Summary Table: Characteristics of the Ecoregions of Oklahoma

25. HIGH PLAINS

Level IV Ecoregion		Physiography	Geology		Soils			Climate			Vegetation	Land Cover and Land Use
	Area (square miles)		Elevation/ Local Relief (feet)	Surficial and Bedrock	Order (Great Group)	Common Soil Series	Temperature/ Moisture Regimes	Precipitation Mean annual (inches)	Frost Free Mean annual (days)	Mean Temperature January min/max; July min/max (°F)		
25b. Rolling Sand Plains	800	Gently undulating to hummocky, sandy plains with sand hills, depressions, and stabilized, partially stabilized, or active sand dunes. Locally, blow outs occur. Small wetlands are found between dunes where the water table is high. Drainage networks are not well established.	2400-4800/ 10-120	Quaternary sand and silt deposits that were laid down by rivers, and subsequently reworked by wind.	Alfisols (Haplustalfs), Entisols (Ustipsamments).	Vona, Dalhart, Tivoli, Pratt. Rapidly permeable and moderately permeable soils occur. Wind erosion is a serious management problem on unstabilized dunes, disturbed sites, or cultivated land.	Mesic/ Ustic	17-20. More than half falls between May and August.	175-185	Mostly 19/46 (up to 19/50 in westernmost areas); 64/94	Potential natural vegetation: sand sagebrush–bluestem prairie. Today, on Dalhart fine sandy loams: blue grama, buffalograss, sand dropseed, and sand bluestem dominate. On Dalhart, Vona, Tivoli, and Pratt loamy fine sands: sand sagebrush, grama, and sand dropseed dominate. On lightly grazed sites, little bluestem is becoming increasingly common. On stabilized dunes: sand sagebrush, grasses, and skunkbush are found.	Grassland, rangeland and, in suitable areas, irrigated cropland growing grain sorghum. Overgrazed rangeland is common. Cattle are wintered on sorghum-stubble fields and on locally grown feeds. Between-dune wetlands attract migrating shorebirds and waterfowl.
25c. Moderate Relief Plains	254	Irregular, rolling to broken, moderately sloping plains. Stream channels are wide, sandy, and usually dry.	2450-4800/ 50-200	Mantled by Quaternary sandy, gravelly and loamy colluvium. Mostly underlain by semiconsolidated, Tertiary-age sand, gravel, silt, clay, and caliche; near the Cimarron River, Jurassic- and Triassic-age sedimentary rock occurs.	Mollisols (Paleustolls), Aridisols (Haplocalcids), Alfisols (Haplustalfs).	Potter, Mansker, Dalhart.	Mesic, Thermic/ Ustic, Aridic	17-20. More than half falls between May and August.	175-185	Mostly 19/46 (up to 19/50 in westernmost areas); 64/94	Potential natural vegetation: short grass prairie (dominants: blue grama, buffalograss, and sand dropseed).	Primarily grassland and rangeland; where cultivated, the principal crops are grain sorghum, small grains, and forage crops. The most rugged, least accessible rangelands have a better cover of grasses than less rugged, more accessible lands which, typically, have been overgrazed.
25e. Canadian/ Cimarron High Plains	2523	Nearly level, rolling, or hummocky plains. Breaks occur near large streams. Playas are found in scattered depressions; they dry up seasonally or after a series of drought years. Prior to the 20th century, perennial stream reaches lost most of their flow in summer, but retained extensive pools; springs contributed to localized flow. Today, channels are often dry, and drainage networks are not well established; only a few ephemeral streams in wide, shallow, sandy channels now flow to playas.	2400-4800/ 10-150	Widely mantled by Quaternary loess that has been subsequently reworked by fluvial activity. Scattered playa deposits occur. Underlain by Tertiary-age sand, gravel, silt, clay, and caliche. These semiconsolidated deposits of the Ogallala Formation serve as an important regional aquifer.	On uplands: Alfisols (Haplustalfs), Mollisols (Argiustolls, Calciustolls, Haplustolls). On the floor of playa basins: Vertisols (Epiaquerts).	On uplands: Richfield, Dalhart, Portales, Ulysses, Pullman. Very deep, fertile, rather fine-textured soils are characteristic and usually derived from loess. Wind erosion is a serious management problem. On the floors of playa basins: Randall. Playa soils developed in clayey sediments and are poorly-drained.	Mesic, Thermic/ Ustic, Aquic	17-20. More than half falls between May and August.	175-185	Mostly 19/46 (up to 19/50 in westernmost areas); 64/94	Potential natural vegetation: short grass prairie (dominants: blue grama and buffalograss). Native in riparian areas: scattered cottonwood with a dense understory composed of shrubby willow. At the beginning of the 19th century, blue grama and buffalograss were common, and bluestem, wiregrass, hairy grama, three awn, and side-oats grama occurred locally. Today, sandy, overgrazed range has been invaded by sand sagebrush, and draws are often treeless. Cottonwoods along the Beaver River near Guymon have died due to the lowering of the water table by groundwater pumping for crop irrigation.	Mostly cropland; land too sandy or steep for farming is rangeland. Main crops are winter wheat and, on sandy soils, grain sorghum. Center pivot irrigation is widely used. Drawdown of the Ogallala Aquifer has reduced stream flow or caused streams to go dry. Rangeland has been widely overgrazed. Concentrated hog feeding operations are common. Natural gas and oil fields occur. Playa wetlands are used by migratory waterfowl and other wetland birds as wintering or stopover places.

26. SOUTHWESTERN TABLELANDS

Level IV Ecoregion		Physiography	Geology		Soils			Climate			Vegetation	Land Cover and Land Use
	Area (square miles)		Elevation/ Local Relief (feet)	Surficial and Bedrock	Order (Great Group)	Common Soil Series	Temperature/ Moisture Regimes	Precipitation Mean annual (inches)	Frost Free Mean annual (days)	Mean Temperature January min/max; July min/max (°F)		
26a. Canadian/ Cimarron Breaks	2751	Dissected canyons, hills, escarpments, buttes, terraces, and along rivers, dunes. Prior to the 20th century, summer flow in perennial reaches was limited, but large, enduring pools occurred; canyon springs contributed to localized stream flow. Today, streams are often dry. The Cimarron River has sandy bottoms and low turbidity at base flow. Streams flowing over deposits of the Ogallala Formation have silty mud substrates (with occasional gravel areas) and high turbidity.	1900-3450/ 100-400	Mantled by Quaternary alluvium, colluvium, terrace deposits, and loess. Along the north side of some rivers and streams: Quaternary sand dunes. Widely underlain by Tertiary-age sand, gravel, silt, calcareous clay, and caliche of the Ogallala Formation. In valley bottoms: exposures of Permian-age shale, sandstone, and siltstone. Near Guymon: Triassic-age sedimentary rocks.	On uplands: Mollisols (Calciustolls, Paleustolls, Haplustolls, Argiustolls), Inceptisols (Haplustepts), Alfisols (Haplustalfs), Entisols (Ustorthents, Ustipsamments), Aridisols (Haplocalcids). Floodplains: Mollisols (Endoaquolls, Haplustolls), Entisols (Ustifluvents, Fluvaquents).	On uplands: Mansic, Potter, Mansker, Woodward, Vona, Otero, Berthoud, Ulysses, Richfield, Pratt, Likes. On floodplains: Sweetwater, Lincoln, Spur, Las Animas, Canadian.	Thermic, Mesic/ Ustic, Aridic, Aquic	19-22	185-195	18/46; 66/95	Potential natural vegetation: mostly short grass prairie (dominants: blue grama and buffalograss); also, along the Beaver River, sand sagebrush–bluestem prairie. Today, on uplands: short grass prairie or mixed grass prairie. In riparian areas: cottonwood, hackberry, mulberry, willow, and plum occur.	Grassland, rangeland, and some riparian woodland. Oil and gas fields occur. Recent drawdown of the Ogallala Aquifer has caused many springs to disappear, thereby reducing stream flow and wetland size. Cattle in and near channels have increased downstream turbidity.
26b. Flat Tablelands and Valleys	110	Flat to gently sloping plains, stream terraces, and valleys. The only perennial stream, the Cimarron River, has a largely sandy substrate, but areas composed of gravel- and cobble-sized material occur. At base flow, turbidity is low.	1700-2100/ 10-150	Mantled by Quaternary alluvium, terrace deposits, and sand dunes. Underlain by Permian-age shale, siltstone, sandstone, and gypsum.	On uplands: Mollisols (Argiustolls), Alfisols (Haplustalfs), Entisols (Ustipsamments). On floodplains: Entisols (Ustifluvents), Mollisols (Hapludolls).	On uplands: Carey, Pratt, Tivoli. On floodplains: Lincoln, Yahola, Spur.	Thermic, Mesic/ Ustic, Udic	22-24	190-200	21/48; 68/96	Potential natural vegetation: sand sagebrush–bluestem prairie and short grass prairie (dominants: blue grama and buffalograss). Today, on sites with sandy soils: sand sagebrush–bluestem prairie. On upland sites with loamy or silty soils: short grass prairie is widespread. On floodplains: sand dropseed, bunchgrasses, sand sagebrush, cottonwood, and willow occur.	Grassland, rangeland, and cropland. The main crops are wheat, grain sorghum, and alfalfa.
26c. Caprock Canyons, Badlands, and Breaks	397	Dissected hills, ridges, buttes, badlands, ledges, canyons, and escarpments. Broken, steep land is extensive. Rivers are saline and shallow. Major streams have sandy substrates, but occasional boulders, gravel, and cobbles occur.	1500-2150/ 75-225	Mantled by Quaternary alluvium and colluvium. Underlain by Permian-age interbedded shale, gypsum, sandstone, siltstone, dolomite, and salt. Rock outcrops are common.	On uplands: Inceptisols (Haplustepts, Calciustepts), Entisols (Ustorthents), Mollisols (Haplustolls, Calciustolls). On floodplains: Entisols (Ustifluvents), Mollisols (Haplustolls).	On uplands: Woodward, Vernon, Knoco, Cornick, Aspermont, Quanah. On floodplains: Yahola, Spur.	Thermic/ Ustic	26-28	205-215	23/50; 68/95	Potential natural vegetation: mesquite–buffalograss and mixed grass prairie (dominants: little bluestem, side-oats grama, blue grama, and Indiangrass). Today, on gypsum soils: distinctive flora adapted to drought and high salt concentrations, including Pinchot juniper. On steep, clayey slopes of badlands: vegetation is sparse or barren. On floodplains: cottonwood, willow, tamarisk, hackberry, American elm, and grasses occur.	Mostly grassland and rangeland; some areas are used for pasture, hay, and cultivated crops. The main crops are small grains and grain sorghum.
26f. Mesa de Maya/ Black Mesa	324	Mesas, knobs, breaks, dissected plains, canyons, and valleys. Many slopes are boulder-strewn, stony, or gravelly. The Cimarron River has substrates of coarse sand interspersed with gravel and cobbles; it usually contains water. Turbidity is fairly low during the winter, but increases in the summer as flow decreases and plankton blooms. Mineralized, spring-fed, high gradient tributaries with boulder, cobble, or gravel substrates emerge from canyons that dissect volcanic flows; water is clear except near livestock watering areas.	3800-4973/ 75-600	Mantled by Quaternary alluvium and colluvium. Capping Black Mesa: Tertiary-age basalt, 60 to 70 feet thick. In canyons and deeply dissected valleys: flat-lying Mesozoic-age sandstone, shale, and some thin limestone. In a few places: semiconsolidated, Tertiary-age sand, gravel, silt, clay, and caliche. Talus slopes and rock outcrops are common.	Entisols (Torriorthents), Inceptisols (Haplustepts), Mollisols (Argiustolls, Paleustolls). On top of Black Mesa: shallow, rocky Mollisols (Haplustolls). On floodplains: Mollisols (Haplustolls).	Travessilla, Berthoud, Carnero, Mansker. On top of Black Mesa: Apache. On narrow floodplains: Spur.	Mesic, Thermic/ Ustic	16-18. More than half falls between May and August.	175	20/50; 63/93	Potential natural vegetation: juniper–pinyon woodland, and on top of Black Mesa, short grass prairie (dominants: blue grama, hairy grama, side-oats grama, galleta, buffalograss, and western wheatgrass). Rocky Mountain and Great Plains flora intergrade in Ecoregion 26e. Today, on north-facing canyon and mesa slopes: shrubs and small trees (mainly pinyon, oneseed juniper, and wavyleaf oak). On south-facing slopes: mesquite and prickly pear occur. On rocky slopes: low shrubs (including hoptree, stinking sumac, and netleaf hackberry) and scattered junipers occur. Intervening uplands are usually dominated by short grasses. In riparian areas: cottonwood, sandbar willow, and peachleaf willow occur. Talus slopes are barren. Near Kenton: small stand containing scattered ponderosa pine and pinyon.	Shrub-, grass-, or tree-covered. Mostly used for grazing. Upland cropland is very limited and produces feed crops. A few bottomland areas are irrigated and grow alfalfa.

27. CENTRAL GREAT PLAINS

Level IV Ecoregion		Physiography	Geology		Soils			Climate			Vegetation	Land Cover and Land Use
	Area (square miles)		Elevation/ Local Relief (feet)	Surficial and Bedrock	Order (Great Group)	Common Soil Series	Temperature/ Moisture Regimes	Precipitation Mean annual (inches)	Frost Free Mean annual (days)	Mean Temperature January min/max; July min/max (°F)		
27d. Prairie Tableland	6782	Level to slightly rolling plains with broad, flat interfluves and low gradient, broad, shallow, and sand- or silt-choked channels; uncommon short reaches with gravel, cobble, or bedrock substrates occur. Streams usually flow strongly after rains, have high suspended sediment concentrations, and go dry in the late summer.	850-1650/ 10-125	Mantled by Quaternary alluvium, terrace deposits, and decomposition residuum of clay loam-, fine sandy loam-, and sandy clay loam-texture. Underlain by Permian-age red shale, sandstone, and siltstone with some Pennsylvanian-age limestone in northeasternmost areas.	On uplands: mostly Mollisols (Paleustolls, Argiustolls, Haplustolls); also Alfisols (Haplustalfs). On floodplains: Mollisols (Haplustolls), Entisols (Ustifluvents).	On uplands: Bethany, Tabler, Kirkland, Grant, Pond Creek, Renfrow, Norge, Kingfisher, Dale, Minco, Dougherty. On floodplains: Port, Reinach, Gaddy, Canadian, Yahola.	Thermic/ Ustic	27-37. Rainfall increases eastward.	190-215. Frost free season is shortest in the northwest.	20/44 in the north to 25/50 in the south; 70/95	Potential natural vegetation: mixed grass prairie (dominants: little bluestem, side-oats grama, blue grama, and Indiangrass). Little bluestem, Indiangrass, big bluestem, switchgrass, buffalograss, blue grama, and side-oats grama are native. Riparian areas support cottonwood, willow, ash, and elm.	Mostly cropland; also, especially on steeper slopes, rangeland. Shelterbelt plantings are common. Main crops include winter wheat, grain sorghum, alfalfa, and in the east where precipitation is the greatest, soybeans. Some cotton is grown on smooth uplands and bottomlands that are suited to mechanization. Oil and gas fields occur.
27h. Red Prairie	2472	Nearly level to rolling plains with scattered ledges and escarpments. Streams originating in, or flowing through, the Flowerpot Shale and Blaine Formation have high mineral concentrations. Many springs occur. Substrates of most streams are composed of mud, but scattered areas have substrates composed of gravel and shale cobbles.	1000-2550/ Mostly 25-100; isolated buttes to 500	Mantled by Quaternary terrace deposits, alluvium, red clay loam decomposition residuum, fine sandy loam decomposition residuum, and along some rivers, dune sand. Mostly underlain by Permian-age sandstone, shale, gypsum, and siltstone.	On uplands: Mollisols (Paleustolls, Argiustolls, Natrustolls), Alfisols (Paleustalfs, Haplustalfs), Inceptisols (Haplustepts), Vertisols (Haplusterts). On floodplains: Entisols (Ustifluvents), Mollisols (Haplustolls).	On uplands: Tillman, Vernon, Hollister, Foard, Nobscot, Grandfield, Tipton, Hardeman, Woodward. Soils derived from gypsum are often shallow and very dry. On floodplains: Yahola, Miller, Clairemont, Lincoln.	Thermic/ Ustic	26-31. Rainfall increases eastward.	200-225. Frost free season is longest in the southeast.	21/49 in the northwest to 26/51 in the southeast; 67/94 in the northwest to 71/97 in the southeast	Potential natural vegetation: mostly mesquite–buffalograss; also, on sandy flats and hummocky sand hills, shinnery (dominants: little bluestem and shin oak). Riparian areas support cottonwood and American elm.	Mostly cropland; some rangeland. The main crops are small grains, cotton, alfalfa hay, and especially on sandier soils, grain sorghum. Small impoundments are common. Some gas production occurs.
27i. Broken Red Plains	2061	Nearly level to irregular plains. Most streams (except those near the Wichita Mountains) are deeply incised and have mud substrates and high turbidity. Near the Wichita Mountains, stream substrates are mostly composed of coarse arkosic sand; scattered areas of gravel and cobbles occur.	700-1300/ Mostly 25-100; up to 250 near the Red River	Mantled by Quaternary alluvium, terrace deposits, and red clay loam decomposition residuum. Underlain by Permian-age sandstone, shale, and in the north, limestone conglomerate.	On uplands: Mollisols (Haplustolls, Argiustolls, Paleustolls, Natrustolls), Alfisols (Haplustalfs), Inceptisols (Haplustepts). On floodplains: Mollisols (Haplustolls), Vertisols (Epiaquerts), Entisols (Ustifluvents).	On uplands: Zaneis, Lucien, Foard, Tillman, Chickasha, Vernon, Grainola. On floodplains: Port, Miller, Roebuck, Clairemont.	Thermic/ Ustic, Aquic	30-34	215-230. Frost free season is longest in the southeast.	25/52; 71/98	Potential natural vegetation: mostly mesquite–buffalograss. Riparian areas support cottonwood, hackberry, American elm, green ash, pecan, and black walnut.	Mosaic of rangeland and cropland. The main crops are small grains, grain sorghum, cotton, and alfalfa. Small impoundments are common. Some oil production occurs.
27k. Wichita Mountains	365	Low mountains and hills. Higher peaks are steep, rugged, and often strewn with boulders. Typically, stream substrates are composed of very coarse sand, gravel, or cobbles.	1100-2464/ 150-1100	Mantled by Quaternary feldspathic sandy fine grus and clayey colluvium (containing shale clasts). Underlain by Cambrian-age granite, gabbro, rhyolite flows, tuffs, conglomerate beds, and diabase sills. Exposed in valleys bottoms: Permian-age limestone conglomerate. Rock outcrops are common.	On uplands: Mollisols (Argiustolls, Natrustolls). On floodplains: Mollisols (Haplustolls).	On uplands: Brico, Lawton, Foard, and rockland. Stony soils are common. On narrow floodplains: Port.	Thermic/ Ustic	29-34. Rainfall increases eastward.	200-215	23/50; 69/95	Potential natural vegetation: cross timbers (dominants: blackjack oak, post oak, and little bluestem). Today, on lower granite hills and on south-facing, higher mountain slopes: open, scrubby, xeric forests (dominants: blackjack oak and post oak) and many glades occur. On north-facing slopes: denser and less xeric forests are found than on south-facing slopes. On lower slopes underlain by gabbro: trees are denser than on granite. On xeric hilltops and on overgrazed lowlands: short grasses with scattered prickly pear, and barren, rocky areas occur. Summits of highest peaks are nearly treeless with only scrubby eastern redcedars and scattered stunted oaks occurring. In riparian areas of enclosed valleys: mesophytic forests containing spotted oak, hackberry, black walnut, American elm, and ash occur.	Open forest, grassland, and rangeland. Includes Wichita Mountains National Wildlife Refuge, wilderness areas, parks, institutional summer camps, and the Fort Sill Military Reservation.
27l. Pleistocene Sand Dunes	2599	Active, barren sand dunes and stabilized sand dunes. Blow outs occur. Many springs occur. Streams have sandy substrates and low suspended sediment concentrations. Drainage networks are poorly developed.	950-2700/ 50-250	Mantled by Quaternary terrace deposits and dune sand.	Alfisols (Haplustalfs, Paleustalfs), Entisols (Ustipsamments), Mollisols (Argiustolls).	Pratt, Tivoli, Shellabarger, Devol, Nobscot, Delwin, Grandfield, Aline. Light, very deep to deep, permeable to rapidly permeable soils are characteristic. Soils are prone to wind erosion if vegetation cover is removed.	Thermic/ Ustic	22-34. Rainfall increases eastward.	190 in the northwest to 215 in the east to 220 in the southwest	22/46 in the east to 21/46 in the northwest to 22/49 in the southwest; 68/95 in the northwest and southwest to 70/95 in the east	Potential natural vegetation: sand sagebrush–bluestem prairie, cross timbers (dominants: blackjack oak, post oak, and little bluestem), and shinnery (dominants: little bluestem and shin oak). Today, mostly covered by sand sagebrush–grassland; sand bluestem, little bluestem, Indiangrass, giant sand reed, sand dropseed, and sandhill bluestem grow among the sand sagebrush. Bare sand occurs. In the east: woody plants stabilize dunes; American elm, hackberry, chittamwood, post oak, blackjack oak, wild grape, sand plum, roughleaf dogwood, aromatic sumac, buttonbush, and skunkbush occur. In subirrigated draws between dunes: American bulrush, buttonbush, and cattails occur. In the west, on hummocky dunes: shin oak and understory grasses occur. Eastern redcedar has invaded some areas.	Mostly rangeland; also, some cropland. Overgrazing has occurred locally. The main crops are grain sorghum, wheat, and alfalfa. Sand dunes are important shelter for wildlife, particularly during prolonged cold or wet periods. Oil and gas fields occur.
27m. Red River Tablelands	1042	Nearly level plains; also escarpments, ledges, and springs. The aquatic environment is often harsh; streams usually have high summer temperatures, slowly moving water, high concentrations of salt, and low dissolved oxygen levels. Larger streams have sandy substrates, but some areas of gravel and cobbles occur. Smaller streams have mud substrates.	1250-1900/ Mostly 10-75; maximum 250	Mantled by Quaternary terrace deposits, alluvium, red silty clay disintegration residuum, gypsum solution residuum, and fine sandy loam disintegration residuum. Mostly underlain by Permian-age shale; Permian-age dolomite, gypsum, and some sandstone also occur. The Blaine Formation acts as an aquifer.	On uplands: Alfisols (Haplustalfs), Mollisols (Paleustolls, Haplustolls), Vertisols (Haplusterts), Inceptisols (Haplustepts). On floodplains: Entisols (Ustifluvents), Mollisols (Haplustolls).	On uplands: Grandfield, Tillman, Vernon, Hollister, Devol, Cornick. Soils derived from gypsum are often shallow and very dry. On floodplains: Yahola, Port.	Thermic/ Ustic	26-29	215-220	24/51; 70/97	Potential natural vegetation: mostly mesquite–buffalograss; also mixed grass prairie (dominants: little bluestem, side-oats grama, blue grama, and Indiangrass) and shinnery (dominants: little bluestem and shin oak). Native on uplands: thorny shrubs (including mesquite) with blue grama, buffalograss, three-awn, prickly pear, and on soils derived from gypsum, lotebush. Elsewhere on uplands: mixed grass prairie is native. On bottomlands: cottonwood, black willow, American elm, western soapberry, hackberry, and tamarisk occur.	Mostly irrigated cropland growing wheat, cotton, alfalfa, and soybeans. Small impoundments and irrigation canals are common. Irrigation water comes from interbedded dolomite-gypsum-shale and surface sources. After use, tail water is pumped back into gypsum sinks. Gypsum wallboard manufacturing occurs.
27n. Gypsum Hills	556	Hills with breaks, escarpments, gorges, ledges, canyons, and gypsum karst features including solution caves. Springs occur. Streams have substrates composed of bedrock, cobbles, or gravel; they have flow in most months of most years.	1200-1750/ 100-250	Hillslopes are mantled by Quaternary sandstone- and gypsiferous, loamy colluvium (with shale clasts). Mantling valleys is Quaternary alluvium. Underlain by Permian-age gypsum, shale, dolomite, fine sandstone, and rock salt. Many rock outcrops occur.	Inceptisols (Haplustepts), Entisols (Ustorthents), Mollisols (Haplustolls).	Vernon, Knoco, Cottonwood, Cornick. Soils derived from gypsum are often shallow and very dry.	Thermic/ Ustic	26-31. Rainfall increases eastward.	190-215. Frost free season is longest in southeast.	17/46 in the northwest to 24/46 in the southeast; 68/95 in the northwest to 72/94 in the southeast	Potential natural vegetation: mixed grass prairie (dominants: little bluestem, side-oats grama, blue grama, and Indiangrass). Native along streams: riparian forests. Gypsum soils support a distinctive flora adapted to rigorous conditions where drought is characteristic and salt concentrations are high. Eastern redcedar is becoming increasingly common. Today, in riparian areas: cottonwood and willow occur.	Rangeland. Caves are important shelter and hibernating sites for wildlife, and are used by bats as summer roosts. Oil and gas fields occur.
27o. Cross Timbers Transition	5901	Rough plains that are sometimes broken. Incised streams occur and have rocky or muddy substrates.	750-1950/ 30-300	Mantled by Quaternary alluvium, terrace deposits, and decomposition residuum of fine sandy loam-, clayey silt-, sandy clay loam-, silty clay-, and clayey loam-texture. Underlain by Permian- and Pennsylvanian-age sandstone and shale as well as some limestone and mudstone conglomerate.	On uplands: Mollisols (Argiustolls, Paleustolls, Haplustolls), Inceptisols (Haplustepts), Alfisols (Paleustalfs, Haplustalfs). On floodplains: Mollisols (Haplustolls), Entisols (Ustifluvents).	On uplands: Renfrow, Zaneis, Vernon, Grainola, Lucien, Grant, Pond Creek, Chickasha, Stephenville, Nash, Minco, Eufaula. On floodplains: Port, Yahola, Pulaski.	Thermic/ Ustic	29-38. Rainfall increases eastward.	205-225. Frost free season is longest in the extreme south.	23/46 in the north and west to 26/49 in the south; 70/94	Potential natural vegetation: mixed grass prairie (dominants: little bluestem, side-oats grama, blue grama, and Indiangrass), cross timbers (dominants: blackjack oak, post oak, hickory, and little bluestem), and tall grass prairie (dominants: big bluestem, little bluestem, switchgrass, and Indiangrass). In the early 19th century, stream banks supported hardwood forest. Since the early 19th century, the abundance of upland trees has greatly increased, the number of upland tree species has increased, and many riparian forests and wetlands have been degraded or lost due to channelization or land use changes. Today, on uplands: scattered oaks, hickories, and increasingly, eastern redcedar occur. In riparian areas: cottonwood, willow, elm, ash, walnut, and pecan are common.	Mixture of rangeland and cropland. The main crops are small grains, grain sorghum, alfalfa, and soybeans. Oil and gas fields occur. Overgrazing, channelization, and releases of water from upstream flood control reservoirs have promoted channel incision. Today, channel incision is much more pronounced than it was in the early nineteenth century.
27p. Salt Plains	62	Salt flats, scattered hummocky mounds, islands, and lakes.	1125-1180/ 5-20	Quaternary salt plain deposits and alluvium.	Salt flats. Entisols (Ustifluvents, Udifluvents).	Mostly salt flats; also some Gracemont, Lincoln.	Thermic/ Ustic, Udic	31	205	20/44; 70/96	On the salt plains proper: seapurslane, western seaweed, and a species of algae occur. On isolated mounds: little bluestem is found. On the outer edge of the salt flats or on the periphery of mounds: alkali sacaton is abundant and saltgrass occurs.	Largely barren; also, small, sparse shrublands and grasslands containing only a few species and a limited number of plants. Includes Salt Plains National Wildlife Refuge.
27q. Rolling Red Hills	6365	Dissected, gently to steeply sloping, rolling hills and breaks. Escarpments occur on erosional fronts and in ravines. Solution caves are found in gypsum. Most streams are entrenched and have sandy, unstable substrates, eroding banks, and turbid water.	1400-2600/ 100-400	Mantled by Quaternary colluvium, terrace deposits, alluvium, and dune sand. Mostly underlain by Permian-age sandstone, shale, and siltstone. In addition, some Permian-age dolomite, gypsum, and salt; in the west, Tertiary-age sand, gravel, silt, calcareous clay, and caliche occurs. Rock outcrops are common.	On uplands: Inceptisols (Haplustepts), Mollisols (Argiustolls), Alfisols (Paleustalfs, Haplustalfs). On floodplains: Mollisols (Haplustolls), Entisols (Ustifluvents).	On uplands: Woodward, Carey, St. Paul, Quinlan, Nobscot, Cordell, Delwin, Devol, Dill, Grandfield, Vernon. On floodplains: Clairemont, Port, Lincoln, Yahola.	Thermic/ Ustic	26-30. Precipitation decreases westward and northward.	185-215. Frost free season decreases northward.	17/45 in the north to 24/48 in the south; 67/95 in the north to 70/96 in the south	Potential natural vegetation: mostly mixed grass prairie (dominants: little bluestem, side-oats grama, blue grama, and Indiangrass); in the west on sandy flats and sand hills, shinnery (dominants: little bluestem and shin oak); in the northwest, short grass prairie (dominants: blue grama and buffalograss) with side-oats grama locally abundant); in easternmost areas, finger-like projections of oak savanna. Eastern redcedar is native to areas sheltered from fire; it is now common due to the combined effects of grazing and fire suppression. Today, along the margins of breaks and on steep, rocky outcrops: side-oats grama is found. On the moisture deficient soils of hilltops: buffalograss occurs. On sandy areas: side-oats grama, hairy grama, buffalograss, shinnery, and/or sand sagebrush are common. On sites with adequate moisture that have not been overgrazed: little bluestem is found. In riparian areas: walnut, bur oak, American elm, mulberry, hackberry, willow, cottonwood, and soapberry occur.	Primarily rangeland, also some cropland. The main crops are wheat, sorghum, and cotton. Many farms were abandoned in the first half of the 20th century due to periodic drought, poor conservation practices, and economic issues. Extensive flood control projects occur and have impacted hydrology. Caves are important shelter and hibernating sites for wildlife, and are used by bats as summer roosts. Gas and some oil production occurs.
27r. Limestone Hills	103	Steep hills and ridges with ledges and intervening narrow valleys. Numerous small ponds occur. Springs are common, but there are no perennial streams. Most channels have moderate gradients, and gravel, cobble, or boulder substrates. However, low gradient channels occur and have mud or sand substrates.	1350-2250/ 50-600	Mantled by Quaternary colluvium (with limestone clasts) and clayey colluvium (containing shale clasts). Underlain by Permian-, Ordovician-, and Cambrian-age limestone, dolomite, limestone conglomerate, sandstone, siltstone, and shale. Many rock outcrops occur.	On uplands: Mollisols (Calciustolls). On narrow floodplains: Entisols (Ustifluvents).	On uplands: Tarrant, Talpa. Soils on hillslopes are typically stony and shallow or very shallow. On narrow floodplains: Clairemont.	Thermic/ Ustic	34	205	23/49; 69/94	Potential natural vegetation: mixed grass prairie (dominants: little bluestem, side-oats grama, blue grama, and Indiangrass).	Rangeland.

28. FLINT HILLS

Level IV Ecoregion		Physiography	Geology		Soils			Climate			Vegetation	Land Cover and Land Use
	Area (square miles)		Elevation/ Local Relief (feet)	Surficial and Bedrock	Order (Great Group)	Common Soil Series	Temperature/ Moisture Regimes	Precipitation Mean annual (inches)	Frost Free Mean annual (days)	Mean Temperature January min/max; July min/max (°F)		
28a. Flint Hills	967	Open, low, rolling hills, cuestas, and plains that are dissected by narrow, steep-sided valleys. Springs are common enough to increase summer base flow in some streams.	800-1350/ 50-300	Mantled by Quaternary alluvium and silty to clayey decomposition residuum (commonly containing fragments of shale, limestone, or chert). Underlain by interbedded, cherty, Pennsylvanian-age limestone and shale. Thin, Pennsylvanian-age limestone caps west-dipping cuestas that rise above shale plains.	On uplands: Mollisols (Haplustolls, Hapludolls, Argiudolls, Argiustolls), Alfisols (Haplustalfs, Albaqualfs). On floodplains: Mollisols (Hapludolls).	On uplands: Shidler, Summit, Steedman, Coweta, Parsons, Dennis, Grainola, Corbin. Upland soils can be stony and shallow. On floodplains: Verdigris.	Thermic/ Udic, Ustic, Aquic	38-42	195-205	22/45; 71/93	Potential natural vegetation: tall grass prairie (dominants: big bluestem, little bluestem, switchgrass, and Indiangrass). Today, on shallow, moisture deficient soils: short grasses such as blue grama, side-oats grama, and hairy grama as well as prickly pear occur. Along the margins of breaks and on steep, rocky outcrops: side-oats grama is found. In narrow riparian areas: bottomland forests containing cottonwood, hackberries, elms, and oaks are common.	Mostly rangeland, but cropland occurs in river valleys and on level, stone-free uplands. Alfalfa, winter wheat, and grain sorghum are produced. Extensive oil fields occur.

29. CROSS TIMBERS

Level IV Ecoregion		Physiography	Geology		Soils			Climate			Vegetation	Land Cover and Land Use
	Area (square miles)		Elevation/ Local Relief (feet)	Surficial and Bedrock	Order (Great Group)	Common Soil Series	Temperature/ Moisture Regimes	Precipitation Mean annual (inches)	Frost Free Mean annual (days)	Mean Temperature January min/max; July min/max (°F)		
29a. Northern Cross Timbers	8377	Rolling hills, cuestas, ridges, and ledges. Stream flow varies from year to year, and season to season. Shallow streams with sandy substrates are typical, but some stream reaches have deep pools, riffles, and bedrock, boulder, cobble, or gravel substrates. In headwater streams, sandstone blocks create isolated, enduring pools.	600-1300/ 100-350	Uplands are mantled by Quaternary clayey silt to silty clay decomposition residuum, clay loam decomposition residuum, and sandy decomposition residuum. Valleys are veneered with Quaternary alluvium. Underlain by Pennsylvanian- and Permian-age sandstone, shale, and limestone. Rock outcrops occur; sandstone blocks and boulders often litter hilltops and hillslopes.	On uplands: Alfisols (Haplustalfs, Paleustalfs), Mollisols (Hapludolls, Haplustolls, Argiudolls, Argiustolls), Inceptisols (Haplustepts), Vertisols (Haplusterts). On floodplains: Mollisols (Hapludolls, Haplustolls), Entisols (Ustifluvents).	On uplands: Darnell, Stephenville, Niotaze, Steedman, Coweta, Dennis, Bates, Clarita, Durant, Shidler, Newalla, Harrah, Chigley, Konawa. Soils can be highly erodible if disturbed. On floodplains: Verdigris, Port, Pulaski, Garvin.	Thermic/ Ustic, Udic	36-46. Precipitation increases eastward.	195 in the north to 225 in the south to 235 in the east. Frost free season shorter than south of the Arbuckles.	23/46 in the north to 26/49 in the south and east; 70/94	Potential natural vegetation: cross timbers (dominants: post oak, blackjack oak, and little bluestem), tall grass prairie (dominants: big bluestem, little bluestem, switchgrass, and Indiangrass), and a mosaic of tall grass prairie and oak–hickory forest. Native on clayey soils from limestone or shale: mostly tall grasses (e.g., little bluestem, big bluestem, switchgrass, and Indiangrass); drier, shallower soils support short grass prairies. Native on shaly lowlands: savanna. Native on porous, coarse-textured, sloping upland soils derived from sandstone: mostly post oak, blackjack oak, and understory grasses; also black hickory, black oak, persimmon, redbud, sumac, and increasingly, eastern redcedar. Native in riparian areas: hackberry, American elm, post oak, black walnut, green ash, willow, sycamore, and cottonwood. Today, scrubby oak forests, oak savannas, riparian forests, and prairie openings occur.	Woodland, grassland, rangeland, pastureland, and limited cropland. The main crops are small grains, grain sorghum, hay, and soybeans. Abandoned farmland is common. Fire suppression and passive land use have allowed the woodland distribution to greatly expand. Extensive, but declining, oil fields occur; associated brine, drilling mud, and petroleum waste products have increased salinity in many streams. Small impoundments are common.
29b. Eastern Cross Timbers	1057	Rolling hills, cuestas, long narrow ridges, and a few strongly dissected areas occur. Stream substrates are mostly composed of quartz sand.	640-1100/ 100-200	Uplands are mantled by Quaternary sand, gravel, silt, and clay decomposition residuum. Valleys are veneered with Quaternary alluvium. Underlain by Cretaceous-age sand, gravel, shale, clay, sandstone, calcareous shale, and limestone.	On uplands: Vertisols (Haplusterts), Mollisols (Calciustolls, Argiustolls), Alfisols (Haplustalfs, Paleustalfs). On floodplains: Mollisols (Hapludolls), Entisols (Ustifluvents).	On uplands: Burleson, Ferris, Tarrant, Dougherty, Konsil, Heiden, Durant, Eufaula, Gasil, Weatherford, Windthorst. Soils can be highly erodible if disturbed. On floodplains: Verdigris, Gracemont.	Thermic/ Ustic	38-46. Rainfall increases eastward.	225-235.	28/51; 72/94	Potential natural vegetation: cross timbers (dominants: post oak, blackjack oak, black hickory, and little bluestem) and tall grass prairie (dominants: big bluestem, little bluestem, switchgrass, and Indiangrass). Native on clayey soils from limestone or shale: mostly tall grasses; drier, shallower soils support short grass prairie. Native on shaly lowlands: savanna. Native on porous, coarse-textured, sloping soils derived from sandstone: mostly post oak, blackjack oak, and understory grasses; also black hickory, black oak, and increasingly, eastern redcedar. Native on bottomlands: pecan, black walnut, American elm, and cottonwood. Today, scrubby oak forests, oak savannas, riparian forests, and prairie openings occur.	Mostly grassland, pastureland, and woodland; some cropland. The main crops are small grains, grain sorghum, forage sorghum, and peanuts. Abandoned farmland is common. Fire suppression and passive land use have allowed the woodland distribution to greatly expand. Small impoundments are common.
29c. Western Cross Timbers	709	Rolling hills, cuestas, and ridges. Stream substrates typically vary between sand and firm clay, with sand more common in lower gradient reaches. Many rocky riffles occur and are composed of boulders, cobbles, or gravel.	675-1200/ 100-200	Uplands are mantled by Quaternary red clay to fine sandy decomposition residuum. Valleys are covered by Quaternary alluvium. Underlain by Cretaceous-, Permian-, and Pennsylvanian-age sandstone, shale, and clay.	On uplands: Alfisols (Haplustalfs, Paleustalfs). On floodplains: Entisols (Ustifluvents), Vertisols (Epiaquerts).	On uplands: Weatherford, Windthorst, Konsil, Darnell, Dougherty, Eufaula. Soils can be highly erodible if disturbed. On floodplains: Pulaski, Roebuck.	Thermic/ Ustic, Aquic	36-38	225-230.	27/51; 71/95	Potential natural vegetation: mostly cross timbers (dominants: blackjack oak, post oak, and little bluestem). Native on porous, coarse-textured soils derived from sandstone: blackjack oak, post oak, and understory grasses. Native on fine-textured soils derived from clay: prairie. Native in riparian areas: pecan, black walnut, American elm, and cottonwood. Today, oak savannas, prairie openings, and bottomland hardwood forests occur.	Grassland, pastureland, rangeland, woodland, and cropland. The main crops are small grains, grain sorghum, forage sorghum, and peanuts. Small impoundments are common. Oil production occurs.
29d. Grand Prairie	85	Nearly level to rolling plains with incised, meandering streams. Stream substrates consist mostly of mud, but there are occasional areas with rocky riffles.	650-1000/ 50-200	Mantled by Quaternary clayey and silty decomposition residuum. Underlain by Cretaceous-age limestone, marl, clay, and shale.	Vertisols (Haplusterts), Mollisols (Argiustolls). On floodplains: Mollisols (Haplustolls).	Durant, Slidell, Heiden, Sanger; these soils are clayey, very slowly permeable, prone to severe sheet erosion, and derived from fine-grained calcareous sediments. On floodplains: Gowen.	Thermic/ Ustic	38-39	225-230	29/51; 72/94	Potential natural vegetation: tall grass prairie (dominants: big bluestem, little bluestem, switchgrass, and Indiangrass). Native on dry, shallow soils with interspersed clay layers: scattered short grass prairie. In riparian areas, where the limestone has been eroded away to expose underlying clays, American elm, hackberry, and pecan occur.	Cropland and, especially on steeper sites, pastureland. The main crops are alfalfa hay, small grains, grain sorghum, corn, peanuts, and pecans. Small impoundments are common.
29g. Arbuckle Uplift	976	Rolling hills and plains. The western 1/3 includes the Ardmore Basin. The eastern 2/3 includes the Arbuckle Plains. Many springs flow from underlying limestone, substantially contributing to stream flow. As a result, streams are cool, and usually have good summer baseflow and low turbidity. Channels are composed of coarse sand, gravel, cobbles, or bedrock. Vernal pools sometimes occur where granite is at the surface.	575-1300/ 75-200	Mostly mantled by Quaternary loamy colluvium (containing limestone or sandstone clasts); over granite, feldspathic grus. Valleys are covered by Quaternary alluvium. Underlying the Arbuckle Plains: mainly Precambrian-age granite and Ordovician-age limestone and dolomite that has been folded and faulted; also, Pennsylvanian-, Mississippian-, and Devonian-age shale occurs. Underlying the Ardmore Basin: Mississippian- and Pennsylvanian-age shale and sandstone that has been folded and faulted. Rock outcrops occur.	On uplands underlain by limestone: Mollisols (Haplustolls, Argiudolls, Calciustolls). On uplands underlain by granite: Alfisols (Paleustalfs), Mollisols (Argiustolls). On floodplains: Mollisols (Haplustolls, Hapludolls), Entisols (Udifluvents, Ustifluvents).	On uplands over limestone: Kiti, Lula, Talpa, Rayford, Shidler, Claremore; soils are mostly shallow, moisture deficient, and erodible. On uplands over granite: Chigley, Agan, Ravia; soils are deep and fertile. On floodplains: Verdigris, Port, Oklared, Pulaski.	Thermic/ Ustic, Udic	38-43. Rainfall increases eastward.	215-235. Frost free season is shortest in protected valleys.	26/49; 71/93	Potential natural vegetation: tall grass prairie (dominants: big bluestem, little bluestem, switchgrass, and Indiangrass) and cross timbers (dominants: post oak, blackjack oak, and little bluestem). Today, prairie is extensive on rolling uplands; in addition, oak woodland occurs on steeper slopes, and bottomland hardwood forest, containing pecan, black walnut, American elm, and cottonwood is found in riparian areas.	Mostly grassland and rangeland; woodland occurs on slopes, in draws, and along streams. Cropland is limited to floodplains and nearly level uplands with deep soils. The main crops are alfalfa, small grains, and grain sorghum. Dimensional stone and crushed stone are quarried from dolomite, limestone, granite, and sandstone. Impoundments are common.
29h. Northwestern Cross Timbers	1850	Mostly rolling hills; nearly level uplands also occur. Includes the canyons of Caddo and Canadian counties that contain permanent streams fed by cliff-base springs. Most streams have fine sandy substrates, but some reaches have firm clay bottoms, others have rocky riffles, and still others have bedrock substrates.	800-1700/ 75-200	Uplands are mantled by Quaternary sandy clay loam decomposition residuum and fine sandy loam decomposition residuum. Valleys are veneered with Quaternary alluvium. Underlain by Permian-age sandstone, siltstone, and shale.	On uplands: Alfisols (Haplustalfs, Paleustalfs), Inceptisols (Haplustepts), Mollisols (Argiustolls). On floodplains: Mollisols (Haplustolls), Entisols (Udifluvents).	On uplands: Darnell, Stephenville, Noble, Konawa, Dougherty, Eufaula, Pond Creek. On floodplains: Port, Yahola, Gracemont.	Thermic/ Ustic, Udic	31-38. Precipitation increases southward and eastward.	200-230. Frost free season increases southward and eastward.	22/47 in the northwest to 27/50 in the south; 68/94 in the northwest to 71/94 in the south	Potential natural vegetation: mostly cross timbers (dominants: blackjack oak, post oak, and little bluestem); also, some tall grass prairie (dominants: big bluestem, little bluestem, switchgrass, and Indiangrass). Native on soils derived from sandstone: woodlands. Native on fine-grained soils: prairies. Today, on uplands: savannas are dominated by blackjack oak, eastern redcedar, post oak, and hickory, and have an understory of tall or mid grasses. In canyons deep enough to be shaded and protected from strong, drying winds: forests of sugar maple and chinquapin oak, basswood, black walnut, American elm, hackberry, and Shumard oak. In riparian areas: willow and cottonwood occur.	Woodland, grassland, rangeland, and especially on level uplands and floodplains, cropland growing small grains, alfalfa, grain sorghum, cotton, and peanuts. Cultivation and overgrazing have widely destroyed native prairie. Small impoundments are common. Flood control and channelization projects affect the canyons of Caddo and Canadian counties. Gas and oil fields occur.
29i. Arbuckle Mountains	208	Anticlinal high hills and low mountains with valleys, ravines, caves, sinkholes, and many rocky ledges. Springs occur along the main drainages and contribute to stream flow. Cool, clear, fast-flowing streams with gravel, cobble, or bedrock substrates are common.	750-1400/ 100-600	Uplands are veneered with Quaternary loamy colluvium (with limestone or sandstone clasts). Valleys are mantled by Quaternary alluvium and travertine. Underlain by folded Mississippian-, Devonian-, Ordovician-, and Cambrian-age limestone, dolomite, sandstone, and shale as well as Cambrian-age rhyolite porphyry. Rock outcrops are common.	On uplands: Mollisols (Haplustolls). On floodplains: Entisols (Udifluvents), Mollisols (Haplustolls).	On uplands: Kiti, Rayford. Stony, shallow and very shallow soils are common on uplands, and are often derived from calcareous residuum or colluvium; they are not suited to tillage. On floodplains: Yahola, Elandco, Garvin.	Thermic/ Ustic, Udic	39-40	215-225	26/51; 70/93	Potential natural vegetation: cross timbers (dominants: blackjack oak, post oak, and little bluestem). In the early 19th century, uplands were covered by prairie or savanna, and ravines supported forests. Today, on shallow upland soils: woodlands occur and contain blackjack oak, post oak, winged elm, Ashe juniper, and eastern redcedar. Today, on rocklands: grasslands occur and are dominated by little bluestem, side-oats grama, and hairy grama; black lace cactus and plains prickly pear are also common. In ravines: mesic forests containing oaks, redbud, American elm, cottonwood, and sycamore are found.	Woodland, grassland, rangeland, and in ravines, mesic forests. Cropland is confined to broad floodplains. Recreational uses are important.

33. EAST CENTRAL TEXAS PLAINS

Level IV Ecoregion		Physiography	Geology		Soils			Climate			Vegetation	Land Cover and Land Use
	Area (square miles)		Elevation/ Local Relief (feet)	Surficial and Bedrock	Order (Great Group)	Common Soil Series	Temperature/ Moisture Regimes	Precipitation Mean annual (inches)	Frost Free Mean annual (days)	Mean Temperature January min/max; July min/max (°F)		
33a. Northern Post Oak Savanna	364	Level to rolling plains. Extensive flats occur. In smaller streams: substrates are dominated by fine sand, but many areas of bedrock, and cobble-gravel riffle sections, occur. In larger streams: substrates are typically composed of mud and very fine sand.	490-720/ 50-200	Mostly mantled by Quaternary silt, clay, sand, and gravel decomposition residuum; along streams, Quaternary alluvium occurs. Underlain by Cretaceous-age plastic shale, marl, limestone, sand, and gravel.	On uplands: Mollisols (Argiustolls, Argiudolls), Alfisols (Paleudalfs). On floodplains: Mollisols (Hapludolls).	On uplands: Durant, Dennis, Boxville, Muskogee. Typically, soils have clayey or loamy subsoil, and are slowly to very slowly permeable; they were derived from clayey or loamy sediment. On floodplains: Verdigris, Gowton.	Thermic/ Udic, Ustic	42-45	230-235	29/51; 71/93	Potential natural vegetation: tall grass prairie (dominants: big bluestem, little bluestem, switchgrass, and Indiangrass) and cross timbers (dominants: blackjack oak, post oak, and little bluestem). Native on floodplains: bottomland forest. Today, in riparian areas: cottonwood, sycamore, willow, elm, and ash occur.	Cropland, pastureland, and riparian forest. Primary crops are peanuts, soybeans, grain sorghum, small grains, hay, and cotton.

35. SOUTH CENTRAL PLAINS

Level IV Ecoregion		Physiography	Geology		Soils			Climate			Vegetation	Land Cover and Land Use
	Area (square miles)		Elevation/ Local Relief (feet)	Surficial and Bedrock	Order (Great Group)	Common Soil Series	Temperature/ Moisture Regimes	Precipitation Mean annual (inches)	Frost Free Mean annual (days)	Mean Temperature January min/max; July min/max (°F)		
35b. Floodplains and Low Terraces	51	Nearly level floodplains and low terraces. Natural levees, swales, oxbow lakes, and meander scars occur. Many areas are frequently flooded, and wetlands are common. Includes meandering, low gradient, slowly flowing reaches of the Little River that have substrates of mud and organic matter.	289-390/ 10-50	Holocene alluvium.	Alfisols (Glossaqualfs), Entisols (Udifluvents).	Guyton, Ochlockonee.	Thermic/ Aquic, Udic	53-55	225	29/53; 70/94	Potential natural vegetation: southern floodplain forest. Today, on better drained sites: southern red oak, white oak, hickories, shortleaf pine, and loblolly pine. On natural levees that are not subject to prolonged flooding: red maple, river birch, sycamore, and American elm. On periodically flooded sites: willow oak, sweetgum, black willow, water oak, Shumard oak, and green ash. On sites submerged for long periods: water hickory, green ash, and overcup oak. On permanently flooded sites: baldcypress.	Forested wetlands, deciduous forest, pastureland, and on better-drained sites that are protected from flooding, some cropland producing hay, soybeans, corn, and grain sorghum. Forest grazing is common. Bottomland forests are critical habitat for waterfowl.
35c. Pleistocene Fluvial Terraces	267	Nearly level to undulating stream terraces; scattered mounds occur. There are several different terrace levels; age and dissection increase with increasing elevation. Where different terraces abut, seeps occur. Substrates are mostly composed of organic material and mud, but areas of gravel also occur.	310-400/ 10-50	Pleistocene fluvial terrace deposits containing sequences of unconsolidated gravel, sand, silt, and clay that are capped, in places, by windblown silt and fine sand.	Alfisols (Glossaqualfs, Paleudalfs). On mounds: Alfisols (Glossudalfs).	Wrightsville, Guyton, Muskogee. On mounds: Elysian. On flats: heavy soils that are saturated during rainy periods, and dry and hard at other times.	Thermic/ Aquic, Udic	48-55. Rainfall decreases westward.	225-235	29/52; 70/94	Potential natural vegetation: oak–hickory–pine forest. Native on floodplains is deciduous forest dominated by American elm, hackberry, water oak, southern red oak, and green ash. On the lowest terrace: extensive hardwood wetlands. On the broad flats of higher terraces: extensive pine flatwoods that are adapted to seasonally wet or dry conditions and dominated by loblolly pine, sweetgum, and oaks; this seasonal hydroxeric regime favors loblolly pine over shortleaf pine. On mounds: large pines occur.	Mainly woodland, pastureland, and wetland; also some cropland producing hay and soybeans. Logging occurs.
35d. Cretaceous Dissected Uplands	2016	Level to hilly, dissected uplands and low cuestas. Large streams are often deep, slowly moving, and have muddy or sandy bottoms; a few rocky riffles occur. In smaller streams, there are many riffle sections with gravel, cobble, and sometimes, boulder substrates; runs over gravel, and pools with sand, silt, or rocky substrates also occur.	310-700/ Less than 50-200	Valleys are mantled by Quaternary alluvium. Uplands are underlain by poorly-consolidated, often calcareous, Cretaceous-age sands, clays, gravels, and limestone.	Ultisols (Hapludults, Paleudults), Alfisols (Hapludalfs, Paleudalfs).	Ruston, Felker, Smithdale, Saffell, Bosville, Bernow, Tiak, Kullit, Romia, Larue. Most soils are well-drained or moderately well-drained. Soils are prone to erosion if disturbed.	Thermic/ Udic	45-55. Rainfall decreases westward.	215-235	28/52; 70/94	Potential natural vegetation: oak–hickory–pine forest. Shortleaf pine is more abundant than loblolly pine in natural woods. Native on floodplains: deciduous forest. Native on northern sites rich in cherty gravels from the Ouachita Mountains: mostly shortleaf pine. Today, moist upland forests are covered by sweetgum, hickories, blackgum, and various species of oak. Drier upland forests are dominated by oaks and pines. On floodplains: American elm, hackberry, water oak, southern red oak, and green ash occur.	Mostly forests and pastureland. The main land uses include logging, livestock farming, and poultry production. A few gently sloping areas are used for crops, including corn, soybeans, hay, small grains, and peanuts.
35g. Red River Bottomlands	168	Broad, level to nearly level floodplains and low terraces. Oxbow lakes, meander scars, backswamps, and natural levees occur. The Red River has fine sand and mud substrates; it is almost continuously turbid.	300-530/ 10-50	Holocene alluvium.	On floodplains: Entisols (Udifluvents), Vertisols (Hapluderts, Epiaquerts), Inceptisols (Eutrudepts, Epiaquepts). On natural levees: Alfisols (Hapludalfs), Mollisols (Argiudolls). On low terraces: Alfisols (Hapludalfs), Mollisols (Argiudolls).	On floodplains: Severn, Roebuck, Pledger, Oklared, Idabel, Redlake, Latanier, Kiomatia, Kaufman, Tuscumbia. On natural levees: Gallion, Caspiana. On low terraces: Karma, Garton.	Thermic/ Udic, Aquic	45-52. Rainfall decreases westward.	225-235	28/52; 70/93	Potential natural vegetation: southern floodplain forest. Native vegetation includes eastern cottonwood, sycamore, hackberry, sweetgum, green ash, pecan, water oak, willow, American elm, southern red oak, and river birch.	Mostly cleared and drained for cropland and pastureland. Artificial levees and drainage ditches are common. Cropland is found on sites protected from flooding. Soybeans, grain sorghum, alfalfa, corn, wheat, and pecans are the main crops. On poorly-drained and flood-prone flats, remnants of deciduous forest occur.
35h. Blackland Prairie	123	Level to rolling uplands. A few cuestas with north-facing escarpments occur.	300-560/ 50-150	Mantled by Quaternary alluvium and calcareous clayey residuum. Underlain by Cretaceous-age limestone, marl, and calcareous shale.	On uplands: Vertisols (Hapluderts), Mollisols (Hapludolls), Alfisols (Epiaqualfs). On floodplains: Vertisols (Hapluderts).	On uplands: Hollywood, Swink, Panola. Dark, very slowly to slowly permeable, deep soils are typical. On floodplains: Kaufman.	Thermic/ Udic, Aquic	47-55. Rainfall decreases westward.	225-235	29/52; 70/94	During and shortly after the Hypsithermal Period in the middle of the Holocene Epoch: prairie. At the beginning of the 19th century: woodland and savanna with scattered, small prairies, and on floodplains, deciduous forest. Today, on uplands: sparse oak–hickory woodlands with understory grasses occur. On floodplains: forests contain American elm, hackberry, water oak, southern red oak, and green ash.	Woodland and, especially, pastureland are common on shallow soils. Cropland is less extensive, but occurs on deeper soils. The main crops are alfalfa hay, soybeans, grain sorghum, corn, and small grains. A few prairie remnants occur.

36. OUACHITA MOUNTAINS

Level IV Ecoregion		Physiography	Geology		Soils			Climate			Vegetation	Land Cover and Land Use
	Area (square miles)		Elevation/ Local Relief (feet)	Surficial and Bedrock	Order (Great Group)	Common Soil Series	Temperature/ Moisture Regimes	Precipitation Mean annual (inches)	Frost Free Mean annual (days)	Mean Temperature January min/max; July min/max (°F)		
36a. Athens Plateau	288	Open hills with scattered east to west trending, low ridges that are divided by narrow valleys. Rocky stream substrates composed of gravel, cobbles, and boulders are common. Locally, in high gradient areas, bedrock substrates occur. Within larger pools, there may be areas with organic material or mud substrates.	375-1100/ 50-400	Slopes are mantled by Quaternary sandy to silty clay colluvium (containing shale chips and sandstone or chert clasts). Narrow valleys are mantled by Quaternary alluvium. Underlain by folded and faulted Mississippian-age shale interbedded with sandstone, chert, black shale, and tuff. Lead and quartz veins occur in fault zones.	On uplands: Ultisols (Hapludults), Alfisols (Paleudalfs), Inceptisols (Dystrudepts). On narrow floodplains: Entisols (Udifluvents), Alfisols (Hapludalfs).	On uplands: Carnasaw, Sherless, Sherwood, Zafra, Pickens, Wetsaw, Bengal, Hector. Gravelly, shaly, or stony areas are common. On narrow floodplains: Ceda, Frizzell.	Thermic/ Udic	54-56. Greatest precipitation falls on south-facing ridges.	195-220. Frost free season is shortest in protected valleys.	25/50; 66/94	Potential natural vegetation: oak–hickory–pine forest. Native on uplands: mixed shortleaf pine–upland deciduous forests. Native along streams: bottomland forests with a rich diversity of understory trees and shrubs. Loblolly pine is not native to Ecoregion 36 in Oklahoma. Today, on uplands: extensive commercial pine plantations and oak–hickory–pine forests occur. Loblolly pine and shortleaf pine are common, but mixed oak–hickory–pine forests now cover less than 20% of Ecoregion 36a. On floodplains: southern red oak, sweetgum, sycamore, white oak, and pines occur.	Mostly evergreen or mixed forest; commercial pine plantations are extensive. Some areas have been cleared for pastureland and hay production. Cattle and broiler chickens are important farm products. Logging and outdoor recreation are important land uses.
36b. Central Mountain Ranges	350	Low mountains with steep, parallel ridges divided by narrow valleys. In the south: open hills. In constricted passages between ridges: waterfalls and rapids. Perennial springs and seeps are common, but not large enough to strongly contribute to summer stream flow. All streams, except the largest, stop flowing in the driest parts of the summer. Rocky stream substrates composed of gravel, cobbles, and boulders are common. In localized, high gradient areas: bedrock substrates. In larger pools: organic material and mud substrates. During low flows: turbidity is low.	375-1550/ 50-500	Slopes are mantled by Quaternary sandy to silty clay colluvium (containing chert or quartz fragments and blocks of quartz, phyllite, or sandstone) and talus. Valleys are veneered with Quaternary alluvium. Underlain by folded and faulted Mississippian-, Silurian-, and Ordovician-age chert, sandstone, novaculite (chert), shale, conglomerate, phyllite, black shale, and minor amounts of limestone. Many rock outcrops occur.	On mountains and ridges: Ultisols (Hapludults), Alfisols (Paleudalfs), Inceptisols (Dystrudepts). On narrow floodplains: Entisols (Udifluvents), Alfisols (Hapludalfs).	On mountains and ridges: Carnasaw, Sherless, Sherwood, Zafra, Pickens, Wetsaw, Bengal, Hector. Shallow, stony soils are common. Many gravelly or stony areas occur. On narrow floodplains: Ceda, Frizzell.	Thermic/ Udic	52-55. Greatest precipitation falls on south-facing ridges.	215-230. Frost free season is shortest in protected valleys.	29/53; 68/95	Potential natural vegetation: oak–hickory–pine forest. Native on uplands: mixed shortleaf pine–upland deciduous forests or mixed shortleaf pine–upland deciduous woodlands. Native along streams: bottomland forests with a rich diversity of understory trees and shrubs. Today, on south-facing upland slopes: shortleaf pine, post oak, black oak, and hickories occur. On north-facing upland slopes: white oak, northern red oak, post oak, mockernut hickory, and maples are found. On floodplains: water oak, willow oak, hickories, sweetgum, and black gum occur.	Mostly mixed forest. On limited areas of rolling land in the south: pastureland or hayland. Includes the McCurtain County Wilderness Area, containing the largest remaining tract of unlogged, old growth oak–shortleaf pine habitat in the United States. Large areas of riparian forest were lost when Broken Bow Lake was constructed and filled.
36d. Fourche Mountains	1052	East to west trending, narrow-crested mountain ridges. Narrow valleys are common, but a few wider valleys have been cut into shale. During the driest part of the summer, all streams stop flowing, but enduring, deep pools may occur. Substrates are mostly composed of gravel and cobbles. However, bedrock bottoms occur locally, and substrates composed of mud and organic matter are common in the lower reaches of larger streams.	500-2700; crestal elevations are highest in the east/ 100-1700	Slopes are mantled by Quaternary colluvium (containing silty clay, silt, sand, and fragments of sandstone and shale). Valleys are veneered with Quaternary alluvium. Mostly underlain by folded and faulted Pennsylvanian-age sandstone and shale. Steepest ridges are capped by Pennsylvanian-age sandstone of the Jackfork Group; some ridges are also underlain by limestone. In the Potato Hills: Mississippian- through Ordovician-age chert, shale, and sandstone. Rock outcrops are common. Boulder fields occur.	On mountains and ridges: Ultisols (Hapludults, Paleudults), Inceptisols (Dystrudepts). On low ridges in broad valleys: Alfisols (Hapludalfs, Natrudalfs). On floodplains: Alfisols (Hapludalfs), Entisols (Udifluvents).	On mountains and ridges: Carnasaw, Clebit, Bengal, Octavia, Pirum. On low ridges in broad valleys: Sobol, Tuskahoma, Wister. On floodplains: Neff, Rexor, Ceda, Dela, Kenn.	Thermic/ Udic	43-50. Rainfall increases eastward.	195-210. Frost free season generally decreases eastward.	28/51; 69/95	Potential natural vegetation: oak–hickory–pine forest. Native on uplands: mixed shortleaf pine–upland deciduous forest. Native in wide valleys: woodland, forest, and prairie. Native near streams: bottomland forest with a rich diversity of understory trees and shrubs. Today, pine–oak, oak, loblolly–shortleaf pine, and oak–pine forests occur. On highest, most exposed ridgetops: gnarled and stunted white, post, and blackjack oaks, black hickory, and grassy openings occur. On north-facing, steep slopes: white oak, black oak, linden, blackgum, and hickories occur. In north-facing coves: mesic forests containing sugar maple, black hickory, black walnut, and white ash. On south-facing slopes: dry, open forests dominated by shortleaf pine, black hickory, and blackjack, black, and post oaks. On steepest south-facing sites with shallow soils: thickets of shrubs and xerophytic, rocky glades occur. On floodplains: southern red, Shumard, white, water, and willow oaks, hickories, maples, green ash, sweetgum, blackgum, eastern cottonwood, sycamore, shortleaf pine, and in the east, American beech occur.	Steeper areas: mostly mixed forest. Broad, gently sloping valleys: mainly forest, pastureland, and hayland. Logging, recreation, and woodland grazing are important land uses. Gently sloping sites have been logged more extensively than steep slopes.
36e. Western Ouachitas	1808	Low mountains and hills that are divided by narrow valleys. Streams have long, wide, deep pools that are interrupted by short, high gradient riffles with cobble and boulder substrates; the pools seem to be greatly oversized relative to stream discharge, but are smaller in all dimensions than those in Ecoregion 37d.	400-2500/ 100-1600	Slopes are mantled by Quaternary sandy to silty clay colluvium (containing shale chips and sandstone or chert clasts). Narrow valleys are veneered with Quaternary alluvium. Underlain mostly by folded and faulted Pennsylvanian- and Mississippian-age sandstone and shale; also some chert occurs.	On mountains: Ultisols (Hapludults, Paleudults), Inceptisols (Dystrudepts). On narrow floodplains: Entisols (Udifluvents).	On mountains: Carnasaw, Pirum, Clebit, Octavia, Bengal. On narrow floodplains: Ceda.	Thermic/ Udic	46-57. Greatest precipitation falls on south-facing ridges. Rainfall increases eastward.	195-225. Frost free season decreases westward.	24/50 in the east to 28/52 in the west; 65/91 in the east to 70/94 in the west	Potential natural vegetation: oak–hickory–pine forest. Native on uplands: woodlands and forests of oak or mixed shortleaf pine–oak. Native on floodplains and low terraces: bottomland forest with a rich diversity of understory trees and shrubs. Today, on uplands: loblolly pine, shortleaf pine, and upland oak–hickory–pine forest codominate. On floodplains: southern red oak, sweetgum, sycamore, white oak, and shortleaf pine occur.	Mostly evergreen or mixed forest; large commercial pine plantations occur. Logging, recreation, and woodland grazing are important land uses. Gently sloping sites have been logged much more extensively than steep slopes.
36f. Western Ouachita Valleys	575	Mountain valleys containing floodplains, stream terraces, scattered low hills, and mountain footslopes. Kiamichi River: bedrock, cobble and boulder substrates occur in the upper parts of Ecoregion 36f, while lower reaches have sand and mud bottoms with occasional rocks. Small and medium streams: long, wide, deep pools that are interrupted by short, high gradient riffles; typically, substrates are composed of cobbles and boulders.	450-1150; crests are lowest in the west/ Mostly 10-150; maximum 300	Mantled by Quaternary terrace, alluvial deposits, and colluvium. Underlain by folded and faulted Mississippian-age shale that is interbedded with sandstone, chert, black shale, and tuff.	On uplands or terraces: Alfisols (Hapludalfs, Paleudalfs, Fragiudalfs, Natrudalfs, Glossaqualfs), Ultisols (Hapludults), Inceptisols (Dystrudepts). On floodplains: Entisols (Udifluvents), Alfisols (Hapludalfs).	On uplands or terraces: Tuskahoma, Stigler, Guyton, Wister, Shermore, Sherwood, Clebit, Sobol. On floodplains: Dela, Neff, Kenn, Ceda, Pushmataha.	Thermic/ Udic, Aquic	48-56. Rainfall increases eastward.	190-205. Frost-free season is shorter than in adjacent, higher elevation ecoregions.	26/52; 67/94	Potential natural vegetation: oak–hickory–pine forest and southern floodplain forest. Prairies were common prior to the 20th century, but are now limited to mima mounds in hay meadows. Today, on floodplains: bottomland forest with southern red oak, green ash, water oak, willow oak, hickories, maples, sweetgum, eastern cottonwood, sycamore, American beech, and shortleaf pine occur. Elsewhere: mixed pine–deciduous woodland or forest occurs and contains white oak, southern red oak, post oak, hickory, blackjack oak, shortleaf pine, and understory grasses (e.g., big bluestem, little bluestem, Indiangrass, and switchgrass).	Pastureland, woodland, hayland, and very limited cropland producing soybeans and small grains. Cattle are grazed on cleared land and fed with locally grown hay. Other land uses are poultry farms and hog operations.

37. ARKANSAS VALLEY

Level IV Ecoregion		Physiography	Geology		Soils			Climate			Vegetation	Land Cover and Land Use
	Area (square miles)		Elevation/ Local Relief (feet)	Surficial and Bedrock	Order (Great Group)	Common Soil Series	Temperature/ Moisture Regimes	Precipitation Mean annual (inches)	Frost Free Mean annual (days)	Mean Temperature January min/max; July min/max (°F)		
37a. Scattered High Ridges and Mountains	387	Disjunct mountains and ridges in the structural Arkoma Basin that are dissected by narrow, steep-sided stream valleys. Stream substrates are a mixture of gravel, cobbles, and boulders.	500-2400/ 50-1900	Slopes are mantled by Quaternary colluvium. Underlain by Pennsylvanian-age sandstone, shale, and coal. Rock outcrops are common.	On uplands: Ultisols (Hapludults, Paleudults), Inceptisols (Dystrudepts). Upland soils are commonly stony or gravelly. On floodplains: Entisols (Udifluvents).	On uplands: Enders, Hector, Carnasaw, Mountainburg, Octavia, Linker, Clebit, Pirum, Bengal, Denman, Sherless, Panama. On floodplains: Ceda.	Thermic/ Udic	48-51. Greatest precipitation falls on south-facing ridges.	205-215	29/51; 69/94	Potential natural vegetation: oak–hickory and oak–hickory-shortleaf pine forests. Today, on uplands: savannas, open woodlands, and forests; post oak, blackjack oak, black hickory, shortleaf pine, planted loblolly pine, and increasingly, eastern redcedar are common. On more mesic sites in ravines and on north-facing slopes: forests contain maples, white oak, northern red oak, and chinquapin oak. In riparian areas: white oak, southern red oak, sycamore, hackberry, ash, and blackgum occur.	Mostly mixed or deciduous forest. Some less steeply sloping areas are used as pastureland or hayland. The main land uses are logging, grazing, and recreation.
37b. Arkansas River Floodplain	136	Level to undulating floodplains and low terraces along the Arkansas River. Natural levees, meander scars, oxbow lakes, point bars, swales, and backswamps occur. The substrate of the Arkansas River is a mixture of mud and sand.	390-500/ Less than 50	Holocene alluvium.	Mollisols (Hapludolls), Entisols (Udifluvents), Inceptisols (Eutrudepts), Vertisols (Hapluderts, Epiaquerts).	Severn, Moreland, Coushatta, Choska, Kiomatia, Oklared, Roebuck. Drainage conditions are variable. Clayey soils on flats and in depressions are poorly-drained. Silty, loamy, or sandy soils, especially on natural levees, are well- to excessively-drained.	Thermic/ Udic, Aquic	46-47	210-215	25/48; 70/94	Potential natural vegetation: southern floodplain forest. Native vegetation is mixed deciduous forest containing bottomland oaks (including bur oak), sycamore, sweetgum, willow, eastern cottonwood, green ash, pecan, hackberry, elm, and understory grasses.	Mostly cleared, drained, and used as cropland or pastureland. Remnant deciduous forest occurs in frequently flooded or poorly-drained areas. Cropland is common in flood-protected sites that have adequate drainage. Soybeans, wheat, grain sorghum, alfalfa, and corn are the main crops. Natural gas production occurs.
37d. Arkansas Valley Plains	1666	Undulating plains interrupted by scattered hills, and ridges in the structural Arkoma Basin. Streams have long, wide, deep pools that are occasionally interrupted by short, high gradient riffles. Pools are larger in all dimensions than those in Ecoregion 36e. Riffles have gravel substrates; their gradients are lower and their substrate type is different than in Ecoregion 36e. During protracted droughts and during most summers, streams typically have little or no flow. In streams that cease flowing, enduring pools may be 0.4 miles long and over 10 feet deep.	Mostly 100-500; maximum 1500/ Mostly 50-200; maximum 800	Mantled by Quaternary alluvium, terrace deposits, and sandy loam to silty clay loam decomposition residuum (containing sandstone fragments and shale chips). Mostly underlain by Pennsylvanian-age shale and sandstone; coal also occurs.	On plains or high terraces: Alfisols (Paleudalfs, Fragiudalfs, Hapludalfs, Natrudalfs), Mollisols (Argiudolls, Hapludolls). On scattered hills and ridges: Ultisols (Hapludults), Inceptisols (Dystrudepts). On terraces or floodplains: Vertisols (Hapluderts), Entisols (Udifluvents), Alfisols (Hapludalfs), Inceptisols (Endoaquepts).	On plains or high terraces: Stigler, Sallisaw, Shermore, Wister, Counts, Tamaha, Vian, Spiro, Kamie, McKamie, Collinsville, Dennis, Bates. Clay-rich, B-horizons are common. On scattered hills and ridges: Mountainburg, Linker, Enders, Bengal, Clebit, Hector, Carnasaw. On floodplains: Moreland, Oklared, Neff, Ceda, Severn, Kenn, Rexor, Rosebloom.	Thermic/ Udic, Aquic	48-50	205-220	26/51; 70/94	Potential natural vegetation: cross timbers (dominants: blackjack oak, post oak, and little bluestem), oak–hickory–shortleaf pine forest, and mosaic of tall grass prairie (dominants: big bluestem, little bluestem, switchgrass, and Indiangrass) and oak–hickory forest. Native on fire-prone plains with moisture deficient soils: scattered prairies with a few large oaks. Native in upland depressions and on flats with impermeable, clay-rich soils or pans: scattered wetlands. Lush deciduous forests are native along streams. Elsewhere on undulating uplands: extensive savanna and woodland composed of post oak, blackjack oak, southern red oak, hickory, and understory grasses are native. Today, in rugged areas: post oak, black oak, white oak, hickories, maple, beech, elm, shortleaf pine, planted loblolly pine, and increasingly, eastern redcedar occur. On floodplains: forests contain eastern cottonwood, sycamore, southern red oak, green ash, hackberry, pecan, sweetgum, black willow, willow oak, white oak, and water oak.	Mostly converted to agriculture; wooded areas are largely restricted to riparian areas, poorly-drained sites, and steepest slopes. Pastureland and hayland are extensive; cropland is limited. Poultry and livestock farming are important land uses. Soybeans, grain sorghum, wheat, and limited amounts of corn are grown. Natural gas production, logging, and surface coal mining occur. Acid water from coal mines affects surface water quality and aquatic biota downstream of mines.
37e. Lower Canadian Hills	2635	Mosaic of hills and valleys in the structural Arkoma Basin. Scattered ridges and numerous ponds occur. Most streams are composed of a series of long pools that are interspersed with occasional, short riffle sections; typically, pools have a mix of substrate types, and riffles have substrates composed of cobbles and gravel. A few streams primarily have sand substrates.	500-1000; maximum 1400/ Mostly 50-300; maximum 700	Mantled by Quaternary terrace deposits, alluvium, and sandy loam to silty clay loam decomposition residuum (containing sandstone fragments and shale chips). Mostly underlain by Pennsylvanian-age shale and sandstone; coal also occurs.	On prairie uplands: Mollisols (Argiudolls, Hapludolls), Alfisols (Albaqualfs). On wooded uplands: Ultisols (Hapludults), Alfisols (Hapludalfs, Haplustalfs), Inceptisols (Haplustepts, Dystrudepts). On high terraces: Alfisols (Hapludalfs, Paleudalfs). On floodplains: Mollisols (Hapludolls, Epiaquolls), Entisols (Udifluvents), Vertisols (Epiaquerts).	On prairie uplands: Dennis, Bates, Bonham, Talihina, Parsons, Collinsville, Taloka. On wooded uplands: Hector, Enders, Stephenville, Darnell, Hartsells, Endsaw, Konawa. On high terraces: Karma, Porum. On floodplains: Verdigris, Osage, Kiomatia, Lanton.	Thermic/ Udic, Ustic, Aquic	41-46. Rainfall increases eastward.	215-235	28/50; 73/91	Potential natural vegetation: cross timbers (dominants: blackjack oak, post oak, eastern redcedar, and little bluestem), tall grass prairie (dominants: big bluestem, little bluestem, switchgrass, and Indiangrass), and mosaic of tall grass prairie and oak–hickory forest. Native along streams: lush deciduous forests. In the early 19th century, scattered tall grass prairie occurred. Today, on high terraces: mixed deciduous forests (including post oak, black oak, southern red oak, and black hickory) are found. On wooded hills and ridges: post oak, blackjack oak, white oak, hickories, eastern redcedar, and shortleaf pine occur. On floodplains: eastern cottonwood, sycamore, oaks, black willow, green ash, pecan, sweetgum, and black walnut occur.	Woodland, pastureland, and cropland. Soybeans, wheat, grain sorghum, alfalfa, peanuts, and corn are the major crops. Strip mining for coal occurs. Acid water from coal mines affects surface water quality and stream biota in a few streams. Minor gas production occurs.

38. BOSTON MOUNTAINS

Level IV Ecoregion		Physiography	Geology		Soils			Climate			Vegetation	Land Cover and Land Use
	Area (square miles)		Elevation/ Local Relief (feet)	Surficial and Bedrock	Order (Great Group)	Common Soil Series	Temperature/ Moisture Regimes	Precipitation Mean annual (inches)	Frost Free Mean annual (days)	Mean Temperature January min/max; July min/max (°F)		
38b. Lower Boston Mountains	836	Low mountains, rounded high hills, and benches in the Ozark Plateau physiographic province. In summer, streams typically have little or no flow, but enduring pools that are fed by interstitial flow may occur. Stream substrates are mostly rocky, and consist of gravel, cobbles, and boulders. Within larger pools, areas with organic material or mud substrates occur.	475-1700/ 150-800	Slopes are mantled by Quaternary colluvium. Valleys are veneered with Quaternary alluvium. Mostly underlain by Pennsylvanian-age sandstone and shale; minor amounts of Pennsylvanian- and Mississippian-age limestone occur. Ecoregion 38b is a part of the Ozark Plateau; strata are much less deformed than in the Ouachita Mountains. Mountaintops are often capped by resistant sandstone. Sideslopes are often underlain by interbedded sandstone and shale. Rock outcrops are common.	On uplands: Ultisols (Hapludults, Paleudults), Inceptisols (Dystrudepts). On floodplains or low terraces: Inceptisols (Endoaquepts, Dystrudepts), Mollisols (Argiudolls, Hapludolls).	On uplands: Hector, Linker, Nella, Enders, Mountainburg, Steprock. Upland soils have low natural fertility, and are often stony or gravelly. On floodplains or low terraces: Rosebloom, Mason, Huntington, Ennis.	Thermic/ Udic, Aquic	44-51. Rainfall increases eastward.	200-220	26/48; 69/92	Potential natural vegetation: mostly oak–hickory forest. Native to uplands: forests and woodlands containing blackjack oak, post oak, and black hickory. Native to broader floodplains: bottomland hardwood forests. Today, on north-facing slopes and in ravines: sugar maple, white oak, chinquapin oak, bitternut hickory, and mockernut hickory occur. On narrow floodplains: forests contain birch, sycamore, cottonwood, elms, and willow.	Mostly forest and woodland. Flatter areas are used as pastureland or hayland. Logging and recreation are important land uses.

39. OZARK HIGHLANDS

Level IV Ecoregion		Physiography	Geology		Soils			Climate			Vegetation	Land Cover and Land Use
	Area (square miles)		Elevation/ Local Relief (feet)	Surficial and Bedrock	Order (Great Group)	Common Soil Series	Temperature/ Moisture Regimes	Precipitation Mean annual (inches)	Frost Free Mean annual (days)	Mean Temperature January min/max; July min/max (°F)		
39a. Springfield Plateau	838	Nearly level to rolling, undissected to slightly dissected portion of the Springfield Plateau physiographic region. Karst features are common, and include caves, sinkholes, solution valleys, and dry valleys. Underground drainage is widespread. Cool springs are common and substantially contribute to stream flow in the summer and fall. As a result, there are many perennial streams. Small cobble and gravel substrates are common, but occasional areas of boulders and bedrock occur.	Mostly 600-1200; maximum 1500/ 50-200	Mantled by Quaternary cherty clay solution residuum. Underlain by Mississippian-age limestone and interbedded chert.	On uplands: Ultisols (Paleudults, Fragiudults), Alfisols (Paleudalfs, Fragiudalfs), Mollisols (Paleudolls). On floodplains or low terraces: Mollisols (Hapludolls).	On uplands: Bodine, Baxter, Eldorado, Craig, Jay, Captina, Etowah. On floodplains or low terraces: Huntington.	Thermic, Mesic/ Udic	45-49	200-215	26/48; 68/91	Potential natural vegetation: mostly oak–hickory forest and some oak–hickory–pine forest. Native on uplands: mixed deciduous forest containing black oak, white oak, blackjack oak, post oak, winged elm, and hickories, as well as some mixed deciduous–shortleaf pine forest. Native on floodplains and low terraces: willow, maples, hickories, birch, American elm, and sycamore. Prior to the 19th century, savanna and tall grass prairies were common and maintained by fire.	Pastureland, hayland, or expanding residential development. Nearly all of the native prairie and most of the forests (outside of rugged or poorly-drained areas) are gone. Limited cropland produces small grains, orchard fruit, grapes, or vegetables. Most farm income is from poultry and cattle. Application of poultry litter to agricultural fields and intensive grazing has impaired downstream water quality.
39b. Dissected Springfield Plateau–Elk River Hills	1542	Moderately to highly dissected, hilly part of the Springfield Plateau physiographic region. Narrow ridgetops are separated by steep V-shaped valleys. Karst features, including dry valleys, are common. Many cool springs occur in valleys and along streams; they substantially contribute to stream flow in the summer and fall. As a result, streams are usually perennial. Bank and hillslope erosion has choked many channel reaches with cherty gravel, causing them to become braided. Other reaches have bedrock substrates.	550-1600/ 50-400	Mantled by Quaternary cherty clay solution residuum, colluvium, and alluvium. Uplands are underlain by Mississippian-age limestone and interbedded chert. Deepest valleys expose early-Mississippian- or Devonian-age shale, dolomite, and limestone. Rock outcrops are common.	On hillsides, ridgetops, or dissected uplands: Ultisols (Paleudults), Alfisols (Paleudalfs). On floodplains or low terraces: Entisols (Udifluvents), Alfisols (Paleudalfs), Mollisols (Hapludolls).	On hillsides, ridgetops, or dissected uplands: Bodine, Baxter, Clarksville, Etowah. Soils on steep hillsides are very cherty. On floodplains or low terraces: Sallisaw, Elsah, Staser, Huntington.	Thermic, Mesic/ Udic	41-48. Rainfall increases southward.	200-215	22/47 in the north to 25/47 in the south; 69/91	Potential natural vegetation: oak–hickory forest and some oak–hickory–pine forest. Native on uplands: oak–woodland, mixed deciduous forest, or mixed deciduous–pine forest containing black oak, white oak, blackjack oak, post oak, hickories, and shortleaf pine. Native on north-facing slopes and in ravines: mesic forest containing sugar maple, white oak, northern red oak. Native on floodplains: bottomland oaks, maples, hickories, sycamore, and American elm. Today, uplands are covered by mostly oak-woodland, mixed deciduous forest, or mixed deciduous–pine forest. Bottomland deciduous forests occur on floodplains.	Mostly woodland or forest. Primary land uses are livestock and poultry farming, woodland grazing, logging, recreation, and quarrying. Numerous, high quality streams and designated scenic rivers occur; they are used for canoeing and rafting.

40. CENTRAL IRREGULAR PLAINS

Level IV Ecoregion		Physiography	Geology		Soils			Climate			Vegetation	Land Cover and Land Use
	Area (square miles)		Elevation/ Local Relief (feet)	Surficial and Bedrock	Order (Great Group)	Common Soil Series	Temperature/ Moisture Regimes	Precipitation Mean annual (inches)	Frost Free Mean annual (days)	Mean Temperature January min/max; July min/max (°F)		
40b. Osage Cuestas	4907	Irregular to undulating plains that are broken by low hills and cuestas with east-facing scarps. Perennial streams occur. Streams are dominated by pools having substrates that are composed of sand, mud, and sometimes, gravel and cobbles. Riffle areas are moderately common and tend to occur every 250 to 1,300 feet; their substrates are composed of gravel, cobbles, and boulders. In the southern third of Ecoregion 40b, streams are often slowly moving and more turbid than more northerly portions.	500-1050/ 50-200	Mantled by Quaternary alluvium, terrace deposits, and fine sandy, silty, and clayey decomposition residuum. Mostly underlain by Pennsylvanian-age sandstone and shale; limestone and coal also occurs.	On prairie uplands: Mollisols (Argiudolls, Paleudolls, Haplustolls), Alfisols (Albaqualfs), Vertisols (Hapluderts). On wooded hills: Ultisols (Hapludults), Inceptisols (Dystrudepts). On floodplains or low terraces: Mollisols (Hapludolls, Argiudolls, Epiaquolls), Entisols (Udifluvents), Vertisols (Epiaquerts).	On prairie uplands: Parsons, Dennis, Bates, Taloka, Okemah, Collinsville, Newtonia, Apperson, Shidler, Coweta, Summit. On wooded hills: Hector, Enders. On floodplains and low terraces: Verdigris, Radley, Choska, Mason, Wynona, Osage, Severn, Kiomatia.	Thermic/ Aquic, Udic, Ustic	44-45	200-205	22/45; 68/91	Potential natural vegetation: mostly tall grass prairie (dominants: big bluestem, little bluestem, switchgrass, and Indiangrass), grading eastward into a mosaic of tall grass prairie and oak–hickory forest; on rocky hilltops, cross timbers (dominants: blackjack oak, post oak, and little bluestem). Native on deep loams derived from shale or limestone: tall grass prairie. Native on floodplains and low terraces: bottomland forests. Today, on rocky hills: dry upland forest and woodland is found. On shallow, gravelly soils of limestone scarps: dry prairie composed of short and tall grasses occurs. In riparian areas: forests contain boxelder, silver maple, bur oak, Shumard oak, American elm, hackberry, pecan, walnut, sycamore, and eastern cottonwood.	Mosaic of rangeland, grassland, cropland, and especially in more rugged areas, woodland. Wooded riparian corridors occur on wettest bottomlands. Wheat, soybeans, grain sorghum, and alfalfa hay are major crops. Livestock (especially cattle) farming is important. Strip mining for coal and oil production have degraded water quality in a few streams.
40d. Cherokee Plains	305	Flat to gently sloping plains and broad valleys. Perennial streams occur and typically have firm clay and mud substrates; occasional gravel riffles occur.	750-950/ 10-100	Mantled by Quaternary alluvium and decomposition residuum of fine sandy-, silty-, and clayey-texture. Underlain by Pennsylvanian-age shale and sandstone; some coal and minor amounts of limestone occur.	On uplands or high terraces: Mollisols (Argiudolls), Alfisols (Albaqualfs). On floodplains: Mollisols (Hapludolls), Vertisols (Epiaquerts).	On uplands or high terraces: Parsons, Dennis, Bates, Taloka, Summit. Clayey, slowly to very slowly permeable soils with claypans are common. After storms, water may stand on surface. In dry weather, soils are deficient in moisture. On floodplains: Verdigris, Osage.	Thermic/ Aquic, Udic	39-45. Rainfall increases southward and eastward.	200-225. Frost free season increases southward.	23/47; 70/94	Potential natural vegetation: mostly tall grass prairie (dominants: big bluestem, little bluestem, switchgrass, and Indiangrass). Today, on areas of greater relief in the east: oak–hickory woodland is common. On poorly-drained sites that are generally flooded during the winter and spring, but dry in summer: thickets of sedges, willow, and buttonbush occur. In riparian areas: forests contain American elm, oaks, hackberry, black walnut, cottonwood, sycamore, and pecan.	Mostly cropland; also rangeland. Riparian areas are wooded. Soybeans, wheat, alfalfa hay, and sorghum are major crops. Cattle and broiler chickens are the main farm products. Much of the historic Picher Mining District no longer supports vegetation, allowing fine particles to be suspended by winds. Extensive tailings remain, and metal-laden, acidic discharges still pollute streams.

SOURCES:

Barber, S.C., 1979, Floristic components of the Gypsum Hills and Redbed Plains area of southwestern Oklahoma: Southwestern Naturalist, v. 24, no. 3, p. 431-437.

Barclay, J.S., 1978, The effects of channelization on riparian vegetation and wildlife in south central Oklahoma, *in* Johnson, R.R., and McCormick, J.F., editors, Strategies for protection and management of floodplain wetlands and other riparian ecosystems–proceedings of the symposium: Washington, D.C., U.S. Department of Agriculture–Forest Service, General Technical Report, WO-12, p. 129-137.

Bingham, R.H., and Bergman, DeRoy L., 1980, Reconnaissance of the water resources of the Enid quadrangle, north-central Oklahoma: Norman, Oklahoma Geological Survey, Hydrologic Atlas 7, Map HA-7, map scale 1:250,000.

Bingham, R.H., and Moore, R.L., 1975, Reconnaissance of the water resources of the Oklahoma City quadrangle, central Oklahoma: Norman, Oklahoma Geological Survey, Hydrologic Atlas 4, Map HA-4, map scale 1:250,000.

Blair, A.P., 1959, Distribution of the darters (*Percidae*, *Etheostomatinae*) of northeastern Oklahoma: Southwestern Naturalist, v. 4, no. 1, p. 1-13.

Blair, W.F., and Hubbell, T.H., 1938, The biotic districts of Oklahoma: The American Midland Naturalist, v. 20, no. 2, p. 425-454.

Booth, W.E., 1941, Revegetation of abandoned fields in Kansas and Oklahoma: American Journal of Botany, v. 28, no. 5, p. 415-422.

Bureau of Economic Geology, 1984, Geologic Atlas of Texas – Dalhart Sheet: Austin, University of Texas at Austin, Bureau of Economic Geology, scale 1:250,000.

Bureau of Economic Geology, 1993, Geologic Atlas of Texas – Perryton Sheet: Austin, Texas, University of Texas at Austin, Bureau of Economic Geology, scale 1:250,000.

Caire, W., 1989, Physiognomic regions of Oklahoma, *in* Caire, W., Tyler, J.D., Glass, B.P., and Mares, M.A., Mammals of Oklahoma: Norman, University of Oklahoma Press, p. 12-26.

Caire, W., Tyler, J.D., Glass, B.P., and Mares, M.A., 1989, Mammals of Oklahoma: Norman, University of Oklahoma Press, 567 p.

Carr, J.E., and Bergman, DeRoy L., 1976, Reconnaissance of the water resources of the Clinton quadrangle, west-central Oklahoma: Norman, Oklahoma Geological Survey, Hydrologic Atlas 5, Map HA-5, map scale 1:250,000.

Chapman, S.S., Omernik, J.M., Freeouf, J.A., Huggins, D.G., McCauley, J.R., Freeman, C.C., Steinauer, G., Angelo, R.T., and Schlepp, R.L., 2001, Ecoregions of Nebraska and Kansas (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey, map scale 1:1,950,000.

Chapman, S.S., Omernik, J.M., Griffith, G.E., Schroeder, W.A., Nigh, T.A., and Wilton, T.F., 2002, Ecoregions of Iowa and Missouri (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey, map scale 1:1,800,000.

Coppedge, B.R., Engle, D.M., Fuhlendorf, S.D., Master, R.E., and Gregory, M.S., 2001, Landscape cover type and pattern dynamics in fragmented southern Great Plains grasslands, USA: Landscape Ecology, v. 16, p. 677-690.

Crockett, J.J., 1964, Influence of soils and parent material on grasslands of the Wichita Mountains Wildlife Refuge, Oklahoma: Ecology, v. 45, p. 326-335.

Crockett, J.J., 1985, Ecology of eastern redcedar in Oklahoma, *in* Wittwer, R.F., and Engle, D.M., editors, Proceedings, Eastern redcedar in Oklahoma Conference: Stillwater, Oklahoma State University, Cooperative Extension Service, E-849, p. 1-8.

Cross, F.B., and Moore, G.A., 1952, The fishes of the Poteau River, Oklahoma and Arkansas: The American Midland Naturalist, v. 47, no. 2, p. 396-412.

Curtis, N.M., Jr., and Ham, W.E., 1979, Geomorphic provinces of Oklahoma, *in* Johnson, K.S., and others, Geology and earth resources of Oklahoma: Norman, Oklahoma Geological Survey, Educational Publication 1, p. 3, map scale 1:2,000,000.

Dhillion, S.S., and Mills, M.H., 1999, The sand shinnery oak (*Quercus havardii*) communities of the Llano Estacado – history, structure, ecology, and restoration, *in* Anderson, R.C., Fralish, J.S., and Baskin, J.M., editors, Savannas, barrens, and rock outcrop plant communities of North America: New York, Cambridge University Press, p. 262-274.

Doerr, A.H., and Sutherland, S.M., 1964, Variations in Oklahoma's climate as depicted by the Köppen and early Thornthwaite classifications: Journal of Geography, v. 63, no. 2, p. 61-66.

Dowling, H.G., 1956, Geographic relations of Ozarkian amphibians and reptiles: Southwestern Naturalist, v. 1, p. 174-189.

Duck, L.G., and Fletcher, J.B., 1945, A survey of the game and furbearing animals of Oklahoma: Oklahoma City, Oklahoma Game and Fish Commission, Division of Wildlife Restoration and Research, Pittman-Robertson Series no. II, State Bulletin no. 3, 144 p.

Dwyer, D.D., and Santelmann, P.W., 1964, A comparison of post oak–blackjack oak communities on two major soil types in north central Oklahoma: Stillwater, Oklahoma State University, Oklahoma Agricultural Research Experiment Station, Bulletin B-626, 15 p.

Engle, D.M., 1985, Effects of eastern redcedar on range forage and livestock production, *in* Wittwer, R.F., and Engle, D.M., editors, Proceedings, Eastern redcedar in Oklahoma Conference: Stillwater, Oklahoma State University, Cooperative Extension Service, E-849, p. 53-60.

Engle, D.M., Bidwell, T.G., and Moseley, M.E., 1996, Invasion of Oklahoma rangelands and forests by eastern redcedar and Ashe juniper: Stillwater, Oklahoma State University, Division of Agricultural Sciences and Natural Resources, Oklahoma Cooperative Extension Service, Circular E-947, 10 p.

Foti, T.L., and Bukenhofer, G.A., 1998, A description of the sections and subsections of the Interior Highlands of Arkansas and Oklahoma: Journal of the Arkansas Academy of Science, v. 52, p. 53-62.

Francaviglia, R.V., 2000, The cast iron forest – a natural and cultural history of the North American Cross Timbers: Austin, University of Texas Press, 296 p.

Glass, B.P., 1989, Zoogeographical affinities, *in* Caire, W., Tyler, J.D., Glass, B.P., and Mares, M.A., Mammals of Oklahoma: Norman, University of Oklahoma Press, p. 27-30.

Goodman, J.M., 1977, Physical environments of Oklahoma, *in* Morris, J.W., editor, 1977, Geography of Oklahoma: Oklahoma City, Oklahoma Historical Society, v. 6, The Oklahoma Series, p. 8-24.

Gray, F., and Galloway, H.M., 1959, Soils of Oklahoma (text and map): Stillwater, Oklahoma State University, Oklahoma Agricultural Experiment Station in cooperation with the U.S. Soil Conservation Service, Miscellaneous Publication, MP 56, 65 p., map scale approximately 1:1,500,000.

Griffith, G.E., Bryce, S.A., Omernik, J.M., Comstock, J.A., Rogers, A.C., Harrison, B., Hatch, S.L., and Bezanson, D., 2004, Ecoregions of Texas (color poster with map, descriptive text, and photographs): Reston, Virginia, U.S. Geological Survey, map scale 1:2,500,000.

Harlan, J.R., no date (possibly1957), Grasslands of Oklahoma: no location (possibly Stillwater), Oklahoma State University, 160 p.

Hart, D.L., Jr., 1983, Reconnaissance of the water resources of the Ardmore and Sherman quadrangles, southern Oklahoma: Norman, Oklahoma Geological Survey, Hydrologic Atlas 3, Map HA-3, map scale 1:250,000.

Havens, J.S., 1977, Reconnaissance of the water resources of the Lawton quadrangle, southwestern Oklahoma: Norman, Oklahoma Geological Survey, Hydrologic Atlas 6, Map HA-6, map scale 1:250,000.

Hoagland, B.W., 1998, Ecoregions, *in* Fallon, A., and Smolen, M., editors, Riparian area management handbook: Stillwater, Oklahoma State University, Division of Agricultural Sciences and Natural Resources, Oklahoma Cooperative Extension Service and Oklahoma Conservation Commission, Circular E-952, p. 5-17.

Hoagland, B.W., 2000, The vegetation of Oklahoma – a classification for landscape mapping and conservation planning: Southwestern Naturalist, v. 45, no. 4, p. 385-420.

Hoagland, B.W., Butler, I.H., Johnson, F.L., and Glenn, S., 1999, The Cross Timbers, *in* Anderson, R.C., Fralish, J.S., and Baskin, J.M., editors, Savannas, barrens, and rock outcrop plant communities of North America: New York, Cambridge University Press, p. 231-245.

Hoagland, B.W., Sorrels, L.R., and Glenn, S.M., 1996, Woody species composition of floodplain forests of the Little River, McCurtain and LeFlore counties, Oklahoma: Proceedings of the Oklahoma Academy of Science, v. 76, p. 23-29.

Irwin, J.H., 1977, Water resources, *in* Morris, J.W., editor, 1977, Geography of Oklahoma: Oklahoma City, Oklahoma Historical Society, v. 6, The Oklahoma Series, p. 25-39.

Johnson, F.L., 1986, Woody vegetation of southeastern LeFlore County, Oklahoma, in relation to topography: Proceedings of the Oklahoma Academy of Science, v. 66, p. 1-6.

Johnson, H.L., and Duchon, C.E., 1994, Atlas of Oklahoma climate: Norman, University of Oklahoma Press, 104 p.

Knechtel, M.M., 1952, Pimpled plains of eastern Oklahoma: Bulletin of the Geological Society of America, v. 63, p. 689-700.

Küchler, A.W., 1964, Potential natural vegetation of the conterminous United States (manual and map): American Geographical Society, Special Publication 36, map scale 1:3,168,000.

Little, E.L., 1980, Baldcypress (*Taxodium distichum*) in Oklahoma: Proceedings of the Oklahoma Academy of Science, v 60, p. 105-107.

Little, E.L., Jr., 1939, The vegetation of Caddo County canyons, Oklahoma: Ecology, v. 20, no. 1, p. 1-10.

Little, E.L., Jr., 1966, Forest trees of Oklahoma: Oklahoma City, Oklahoma Department of Agriculture, Forestry Services, Publication no. 1, revised edition no. 14, 205 p.

Loveland, T.R., Merchant, J.W., Brown, J.F., Ohlen, D.O., Reed, B.C., Olsen, P., and Hutchinson, J., 1995, Seasonal land-cover regions of the U.S.: Annals of the Association of American Geographers, v. 85, no. 2, p. 339-355.

Marcher, M.V., 1969, Reconnaissance of the water resources of the Fort Smith quadrangle, eastern-central Oklahoma: Norman, Oklahoma Geological Survey, Hydrologic Atlas 1, Map HA-1, map scale 1:250,000.

Marcher, M.V., and Bergman, DeRoy L., 1983, Reconnaissance of the water resources of the McAlester and Texarkana quadrangles, southeastern Oklahoma: Norman, Oklahoma Geological Survey, Hydrologic Atlas 9, Map HA-9, map scale 1:250,000.

Marcher, M.V., and Bingham, R.H., 1971, Reconnaissance of the water resources of the Tulsa quadrangle, northeastern Oklahoma: Norman, Oklahoma Geological Survey, Hydrologic Atlas 2, Map HA-2, map scale 1:250,000.

Master, L.L., Flack, S.R., and Stein, B.A., editors, 1998, Rivers of life–critical watersheds for protecting freshwater biodiversity: A NatureServe Publication, The Nature Conservancy in cooperation with Natural Heritage Programs and the Association for Biodiversity Information, 71 p.

Masters, R.E., 1993, Oklahoma's endangered and threatened species: Stillwater, Oklahoma State University, Division of Agricultural Sciences and Natural Resources, Oklahoma Cooperative Extension Service, Forestry Extension Report 6, 44 p.

Masters, R.E., Skeen, J.E., and Garner, J.A., 1989, Red-cockaded woodpecker in Oklahoma – an update of Wood's 1974-77 study: Proceedings of the Oklahoma Academy of Science, v. 69, p. 27-31.

McDonald, C.B., 1976, A floristic study of Washington County, Oklahoma: Proceedings of the Oklahoma Academy of Science, v. 56, p. 53-54.

Miller, R.J., and Robison, H.W., 1973, The fishes of Oklahoma: Stillwater, Oklahoma State University Press, 246 p.

Morris, J.W., editor, 1977, Geography of Oklahoma: Oklahoma City, Oklahoma Historical Society, v. 6, The Oklahoma Series, 182 p.

Morton, R.B., 1980, Reconnaissance of the water resources of the Woodward quadrangle, northwestern Oklahoma: Norman, Oklahoma Geological Survey, Hydrologic Atlas 8, Map HA-8, map scale 1:250,000.

Ortenburger, A.I., and Bird, R.D., 1933, The ecology of the western Oklahoma Salt Plains: Publications of the University of Oklahoma Biological Survey, v. 5, no. 3, p. 49-64.

Palmer, E.J., 1924, The ligneous flora of Rich Mountain, Arkansas and Oklahoma: Journal of the Arnold Arboretum, v. V, p. 108-134.

Penfound, W.T., 1962a, Influence of a wildfire in the Wichita Mountains Wildlife Refuge, Oklahoma: Ecology, v. 49, no. 5, p. 1003-1006.

Penfound, W.T., 1962b, The savanna concept in Oklahoma: Ecology, v. 43, no. 4, p. 774-775.

Peterson, R.S., and Boyd, C.S., 1998, Ecology and management of sand shinnery communities–a literature review: Fort Collins, U.S. Department of Agriculture–Forest Service, Rocky Mountain Research Station, General Technical Report, RMRS-GTR-16, 44 p.

Petranka, J.W., and Holland, R., 1980, A quantitative analysis of bottomland communities in south-central Oklahoma: Southwestern Naturalist, v. 25, no. 2, p. 207-214.

Pettyjohn, W.A., White, H., and Dunn, S., 1983, Water atlas of Oklahoma: Stillwater, Oklahoma State University, University Center for Water Research, 72 p.

Rhodes, L.K., 1980, Correlation between vegetation and geologic formations in Oklahoma: Norman, Oklahoma Geological Survey, Oklahoma Geology Notes, v. 40, no. 2, p. 47-62.

Rice, E.L., 1965, Bottomland forests of north-central Oklahoma: Ecology, v. 46, no. 5, p. 708-714.

Rice, E.L., and Penfound, W.T., 1959, The upland forests of Oklahoma: Ecology, v. 40, no. 4, p. 593-608.

Richmond, G.M., and Christiansen, A.C., editors, 1993, Quaternary geologic map of the Wichita 4° x 6° quadrangle, United States: Reston, Virginia, U.S. Geological Survey, Quaternary Geologic Atlas of the United States, Miscellaneous Investigations Series, Map I-1420 (NJ-14), map scale 1:1,000,000.

Richmond, G.M., and Christiansen, A.C., editors, 1994, Quaternary geologic map of the Dallas 4° x 6° quadrangle, United States: Reston, Virginia, U.S. Geological Survey, Quaternary Geologic Atlas of the United States, Miscellaneous Investigations Series, Map I-1420 (NI-14), map scale 1:1,000,000.

Richmond, G.M., and Weide, D.L., editors, 1993, Quaternary geologic map of the Ozark Plateau 4° x 6° quadrangle, United States: Reston, Virginia, U.S. Geological Survey, Quaternary Geologic Atlas of the United States, Miscellaneous Investigations Series, Map I-1420 (NJ-15), map scale 1:1,000,000.

Rogers, C.M., 1954, Some botanical studies in the Black Mesa region of Oklahoma: Rhodora, v. 56, no. 670, p. 205-212.

Rollins, D., 1985, Controlling eastern redcedar with prescribed fire, *in* Wittwer, R.F., and Engle, D.M., editors, Proceedings, Eastern redcedar in Oklahoma Conference: Stillwater, Oklahoma State University, Cooperative Extension Service, E-849, p. 71-83.

Smith, B.A., Tyrl, R.J., and Masters, R.E., 1997, Floristic inventory of the McCurtain County Wilderness Area, Oklahoma: Proceedings of the Oklahoma Academy of Science, v. 77, p. 99-102.

Smith, R., 1985, Importance of eastern redcedar for wildlife, *in* Wittwer, R.F., and Engle, D.M., editors, Proceedings, Eastern redcedar in Oklahoma Conference: Stillwater, Oklahoma State University, Cooperative Extension Service, E-849, p. 27-30.

Smola, N.E., 1985, Conservation uses of eastern redcedar, *in* Wittwer, R.F., and Engle, D.M., editors, Proceedings, Eastern redcedar in Oklahoma Conference: Stillwater, Oklahoma State University, Cooperative Extension Service, E-849, p. 31-34.

Snook, E.C., 1985, Distribution of eastern redcedar on Oklahoma rangelands, *in* Wittwer, R.F., and Engle, D.M., editors, Proceedings – Eastern Redcedar in Oklahoma Conference: Stillwater, Oklahoma State University, Cooperative Extension Service, E-849, p. 45-52.

Stadler, S.J., Carney, G.O., and Gregory, M., 1992, The meridian of the plains – a natural boundary in Oklahoma, *in* Janelle, D.G., editor, Geographical snapshots of North America: New York, Guilford Press, p. 250-254.

Stahle, D.W., and Hehr, J.G., 1984, Dendroclimatic relationships of post oak across a precipitation gradient in the southcentral United States: Annals of the Association of American Geographers, v. 74, no. 4, p. 561-573.

Stein, B.A., Kutner, L.S., and Adams, J.S., editors, 2000, Precious Heritage: New York, Oxford University Press, a joint project of The Nature Conservancy and Association for Biodiversity Information, 399 p.

Stevenson, M.M., Schnell, G.D., and Black, R., 1974, Factor analysis of fish distribution patterns in western and central Oklahoma: Systematic Zoology, v. 23, no. 2., p. 202-218.

Taylor, R.J., 1965, Shortleaf pine (*Pinus echinata*) in Bryan County, Oklahoma: Southwestern Naturalist, v. 10, no. 1, p. 42-47.

Thornthwaite, C.W., 1948, An approach toward a rational classification of climate: Geographical Review, v. 38, no. 1, p. 53-94.

Toepfer, C.S., Williams, L.R., Martinez, A.D., and Fisher, W.L., 1998, Fish and habitat heterogeneity in four streams in the Central Oklahoma/Texas Plains Ecoregion: Proceedings of the Oklahoma Academy of Science, v. 78, p. 41-48.

Ungar, I.A., 1968, Species-soil relationships on the Great Salt Plains of northern Oklahoma: The American Midland Naturalist, v. 80, no. 2, p. 392-406.

Uno, G.E., and Collins, S.L., 1987, Primary succession on granite outcrops in southwestern Oklahoma: Bulletin of the Torrey Botanical Club, v. 114, no. 4, p. 387-392.

U.S. Department of Agriculture–Forest Service, 1969, A forest atlas of the South: New Orleans, Louisiana, U.S. Department of Agriculture–Forest Service, Southern Forest Experiment Station and Southeastern Forest Experiment Station, 27 p.

U.S. Department of Agriculture–Forest Service, 1999a, Ozark-Ouachita Highlands assessment – aquatic conditions, report 3 of 5: Asheville, North Carolina, U.S. Department of Agriculture–Forest Service, Southern Research Station, General Technical Report, SRS-33, 317 p.

U.S. Department of Agriculture–Forest Service, 1999b, Ozark-Ouachita Highlands assessment – summary report, report 1 of 5: Asheville, North Carolina, U.S. Department of Agriculture–Forest Service, Southern Research Station, General Technical Report, SRS-31, 56 p.

U.S. Department of Agriculture–Forest Service, 1999c, Ozark-Ouachita Highlands assessment – terrestrial vegetation and wildlife, report 5 of 5: Asheville, North Carolina, U.S. Department of Agriculture–Forest Service, Southern Research Station, General Technical Report, SRS-35, 201 p.

U.S. Department of Agriculture–National Agricultural Statistics Service, 1999, 1997 census of agriculture: Washington, D.C., U.S. Department of Agriculture–National Agricultural Statistics Service, http://agcensus.mannlib.cornell.edu/.

U.S. Department of Agriculture–Natural Resources Conservation Service, State Soil Geographic Data Base (STATSGO) (electronic data).

U.S. Department of Agriculture–Natural Resources Conservation Service, various county soil surveys of Oklahoma.

U.S. Department of Agriculture–Soil Conservation Service, 1981, Land resource regions and major land resource areas of the United States (booklet and map dated September, 1978): Washington, D.C., U.S. Department of Agriculture–Soil Conservation Service, Agriculture Handbook 296, 156 p., map scale 1:7,500,000.

U.S. Environmental Protection Agency, 2005, Level III ecoregions of the continental United States: Corvallis, Oregon, U.S. Environmental Protection Agency–National Health and Environmental Effects Research Laboratory, Western Ecology Division, Map M-1, various scales.

Ware, G.H., and Penfound, W.T., 1949, The vegetation of the lower levels of the floodplain of the South Canadian River in central Oklahoma: Ecology, v. 30, no. 4, p. 478-484.

Webb, R.G., 1970, Reptiles of Oklahoma: Norman, University of Oklahoma Press, 370 p.

Wiedeman, V.E., and Penfound, W.T., 1960, A preliminary study of the shinnery in Oklahoma: Southwestern Naturalist, v. 5, no. 3, p. 117-122.

Wilkinson, D.L., Schneller-McDonald, K., Olson, R.W., and Auble, G.T., 1987, Synopsis of wetland functions and values – bottomland hardwoods with special emphasis on eastern Texas and Oklahoma: Washington, D.C., U.S. Department of the Interior–Fish and Wildlife Service–National Ecology Center, Biological Report, v. 87, no. 12, 132 p.

Williams, L.R., Toepfer, C.S., and Martinez, A.D., 1996, The relationship between fish assemblages and environmental gradients in an Oklahoma prairie stream: Journal of Freshwater Ecology, v. 11, no. 4, p. 459-468.

Wood, D.S., and Schnell, G.D., 1984, Distributions of Oklahoma birds: Norman, University of Oklahoma Press, 209 p.

Woods, A.J., Foti, T.L., Chapman, S.S., Omernik, J.M., Wise, J.A., Murray, E.O., Prior, W.L., Pagan, J.B., Jr., Comstock, J.A., and Radford, M., 2004, Ecoregions of Arkansas : Reston, Virginia, U.S. Geological Survey, map scale 1:1,000,000.

Zanoni, T.A., Risser, P.G., and Butler, I.H., 1979, Natural areas for Oklahoma – important areas of natural significance in Oklahoma: Norman, Oklahoma Natural Heritage Program, 72 p.

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