Illinois River Cooperative River BasinBasin Resource Base Report

Prepared by

United States Department of Agriculture

Soil Conservation Service

and

Forest Service

In cooperation with

Arkansas Soil and Water Conservation Commission

and

Oklahoma Conservation Commission

March 16, 1992

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Abstract

The Illinois River Basin Resource Base Report was prepared to better define the water quality problems of the Illinois River Basin. The report describes the basic natural, physical, and human resources of the basin. It includes data on animal numbers and other factors that can adversely impact its water quality. In recent years the degradation of water quality in the basin has become more apparent.

The principal objectives of the Illinois River Basin study were to better define water quality problems, to prioritize watersheds needing project action to improve water quality, and to develop separate water quality project plans on high priority watersheds in Arkansas and Oklahoma. Local decisionmakers will use these plans to obtain assistance in implementing water quality improvement measures in the basin.

The Illinois River Basin study was requested by the Arkansas Soil and Water Conservation Commission and the Oklahoma Conservation Commission because of the concerns about the degradation of water quality and its effect on the public. The United States Department of Agriculture (USDA) is authorized to participate in the study under the provisions of Section 6 of the Watershed Protection and Flood Prevention Act, Public Law 83-566, as amended (16 U.S.C. 1001-1008). Cooperating in the study were the USDA Soil Conservation Service (SCS), USDA Forest Service (FS), Arkansas Soil and Water Conservation Commission (ASWCC), and the Oklahoma Conservation Commission (OCC).

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Illinois River Cooperative River Basin Resource Base Report

Study Area Setting

Location

The Illinois River Basin is in northwest Arkansas and northeastern Oklahoma's Green Country (fig. 1). Headwaters of the Illinois River begin in the Ozark region of Northwest Arkansas, near Fayetteville. The river meanders westerly through the Ozarks and crosses into Oklahoma 5 miles south of Siloam Springs, Arkansas, near the town of Watts, Oklahoma. At the state line, Lake Frances slows the river flow temporarily before it continues generally westward to the confluence of Flint Creek in Delaware County. The river then flows southwest toward Tahlequah (photo 1) and enters Tenkiller Reservoir about 12 miles downstream of Tahlequah. Below Tenkiller Dam the river flows another 12 miles to its confluence with the Arkansas River. The Illinois drains 1,069,530 acres of land, including 493,500 acres in Benton, Washington, and Crawford Counties, Arkansas, and 576,030 acres in Delaware, Adair, Cherokee, and Sequoyah Counties, Oklahoma.

The Illinois River Basin contains meandering streams and deep, clear lakes set in valleys surrounded by mountains that host a myriad of seasonal color changes. Dogwoods and redbuds bloom during spring, turning the mountainsides into a patchwork quilt of pink and white. Quilt squares are stitched with pastel colors from a wide variety of flowers and shrubs. Summers turn the mountains into vibrant shades of green. Autumn, however, brings the "flaming fall revue" to the forest. The blazing colors peak just in time for the many folk festivals held each fall. People from all over the United States come to

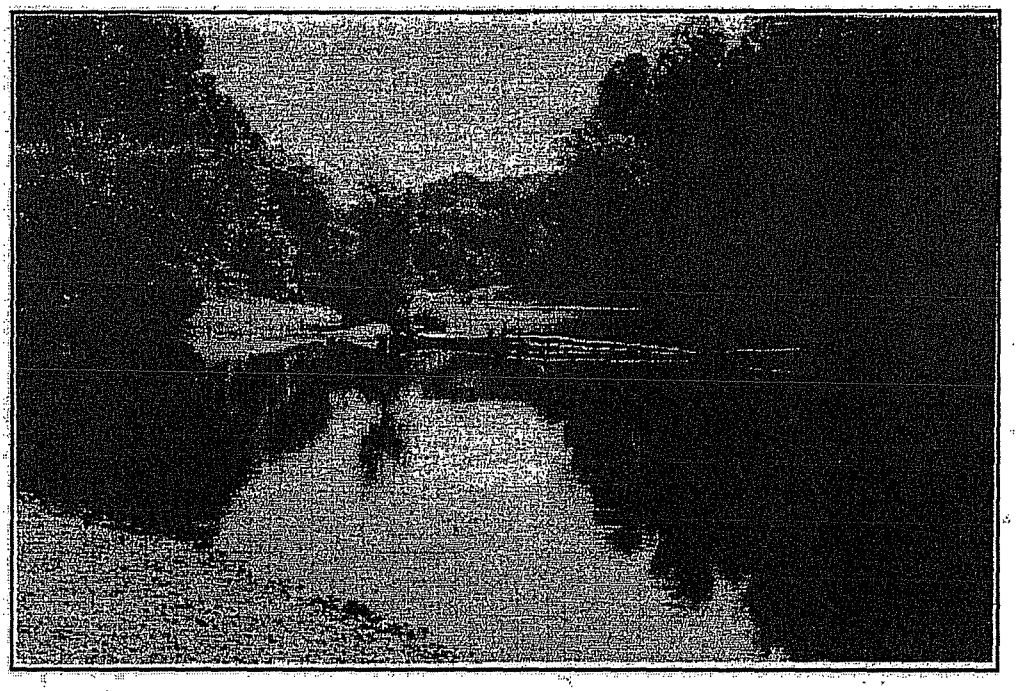


Photo 1. Illinois River at the confluence with Baron Fork.

enjoy the music and crafts of the hills. Winter is also a popular time to visit and view the mountains. On a clear winter day, residents and tourists can see for miles from high mountain vantage points. Hardwoods drop their leaves, allowing views of lakes, streams, and hills below. Frost silvers dark branches, and bright berries peek from evergreens. Hidden landforms stand out in bold relief, revealing their ancient beauty.

Climate

The river basin has a temperate, continental climate that is moist and subhumid. It is a transitional area that receives warm, moist air from the Gulf of Mexico and is regularly penetrated by cool, dry air from the north and northwest. Rapid penetration of cool air frequently results in significant variations of temperature, precipitation, cloudiness, and wind velocity. The seasonal climate characteristics vary in intensity from year to year, but changes between seasons are gradual.

The heaviest seasonal rains are in the spring and fall and are associated with frontal passage. Figure 2 depicts the mean annual precipitation in the Illinois River basin. The greatest incidence of severe loca storms and tornadoes occurs in the spring. Summer days are generally hot, but are usually relieved by cool nights, pleasant breezes, and occasional heavy local convectional showers. Autumn has long periods of mild, sunny days with sufficient rainfall for good growth of cool-season grasses and small grains. Winter is mostly moderate and sunny with cold periods that generally last only a few days. The average maximum temperature is 73 degrees Fahrenheit, and the average annual precipitation ranges from 40 to 54 inches. Rainfall is distributed fairly uniformly throughout the year (table 1). Based on a 100-year record at the Fayetteville Experiment Station, the average annual rainfall is 41.93 inches.

Table 1. *Monthly rainfall distribution (9)*

Month	Rainfall	Month	Rainfall
	Inches		*Inches*
January	1.78	July	3.56
February	2.45	August	3.47
March	3.46	September	4.09
April	4.44	October	3.21
May	5.17	November	3.23
June	4.55	December	2.52

The area is subject to heavy local rains totaling of 5 to 10 inches over extensive areas. The maximum 24-hour rainfall at the Fayetteville Experiment Station was recorded on July 25, 1960, when 9.60 inches fell. The largest monthly rainfall of record for this station was 15.07 inches in March 1898. The least was 0.04 inch in October 1963.

Mean temperature at the Fayetteville Experiment Station ranges from 35.8 degrees Fahrenheit in January to 79.1 degrees Fahrenheit in July. Mean July temperatures range from 76 to 82 degrees Fahrenheit (fig. 3). Extreme temperatures of record at the Fayetteville Experiment Station reached 111 degrees on July 14, 1954, and minus 24 degrees on February 12, 1899.

The normal frost-free period near Fayetteville is 202 days and extends from April 6 to October 26. Normal frost-free periods for the area range from 180 to 220 days (fig. 4).

Geology and physiography

The Ozark Plateaus are part of a large structural dome that centers in southeastern Missouri (fig. 5). Rock formations in the basin lie on the south flank of the dome. The beds have a regional dip to the south of about 1 degree. Minor folds of limited extent are superimposed on the regional dome, and normal faulting is fairly common.

Geologic formations range in age from Ordovician to Quaternary. The area adjacent to Tenkiller Reservoir in Sequoyah and Cherokee Counties, Oklahoma, is predominantly Pennsylvanian age. Rocks further north and northeast, however, are mostly Mississippian age. Recent alluvium occurs along the major stream channels throughout the basin.

The basin is basically divided into two physiographic areas—the Springfield Plateau and the Boston Mountains (fig. 6). The Arkansas River Valley forms the extreme southernmost tip of the basin in Sequoyah County, Oklahoma. The Springfield Plateau, which occupies the northern two-thirds of the basin, consists of gently undulating to steeply rolling topography. Much of the plateau is locally called "prairies." The prairies make up the most productive farmland in the area.

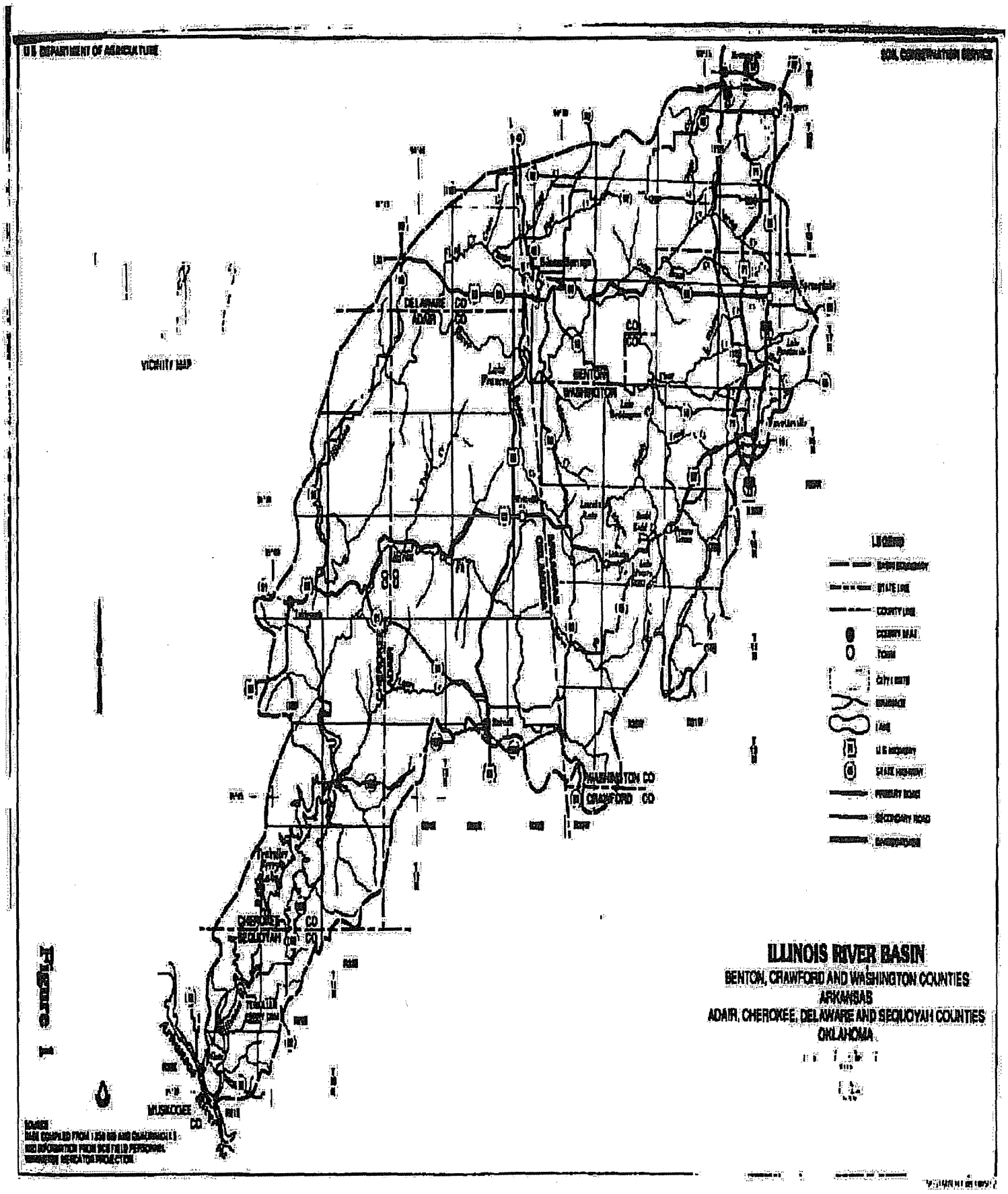
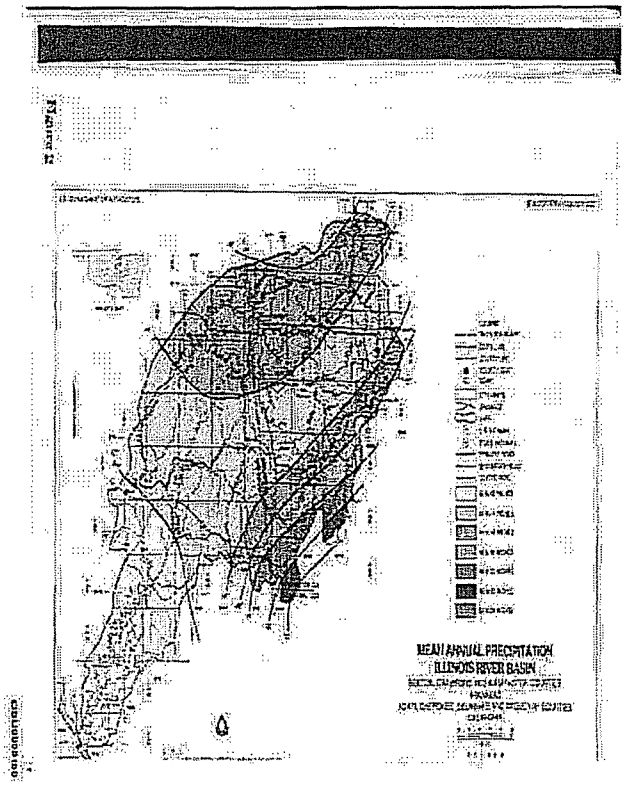
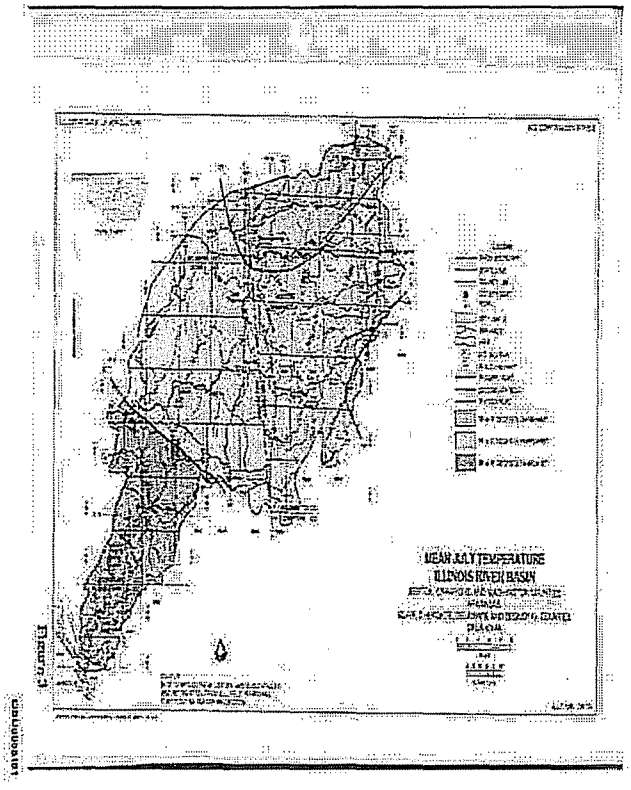

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
VICINITY MAP
DELAWARE CO
ADAIR CO
BENTON
WASHINGTON
WASHINGTON CO
CRAWFORD CO
CHEROKEE CO
SEQUOYAH CO
MUSKOGEE CO
LEGEND
ILLINOIS RIVER BASIN
BENTON, CRAWFORD AND WASHINGTON COUNTIES
ARKANSAS
ADAIR, CHEROKEE, DELAWARE AND SEQUOYAH COUNTIES
OKLAHOMA

Figure 1


MEAN ANNUAL PRECIPITATION
ILLINOIS RIVER BASIN


MEAN JULY TEMPERATURE
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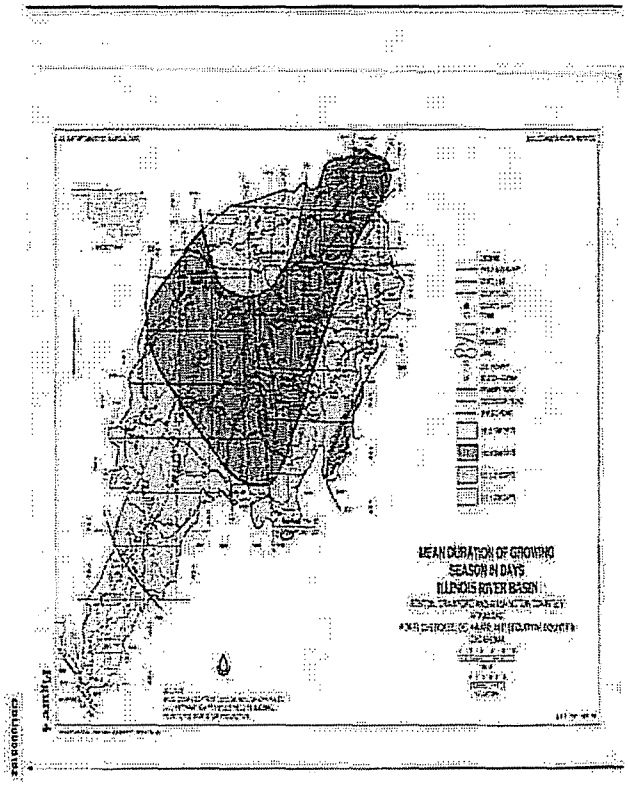
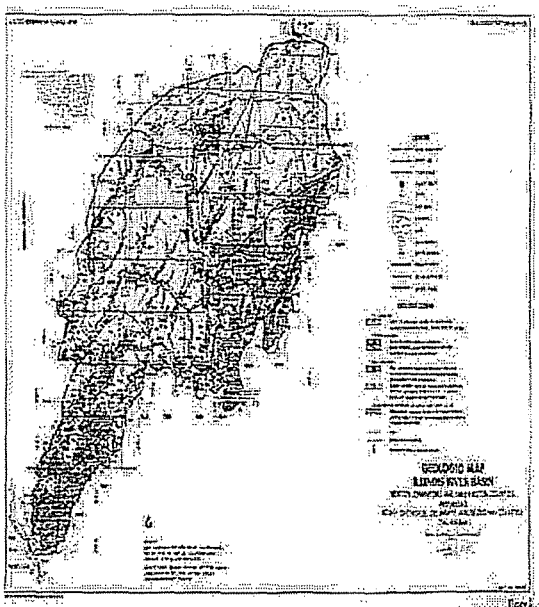

MEAN DURATION OF GROWING
SEASON IN DAYS
ILLINOIS RIVER BASIN


GEOLOGIC MAP
ILLINOIS RIVER BASIN

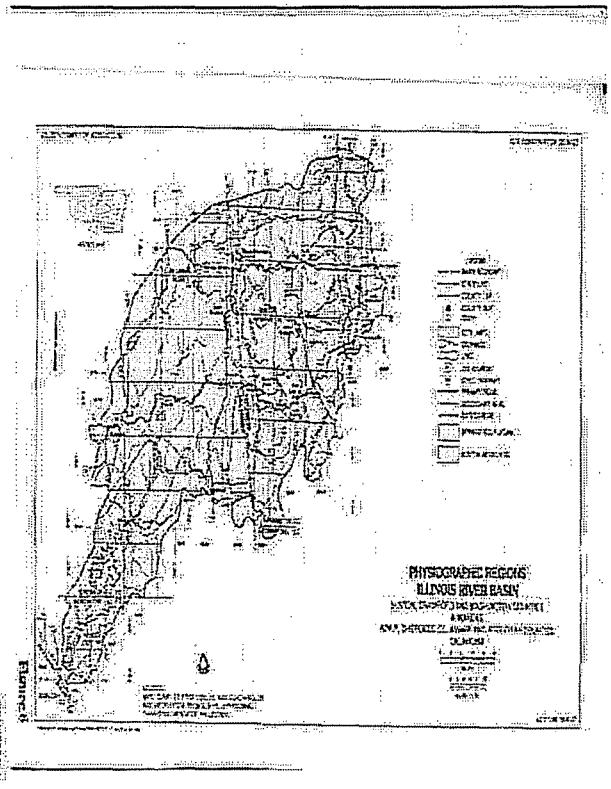


Figure 8

Most surface rocks of the Springfield Plateau belong to the Boone Formation. They consist of limestone, limestone and nodular chert, interbedded limestone and chert, and in some exposures just chert. This formation is about 300 feet thick and is underlain by St. Joe noncherty, crystalline fossiliferous limestone.

All limestone above the lower limestone member is nearly pure calcium carbonate and is very soluble. Ground water has formed a network of underground drainage channels in the limestone. Sinkholes, caves, and fissures are common. Large quantities of chert are left behind as the semi-insoluble surface residue after the limestone has been dissolved by ground water. The chert itself often loses original calcium carbonate and some silica, making much of it fairly light weight and porous. This mantle of chert debris formed by the weathering process is important because it tends to check and hold runoff from precipitation. Springs are numerous throughout the area, and wells obtain water directly from the chert mantle or from the fractures and solution channels in the underlying limestone. The mantle also feeds the springs.

The Boone Formation in Oklahoma is subdivided into the St. Joe "Group," Reeds Spring, and Keokuk Formations. The Reeds Spring Formation consists of equal amounts of chert and fine-grained, dense limestone, while the Keokuk Formation is massive, fossiliferous chert.

The Boston Mountains, the highest of the plateaus in the Ozarks, form the southern part of the Illinois River basin. They appear more severely eroded than the other plateaus. Local relief in some places exceeds 1,500 feet. The steep slopes and overall ruggedness cause them to be called the "Boston Mountains," rather than "Boston Plateau."

The Boston Mountains are underlain, in ascending order, by the Batesville Sandstone, Fayetteville Shale, Pitkin Limestone, Hale Formation, Bloyd Shale, and Atoka Formation. The Batesville Sandstone, which is underlain by the Boone Formation, is a coarse-grained, brown sandstone.

Fayetteville Shale is black, fissile and carbonaceous shale. The formation was named for Fayetteville, Arkansas, where it is widely exposed. In Oklahoma the Fayetteville Formation consists of interbedded limestone and fissile shale.

The Pitkin Limestone consists of massive layers of compact, bluish-gray fossiliferous limestone. Because of the weathering of the nonresistant underlying Fayetteville Shale, the Pitkin stands out as a steep cliff. The height is ordinarily the thickness of the formation. The Fayetteville Shale and Pitkin Limestone Formations generally yield small to moderate amounts of fair to good ground water.

The Hale Formation includes the Cane Hill member. It is mostly interbedded siltstone, shale, and sandstone and consists of overlying Prairie Grove sandstone and sandy limestone.

The Bloyd Shale consists mostly of dark gray to black silty shale and siltstone. It has some sandy limestone alternating with dark shale. The Hale and Bloyd Formations probably yield only small amounts of fair to poor ground water.

The Atoka Formation, the youngest formation in the basin, caps the higher summits in the Boston Mountains. It is primarily alternating beds of shale and sandstone. The sandstone, despite its prominence, makes up about 25 percent of the formation, while shale and siltstone account for the rest. The Atoka Formation yields limited amounts of poor quality ground water.

Land use

Grassland totals 483,670 acres, or about 45 percent of the river basin (fig. 7). Developed cool-season grasses

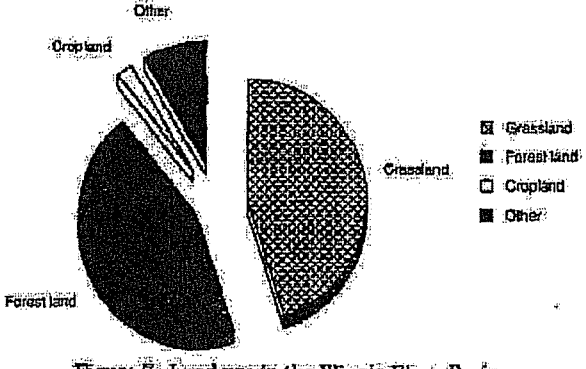


Figure 7. Land use in the Illinois River Basin.

Table 2. *Land use*

Land use	Arkansas		Oklahoma			
	Acres	Percent	Acres	Percent	Totals	Percent
Grassland	243,508	49	240,162	42	483,670	45
Forest land	182,500	37	292,032	50	474,532	44
Cropland	13,407	3	4,854	1	18,261	2
Orchard\vineyard	7,212	1	3,202	1	10,414	1
Urban	37,900	8	20,065	3	57,965	6
Other	8,973	2	15,715	3	24,688	2
Totals	493,500	100	576,030	100	1,069,530	100

make up about 79 percent of the grassland, and warm-season species dominate the rest. Grassland is the dominant land use around confined animal operations. Land application of animal waste occurs almost exclusively on grassland.

Forest land makes up about 44 percent of the study area, or 474,532 acres. It is characteristic mid-south upland hardwoods (table 2). Total forest land acreage increased about 10 percent between 1975 and 1985. Oak-hickory is the dominant forest type, accounting for 91 percent of the acreage. Oak-shortleaf pine and shortleaf pine types occur in scattered stands on south slopes and ridgetops. They make up another 7 percent of the forest land area. Elm-ash-cottonwood and oak-gum-cypress in stream bottom positions account for the rest.

Private, nonindustrial ownership accounts for 87 percent (412,843 acres) of the forest land (fig. 8). National Forest ownership is about 6 percent, (28,472 acres), and other governmental ownership makes up the rest (33,217 acres) (fig. 9).

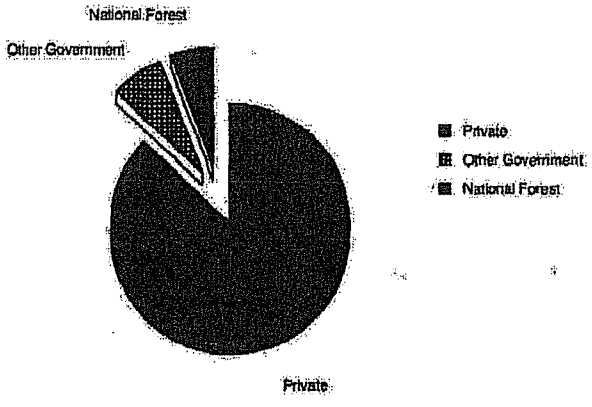


Figure 8. Illinois River Basin forest land ownership. (USDA, Forest Service)

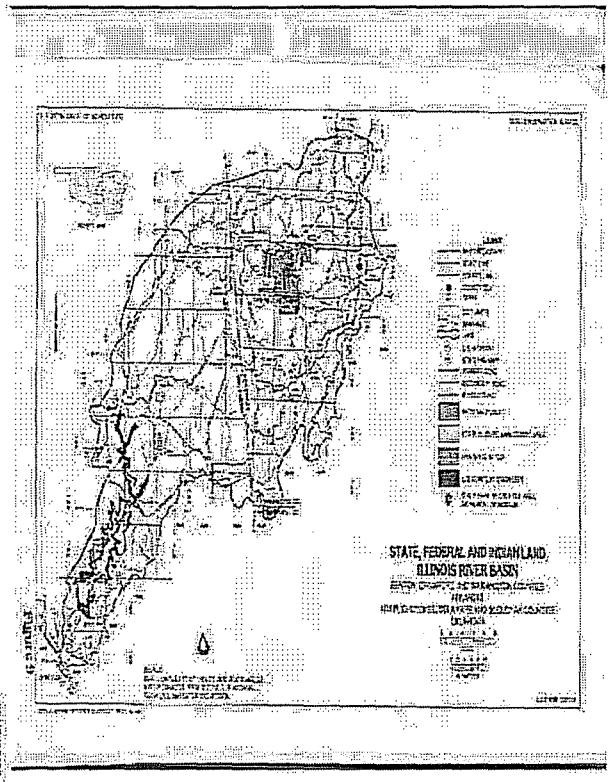
National Forest lands are managed under the multiple use concept using standards and guidelines specified in the Forest Management Plan. Management of all forest resources—water, timber, wildlife, forage, and recreation—is coordinated to get the greatest sustained public benefit while maintaining or improving resource conditions.

Cropland covers about 18,261 acres (2 percent) and is restricted to narrow flood plains and a few scattered upland fields. Crops include soybeans, grain sorghum, wheat, and a few speciality crops. Small areas of prime farmland and additional farmland of statewide importance are scattered throughout the basin area.

Orchards and vineyards make up about 10,414 acres (1 percent) and consist mainly of apples.

Urban areas cover about 57,965 acres (6 percent). They include all or parts of Fayetteville, Springdale, Siloam Springs, Rogers, Lincoln, Prairie Grove, Gentry, Stilwell, Tahlequah, Westville, and several small communities.

About 24,688 acres (2 percent) of the river basin can be grouped as other land use. Confined animal operations cover 5,000 acres, and roads, farmsteads, railroads, other transportation facilities, barns, and other buildings are included in this use. Water, including numerous small lakes, ponds, and streams, is also included. Farm ponds and small structures are in some of these areas. Major lakes include Tenkiller, Wedington, Elmdale, Bob Kidd, Lincoln, Prairie Grove, and Gentry.


STATE, FEDERAL AND INDIAN LAND,
ILLINOIS RIVER BASIN

Natural Resources

Soils

Major soils within the Illinois River Basin are in the Captina, Clarksville, Enders, Jay, Linker, Mountainburg, Nella, Nixa, Noark, Razort, Steprock, and Waben series (fig. 10).

The Captina series consists of soils that are deep, moderately well drained, and slowly permeable. These loamy soils are on broad upland flats and stream terraces. Slope range is 1 to 6 percent. These soils formed in loamy material overlying cherty limestone or siltstone. They are used mainly for pasture and hay. Other uses include cultivated crops, vineyards, and orchards. Runoff is medium, and hazard of erosion is moderate to severe depending on slope gradient and length. Soil leaching potential is nominal, while runoff potential is intermediate.

The Clarksville series consists of soils that are deep, somewhat excessively drained, and moderately rapidly permeable. These loamy and very cherty soils are on hillsides. Slope range is 12 to 60 percent. These soils formed in residuum derived from cherty limestone. They are used mainly as woodland, but in a few areas, they have been cleared and are used for pasture. Slope and high content of chert fragments restrict the use of farm equipment. The hazard of erosion is severe to very severe depending on slope gradient and length. Soil leaching potential is intermediate, and runoff potential is intermediate to high.

The Enders series consists of soils that are deep, well drained, and very slowly permeable. These loamy, gravelly or stony soils are on sides and tops of mountains and ridges. They are commonly intermingled with Nella soils in a complex pattern. Slope range is 3 to 40 percent. These soils formed in a thin layer of loamy colluvial material and in underlying clayey residuum derived from acid shale. They are used mainly as woodland in steeper areas and pasture in less sloping areas. Runoff is medium to rapid, and the hazard of erosion is severe to very severe depending on slope gradient and length. Steep slopes and surface stones interfere with management in some areas. Soil leaching potential is nominal, and runoff potential is intermediate to high.

The Jay series consists of soils that are deep, moderately well drained, and slowly permeable. These loamy soils are on broad uplands. Slope range is 1 to 8 percent. These soils formed in loamy material overlying cherty limestone or siltstone. They are used mainly for pasture and hay. Other uses include cultivated crops, vineyards, and orchards. Runoff is medium, and the erosion hazard is moderate to severe depending on slope gradient and length. Soil leaching potential is nominal, and runoff potential is intermediate.

The Linker series consists of soils that are moderately deep, well drained, and moderately permeable. These loamy, gravelly or stony soils are on ridges and mountaintops. They are commonly intermingled with Mountainburg soils in a complex pattern. Slope range is 1 to 12 percent. These soils formed in residuum of acid sandstone. They are used mainly for pasture and hay. Runoff is medium to rapid, and the hazard of erosion is moderate to severe depending on slope gradient and length. Soil leaching potential and runoff potential are intermediate.

The Mountainburg series consists of soils that are shallow, well drained, and moderately rapidly permeable. These very gravelly or stony soils are on benches and tops of hills and mountains. They are commonly intermingled with Linker or Nella soils in a complex pattern. Slope range is 3 to 60 percent. These soils formed in residuum of acid sandstone. They are used mainly as woodland, but in a few of the less sloping areas, these soils have been cleared and are used for pasture. Surface stones, rock outcrop, and steep slopes limit the use of equipment in many areas. These soils are droughty because of their shallow depth to bedrock and high content of coarse fragments. Runoff is medium to rapid, and the hazard of erosion is moderate to very severe depending on slope gradient and length. Soil leaching potential and runoff potential are high.

The Nella series consists of soils that are deep, well drained, and moderately permeable. These loamy gravelly or stony soils are in colluvial positions on side slopes, benches, and foot slopes. They are commonly intermingled with Enders soils in a complex pattern. Slope range is 8 to 40 percent. These soils formed in colluvium derived from acid sandstone, siltstone, and shale. They are used mainly as woodland, but in a few areas, these soils have been cleared and are used for

pasture and hay. Runoff is medium to rapid, and the hazard of erosion is moderate to very severe depending on slope gradient and length. Steep slopes and surface stones interfere with management in some areas. Soil leaching potential is intermediate, and runoff potential is intermediate to high.

The Nixa series consists of soils that are deep, moderately well drained, and very slowly permeable. These loamy and very cherty soils are on long, narrow ridgetops. Slope range is 3 to 12 percent. These soils formed in residuum derived from cherty limestone. Most areas are used for pasture, but some tracts are wooded. Runoff is medium to rapid, and the hazard of erosion is moderate to severe depending on slope gradient and length. The chert fragments in the surface layer interfere with tillage operations. Soil leaching potential is nominal, and runoff potential is intermediate.

The Noark series consists of soils that are deep, well drained, and moderately permeable. These loamy and very cherty soils are on sides and tops of hills and ridges. Slope range is 3 to 40 percent. These soils formed in residuum from cherty limestone. Steeper areas of these soils are used mainly as woodland, while the gently sloping to moderately sloping areas are used mainly for pasture and hay. Runoff is medium to very rapid, and the hazard of erosion is severe to very severe depending on slope gradient and length. Chert fragments in the surface layer interfere with tillage operations. Soil leaching potential is intermediate, and runoff potential is intermediate to high.

The Razort series consists of soils that are deep, well drained, and moderately permeable. These loamy soils are on flood plains. Slope range is 0 to 3 percent. These soils formed in loamy and gravelly sediment washed from predominantly cherty upland soils. They are used mainly for pasture and hay, but some tracts are used for cultivated crops. Occasional flooding is a moderate hazard on these soils. Soil leaching potential is intermediate, and runoff potential is nominal except during periods of flooding.

The Steprock series consists of soils that are moderately deep, well drained, and moderately permeable. These loamy, very gravelly or stony soils are on sides of hills, mountains, and ridges. They are commonly intermingled with Enders or Mountainburg soils in a complex pattern. Slope range is 3 to 40 percent. These soils formed in residuum derived from acid sandstone, siltstone, and shale. They are used mainly as woodland, but in a few areas, these soils have been cleared and are used for pasture and hay. Runoff is medium to rapid, and the hazard of erosion is moderate to very severe depending on slope gradient and length. Steep slopes and surface stones interfere with management in some areas. Soil leaching potential is intermediate, and runoff potential is intermediate to high.

The Waben series consists of soils that are deep, well drained, and moderately rapidly permeable. These cherty and loamy soils are on fans, foot slopes, and narrow terraces. Slope range is 3 to 12 percent. These soils formed in cherty and very cherty alluvium and colluvium. They are used mainly for pasture and hay, and a few areas are woodland. Runoff is medium, and the hazard of erosion is moderate to severe. Soil leaching potential and runoff potential are intermediate.

Minor soils within the Illinois River Basin Area are in the Allegheny, Bolivar, Choska, Craig, Cupco, Dennis, Eldorado, Hector, Kiomatia, Midco, Neff, Oklared, Peridge, Pickwick, Secesh, Severn, Sallisaw, Shermore, Stigler, Taloka, and Tonti series.

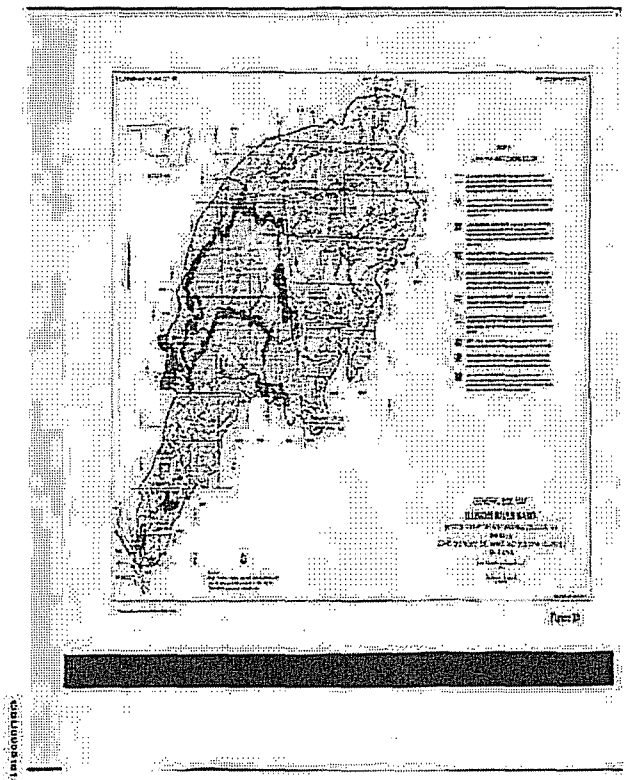
Water

Surface water

The major tributaries of the Illinois River include Flint Creek, Osage Creek, Clear Creek, Muddy Fork, Cincinnati Creek, Ballard Creek, Baron Fork, Caney Creek, and Tyner Creek.

The Illinois River generally maintains a perennial flow. The lowest flow ever recorded at the U.S. Geological Survey (USGS) gaging station near Tahlequah was 0.1 ft^3/s, which occurred in October 1956 after an extended drought. USGS records on some of the upper tributaries do indicate periods of zero flow on the surface during extended dry periods.

But even during periods of no surface runoff, interflow and baseflow contribute to the stability of the perennial flow in the lower part of the river. Stream flow is generally highest from March through June and



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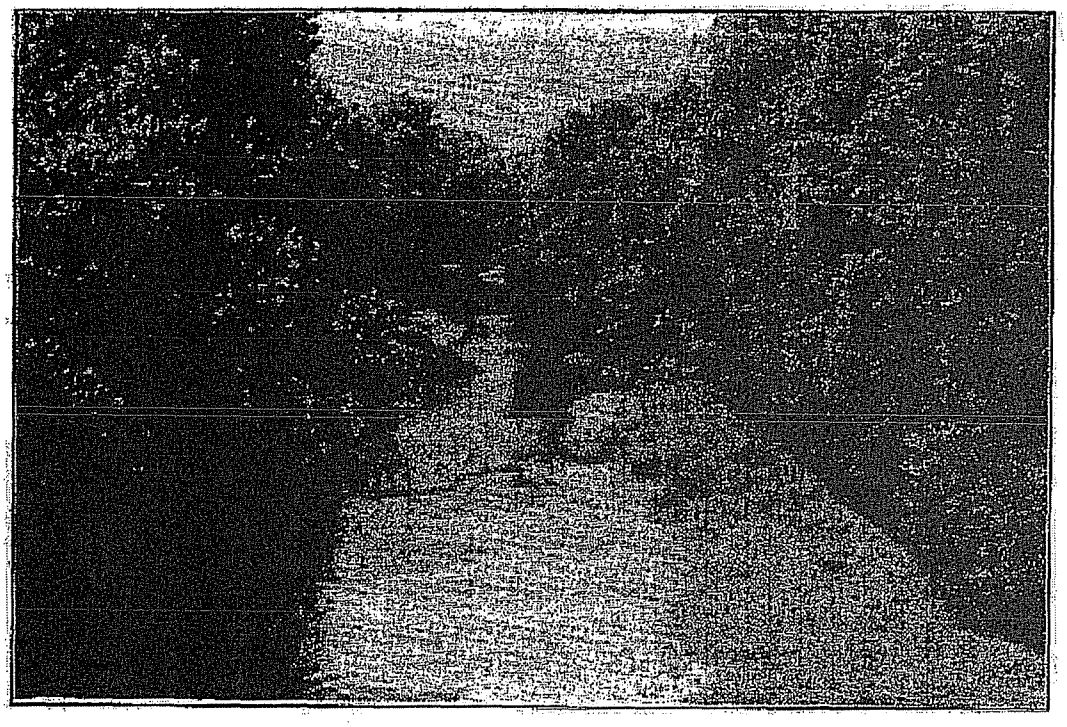

Photo 2. Illinois River during low flow period.

lower from July through October. Streams are used primarily for recreation (fishing, swimming, and canoeing) and livestock water when flows are adequate.

The water quality of the Illinois River in Arkansas and Oklahoma has been a concern for the last two decades. It has increased the development of and dependence on surface water sources in the basin for public water supplies.

The beauty of the river has led to the development of recreation-based tourism. The scenic river system in Oklahoma includes the Illinois River for recreational purposes. The potential loss of these uses because of water quality degradation is a grave concern. The water quality indicators supporting this concern are from water quality data and direct observation. The river is not as clear as in earlier times, and algae blooms are quite common along some parts of the river system. Substrate rocks along the lower stretches of the Illinois River are coated with black slime. Late in summer, the upper end of Lake Tenkiller resembles a pea soup color. The sources of pollution entering the watershed include animal waste, septic systems, urban runoff, erosion, and municipal effluent.

The major lakes in the basin include Lincoln Lake, Bob Kidd Lake, Lake Prairie Grove, Lake Wedington, Lake Fayetteville, Lake Frances, and Tenkiller Ferry Lake. Lincoln Lake, Bob Kidd Lake, and Lake Prairie Grove were constructed primarily for flood control purposes. Lincoln Lake and Lake Prairie Grove are also used as municipal and industrial water supplies for the towns of Lincoln and Prairie Grove. Bob Kidd Lake is managed for recreational fishing by the Arkansas Game and Fish Commission, and Lake Fayetteville and Lake Wedington are used primarily for fishing and boating.

Tenkiller Reservoir is the largest lake in the river basin. It is in Oklahoma on the Illinois River about 12 miles upstream from the confluence with the Arkansas River. This lake was constructed by the Corps of Engineers primarily for flood control, municipal and

domestic water supply, and power generation. It is also used extensively for recreational activities including fishing, boating, swimming, and scuba diving. Gentry Lake is used as a cooling lake for the Flint Creek power plant.

Ground water

Ground water is a valuable resource in the Illinois River Basin. Wells and springs provide water for many rural homes, towns, and industries in the Oklahoma part of the basin. As the population and industry continue to grow, the demand will increase for this water.

Underlying the Illinois River Basin are various soil and rock formations. Below a certain level the pore spaces and cracks of the formations are completely filled with water. Where these openings are large enough and sufficiently interconnected, the rocks yield water to wells. These water yielding formations, called aquifers, are the primary sources of the ground water of the Illinois River Basin. The aquifers are the Boone Chert, the Burgen Sandstone (Oklahoma), and the Roubidoux formations.

Much of the surface of the basin is covered by the Boone Chert formation. In Oklahoma, the Keokuk and Reed Springs formations (St. Joe Group) are commonly grouped together to form the Boone Chert. Within the basin area the formation consists of about 250 feet of massive chert with beds of cherty limestone in the lower part. The formation is locally fractured and cavernous. Throughout most of the Oklahoma part of the basin, the Boone Chert formation is a fairly reliable source of fair to good quality water. The average yield of 120 wells in this formation was 3.5 gpm, about 10 percent of the wells yield more than 10 gpm, and some yields of 50 gpm have been obtained. The numerous springs that emanate from this formation provide baseflow for the streams in the basin even during dry periods. The Boone Chert aquifer is recharged by local precipitation. The precipitation enters the aquifer by percolating through the highly permeable areas of the soil surface layer and through fractures in rock outcrops in the immediate area.

Underlying the Boone Chert aquifer in Oklahoma is the Burgen Sandstone formation. The Burgen aquifer covers about the same area of the basin as the Boone Chert, but occurs at a deeper level. The Burgen formation consists mainly of fine to medium sandstone with inclusions of shale, limestone, and dolomite beds. At Watts, Oklahoma, the Burgen formation was logged at 364 feet below the surface and 120 feet thick. Average thickness of the aquifer is about 100 feet. This aquifer provides moderate well yields of 5 to 15 gpm.

The Roubidoux formation, a large deep aquifer, underlies roughly all of the basin in Oklahoma north of Baron Fork Creek and the northern part of the basin in Arkansas. This formation is a 100- to 200-foot thick layer of sandy and cherty dolomite interbedded with sandstone. Depth to the Roubidoux ranges from 500 to 1,500 feet. One logging record at a site near Westville, Oklahoma, recorded it at 1,185 feet. Water well yields range from 50 to 250 gpm and are occasionally higher. This aquifer is recharged from precipitation falling on its outcrop area in southwest Missouri.

Alluvium and terrace deposits along the Illinois River also provide some favorable ground water supplies.

The Boone formation is recharged from local percolation through the highly permeable overlying cherty soil and fractures in rock outcrops As a result, it is vulnerable to local sources of pollution. Nutrients and bacteria from animal waste applied to fields and inadequate domestic septic systems could potentially contaminate the aquifer.

Reliable data on ground water quality within the Illinois River are limited. Health Department and Cooperative Extension Service tests on well water samples within the basin indicate that some private and public wells have been contaminated by fecal coliform bacteria and nutrients. Insufficient data are available to identify a pattern of contamination for the extent and sources of this contamination. Overall, no data sets were found that had adequate quality assurance and quality control to truly depict the extent that shallow ground water quality within the basin has been influenced by nonpoint source pollution.

Several studies are attempting to remedy the need for additional data on ground water resources, but until results of the studies are official, the data cannot be included in this report.

Wildlife

General

The first visitors to the river basin saw bears, deer, wild turkeys, prairie chickens, and even bison and elk. By 1900, habitat destruction and the slaughter of wildlife by some settlers and market hunters had decimated local populations of these animals. In the 1930's, storyteller Vance Randolph noted that deer and turkeys were "practically extinct" in this section of northwest Arkansas and northeast Oklahoma.

Fortunately for outdoor enthusiasts, the situation has improved. Though some game and nongame species have not returned to the Ozarks, others have responded to government protection, stocking, and wildlife management. The Ozarks have proved to be fairly resilient, and populations of large and small mammals, birds, and various game and fish are adequate.

Wildlife distribution and populations depend largely on the quantity and quality of available habitat. Habitat conditions are in turn influenced by land use (photo 3), land management, distribution of water, climate, human influences, and other factors. Therefore, wildlife populations are in general directly proportional to the availability and suitability of the habitat. Wildlife species are opportunistic in obtaining necessary life requisites. The most favorable habitat condition for terrestrial wildlife is a mixture of vegetative cover types that are all within the home range of the various species. Diversity, then, is an important element of productivity. Within the Illinois River Basin, many such areas exist.

Terrestrial wildlife habitat and species

The land use of the Illinois River Basin has been placed into six categories. Table 2 illustrates these land uses and the respective acreages and percentages of each for each state. Wildlife habitat can best be described in terms of vegetative cover types. From the six land use categories, three general vegetative cover types can be delineated to describe the terrestrial wildlife habitat of the basin.

a. *Upland and bottomland timber* (Forest land use category—474,532 acres). Timbered habitat is the second most abundant cover type in the study area. Species composition varies according to soil type, moisture conditions, slope direction, and other external factors.

Photo 3. Habitat conditions are influenced by land use.

Upland timber can be described in general as an oak-hickory forest with varying percentages (0 to 50) of shortleaf pine. Dominant oak and hickory species include post oak, blackjack oak, black oak, white oak, black hickory, and mockernut hickory.

Bottomland timber can include several of the upland timber species, but additional species commonly are willow, cottonwood, elm, maple, sycamore, plum, ash, and other varieties of oak. Timbered habitat provides all or some life requisites for many wildlife species. Wildlife species or groups that rely on timbered habitats include white-tailed deer, fox squirrels, gray squirrels, cottontail rabbits, swamp rabbits, skunks, coyotes, foxes, raccoons, opossums, mice, rats, wild turkeys, bobwhite quail, woodpeckers, owls, hawks, and songbirds including nuthatches, warblers, and chickadees. Several species of reptiles and amphibians are also included.

b. *Seasonal herbland* (Grassland use category—483,670 acres). Grassland is the most abundant cover type and includes native range, native pasture, and improved pasture. Species composition varies according to soil type, moisture conditions, and management practices.

Well-managed native range or pasture is a mixture of tall grasses composed principally of big bluestem, little bluestem, switchgrass, and Indiangrass. These areas may also include numerous legumes and forbs. If not managed properly, broomsedge, silver bluestem, splitbeard bluestem, and ragweed may become dominant. Introduced pasture in the basin consists mainly of bermudagrass or fescue.

Seasonal herbland habitat, like timbered habitat, provides all or some life requisites for many wildlife species. Wildlife species or groups commonly associated with seasonal herbland include white-tailed deer, rabbits, skunks, coyotes, fox, mice, rats, bob-white quail, mourning doves, hawks, flycatchers, shrikes, sparrows, reptiles, and amphibians.

c. *Cropland* (Cropland and orchard/vineyard land use categories—28,675 acres). This cover type consists of areas used for seasonal crops requiring frequent or seasonal tillage, intensive management practices, or both. Species composition varies according to soil types, moisture conditions, and production goals or purposes. Crops within the basin include wheat, soybeans, oats, corn, sorghums, alfalfa, beans, strawberries, apples, blueberries, and peaches.

In general, cropland is most important to wildlife as a source of food. Many wildlife species use not only the crop being grown, but associated vegetation and insects. Wildlife species or groups that may rely heavily on cropland as a food source include white-tailed deer, rabbits, raccoons, fox, mice, rats, wild turkeys, bob-white quail, mourning doves, flycatchers, and sparrows.

Distribution and abundance of wildlife populations depend on quality and quantity of habitat. Habitat quality in turn depends on types and distributions of land uses, condition and successional stages of plant species, amount and distribution of water, climate, weather, human influences, and other factors. Wildlife populations are products of the land and are vitally dependent on and controlled by quality and quantity of plants and water.

Wetland wildlife habitat and species

Wetland wildlife habitat is provided by the lakes, ponds, streams, marshes, and low-lying areas of the basin. These aquatic areas provide essential habitats for many water-oriented species. Included among these species are groups of ducks, geese, herons, egrets, shore birds, raccoons, rabbits, beavers, muskrats, reptiles, and amphibians.

Endangered and threatened species

The Endangered Species Act of 1973 (Public Law 93-205) as amended was passed to check the rapid decline of native fish, wildlife, and plants in the United States. The U.S. Fish and Wildlife Service is charged with determining which species face extinction through man's alteration of their habitat, protecting them from further decline, and providing for their

continued survival. All Federal agencies are charged with using their authority to carry out programs for the conservation of threatened and endangered species. They must ensure that any action authorized, funded, or carried out by them does not jeopardize the continued existence of any threatened or endangered species or result in the adverse modification of critical habitat of such species.

Endangered species are defined in the Act as any species in danger of extinction throughout all or a significant part of its range other than a species of the Class Insecta determined by the Secretary of the Interior to constitute a pest whose protection under the provisions of the Act would present an overwhelming and overriding risk to man. Threatened species are defined as any species that is likely to become an endangered species within the foreseeable future throughout all or a significant part of its range. Several endangered species are known to inhabit the Illinois River basin (table 3).

Fishery

Fishing opportunities abound along the Illinois River and at Lake Tenkiller. At least 68 species of fish including largemouth and smallmouth bass, white bass, striped bass, crappie, catfish, and rainbow trout exist in this clear water reservoir and associated streams. Fishing methods and success vary with the time of year.

Smallmouth bass provide some scrappy fighting in the summer. While 14-inch smallmouth are hard to come by, these fish can certainly add excitement to a fishing trip. While these fish are caught in the reservoir area, most fishing success is in the upper Illinois River and the Barron Fork Creek where the water is swift and clear. Taking lightweight fishing tackle on a float trip can provide some excellent fishing.

White bass (sandies) provide fishing opportunities in the spring as they head for the upper part of the Illinois River to spawn. Crappie fishing is also best in the spring as the fish prepare for spawning. Look for small pea gravel type banks and shallow water willow trees. Spring fish are in water 1 to 5 feet deep. Crappie are in deep water during the summer. Brush shelters and submerged trees at depths of 15 to 45 feet are the best areas to fish for crappie. Black and white crappie are in Lake Tenkiller, with white being more prevalent. Average size is about 0.5 to 1.5 pounds, with a maximum weight of 5 pounds.

Striped bass are also in Lake Tenkiller, but in limited numbers. They closely resemble the white bass,

Table 3. *Threatened and endangered species in the Illinois River Basin* (U.S. Department of Interior, Fish and Wildlife Service)

Species	Status*	Distribution in study area
Mammals		
Gray bat (*Myotis grisescens*)	E	Adair, Benton, Cherokee, Delaware, Washington
Ozark big-eared bat (*Plecotus townsendiingens*)	E	Adair, Cherokee, Delaware, Washington
Birds		
Bald eagle (*Haliaeetus leucocephalus*)	E	Benton, Cherokee, Delaware, Sequoyah
American peregrine falcon (*Falcoperegrinus anatum*)	E	Entire basin
Interior least tern (*Sterna antillarum*)	E	Sequoyah
Piping plover (*Charadrius melodus*)	T	Cherokee, Delaware, Sequoyah
Fish		
Ozark cavefish (*Amblyopsis rosae*)	T	Benton, Delaware
Insects		
American burying beetle (*Nicrophorus americanus*)	E	Cherokee

* E = Endangered; T = Threatened