LAND USE

Historical and Recent Land Use

General

The earliest settlers to the general region were Native Americans. Within some portions of the watershed, the exact tribes were the Mound Builders (Goodspeed 1889). Mounds can be still found in Pulaski County. Other tribes that frequented the area on hunting excursions were Kickapoo, Osage, and Delaware.

Early American settlers to the upper watershed region migrated from Kentucky and Tennessee near 1834, although Texas County saw Americans as early as 1826 (Goodspeed 1889). Many of these early migrants were attracted to the abundant game (deer, elk, bear, and turkey). Once US lands in the region were proclaimed open for sale, immigration to the area increased in the 1840s. The St. Louis and San Francisco Rail Road increased settlement in 1870 and also brought further communication with Springfield and St. Louis.

Since this time, some streams have been adversely affected by land-use practices. Erosion, siltation, nutrient, and pesticide pollution are the result of Ozark practices such as forest clearing, uncontrolled burning, uncontrolled livestock grazing, poor farming, and unregulated gravel mining. Written historic observations of early settlers and explorers described fertile bottoms with clear flowing water. Nevertheless, geologists working in the late 1800s, before significant land use, describe Ozark streams as having large quantities of gravel in streambanks (Jacobson and Primm 1994). Early settlers logged the land and thereafter farmed the bottomland areas and grazed the arid upland areas. Pasture was maintained by burning. Jacobson and Primm (1994) suggested that this practice of grazing and burning effectively removed topsoil and loosened the cherty gravelly soil that eventually accumulated in streams.

Population

Historical county population size in Gasconade, Laclede, Maries, Osage, Pulaski, Phelps, Texas, Webster, and Wright counties of the Gasconade River watershed took a sharp increase after the land sales of the 1840s. By the 1890s the populations of many Ozark counties of Missouri were quite large, reaching as high as 50,000 individuals within the general area, although only Texas County within the Gasconade River watershed exceeded 19,500 individuals at that time (Figure 4). Communities forged existence along the Gasconade River and its tributaries. In fact, the Gasconade County Seat was on the Gasconade River in several locations but was moved to Hermann after being swamped by the flooding river at each previous location (Ohunan 1983).

Recent county population size in the Gasconade River watershed was last estimated during the 1990 US Census (Figure 4). The most populated areas were Pulaski and Phelps counties, which constituted the middle portion of the watershed, containing all the major springs. The presence of the military base Fort Leonard Wood and a growing City of Rolla explained the comparatively larger population size in Pulaski and Phelps counties. The least populated areas were the lower watershed areas, represented by Maries, Osage, and Gasconade counties. Camden County was included in Figure 4 because it borders the watershed boundaries.

An analysis was done on the human population density of the 14-digit Hydrologic Unit (HU) (Figure 5).

As demonstrated, the highest human density of any HU was the Roubidoux Creek HU #10290201-050, bolstered by the presence of Fort Leonard Wood Military Base. However, a summarized Missouri Department of Transportation's (MoDOT) lettered-highway dataset (other road types such as the county roads, Gasconade, Laclede, Maries, Osage, Pulaski, Phelps, Texas, Webster, and Wright, were not included in this summary and would add considerably to the totals) indicates that the road density and number of stream road crossing in the Roubidoux Creek were comparatively low. Population densities, road densities, and number of stream road crossings do not correlate. For example, the Lower Osage Creek HU and the Middle Gasconade River HU had human population densities ranging between 33.2 - 46.1 individuals per square mile. Interstate 44 travels through northern Pulaski County and northeastern Laclede County or the Lower Osage Creek and Middle Gasconade River HU, which explains the high road density values in Figure 5. Given the higher stream density (not represented) in the upper watershed, the number of stream road crossings is accurately represented. Stream disturbance and degradation is apparent in these watersheds (See subsections' Grazing and Natural Resource Conservation Service Projects).

Demographic trend information, Gasconade, Laclede, Maries, Osage, Pulaski, Phelps, Texas, Webster, and Wright, in each county within the watershed indicates moderate human population growth from 1990-97 and a potential increase in population outside incorporated areas, i.e., towns and cities. When increases in populations are one-half to two-thirds the incorporated populations increase, this trend may be substantial and could indicate population movement to rural areas. Since 1990 the rate of increase in open-country populations has been more rapid than in town populations (OESDA 1999).

Farming

By the 1890s, a typical farm was a production mixture of beef, hogs, sheep, fruit, and other products. Farmers were producing a considerable amount of grain in the form of wheat and corn, mainly to feed their livestock.

From 1850 to the present, farm production of hogs, pigs, and sheep has dwindled, but the number of cattle on farms has increased steadily (MASS 1997). While crop agricultural industries have declined, the land has been converted to pasture to accommodate a growing beef industry. Milk cow production reached a peak in 1950-60s, but all counties in the Gasconade River watershed varied in declined rate from slightly to moderately in number of head with the exception of Wright and Webster counties, which have seen moderate increases.

In 1899, cropland used for the production of wheat, corn, and hay produced more bushels than in recent years (MASS 1997). At that time, wheat production ranged from 426,000 bushels in Gasconade County and to 57,000 bushels in Pulaski County. Cropland production of corn was highest in 1899 and 1909 within Laclede County (837,000 bushels) and lowest in Wright County (505,000 bushels). Unlike corn production, which was more affected by changes in yield per acre with the advent of fertilizer in the 1950s and overall consumer demand, as the cattle production rose, production of hay increased. Texas County, aptly named after the State of Texas with its high cattle production, harvested a whopping 131,500 tons of hay in 1996.

Fruit and tomato production had its day in the southern counties of the Gasconade River watershed. As early as the 1890s, Webster County, Missouri led the nation in the production of apples (SCS 1990). The apple industry shriveled in the 1930s as a result of economic factors. Blossoming in the 1930s, the production of tomatoes for the canning industry became an important part of the rural economy. Several

large-scale tomato canning factories reduced production due to 1) a poor market, 2) competition with a growing dairy industry, and 3) the added expense of meeting stricter government regulations (SCS 1990).

Cropland yields per acre have substantially increased since the 1950s when the petroleum industry introduced fertilizers. County use of fertilizer on cropland increased 50 to 85% from the 1950s. One side effect of fertilizer application is the nutrient enrichment of streams from cropland runoff. Today, conservation management practices help reduce dependence on chemical fertilizers. Several counties, Gasconade, Laclede, Maries, Osage, Pulaski, Phelps, Texas, Webster, and Wright, within the MDC East Central Region and the Gasconade River watershed have improved farmland though the use of conservation practices. Precision agriculture and use of remote sensing have helped maintain good yields and lessen the soil erosion and nonpoint source pollutants.

Herbicides, like Atrazine, enter surface water by runoff or through atmospheric deposition or groundwater. Atrazine, Cyanzine, Metribuzin, and Simazine are herbicides in the triazines chemical (see below) and are applied only by certified applicators.

Herbicide Chemical family Mechanism of action

Atrazine	triazine	Photosynthetic inhibitor
Cyanazine	triazine	Photosynthetic inhibitor
Metribuzin	triazine	Photosynthetic inhibitor
Simazine	triazine	Photosynthetic inhibitor
Alachlor	chloroacetamide	Growth inhibitor

In groundwater tests for herbicides Atrazine, Tebuuthiuron, and p,p’-DDE by USGS indicate that there are detectable amounts of these herbicides in the Fort Leonard Wood portion of the Big Piney River watershed and no detectable amounts in the Roubidoux Creek watershed (Imes et al. 1996). The USGS/Missouri Department of Natural Resources Fixed Station Co-op Monitoring Program found at Jerome 0.0 ug/l, 0.0 ug/l, and 0.02 ug/l of Atrazine in November 1992, April 1994, and June 1996, respectively. Also, tested at the same time and location with no detectable quantities were the herbicides’ Cyanazine, Metribuzin, Alachlor, or Simazine. As part of the Ozark NAWQA Study, Woods Fork was

tested at Hartville in 1994 and 1995 for Atrazine, Alachlor, Cyanzine, Metribuzin, and Simazine (USGS 1994-95).

The State of Missouri Unified Watershed Assessment Final Report identified the Upper Gasconade watershed as having high total animal unit density.

Grazing

Demand for additional livestock forage generated more land clearing for pasture. Cropland acres expansion, riparian area clearing, and increased pressure on pasture land from cattle grazing, induced greater releases of gravel into streams. Missouri livestock production (livestock numbers) has grown to a rank of number 2 in the nation (MASS 1997).

Jacobson and Primm (1994) demonstrated a trend in the rural Ozarks toward increased populations of cattle and increased grazing density. Increased grazing density translates into greater populations of cattle per unit area. Within the Gasconade River watershed the number of cattle per pastured acre shows a general climb from census year 1920-1992 (Figure 6). This trend has the potential to precipitate stream-channel disturbance from increased runoff and sediment supply. Nearly all counties have higher numbers of cattle per acre during the 1940s than during any census year. Also, from 1960-92, populations of cattle have increased yet total improved land in farms has decreased. In fact, by the 1960s livestock open range grazing was essentially halted, allowing landowners to improve grazing management and reduce woodland pasturing as demonstrated by a reduction in total acres in woodland pasture (MASS 1997).

Nationwide, Missouri is the second to Texas in production of cattle with 4.45 million head produced in 1997 (MASS 1997). For counties within the Gasconade River watershed, cattle numbers per pastured acre have steadily increased from the 1920s where counties were between 0.25-0.5 cattle per acre (Figure 6). Today, cattle numbers per acre are roughly 0.6-0.8 in most of these counties. Those counties with the highest density and good cattle growing conditions are Webster, Maries, and Wright. Good cattle growing conditions can be attributed to appropriate soil types for growing pasture grasses and summers and winters that are not too harsh.

Cattle watering in Missouri is frequently accomplished using a stream or pond. In fact, a state standard designated use of many permanent streams is livestock watering. However, if cattle stocking rates along a riparian stream corridor are too high, the stream could develop poor pool areas, wide and shallow channels, and more sediment and gravel in the channel. Help could come in the form of fencing cattle from the stream.

For example, a segment of a 3rd-order unnamed tributary to the Gasconade River within the Lower Gasconade River watershed developed the above mentioned symptoms of cattle overgrazing: poor pool areas, wide and shallow channel, poor riparian corridor, and gravel choking the channel. This tributary (Osage County (T44N R7W S24) received several different treatments to heal an eroded streambank on a farmer’s land (Table 19; Habitat Section). In 1994, a cedar tree revetment was used to stabilize the streambank. Cattle were subsequently fenced out of the stream, and willow stakes were placed on the streambank (Rob Pullium, personal communication). Today, the streambank is healing with willows more than six feet tall, and the stream has scour pools that support fish.

Alternative (off-stream) watering sources offer an alternative to stream cattle watering. The Alternative

Watering Sources for Planned Grazing Systems is designed to provide funds for stream-side landowners who are implementing a planned grazing system practice with the Soil and Water Conservation Program. Researchers in Virginia have found that alternative watering sources, such as spring-fed watering troughs, are utilized 93% of the time, as compared to the time spent drinking from a stream (Sheffield et al. 1996). Use of the stream area by cattle was reduced by 58% when an off-stream water source was made available. Associated benefits from the reduced stream use were the reduction in streambank erosion and fecal bacteria.

Mining

Zinc and lead were discovered in the southern portions of Texas, Webster, and Wright counties in the mid-1800s (Goodspeed 1889). Mining activity was well underway by the 1880s in the Berry Diggings (Section 1, Township 28, Range 16), Lead Hill Zinc Mines (Section 25, Township 28, Range 16), Panther Creek Mines, and Cabool Mining Company (1887). The Berry Diggings became the Ozark Mining Company in May 1885, following which several family farms were purchased: the Berry farm, Baker farm, and McMullen farm. This general area is in the vicinity of the Baker Creek watershed, a tributary to Rippee Creek. A zinc blend, disseminated with some flint and siliceous lime-rock and a little galena, distinguished the deposit. Large quantities of lead were taken from the Panther Creek Mines. Finally, the Cabool Mining Company removed zinc from headwaters of the Gasconade River watershed.

The Missouri Department of Natural Resource's (MDNR) Inventory of Mine Occurrences and Prospects (IMOP) Database lists past producers of zinc, iron, lead, clay, and limestone (MDNR 1999b). Many of these ores were extracted from the surface with manual labor. Extracting both zinc and lead, the Brunet Diggings and the Lead Hill Diggings were found in the Roubidoux Creek watershed. Not heavily mined, zinc was extracted by one past producer within the Upper Osage Creek and five past producers of zinc within the Upper Gasconade River Tributaries HU. Lead was heavily sought after in Wright County and within the Upper Gasconade River Tributaries HU. The ore was mainly extracted from the surface but of the 20 sites found in the watershed three sites were underground, the deepest being 70 feet. Its effects on the groundwater and surface water are unknown. As mentioned above, iron has been mined since the mid-1800s. The most heavily mined watersheds were the Lower Gasconade River HU and the Little Piney Creek HU. Both the Childress Mine and the Licking Mine were underground extraction sites. Past clay and limestone pits are peppered throughout the entire watershed, in particular the Lower Gasconade River HU, the Lower Gasconade River Hills HU, and the Third Creek HU.

Present mining activity is not as pronounced in the Gasconade River watershed. In this watershed prospected ores were iron, lead, zinc, bituminous coal, clay, and limestone (MDNR 1999a). Some developed deposits of iron ore can be found in the Little Piney Creek HU, but none of these are actively mined. The present effects of the past mining sites on the stream ecosystem are not known. Some of these iron ore and lead extraction sites are rather small in acreage.

While often having a more pronounced effect on the landscape, many of the past clay and limestone pits are still visible on the landscape. The only active clay mine in the watershed is in the lower Gasconade River. Boethemeyer Clay Mine discharges to a tributary of Second Creek (MDNR 1997). The remaining surface mining sites in the watershed are limestone extraction. These sites are scattered throughout the watershed, but the largest concentration can be found in the lower watershed. The upper watershed areas have three limestone quarries, totaling 69 acres (MDNR 1999a).

Sand and Gravel Operations

In the Sand and Gravel Resources of Missouri (1918), Dake describes "Second Sandstone" rock outcrops found near Whetstone, Clark, Lick Fork, Elk, and Beaver creeks. Some of the rock was found near the St. Louis and San Francisco Railroad crossing and past quarried bluffs in the vicinity of Mansfield, Missouri. Other sandstone deposits were reported along the Gasconade River, Mill and Bear creeks, but were of little commercial value.

Dake (1918) reports that the most important source of sand and gravel for construction was from Missouri streams. Ozark streams during 1913 produced approximately 20% of the State's sand and gravel. The Gasconade River watershed was not a major producer of sand and gravel as the Meramec River, although the Little Piney River had operations in Phelps County. Freeman, J. H. and the Pillman Bros. mined several gravel and sand bars derived from the Roubidoux Sandstone Formation. The limited market for this region, chiefly St. James and Springfield at that time, reduced the operations within this watershed.

Prior to 1991 sand and gravel mining was generally unregulated. In 1991, legislation gave regulatory authority to governmental agencies to require that sand and gravel miners follow stream channel mining guidelines of gravel bars and floodplains. The Army Corps of Engineers (COE) and the Missouri Department of Natural Resources (MDNR) issue permits for the mining of stream sand and gravel. During portions of the 1990s, the COE has been involved in sand and gravel mining in areas that were not navigable waters of the US because of a federal court ruling know as the Tullock Rule. In general, the Tullock Rule stated that incidental dripping or "fall back" from the sand and gravel dragline bucket constituted a discharge, which required a GP-34M 404 permit for sand and gravel mining that is below the stream's water line. This means that pre-Tullock and post-Tullock laws allowed mining within flowing water or below the stream's water line. This rule was subsequently over-turned by the US Supreme Court in COE vs The American Mining Association.

For instream operations, mining permits contain a Stream Protection Plan as required by the Permit and Performance Requirements for Industrial Mineral Open Pit and In-Stream Sand and Gravel Operations, Chapter 10 Code of State Regulations 40-10.020 (2)(D)3 (MDNR 1994c). The basic language of the regulation, outlined in Chapter 10 Code of State Regulations 40-10.020 (2)(D)4, requires the operator to describe "measures that will be taken to minimize impacts on the stream environment..... confining active mining to gravel bars rather than in flowing water, and restricting damage to stream banks or bank vegetation....."(MDNR 1994c). Enforcing the Stream Protection Plan requires proving that an action taken by an instream sand and gravel operator has violated his Stream Protection Plan and that such a violation will incur a reclamation liability such as streambank damage due to head cutting.

Present regulations may not adequately protect stream resources and thwart losses of fisheries productivity, biodiversity, recreational potential, streamside land, public infrastructure (roads, bridges, and utilities), and real estate value (Roell 1999). A prescription for stream gravel mining should be developed to continue a viable sand and gravel extraction industry. The Army Corps of Engineers and the Missouri government recognize the economic benefits of sand and gravel extraction; nevertheless, the need for alternatives that would lower risks of upstream headcutting, sedimentation, and environmental effects of operational conditions such as release of petroleum products and species of conservation concern is important (Roell 1999).

Sand and gravel operations remain a presence in both the upper and lower 8-digit watersheds, especially prevalent in the lower watershed. Since the initiation of the East Central Region Stream Environmental

Review Database in 1996, Missouri Department of Conservation has tracked 90 sand and gravel extraction permitted sites in the Lower Gasconade watershed (MDC 1999), many of which are alternatively active and inactive as mining depletes the mineral resources and the occasional high flows replenish them. Sand and gravel mining appears to be new to the upper watershed, however, given the low number of permitted operators per watershed area and the few historic observations of sand and gravel mining (COE 1999, MDNR 1999).

Using the Army Corps of Engineer's Regulatory Analysis Management System database, which encompasses the entire watershed, we found a range of 1-25 permits per HU and a mean of 11.6 ±7.8 permits per HU (COE 1999). A density of sand and gravel site permits for 11-digit HUs was determined for the period of February 1992 - February 1999 (Figure 7). The 8-digit Lower Gasconade River watershed with its more than 500,000 acres of land had high densities of permits ranging from 0.05-0.075 permits/square mile. Lower densities of permitted sand and gravel sites ranging from 0.008-0.075 permits/square mile were found in the 8-digit Upper Gasconade River watershed with its more than one million acres. Beaver Creek HU was heavily mined for its relatively small size.

Logging

Forests in the area have been burned, grazed, and over harvested. Pre-settlement vegetation was diverse and consisted of oak-hickory woodlands, scattered prairie grasslands on gently rolling uplands, bottomland hardwoods on most alluvial plains, oak savanna and barrens on upland sites, and oak-pine forests (East Central RCT 1998). Particularly damaging to stream water quality, logging has impacted bottomland forests and old-growth forests. Unlike today, forest practices in the past did not respect small order stream riparian zones. Steep topography and poor soils creates slow regeneration, thus explaining the present condition of the forests in the watershed. In order to improve the quality of wood products in Missouri, Missouri Department of Conservation began fire suppression in the 1940s (East Central RCT 1998). The end result was fewer wildfires and improved quality and quantity of wood products.

As early as the mid-1800s forests in the Gasconade River valley were being harvested. In fact, in 1889 Goodspeed reported that the lumber trade was a booming industry in Texas County. Once the forests were cleared and roads were built, the period of commodity transport on the Big Piney and the Gasconade rivers came to an end in the late 1920s. Before significant road construction, railroad ties were floated to railroad crossings or yards then shipped to mills where the final products were produced. Concern over the effects of tie transport on stream fish populations led to state regulations near the turn of the century. Still earlier, the T. J. Moss Tie Company began delaying their tie drives on the Black River until June 1 to reduce impacts on the spawning fish populations (MDC 1995).

The forests in Missouri are in good health. Missouri's Eastern Ozarks, with 67% of the State's forest land, offers a wide variety of the major forest types: Black-scarlet oak, white oak, post-blackjack oak, and maple-beech (USDA Forest Service 1999). Forest products produced annually exceed $3.3 billion. There are more than 2,600 forest product-related firms employing more than 33,000 people with a total payroll of about $500 million per year. In 1994, 709 million board feet were cut, 90% of the total was oak (USDA 1998).

According to the 1989 survey of Timber Resources of Missouri's Northwest Ozarks (comprising Maries, Phelps, Pulaski, Laclede counties and nine other counties west of the Gasconade River watershed), conducted by the USDA Forest Service, 2.2 million acres of harvestable forest were reported, which is up nearly 13% over the 1.9 million acres reported in 1972 (Smith 1990). Recent 1989 forest survey

information estimates approximately 2.91 billion board feet of sawtimber and 1.15 billion cubic feet of growing stock in the Northwest Ozarks. Annual growth totaled 80.7 million board feet of sawlogs in 1988, and annual growth of growing stock totaled 29.9 million cubic feet. Estimated removals in 1989 were 9.0 million cubic feet of sawtimber, or about 30% of the annual growth.

Based on these estimates, the forests in the Gasconade River watershed have sustainable forest production. The largest percentage of the forest land in the watershed is privately owned, the next largest percentage is owned by federal agencies (USFS, US Army), and a smaller percentage by state governments.

Recent Land Use / Land Cover

Recent land use and land cover is best obtained from satellite imagery. Using the Thematic Mapper satellite digital image (Figure 8a & 8b), land-cover class names were developed from the Missouri Land Cover Classification Scheme (1997) by MORAP. Several spectral classes were collapsed into generalized land-cover categories (MORAP 1997). In the Gasconade River watershed, each generalized land-cover category acreage was determined for the Hydrologic Unit Code (HUC). Within the Upper Gasconade River watershed (HUC # 10290201) the land cover categories were quantified to have 46% deciduous and mixed forest, 42% grassland, 6.5% cropland, and 4.9% urban (Table 4). In contrast, the Lower Gasconade River watershed (HUC # 10290203) had 65.5% deciduous and mixed forest, 26.1% grassland, 7% cropland, and 0.9% urban.

Recreation

Nationwide growth in water-based recreation has steadily grown over the last 15 years. Knowledge of the recreational use types and patterns in the Gasconade River watershed can be used to manage for multiple uses, especially as annual river recreation benefits are $2.6 million (MDC 1991b).

A comprehensive recreational use survey on the Gasconade River was conducted from 1977-78 by George Fleener. The results of this study were compared to a study conducted in Summer 1989 by MDC Fisheries Research to determine recreational use losses caused by the Shell pipeline oil spill of December 24, 1988. Recreational use at six Department of Conservation access sites, comparing 1989 and 1977/78 use visits of 30 recreational use types, indicates no significant statistical difference between 1977/78 and 1989 estimates in five of the six access sites (MDC 1991b). There was a 14% decline in total use hours from 1977/78 to 1989 with larger declines in some activity categories (MDC 1991b). In the 1977 survey, angling, boating, MDC camping, and swimming were the top four activities from greatest to least recreational use. In 1989, fishing, once again, was the most popular activity accounting for nearly 50,000 hours of recreation. Sightseeing and nature study were the second most popular, which was not a popular category in 1977. Camping trips in the summer of 1989 were the least popular of the four categories and dropped somewhat over 1977 estimates. Overall, despite declines in some recreational activities, results of the 1989 public use survey showed that the river use was little affected by the Shell pipeline oil spill.

Personal interviews from the 1989 survey illuminated the demographics of the recreationist, the primary recreational uses, and trends in recreational use. The characteristic Gasconade River user is male, age 25-44, and a vast majority of the users are of local origin from five counties along the river. Two-thirds of the recreational uses are spent fishing or camping. Trends in use indicate increasing use after 1977 then a decline in 1986 and 1987.

In a telephone survey to estimate angler effort and success in Missouri waters, the Gasconade River was

among the third highest in days fished within three of the six years listed (Weithman 1991). It also was the largest watershed listed. When angler effort was calculated based on angler effort per watershed area (Table 5), the Gasconade River was slightly less fished than more urban watersheds such as the Meramec and the Bourbeuse rivers.

Natural Resources Soil Conservation Projects

Six Special Area Land Treatment (SALT) watersheds are found in the Gasconade River watershed (CARES 1999c). Although some of the lower watershed's SALTs are no longer active, particularly numerous are the SALT projects in the Upper Gasconade River watershed. Nutrient problems have plagued these areas for several years, the source of the problem being cattle manure.

Public Areas

The entire Gasconade River watershed, with an expansive land area of 1,797,130 acres or 2,806.9 square miles (see Table 2, Geomorphology Section), has approximately 12% or 221,040 acres in public land ownership (Table 6). Ninety-five percent of the public land in the watershed is owned by the US Forest Service, 4.9% is owned by the state (MDC), and less than 1% by nonpublic entities (Figure 9). Approximately, 1,322 acres of state and private land are located in the Big Piney River watershed.

Stream Frontage

The miles of stream frontage on public land were analyzed within ArcView GIS. Using the digitized 1:100,000-scale stream network and the public lands layer (Figure 9), a determination of whose stream segments intersecting the public lands polygons was compiled. A rough estimate of 1,070 miles of stream was found on public land. In most cases both sides of the stream were on public land, which increased the mileage to 2,140. Most of these streams were within the Mark Twain National Forest. A more detailed estimate within individual public land parcels was not possible given the limitation of the 1:100,000-scale stream network.

Stream Access

A total of 23 stream access areas in the Upper and Lower Gasconade River (Figure 9) provide numerous opportunities for water-based recreation. Three public land improvement projects are to be completed in FY2001 within the Upper and Lower Gasconade River watersheds, and two of the projects are to improve stream access (EC RCT 1998). MDC Design and Development Division will fund the Jermone Access ramp repairs (Ryck 1998). Cooper Hill Conservation Area and Roubidoux Island Access will have development of an entrance road, parking lot, concrete boat ramp, and associated facilities. Cooper Hill CA fronts Third Creek in addition to the Gasconade River. This section of the Gasconade River has an excellent fishery and limited access. This site fills a high priority need identified in the Stream Area Program Strategic Plan (1994).

Corps of Engineers 404 Jurisdiction

The entire Gasconade River watershed is under the jurisdiction of the Kansas City District of the U.S. Army Corps of Engineers.

Section 404 regulation permitting, inquiries, and violation reports for the Lower Gasconade River watershed should be directed to the Missouri State Regulatory Office:

221 Bolivar Street, #103, Jefferson City, MO 65101;

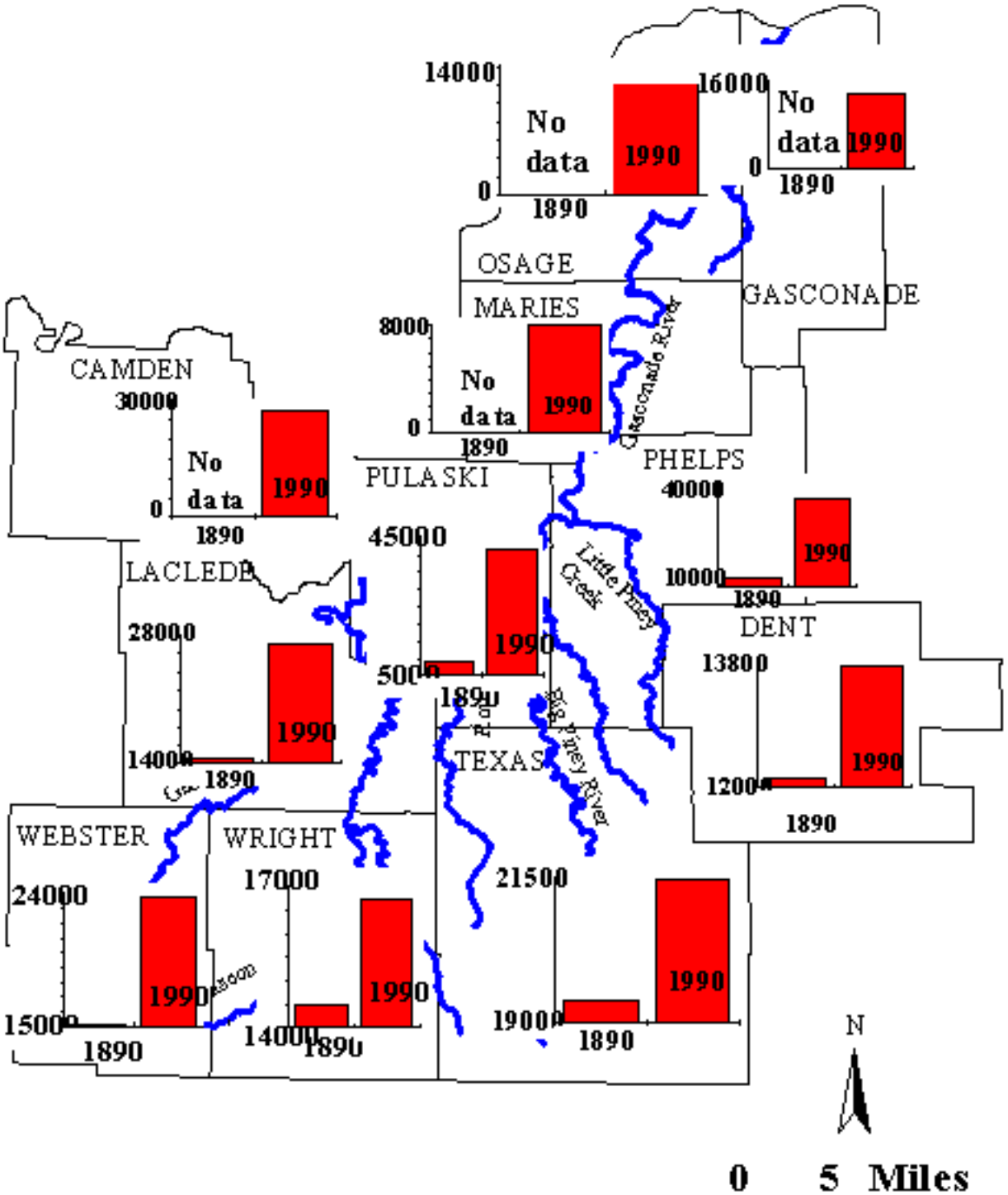
Phone: 573-634-4788.

For the Upper Gasconade River watershed, Section 404 regulation permitting, inquiries, and violation reports should be directed to the Truman Satellite Office:

Route 2, Box 29-C, Warsaw, MO 65355;

Phone: 660-438-6697.

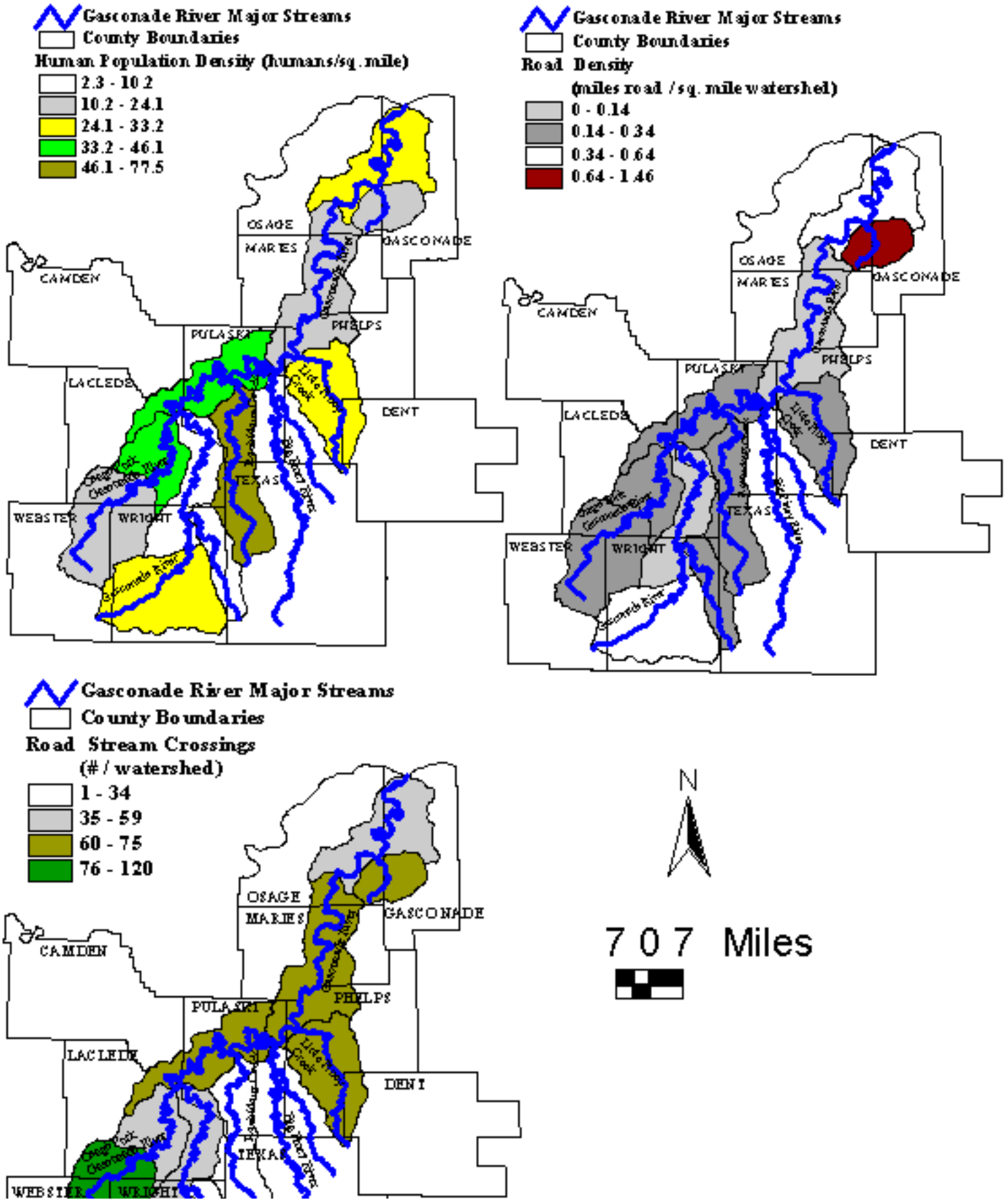
Figure 4. 100-Year county population change in the Gasconade River Watershed

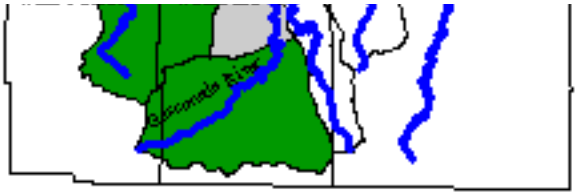


Data Sources: USGS Topos (streams);
Population data from 1990 US Census and A Resminiscent History of the Ozark Region (1956).

Map created by Todd J. Blanc, 2/99

Figure 5. Gasconade population and road density analysis

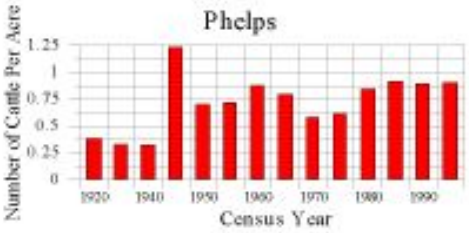




Data Sources: Population density -- US 1990 Census data; Roads -- MO Department of ransportation; Streams-- USGS Topos

Map Production: Todd J. Blanc 3/99

Number of Cattle per Pastured Acre
Gasconade River Watershed Counties



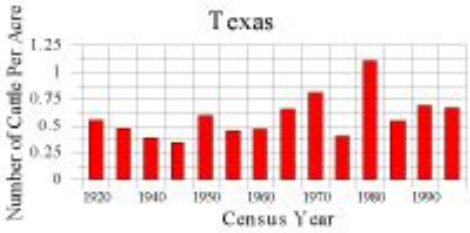
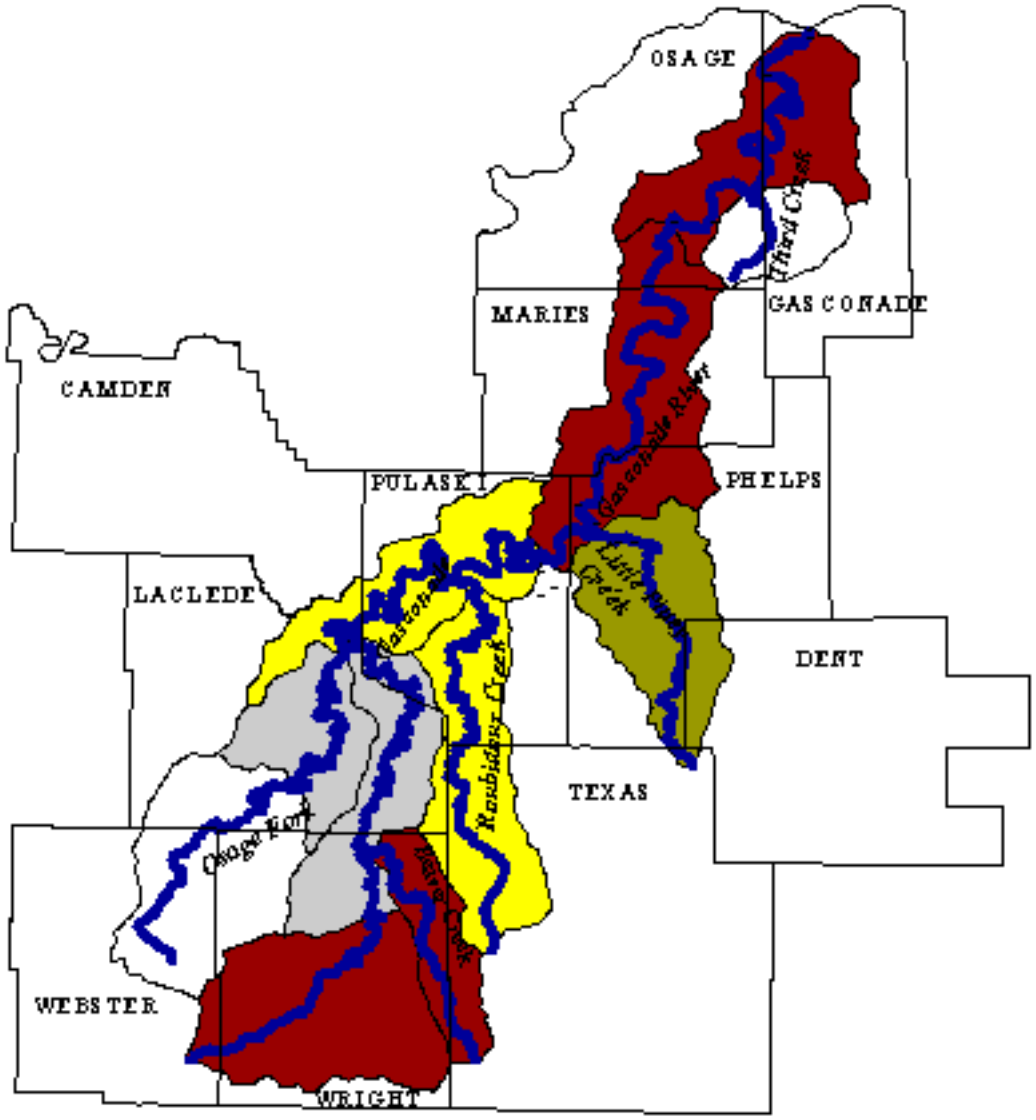


Figure 7. Density of sand and gravel site permits in the Gasconade River Watershed



Legend

- Counties
- Gasconade River Major Streams

Density of Sand and Gravel Permitted Sites

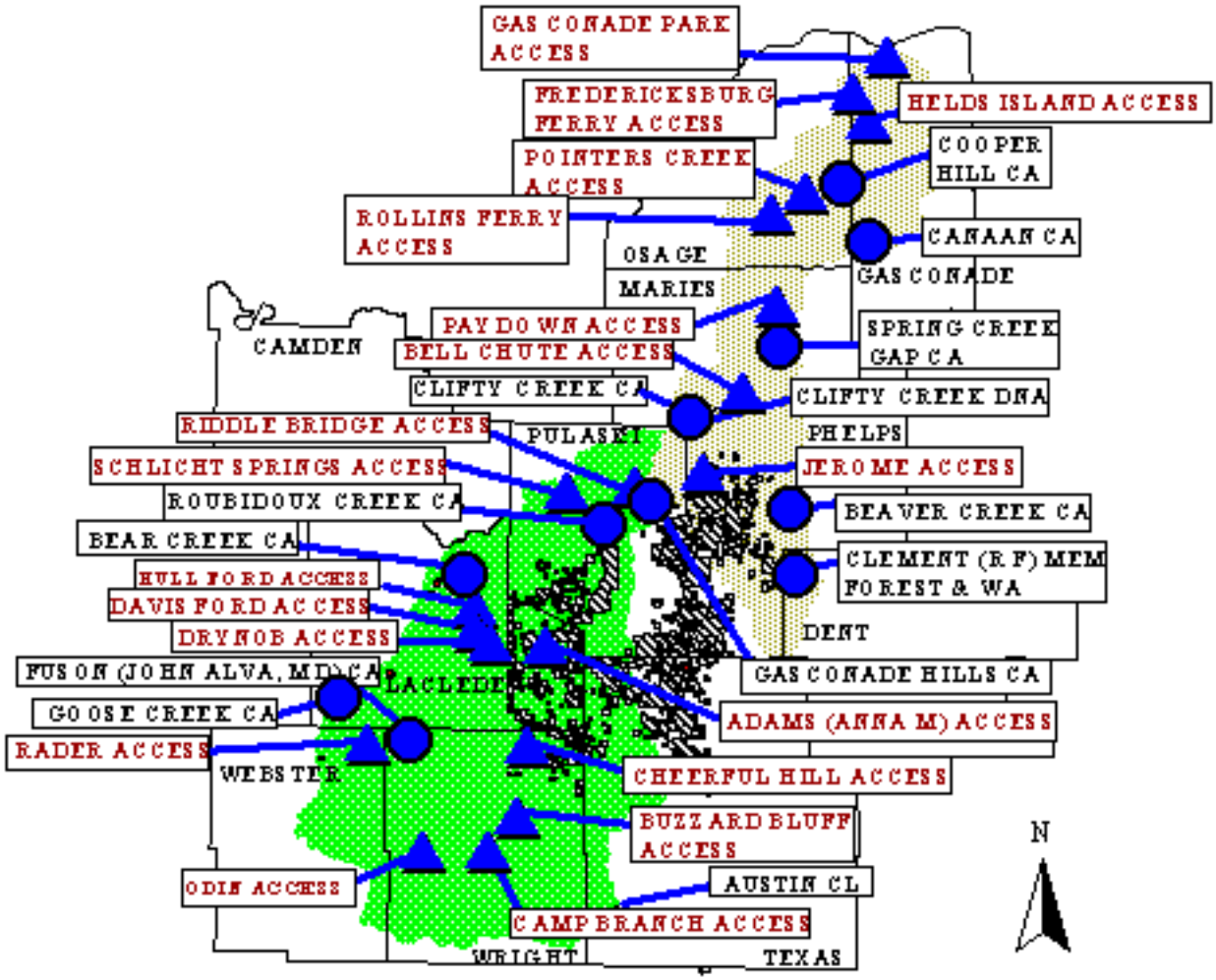
- 0.008 - 0.009 (permits/sq. mile)
- 0.009 - 0.026
- 0.026 - 0.04
- 0.04 - 0.056
- 0.056 - 0.075

N

Data Source: Gasconade River Watershed Sand and Gravel Site Permits from 1992-99. Kansas City District Corps of Engineers, Regulatory Analysis Management System.

Map Production: Todd J. Blanc, Missouri Department of Conservation, August 1999

Figure 9. Public lands in the Gasconade River Watershed



Legend

Gasconade Public Lands

- MO Department of Conservation River Access
- MO Department of Conservation Areas (CA/DNA)
- Private
- United States Forest Service
- Major Highways
- County Boundaries

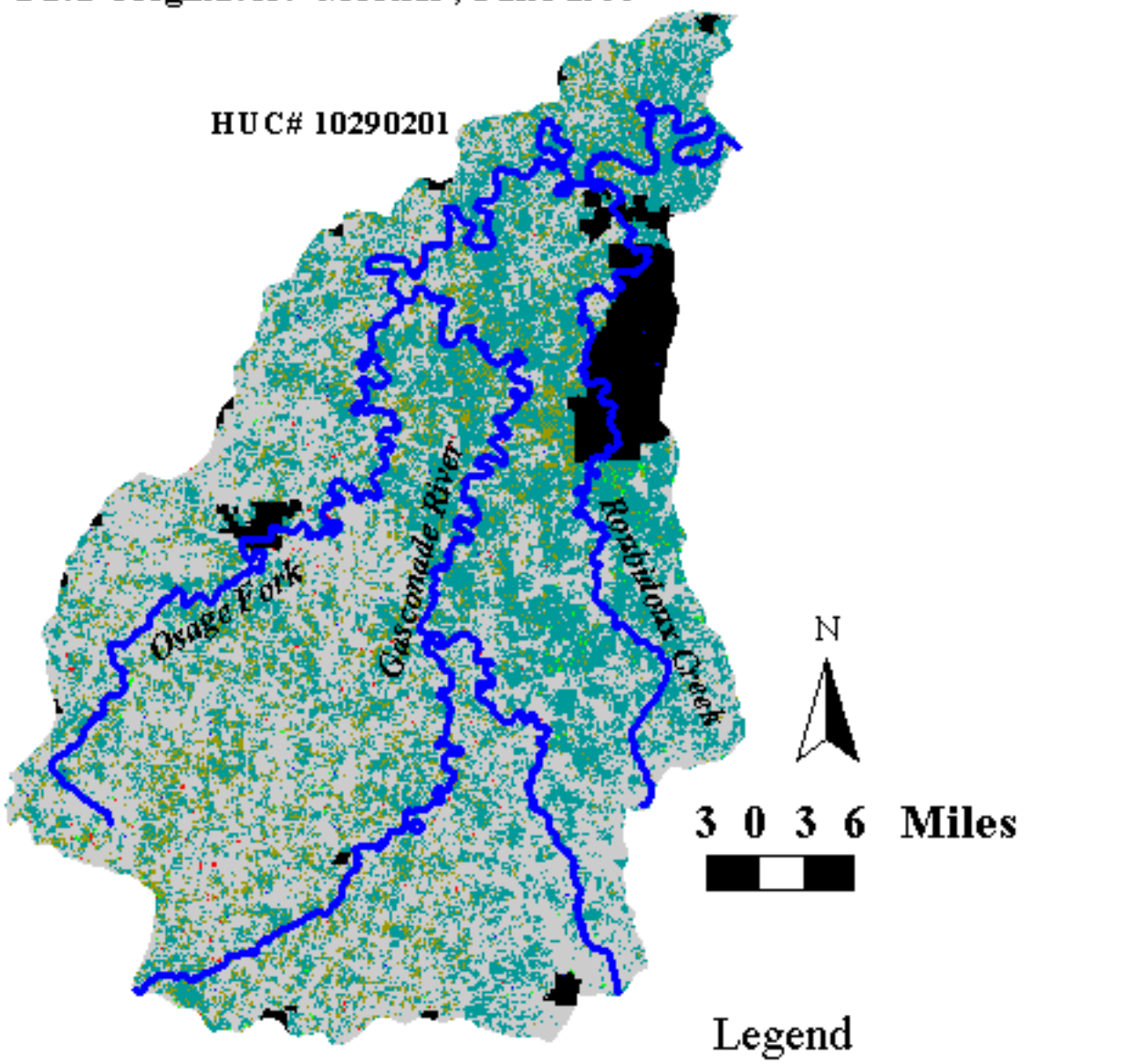
Gasconade Watershed

- Upper Gasconade River Watershed
- Lower Gasconade River Watershed

Data source: Public lands--MDC Policy Coordination; USGS Topos- streams and municipalities.

Map Production: Todd J. Blank, Missouri Department of Conservation, March 1999.

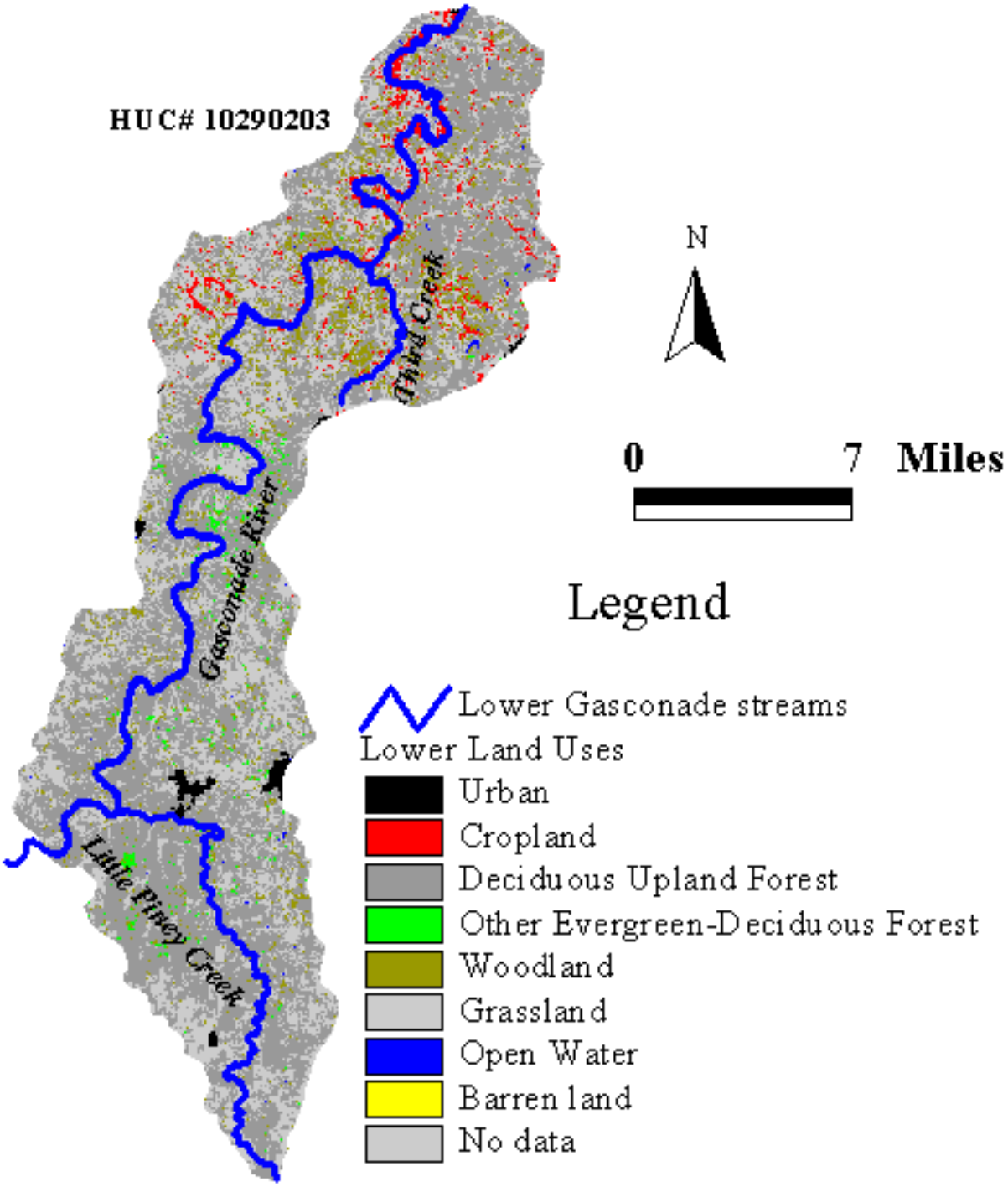
Figure 8a. Upper Gasconade River watershed land use/land cover
Data Originator: MoRAP, June 1999



Imagery data from the Thematic Mapper Satellite with 30-meter resolution.

Map Production: Todd Blanc, Missouri Department of Conservation, August 1999

Figure 8b. Lower Gasconade River watershed land use/ and cover Data Originator: MoRAP, June 1999



Imagery data from the Thematic Mapper Satellite with 30-meter resolution.

Map Production: Todd Blanc, Missouri Department of Conservation, August 1999

Table 4. MORAP Phase I Land Cover acreage for the Upper and Lower Gasconade River watershed. Several other watersheds are listed for comparison to the watersheds in this inventory. Percentage tree cover, grassland, and cropland are also listed.

H.U.C.	Deciduous	Mixed	Grass	Crop	Urban	Water	Total Acreage
10290201[1]	472,543	54,729	485,041	75,040	55,805	2,831	1,145,989
Percentages:		% Tree = 46.0	% Grass = 42.0	% Crop = 6.5	% = 4.9	% = 0.3	
10290202[2]	231,065	66,839	132,137	19,786	31,375	1,131	482,333
Percentages:		% Tree = 61.8	% Grass = 27.0	% Crop = 4.1	% = 6.9	% = 0.2	
10290203[3]	355,323	78,351	173,716	46,767	5,934	3,660	663,751
Percentages:		% Tree = 65.5	% Grass = 26.1	% Crop = 7.0	% = 0.9	% = 0.5	
71401024	891,160	63,151	285,304	61,164	70,690	6,198	1,377,667
Percentages:		% Tree = 69.8	% Grass = 20.7	% Crop = 4.4	% = 5.1	% = 0.5	
10290111[5]	272,064	87,790	213,683	93,663	9,351	6,535	683,086
Percentages:		% Tree = 52.8	% Grass = 31.2	% Crop = 13.7	% = 1.4	% = 0.9	
10290102[6]	43,696	1,387	128,698	122,990	5,162	7,092	309,025

Percentages:		% Tree = 14.6	% Grass = 41.6	% Crop = 39.8	% = 1.7	% = 2.3	
71401037	250,207	24,570	180,400	65,156	14,662	2,330	537,325
Percentages:		% Tree = 51.3	% Grass = 33.5	% Crop = 12.1	% = 2.7	% = 0.4	
71401048	341,303	66,908	156,822	32,991	15,377	4,377	617,778
Percentages:		% Tree = 66.1	% Grass = 25.3	% Crop = 5.1	% = 2.5	% = 0.7	

[1]- Upper Gasconade; [2]- Big Piney River; [3]- Lower Gasconade; [4]- Meramec River;

[5]- Lower Osage River; [6]- Maries River; [7]- Bourbeuse River; [8]- Big River

Table 5. Estimates of days fished per total watershed area in acres on the Gasconade River and selected rivers in Missouri (Weithman 1991).

	Year					
Location[a]	1983	1984	1985	1986	1987	1988
Big	0.0839	0.0247	0.0994	0.0439	0.0505	0.0524
Bourbeuse	0.1018	0.0496	0.0283	0.0325	0.1209	0.0394
Gasconade	**0.0491**	**0.0474**	**0.0517**	**0.0381**	**0.0630**	**0.0543**
Meramec	0.1071	0.0760	0.0684	0.0484	0.1022	0.1153
St. Francis	0.0187	0.0580	0.0779	0.0318	0.0040	0.0328
Total	0.3793	0.3137	0.4036	0.2265	0.3446	0.3270

[a] The estimates of effort listed for each river or stream include days of fishing on all smaller tributaries in the watershed.

Table 6. Public land ownership (MDC, MoRAP 1997) and acreage within the Gasconade River watershed including Big Piney River watershed (**Bolded**).

Name	Acres	Owner
United States Forest Service	209,828.82	United States Forest Service
Adams (Anna M) Access	16.43	MO Dept. of Conservation (MDC) [a]
Allen (Wilbur) Mem CA[1]	375.57	MDC
Austin Community Lake	56.06	MDC
Baptist Camp Access	7.41	MDC
Bear Creek CA	758.01	MDC
Beaver Creek CA	147.35	MDC
Bell Chute Access	8.10	MDC
Boesl (L A) Outdoor Education Area	8.81	MDC
Boiling Spring Access	11.18	MDC
Bray (Marguerite) CA	129.10	MDC
Buzzard Bluff Access	82.08	MDC
Cabool Towersite	17.43	MDC
Camp Branch Access	21.03	MDC
Canaan CA	1,397.50	MDC
Canaan Towersite	3.15	MDC
Cheerful Hill Access	55.97	MDC
Clement (R F) Mem Forest & WA	512.98	MDC
Clifty Creek CA	255.39	MDC
Clifty Creek DNA[2]	253.70	Private
Cooper Hill CA	247.40	MDC
Davis Ford Access	17.02	MDC

Dixon Towersite	43.78	MDC
Dog's Bluff Access	4.59	MDC
Dripping Springs DNA	9.14	Private
Dripping Springs NA[3]	2.07	MDC
Drynob Access	15.51	MDC
Eck (Peter A) CA	113.65	MDC
Eck Memorial DNA	270.59	MDC
Fredericksburg Ferry Access	6.03	MDC
Ft Leonard Wood Towersite	63.79	MDC
Fuson (John Alva, Md) CA	1,270.67	MDC
Gasconade District Head Quarters	4.14	MDC
Gasconade Hills CA	362.73	MDC
Gasconade Park Access	1.86	MDC
Goose Creek CA	365.99	MDC
Great Spirit Cave CA	13.26	MDC
Hazelgreen Access	0.61	MDC
Helds Island Access	10.58	MDC
Horseshoe Bend DNA	95.26	Private
Horseshoe Bend NA	223.12	MDC
Houston Forestry Office	1.86	MDC
Houston Towersite	20.21	MDC
Hull Ford Access	11.80	MDC
Jerome Access	9.57	MDC
Lebanon Forestry Office	10.21	MDC

Lebanon Towersite	3.37	MDC
Lenox Towersite	6.02	MDC
Mason Bridge Access	9.26	MDC
Mineral Springs Access	6.58	MDC
Niangua CA	137.93	MDC
Odin Access	131.25	MDC
Osage Fork CA	282.44	MDC
Paydown Access	6.41	MDC
Pilot Knob Towersite	4.14	MDC
Piney River Narrows DNA	249.10	Private
Piney River Narrows NA	17.98	MDC
Pointers Creek Access	18.05	MDC
Quercus Flatwoods DNA	52.02	MDC
Rader Access	65.45	MDC
Riddle Bridge Access	7.58	MDC
Rollins Ferry Access	20.19	MDC
Ross Access	2.70	MDC
Roubidoux Creek CA	289.50	MDC
Ryden Cave CA	29.20	MDC
Schlicht Springs Access	13.18	MDC
Simmons Ford Access	3.28	MDC
Spring Creek Gap CA	1,797.10	MDC
Spring Creek Gap Glades DNA	42.24	MDC
White (George O) SF4 Nursery	702.16	MDC

inholding	1.92	Private
Total public land acreage	221,040.58	

[1]Conservation Area, [2]Designated Natural Area, [3]Natural Area, [4]State Forest. Missouri Department of Conservation (MDC) [a]