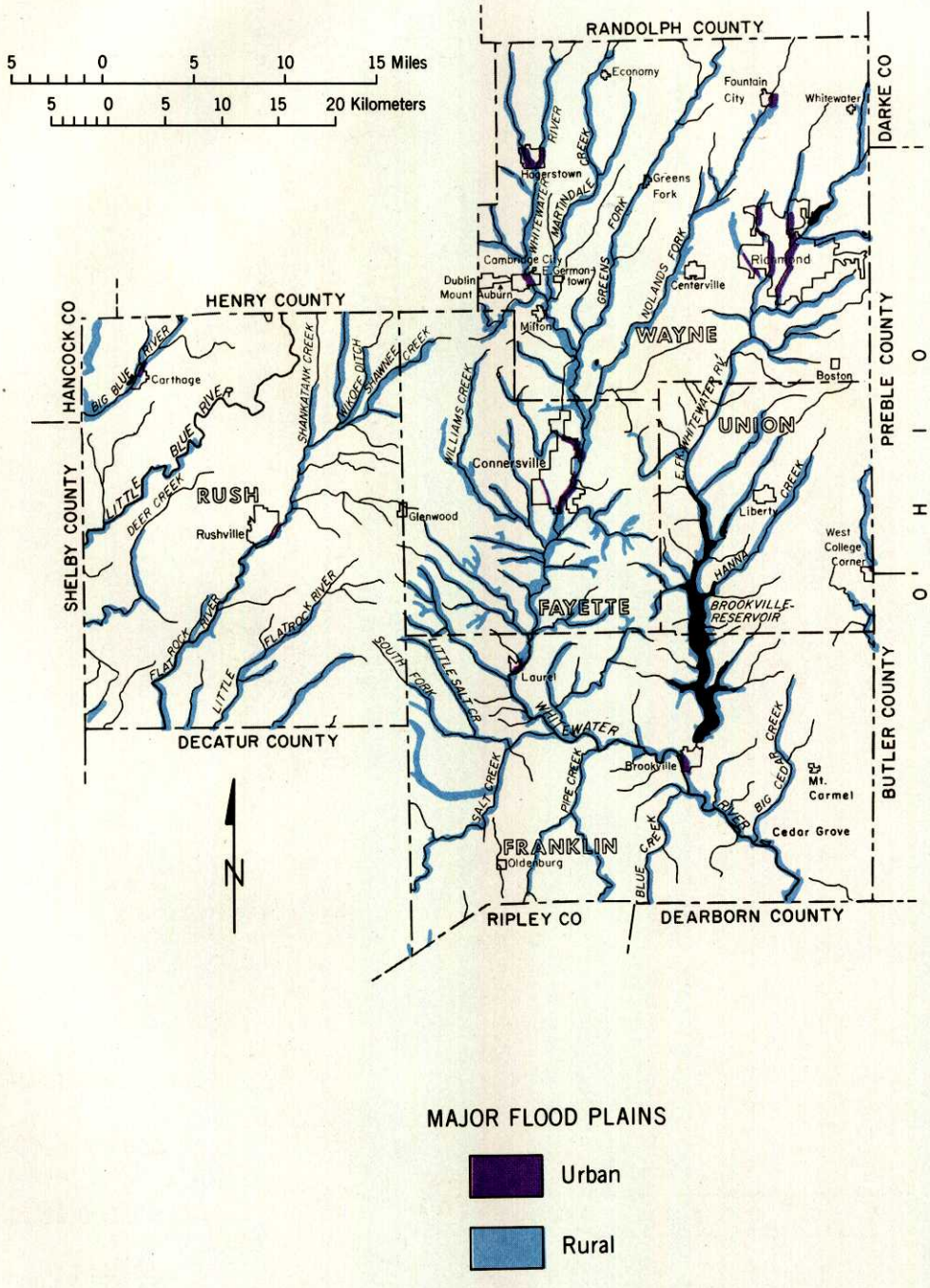


Figure 177
Map of Region Nine showing the location of the soil associations that appear to possess an economic potential for the irrigation of croplands.



MAJOR FLOOD PLAINS

Urban

Rural

Figure 178
Map of Region Nine showing the major flood plains.

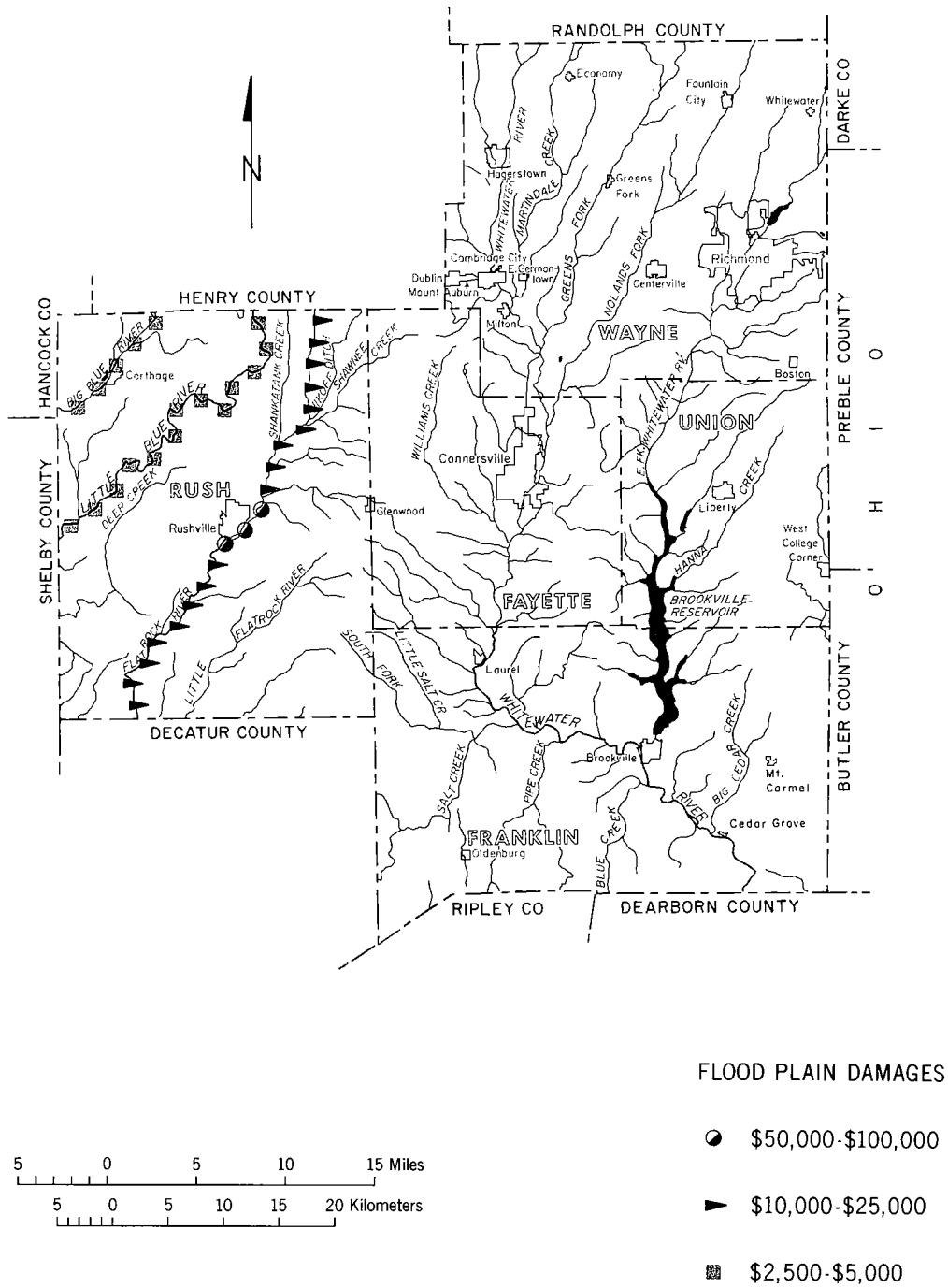


Figure 179
Map of Region Nine showing the estimated average annual flood damages per mile along selected streams.

construction of one flood water retarding structure, three multi-purpose flood water retarding-recreation structures with public-recreation facilities, two multi-purpose flood retarding-water supply structures, one channel recreation development, and 17.6 miles of multipurpose flood prevention and drainage cannel work. The project is designed to reduce flood water damages on about 6,800 acres of land but has not been implemented because local landowners are dissatisfied with aspects of the project.

Flood Plain Management Participants in the emergency phase of the National Flood Insurance Program include unincorporated Fayette, Franklin, Rush, and Wayne Counties as well as the communities listed below.

Table 146
Communities participating in the emergency phase of the National Flood Insurance Program.

Brookville	Hagerstown
Cambridge City	Laurel
Carthage	Milton
Cedar Grove	Richmond
Connersville	Rushville
Greenfork	Spring Grove

Agricultural Drainage

Approximately twenty-five percent of the soil associations in Region Nine have "severe" wetness characteristics, twenty-six percent have "moderate" wetness characteristics, while forty-nine percent have "slight" wetness characteristics. The general location of the soil associations with these soil wetness characteristics are shown in Figure 180.

There are approximately 512 miles of legal drains in the region, which serve as the main collectors and outlets for on-farm drainage systems. The maintenance of this system of legal drains is the responsibility of the local county drainage boards or, in a limited number of cases, of conservancy districts. No legal entity is responsible for maintaining drainage on the other streams in the region.

Soil Erosion

The erosion potential of soil associations within the region are shown in Figure 181. Thirty-five percent of the region is rated as having a "high" erosion hazard potential and five percent a "very high" erosion hazard potential. These areas are located along the Whitewater River and its tributaries within the lower two-thirds of the region. Twenty-eight percent of the region is rated as having a "medium" soil erosion potential. This represents areas in the northern portion of the region in Wayne County, and along the Flatrock and Little Blue Rivers in Rush County. The remaining thirty-two percent of the land is predominantly level and ranks as having a "low" erosion potential for land left in a fallow state.

WATER QUALITY

The surface streams within the region routinely surveyed for water quality by the Indiana State Board of Health are the West and East Forks of the Whitewater, Flatrock, and Blue Rivers. Water quality standards are established by the Stream Pollution Control Board regulation SPC IR-4, the Water Quality Standards for the State of Indiana.

Samples from the West Fork of the Whitewater River did not indicate any serious violations of standards. The discharge from Cambridge City to the river caused a slight rise in the biochemical oxygen demand, suspended solids, and fecal coliform bacteria levels. These levels quickly returned to those levels found upstream of the city.

Samples of the water quality of the East Fork of the Whitewater River did not indicate any violations of standards that limit water use. All discharge permit holders surveyed were in compliance with permit limits.

Samples of the Whitewater River did not indicate any violation of standards. The fecal coliform bacteria levels in the Whitewater River were elevated in the Brookville, New Trenton, and West Harrison areas of the river, but there were no reports of these levels inhibiting water uses.

The Flatrock River receives considerable agricultural drainage and municipal and industrial effluent from the city of Rushville. However, water quality standards were generally maintained except during extreme low-flow conditions.

The Blue River also receives a large amount of agricultural runoff water. Water quality samples indicated no violation of standards that inhibited stream uses.

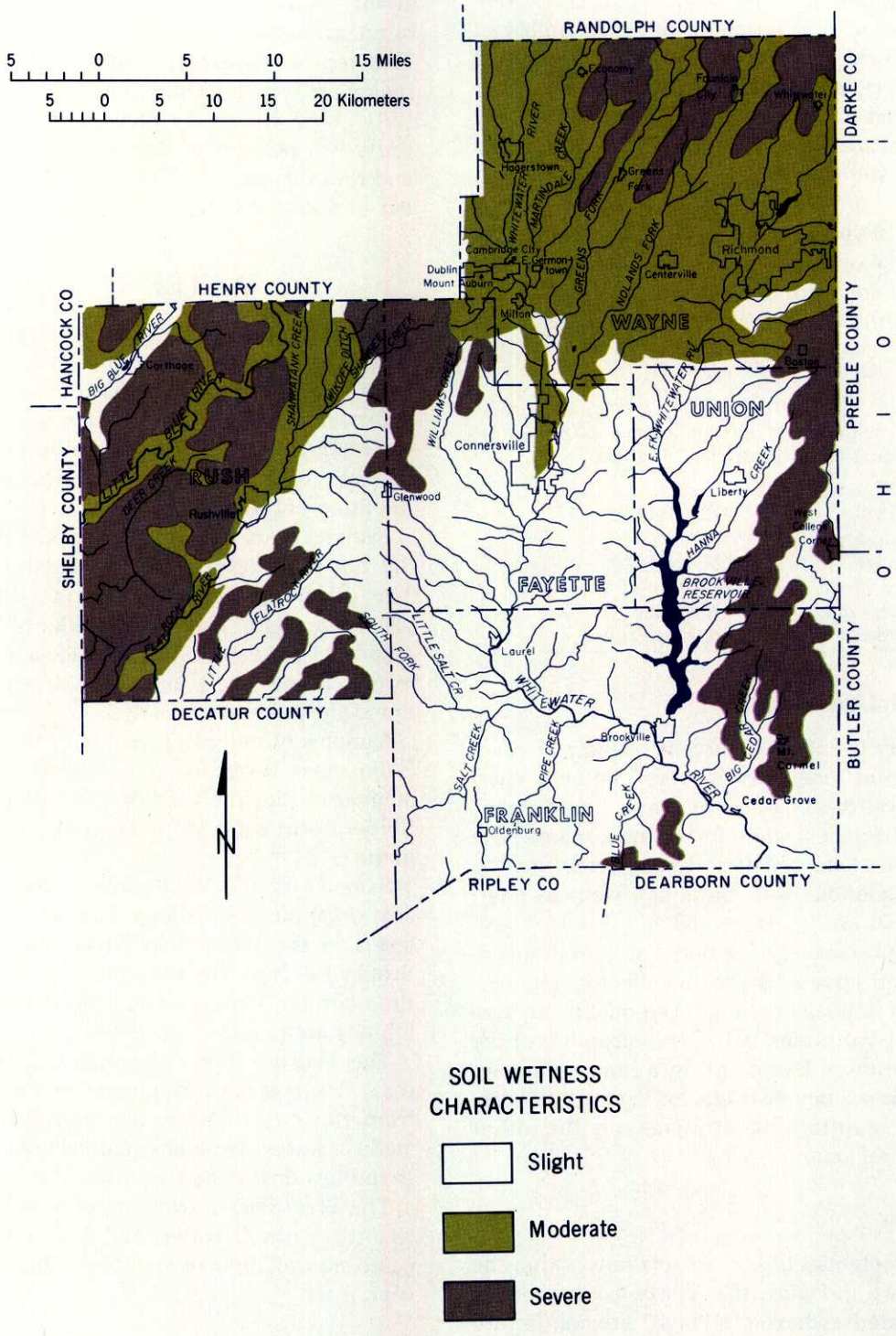
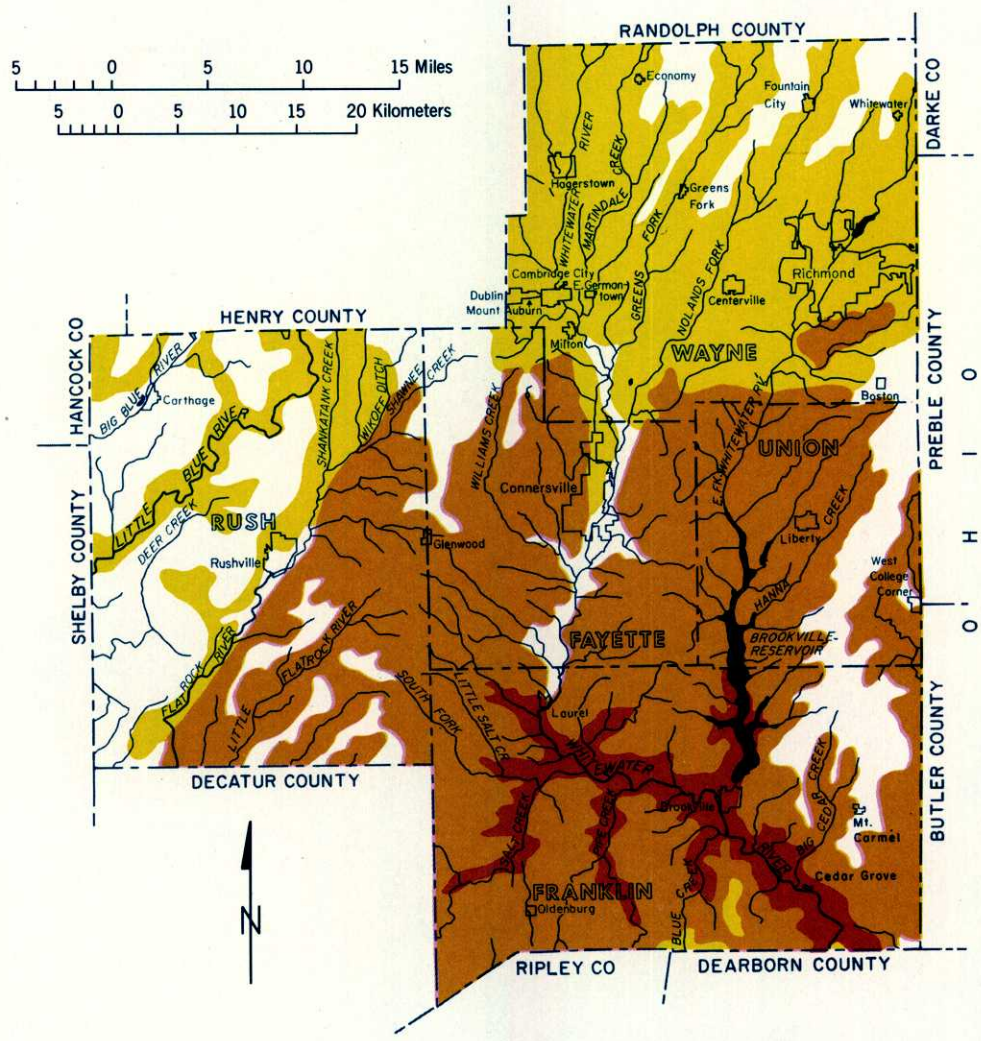


Figure 180
Map of Region Nine showing the location of the wetness characteristics of soil associations.



SOIL EROSION POTENTIAL

- Low
- Medium
- High
- Very high

Figure 181
Map of Region Nine showing the erosion potential of the soil associations.