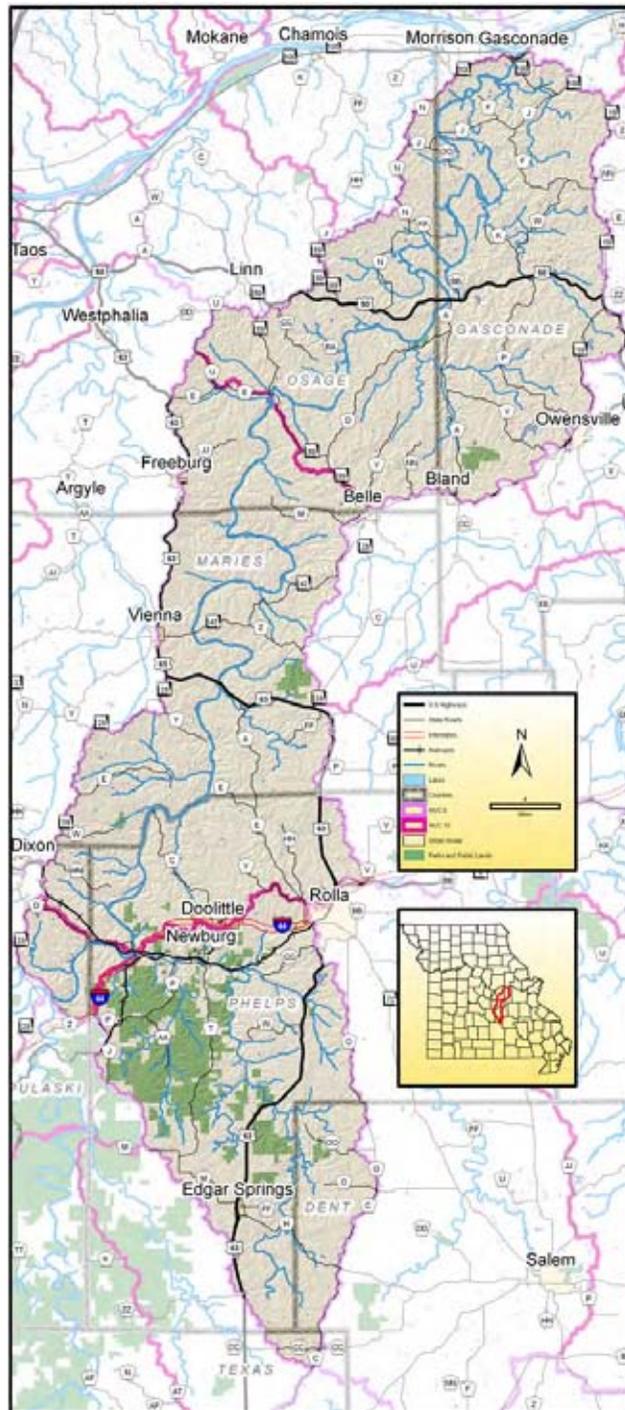


Lower Gasconade River – 10290203

8 – Digit Hydrologic Unit Profile and Resource Assessment Matrix



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This Project was supported by the United States Department of Agriculture Natural Resources Conservation Service through the Cooperative Conservation Partnership Initiative, the Missouri Agricultural Experiment Station, and the University of Missouri Extension.

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Summary

The Lower Gasconade Watershed (Hydrologic Unit 10290203) is a 1,030 square mile watershed in central Missouri. Agricultural activity is concentrated on ridgetops and bottoms adjacent to streams. Residential development is starting to take place throughout the watershed. The watershed is characterized by steep topography and significant forestation. Agricultural operations are primarily livestock-based, consisting primarily of hay and pasture. The watershed is predominately private land, with only 6.0 percent in public holding, most of which is the Mark Twain National Forest in the southern part of the watershed.

The watershed is situated on Karst topography with a number of springs located throughout the watershed; a significant number of sinkholes are located along the southwestern boundary of the watershed. The watershed contains four Common Resource Areas (CRAs) – Central Plateau, Gasconade River Hills, Missouri River Alluvial Plain and the Northern Inner Ozark Border. The Central Plateau, Northern Inner Ozark Border and the Gasconade River Hills are the major CRAs in the watershed. Cropland comprises only 2.9 percent of the land cover, while grassland is 31.2 percent, and deciduous forest is 53.5 percent. Highly erodible land is some 61.6 percent of the watershed, followed by 19.6 percent of potentially highly erodible land; only 7.1 percent is identified as prime farmland. Only three Confined Animal Feeding Operations are permitted in the watershed; two are swine operations and one is a dairy. The only 303(d) listed stream in the watershed is the Gasconade River from the confluence of the Big Piney and Gasconade Rivers to the Missouri River.

Local stakeholder meetings held at Belle, Vienna and Rolla in March and April of 2007, respectively, identified corn, soybeans, wheat and milo as the primary crops. These crops are grown mainly in bottoms. Fescue, orchard grass, and some warm season grasses are grown for pastures. Most grazing is continuous, with little intensive rotational grazing taking place. Various conservation practices were mentioned, with most relating to livestock management, although some related to forestry. A number of natural resource issues were identified; the majority of the specific issues were related to river management and urban encroachment, to some extent.

The Resource Assessment is summarized in the following table, by Conservation System - Treatment Level for cropland, forest land, grassland and urban uses.

Summary – Continued
Summary of Resource Assessment – acreages and costs, by Conservation System – Treatment Level, for Cropland, Forestland, Grassland and Urban uses.

Conservation System – Treatment Level	Current Conditions (acres)	Future Conditions (acres)	USDA Investment (\$ - PV)	Private Investment (\$ - PV)
Cropland				
Baseline	11,636	5,818		
Progressive	5,818	8,727	30,923	27,940
Resource Mgmt.	1,939	4,848	636,797	350,543
Total		6,981	667,720	378,483
Forestland				
Baseline	328,306	196,983		
Progressive	41,038	127,218	8,907,863	7,887,838
Resource Mgmt.	41,038	86,180	13,755,047	11,391,687
Total		143,634	22,662,910	19,279,525
Grassland				
Baseline	134,276	80,566		
Progressive	51,645	74,885	3,986,665	4,295,748
Resource Mgmt.	20,685	51,128	93,264,065	82,501,263
Total		64,039	97,250,730	86,797,011
Urban				
Baseline	2,936	2,554		
Progressive	163	382	11,133	6,487
Resource Mgmt.	163	326	56,033	53,458
Total		398	67,136	59,945

PV – Present Value of costs.

Introduction

Watershed management planning is a process which, if successfully applied, will result in a sustainable supply of water of adequate quantity and quality to support residential, agricultural, commercial and industrial needs. The process consists of several phases:

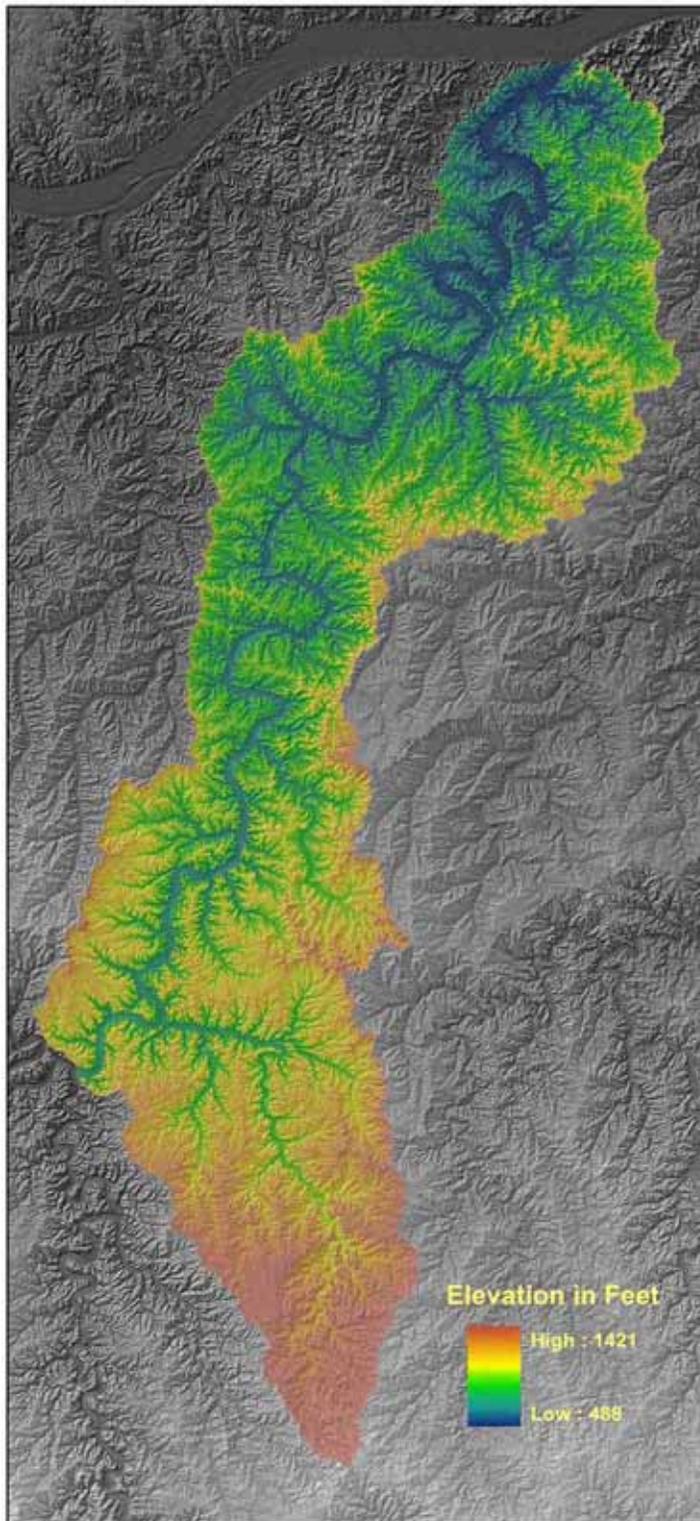
- Identifying the various factors which impede the watershed from providing a safe and reliable supply of water and related products to the users.
- Stating a set of measurable objectives for removing or resolving the impediments to water quality.
- Identifying a set of strategies and practices and strategies that will enable attainment of the objectives.
- Acquiring needed resources – technology, personnel, funding – to implement the strategies and practices.

The initial phase is the one which sets the stage for the following phases of plan development, so it must be conducted to yield the needed information in a most efficient and timely way. The initial information needed consists of an accurate and comprehensive description of the social, physical and biological characteristics of the watershed, (watershed profile), an enumeration of the natural resource concerns and issues impacting water quality and quantity in the watershed, and an assessment of the possible conservation practices that might be applied in the watershed along with their respective costs and benefits from implementation.

USDA Natural Resource Conservation Service has sponsored development of a process for generating this initial information called “Rapid Watershed Assessment.”

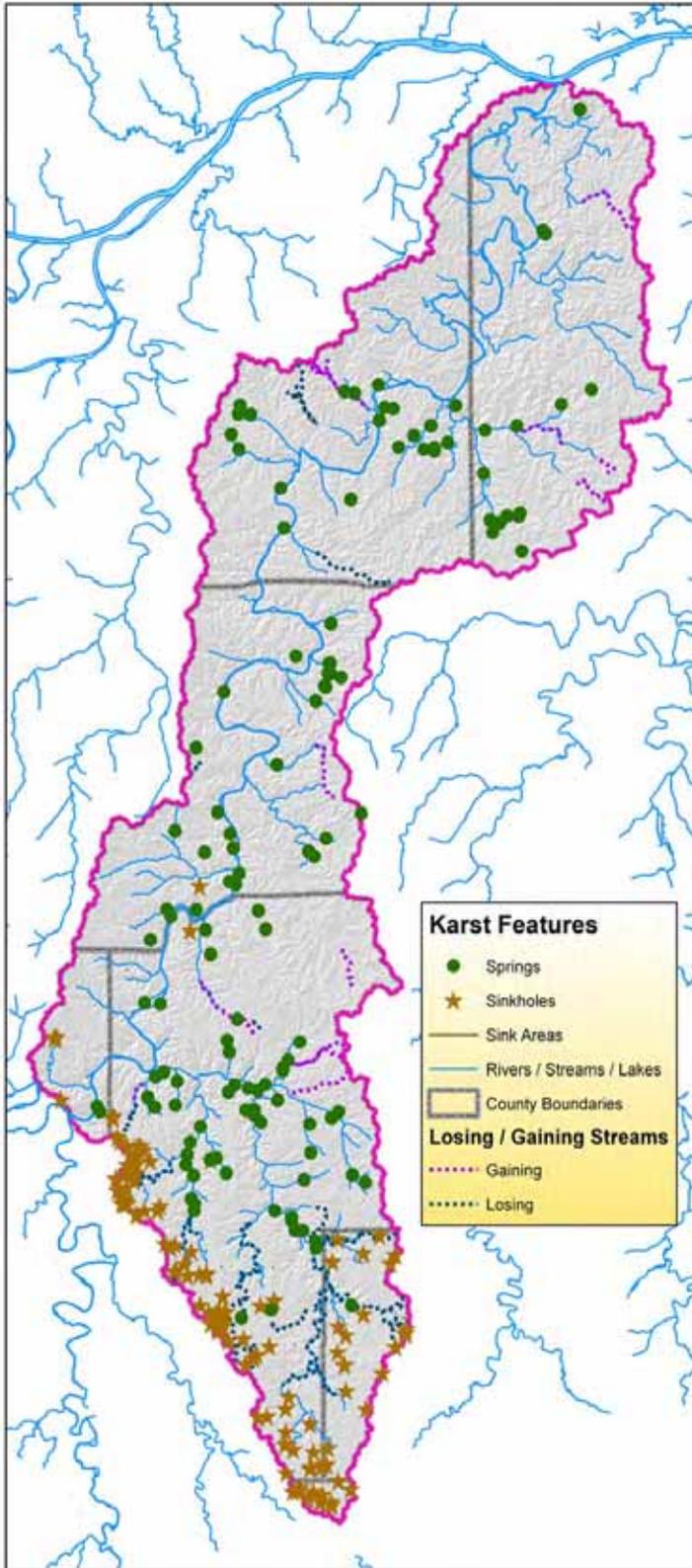
Assessments will provide a “... rough picture of resource conditions and conservation efforts” for Missouri’s large watersheds and can be used as a focal point for locally led identification of resource concerns and priorities.”

The Lower Gasconade Watershed is 1 of 19 rapid watershed assessments completed on 8-digit hydrologic units in Missouri which were selected for inclusion in a pilot project to further develop and refine this process. Watersheds were selected based on information contained in the Missouri Unified Watershed Assessment and the Missouri Department of Natural Resources 303(d) list.



Relief Map

The Lower Gasconade Watershed (Hydrologic Unit – 10290203), a 1,030 square mile watershed in central Missouri, was selected for its topography, and mix of agricultural activities and residential development. Agricultural activity is concentrated on ridge tops and in areas immediately adjacent to streams and there is widespread residential development taking place in various areas, which impacts both water quantity and quality. It is characterized by steep topography and significant forestation. The upper portion contains significant areas of public land, including a portion of the Mark Twain National Forest. Agriculture operations are predominately livestock-based, consisting primarily of hay and pasture. Drainage within the basin flows north from southern Phelps County to the Missouri River at Gasconade. The watershed is traversed by Interstate 44 and US Highway 63, with Rolla serving as the main population center. The Lower Gasconade Watershed is located along the northern boundary of the Ozark Plateau region of the state. The topography is quite hilly, with substantial relief.



Karst Features

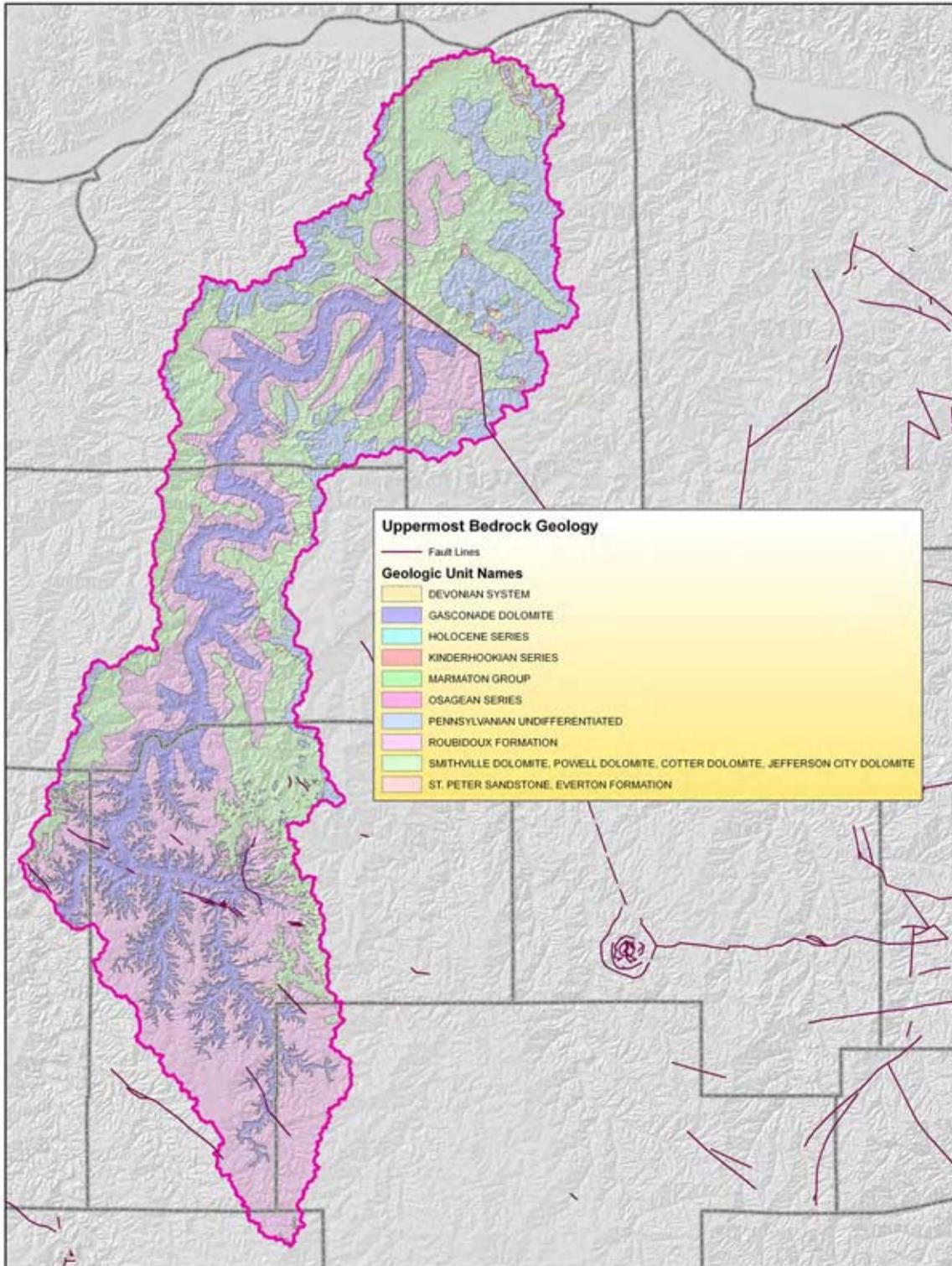
Karst topography is a landscape shaped by the dissolution of a soluble layer or layers of bedrock. These landscapes display distinctive surface features and underground drainages.

For the Lower Gasconade River sub-basin, there are a total of 15 gaining streams and 34 losing streams. There are also 126 sinkholes and 133 sink areas, mostly in the northern plateau. There are 130 total springs evenly distributed throughout the watershed, with 46 being named. Of the named springs, only 29 have been measured, with Lane Spring and Boiling Spring rating magnitude 2 (10-100 cfs). 10 separate springs rate magnitude 3 (1-10 cfs), 2 rate magnitude 4 (100 gpm – 1 cfs), 10 are magnitude 5 (10-100 gpm), and 5 are magnitude 6 (1-10 gpm).

A gaining stream is one in which the channel bottom is lower than the level of the surrounding groundwater table. Water moves from the ground into the channel, gaining water flow from the subsurface.

A losing stream is one which is above the groundwater table. Water moves from the channel into the surrounding ground, losing water flow to the subsurface.

Geologic Features



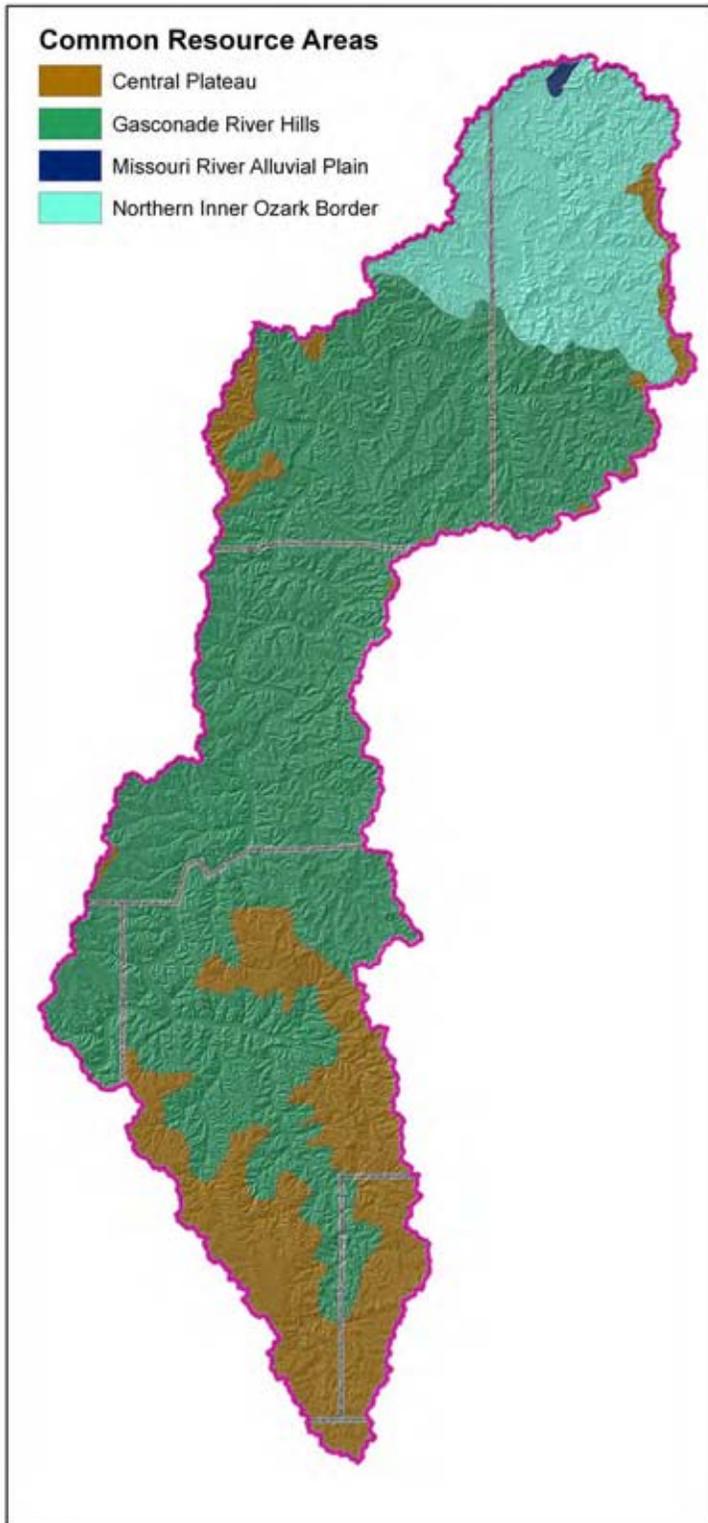
Geologic Features – Continued

The geology of a watershed shows bedrock formations (or parent materials) which will produce soils that will in turn influence water quality, biological activity, and aquatic life in a stream. Different types of bedrock also control how channels develop.

For this sub-basin, the majority of the bedrock in the large river and stream bottoms is made up of Gasconade Dolomite surrounded by a Roubidoux Formation. Smithville Dolomite, Powell Dolomite, Cotter Dolomite, and Jefferson City Dolomite are found in upland areas that surround the Roubidoux Formation. There is minimal impact from surface fault lines on this watershed, with some faults running near I-44 in the southern half, and another running near U.S. Hwy 50 in the northern half.

Bedrock Descriptions

Unit Name	Unit Description
	rock type 1; rock type 2; rock type 3
Smithville Dolomite, Powell Dolomite, Cotter Dolomite, Jefferson City Dolomite	dolostone (dolomite); sandstone; shale, conglomerate, chert
Roubidoux Formation	sandstone; chert; dolostone (dolomite)
Gasconade Dolomite	dolostone (dolomite); sandstone
Pennsylvanian Undifferentiated	shale; limestone; sandstone, coal
Osagean Series	limestone; chert; dolostone (dolomite), shale
Holocene Series	clay; silt; sand, gravel
Kinderhookian Series	limestone; siltstone; shale, sandstone
Devonian System	limestone; sandstone; shale, chert
Marmaton Group	limestone; shale; sandstone, clay, coal
St. Peter Sandstone	dolostone (dolomite); sandstone; limestone



Common Resource Areas

Common Resource Area (CRA) map delineation is defined as a geographical area where resource concerns, problems, or treatment needs are similar. It is considered a subdivision of an existing Major Land Resource Area (MLRA) map delineation or polygon. Landscape conditions, soil, climate, human considerations, and other natural resource information are used to determine the geographic boundaries of a Common Resource Area

Common Resource Areas – Continued**General Descriptions of Common Resource Areas**

The Lower Gasconade River Watershed is comprised of four Common Resource Areas (CRAs), described as:

Central Plateau – Consists of some of the least dissected portions of the Ozark Highlands. Dominated by carbonate lithology, it is strongly karstic in many portions and is mantled by a very thick solution residuum. Lack of surface water and droughty soils are characteristics. Much of the land has been cleared for pasture although oak forests and brush dominate locally.

Gasconade River Hills – Consists of the deeply dissected landscapes. Steep slopes, narrow ridges, and narrow valley bottoms occur virtually everywhere. Soils are rocky and frequently thin over carbonate and sandstone bedrock principally of the Roubidoux and Gasconade Formations. Local karst and large springs are characteristic. Oak forests and oak-pine cover most of the region.

Missouri River Alluvial Plain – Consists of the Missouri River channel and its adjoining alluvial plain across the northern Ozarks. Formerly the channel contained numerous islands and bars, but in the last half century it has been narrowed, its islands virtually eliminated, and its banks stabilized. Soils are deep and loamy. The alluvial plain is subject to flooding. Land use is chiefly row crops.

Northern Inner Ozark Border – Consists of dissected plains and hills with various expressions of local relief with a range of 150-300 feet. The CRA is defined largely by its association with the dolomites and loess-mantled ridges. Land use is extremely varied, from row crops and improved pasture to overgrown glades and dense second-growth oak forests.



Major Land Resource Areas (MLRA)

Major land resource areas (MLRAs) are geographically associated land resource units (LRUs). Identification of these large areas is important in statewide agricultural planning and has value in interstate, regional, and national planning. Dominant physical characteristics, such as physiography, geology, climate, water, soils, biological resources, and land use are used to describe MLRAs.

Major Land Resource Areas – Continued**Major Land Resource Area (MLRA) Descriptions**

The Lower Gasconade Watershed is located in two MLRAs as described below:

115B – Central Mississippi Valley Wooded Slopes

Land use: Nearly all this area is in farms, and approximately 40 percent is cropland. Feed grains and hay for livestock are the principal crops, but grape vineyards and peach and apple orchards are important in some places. Some 35 percent of the area is forested, which includes some national forests. Most of the remainder of the farmland is in permanent pasture and native grasses. The hazards of erosion and sedimentation are severe in urban areas near St. Louis and other cities and on the farmland.

Elevation and topography: Elevation ranges from 100m on the main valley floors to 300m on the ridge tops. This dissected glacial till plain has rolling narrow ridge tops and hilly to steep ridge slopes and valley sides. The small streams have narrow valleys and steep gradients; the major rivers have nearly level broad flood plains. Valley floors are tens of meters below the adjoining hilltops.

Climate: Average annual precipitation ranges from 900 to 1,150 mm; approximately two-thirds of the precipitation falls during the freeze-free period. The maximum is in spring and early in summer and the minimum from mid-summer through autumn. Average annual temperature ranges from 12° to 14°C, with an average freeze-free period of 180 to 200 days, increasing from north to south.

Water: In most years precipitation is adequate for the crops commonly grown, but in some years yields are reduced by drought. Ground water is the source of water for domestic and livestock needs on farms. The Mississippi, Missouri, and Ohio Rivers are major transportation arteries and are also used for recreation.

Soils: Most of the soils are Udalfs. They are deep and medium textured to moderately fine textured and have a mesic temperature regime, an udic moisture regime, and mixed mineralogy. Well drained and moderately well drained Hapludalfs (Alford, Fayette, Menfro, Muren, Weller, and Winfield series) are in silty loess; other Hapludalfs (Gara, Hickory, Keswick, and Lindley series) are in glacial till; and still others (Bloomfield and Princeton series) are in sandy aeolian material. Well drained and moderately well drained Fragiudalfs (Grenada, Hatton, and Hosmer series) are on ridgetops in silty material. Well drained, cherty Paleudalfs (Goss series) weathered from cherty limestone. Somewhat excessively drained shallow Hapludolls (Gasconade series) are on steep slopes. Udifluvents (Eel, Genesee, Haymond, Nodaway, and Sharon series), Fluvaquents (Piopolis, Shoals, and Wakeland series), Haplaquolls (Beaucoup, Darwin, and Wabash series), and Hapludolls (Leta series) are on flood plains.

Potential natural vegetation: This area supports a forest flora consisting mainly of oak and hickory species.

Major Land Resource Area - Continued**116A – Ozark Highland**

Land use: Approximately 70 percent of this area is forests or woodland, most of which is in large holdings, national forests, or farm woodlots. Some 20 percent is pasture, mainly of introduced grasses and legumes. Approximately 10 percent is cropland. Corn, feed grains, and hay for dairy cattle and other livestock are the principal crops. Orchards, vineyards, and truck crops are important on some of the more friable deep soils. Summer droughts and steep slopes are major land use problems.

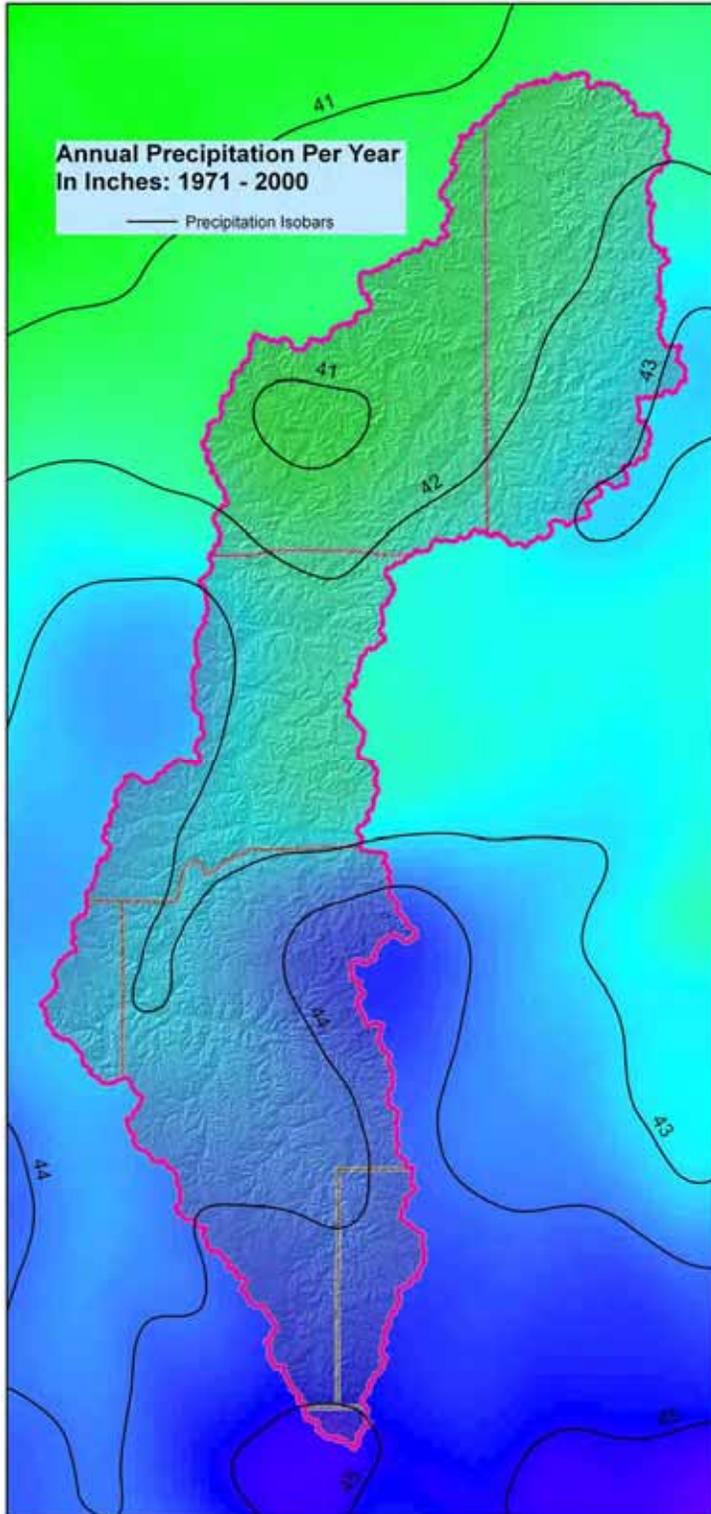
Elevation and topography: Elevation ranges from 200 to 500m. The sharply dissected limestone plateaus have narrow rolling ridge tops that break sharply to steep side slopes. Valleys are narrow and have steep gradients, especially in the upper reaches. Local relief is in meters to tens of meters.

Climate: Average annual precipitation ranges from 1,025 to 1,225 mm. Maximum precipitation events are in spring and early in summer, and the minimum is in midsummer. Average annual temperature ranges from 13° to 16°C, with an average freeze-free period of 180 to 200 days.

Water: The moderate precipitation is adequate for crops and pasture. On most farms shallow wells or springs supply water for domestic needs and for livestock, but deep wells are required for large quantities. Water from deep wells is of good quality but is hard. Small ponds on many individual farms provide some water for livestock, and a few large reservoirs are used for flood control and for recreation.

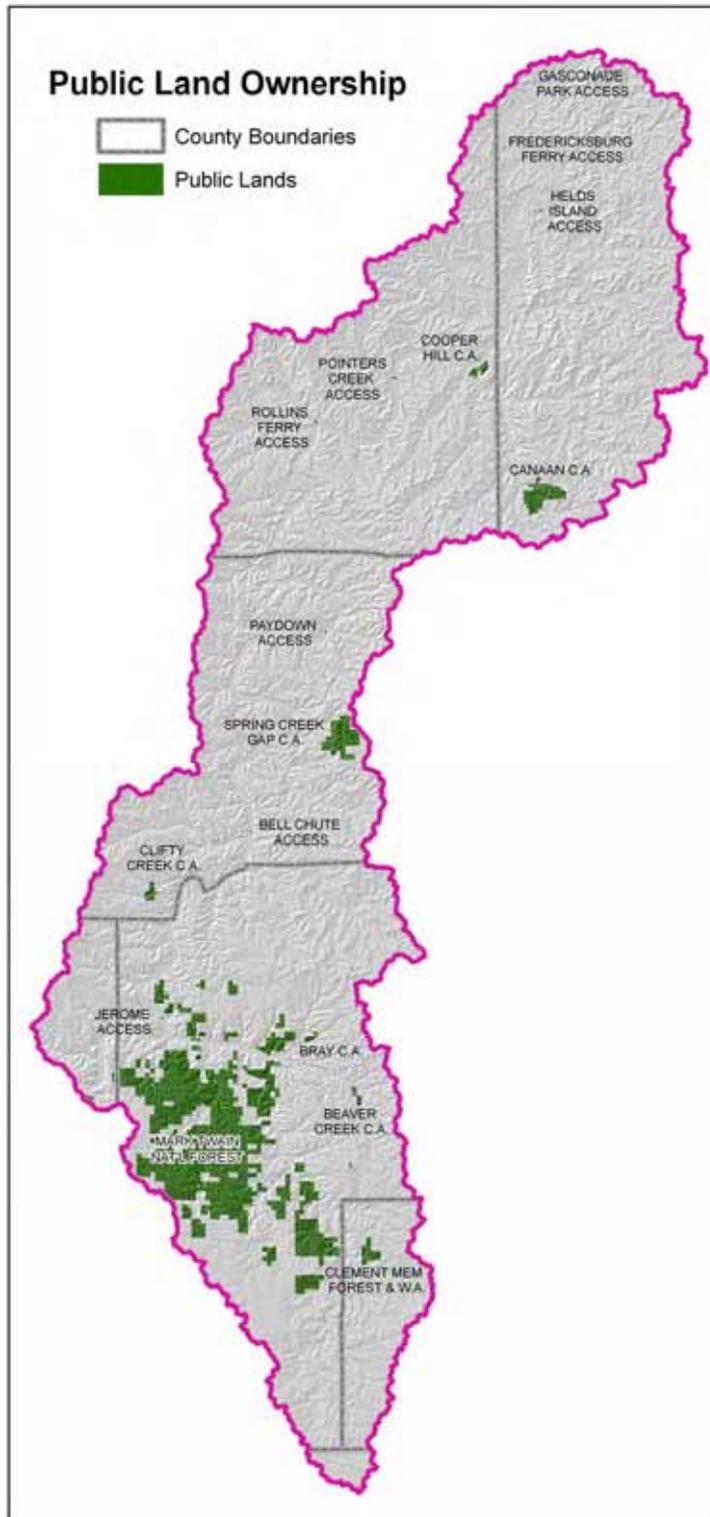
Soils: Most of the soils are Udults and Udalfs. They are deep, medium textured to fine textured, cherty soils that weathered from limestone. They have a mesic temperature regime, an udic moisture regime, and siliceous or mixed mineralogy. Somewhat excessively drained to well drained Paleudults (Clarksville, Coulstone, Macedonia, Noark, and Poynor series) and Paleudalfs (Peridge and Goss series) are on ridges and side slopes. Moderately well drained, nearly level to moderately steep Fragiudults (Captina and Nixa series) are on slopes. Somewhat excessively drained, shallow Hapludolls (Gasconade series) and areas of rock outcrop are on steep, dissected landscapes. Udifluvents (Midco and Elsay series) on flood plains and Hapludalfs (Razort and Secesh series) on terraces are in stream valleys. Fine textured Hapludults (Agnos and Gassville series), Paleudalfs (Gepp series), and Paleudults (Doniphan series) also occur.

Potential natural vegetation: This area supports oak-hickory and oak-hickory-pine forests. Oak-hickory-pine forests are more dominant in the east. Glades, openings having bedrock outcrops or that are shallow to bedrock, support a more herbaceous vegetation consisting primarily of Indiangrass, little bluestem, and dropseeds. Glades are more common in the southwest.



Average Annual Precipitation

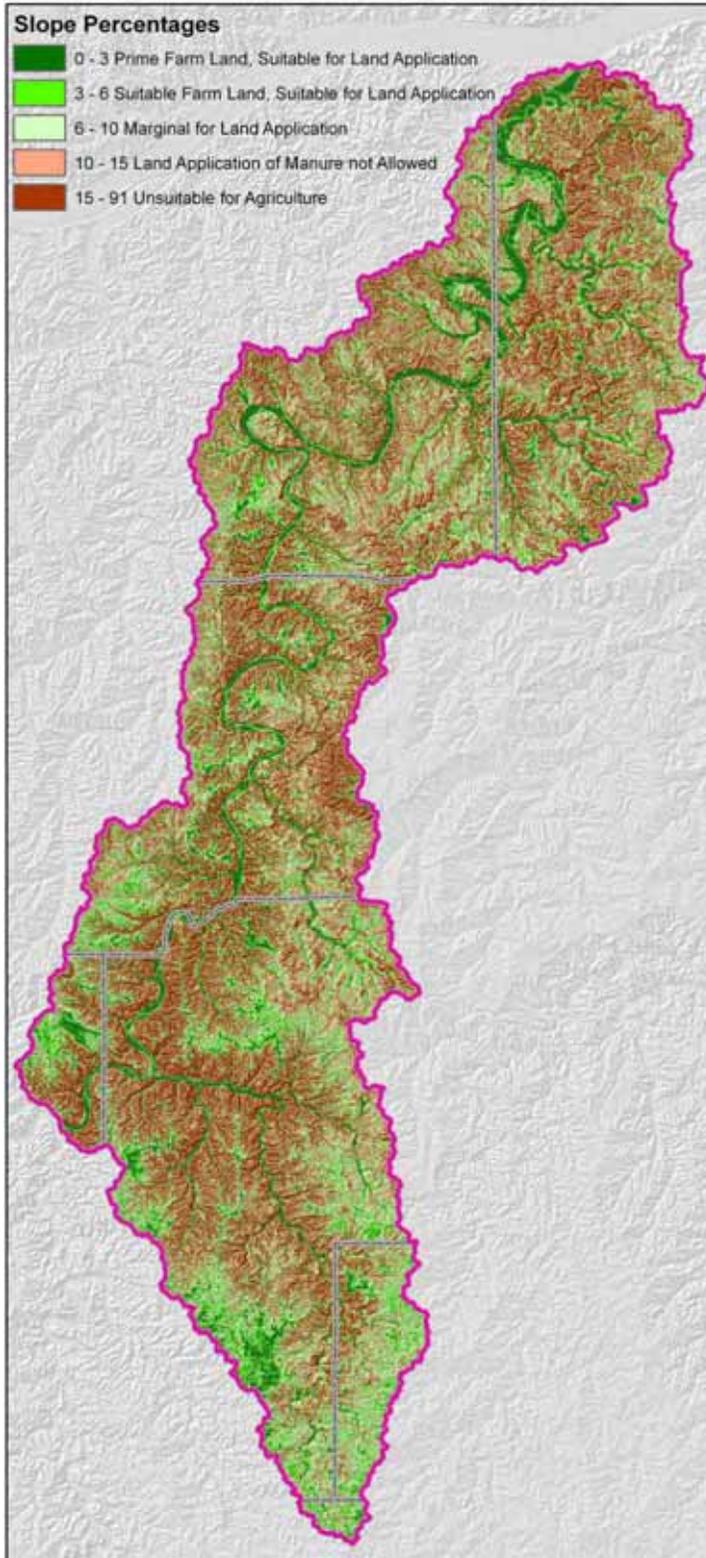
Data collected from 1971 to 2000 shows that the precipitation range for the Lower Gasconade area is from 41 inches per year in the northern areas of the watershed to 45 inches per year in the extreme southern tip that dips into Texas County.



Land Ownership

Of the 661,149 acres that comprise the Lower Osage River sub-basin, only 40,076 acres (or 6%) are public holdings. The remaining 621,073 acres (or 94%) is owned by private landowners.

The largest public land areas in this watershed are: Mark Twain National Forest – 35,506 acres; Spring Creek Gap Conservation Area – 1,779 acres; Canaan Conservation Area – 1,409 acres; and Clement Memorial Forest and Wildlife Area – 513 acres.



Land Slope

The best slopes for agriculture are located along the flood plains of the Gasconade River, along with the broader ridges on the south side of the watershed. Most of the areas unsuitable for farming occur on the steep ridges and gullies that surround stream and river floodplains.

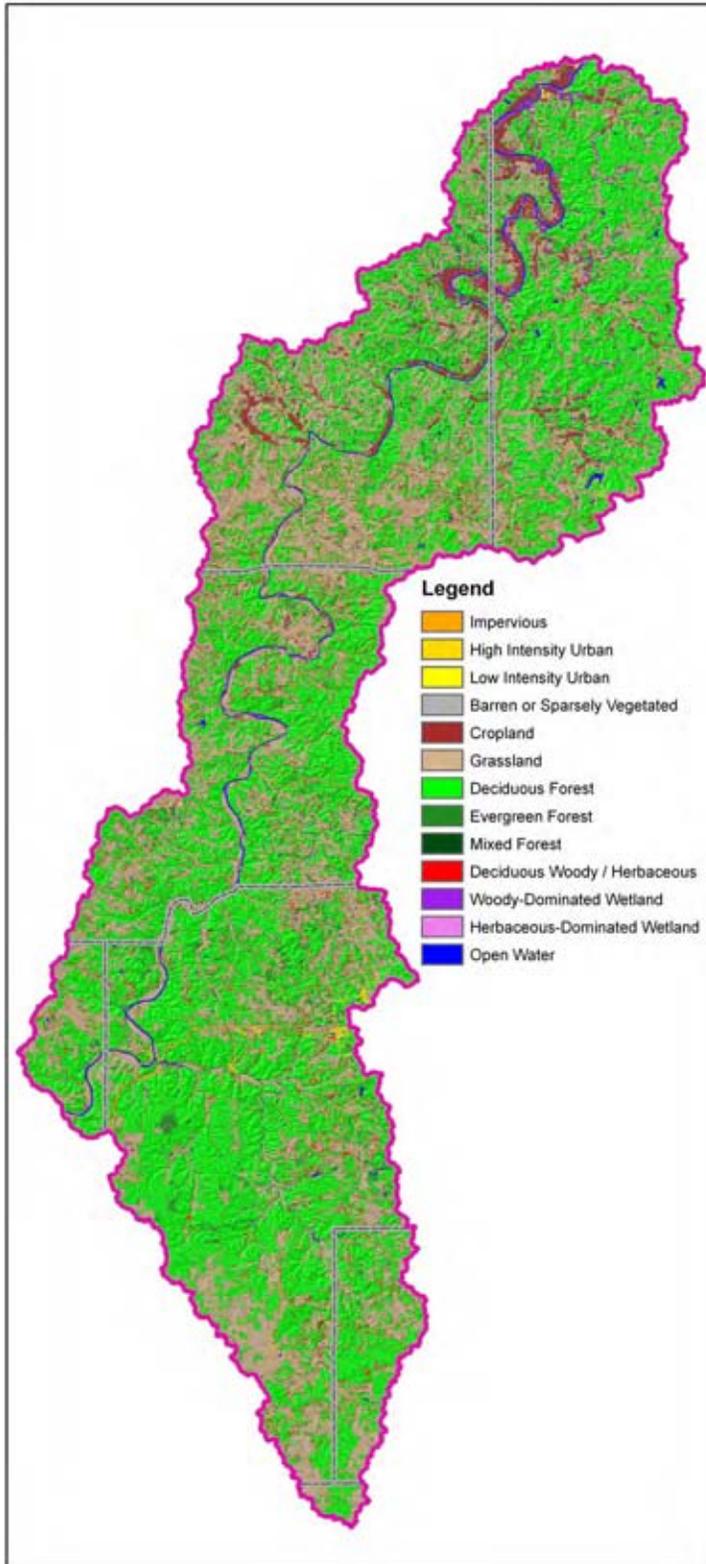
Slope classification is an important factor in determining the potential for runoff of soil and chemicals into surface water. It is not the only determinant. Soil cover, in the form of growing plants and crop residue, aids in reducing runoff.

The slope categories describe a site's suitability for crop production and for receiving manure applications. Soil with over 10% slope is unsuitable for manure application according to current environmental regulations.

Several opportunities exist to manage steep land to reduce the likelihood of soil erosion or chemical runoff. The University of Missouri Extension has educational materials on installing terraces, planting buffers and other management activities to stabilize land.

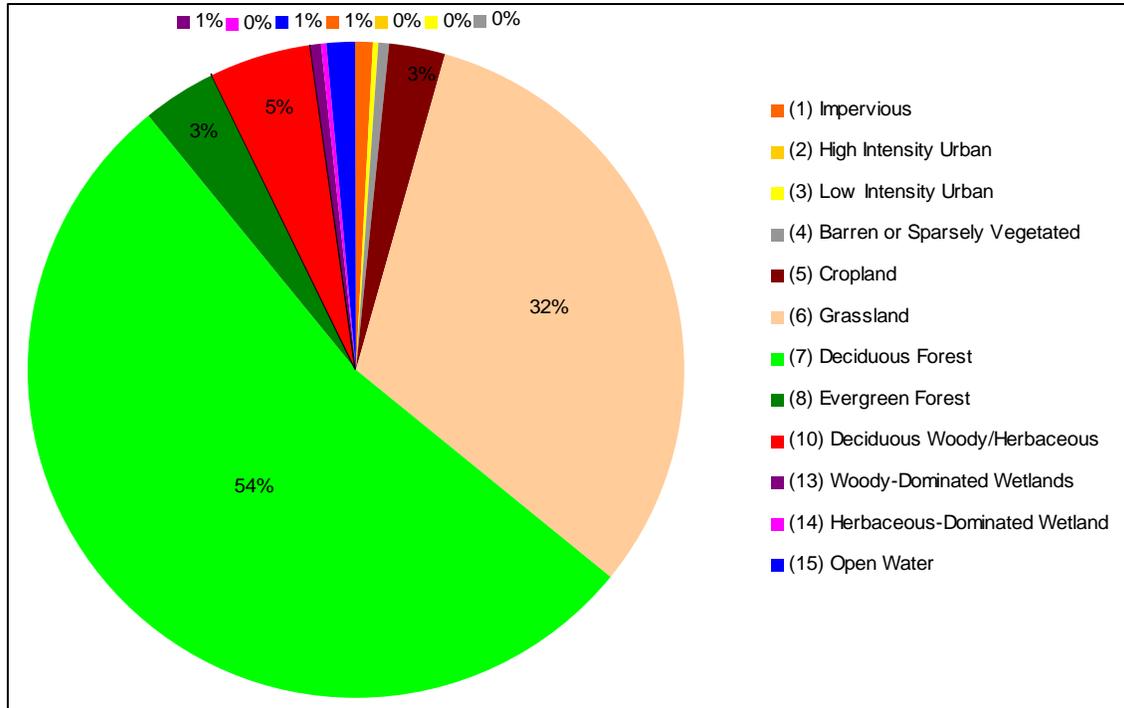
Land Use / Land Cover

Land Use and Land Cover (LULC) describe the vegetation, water, natural surface, and cultural features on the land surface.



Land Use / Land Cover – Continued

Graph of Total Land Cover / Land Use



LAND COVER/LAND USE	PUBLIC	PUBLIC	PRIVATE	PRIVATE	TRIBAL	TRIBAL	TOTALS	TOTALS
	Acres	%	Acres	%	Acres	%	Acres	%
(1) Impervious	74.6	0.19%	4830.1	0.78%	0	0.00%	4904.7	0.74%
(2) High Intensity Urban	3.3	0.01%	388.8	0.06%	0	0.00%	392.1	0.06%
(3) Low Intensity Urban	30.9	0.08%	2839.2	0.46%	0	0.00%	2870.1	0.43%
(4) Barren or Sparsely Vegetated	13.5	0.03%	2360.1	0.38%	0	0.00%	2373.6	0.36%
(5) Cropland	36.4	0.09%	19356.1	3.12%	0	0.00%	19392.5	2.93%
(6) Grassland	1436.3	3.58%	205141.6	33.03%	0	0.00%	206577.9	31.24%
(7) Deciduous Forest	35464.1	88.51%	318090	51.21%	0	0.00%	353554.1	53.48%
(8) Evergreen Forest	2024.3	5.05%	20418.2	3.29%	0	0.00%	22442.5	3.39%
(9) Mixed Forest	1.3	0.00%	0	0.00%	0	0.00%	1.3	0.00%
(10) Deciduous Woody/Herbaceous	800.1	2.00%	33583	5.41%	0	0.00%	34383.1	5.20%
(11) Evergreen Woody/Herbaceous	0	0.00%	0	0.00%	0	0.00%	0	0.00%
(13) Woody-Dominated Wetlands	14.4	0.04%	3901.3	0.63%	0	0.00%	3915.7	0.59%
(14) Herbaceous-Dominated Wetland	17.3	0.04%	559.4	0.09%	0	0.00%	576.7	0.09%
(15) Open Water	152.5	0.38%	9620.4	1.55%	0	0.00%	9772.9	1.48%
TOTALS	40069		621088.2		0		661157.2	
% OF TOTAL		6.06%		93.94%				

Only 3 percent of the watershed is in cropland; 31 percent is in grassland; and 53 percent is in deciduous forests.

Land Cover / Land Use – Continued

LAND CAPABILITY CLASS		Acres	Percent
<p><i>~Based on Cropland and Pastureland only</i> <i>~Uses Non-Public Lands only</i></p>	I	1756.7	0.79%
	II	31270.6	13.98%
	III	102808.3	45.96%
	IV	46193.7	20.65%
	V	2.9	0.00%
	VI	34367.6	15.36%
	VII	4148.7	1.85%
	VIII	3151.6	1.41%
	Total Acres Croplands and Pasturelands		223700.1

Capability class is the broadest category in the land capability classification system. Class codes 1, 2, 3, 4, 5, 6, 7, and 8 are used to represent both irrigated and non-irrigated land capability classes.

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or require special conservation practices, or both.

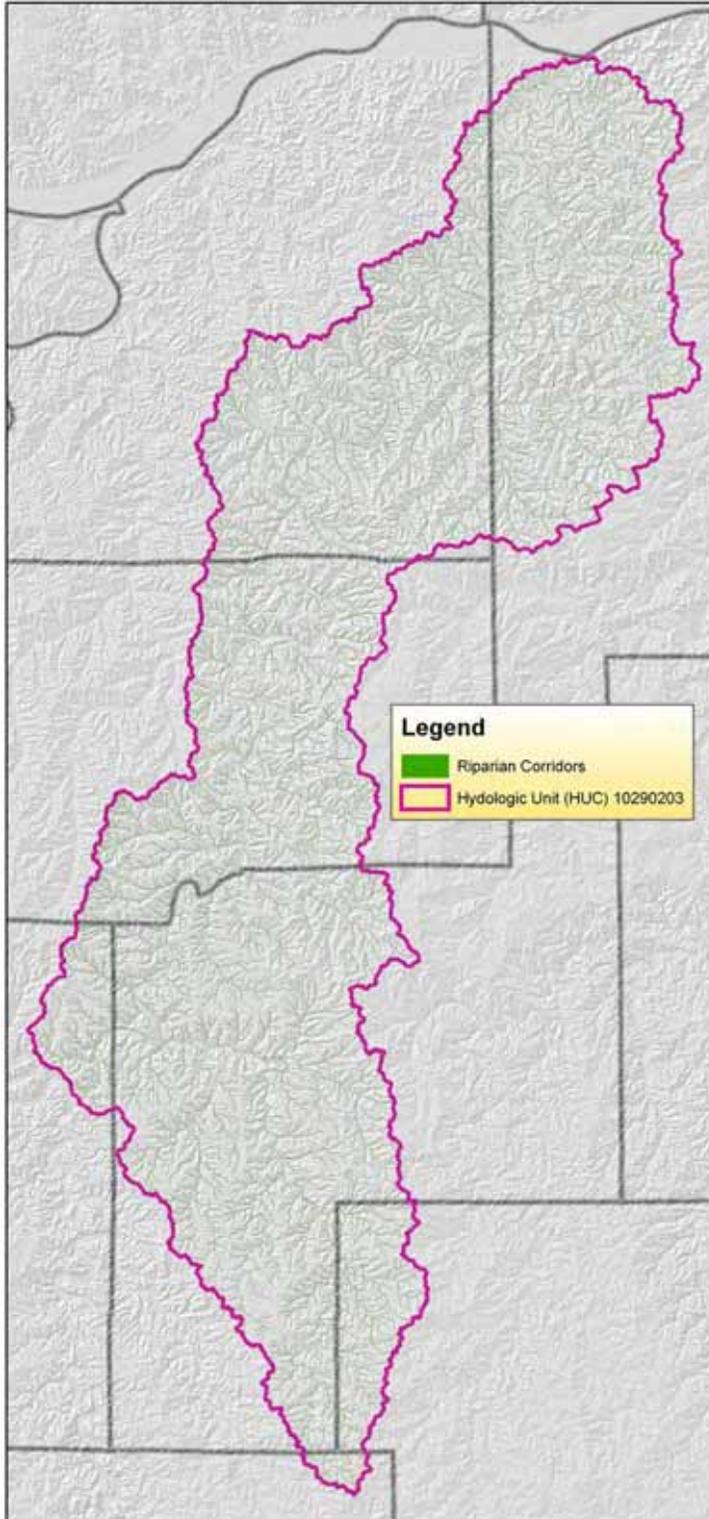
Class IV soils have very severe limitations that restrict the choice of plants or require very careful management, or both.

Class V soils have little or no hazard of erosion but have other limitations, impractical to remove, that limit their use mainly to pasture, range, forestland, or wildlife food and cover.

Class VI soils have severe limitations that make them generally unsuited to cultivation and that limit their use mainly to pasture, range, forestland, or wildlife food and cover.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use mainly to grazing, forestland, or wildlife.

Class VIII soils and miscellaneous areas have limitations that preclude their use for commercial plant production and limit their use to recreation, wildlife, or water supply or for esthetic purposes.



Riparian Corridors

A Riparian Corridor is a unique plant community that grows near a river, stream, lake, or other natural body of water. This vegetation serves a variety of functions that helps maintain the quality of water which it envelopes, including: filtering sediment from runoff before it enters rivers and streams, helping protect stream banks from erosion, providing storage area for flood waters, and providing habitat and food for fish and wildlife. A Riparian Corridor also maintains green spaces and other aesthetics associated with stream banks and lake shores.

These corridors have been built by buffering the National Hydrology Dataset (NHD) by 50 feet, and using the created buffered lines to clip out data from the Common Land Unit (CLU) dataset.

Riparian Corridor - Continued

Most of the Riparian Corridors are found on agricultural land (cropland or forestland) within the watershed.

Riparian Corridor Lands	TOTALS	
	Acres	Percent
*Crop OR unclassified OR Public Land	4883	15.78%
Urban	547	1.77%
Cropland	3683	11.90%
Rangeland	5	0.02%
Forestland	19618	63.39%
Water	1419	4.59%
Mined Land	0	0.00%
Other Agriculture Lands	768	2.48%
Unclassified	24	0.08%
TOTALS	30947	

* These figures have been developed from attributes usually limited to areas that are not USDA program fields. Sometimes if there are program fields included, it is added as “crop”, however it can also just mean that it is public land, has yet to be evaluated, or is undetermined as to what is there.



Highly Erodible Lands

Erosion is defined as the wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Roughly 81% of the lands in the Lower Gasconade River sub-basin are defined as either Highly Erodible or Potentially Highly Erodible.

Highly Erodible Lands - Continued

HIGHLY ERODIBLE LANDS		Acres	Percent of Total
	Unrated Areas	5701	0.86%
	Highly Erodible Land	407239	61.6%
	Not Highly Erodible Land	118554	17.93%
	Potentially Highly Erodible Land	129655	19.61%
	TOTAL	661149	



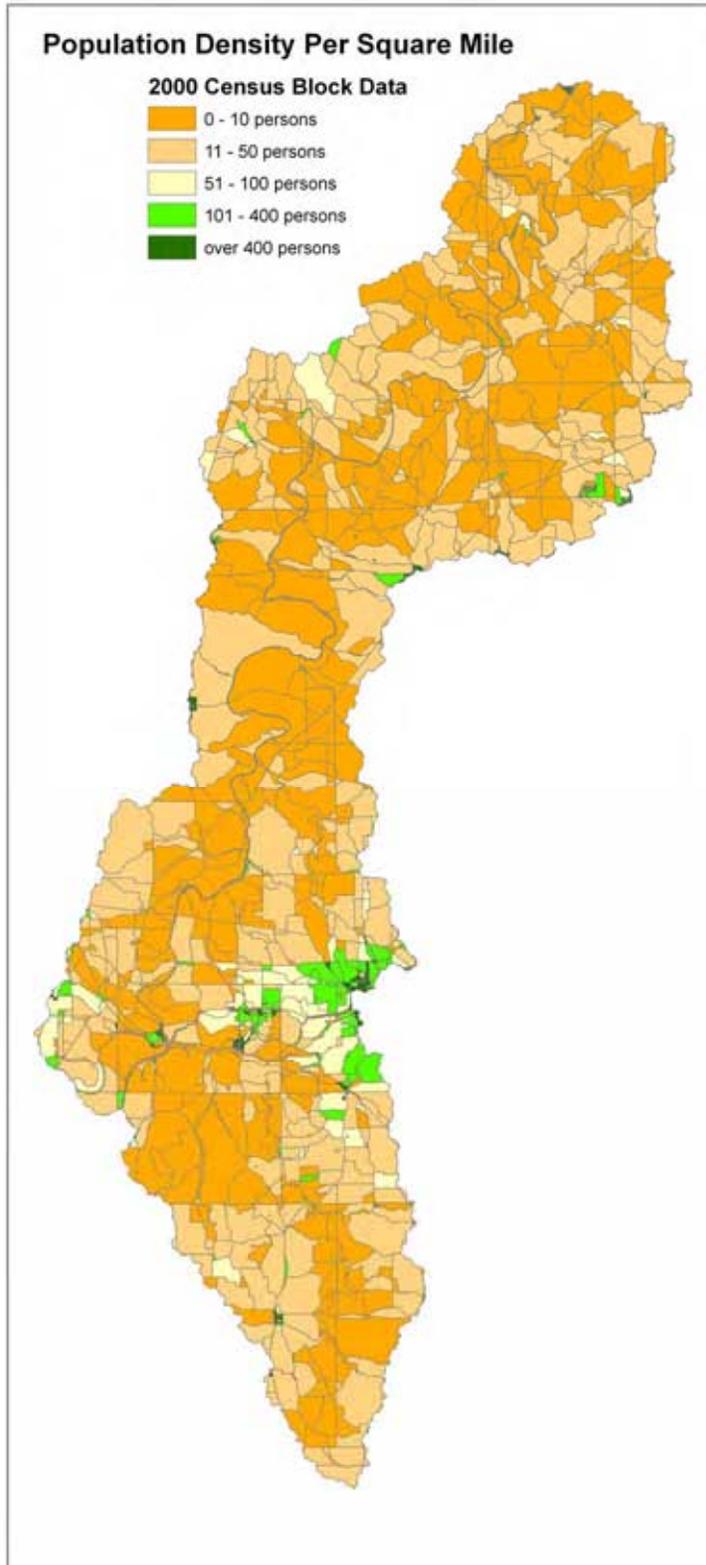
Prime Farmland

Prime Farmland is defined as land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is also available for these uses.

Prime Farmland – Continued

PRIME FARMLANDS	Acres	Percent of Total
	All Areas are Prime Farmland	46973
Farmland of Statewide Importance	227544	34.42%
Not Prime Farmland	338657	51.22%
Prime Farmland if Drained	12068	1.83%
Prime Farmland if Protected from flooding, or not frequently flooded during the growing season	35906	5.43%
TOTAL	661148	

Just over 41% of the farmland in the watershed is classified as Prime Farmland or Farmland of Statewide Importance; 51% is classified as Not Prime Farmland. Another 7% would be considered prime farmland if it were drained or otherwise protected.



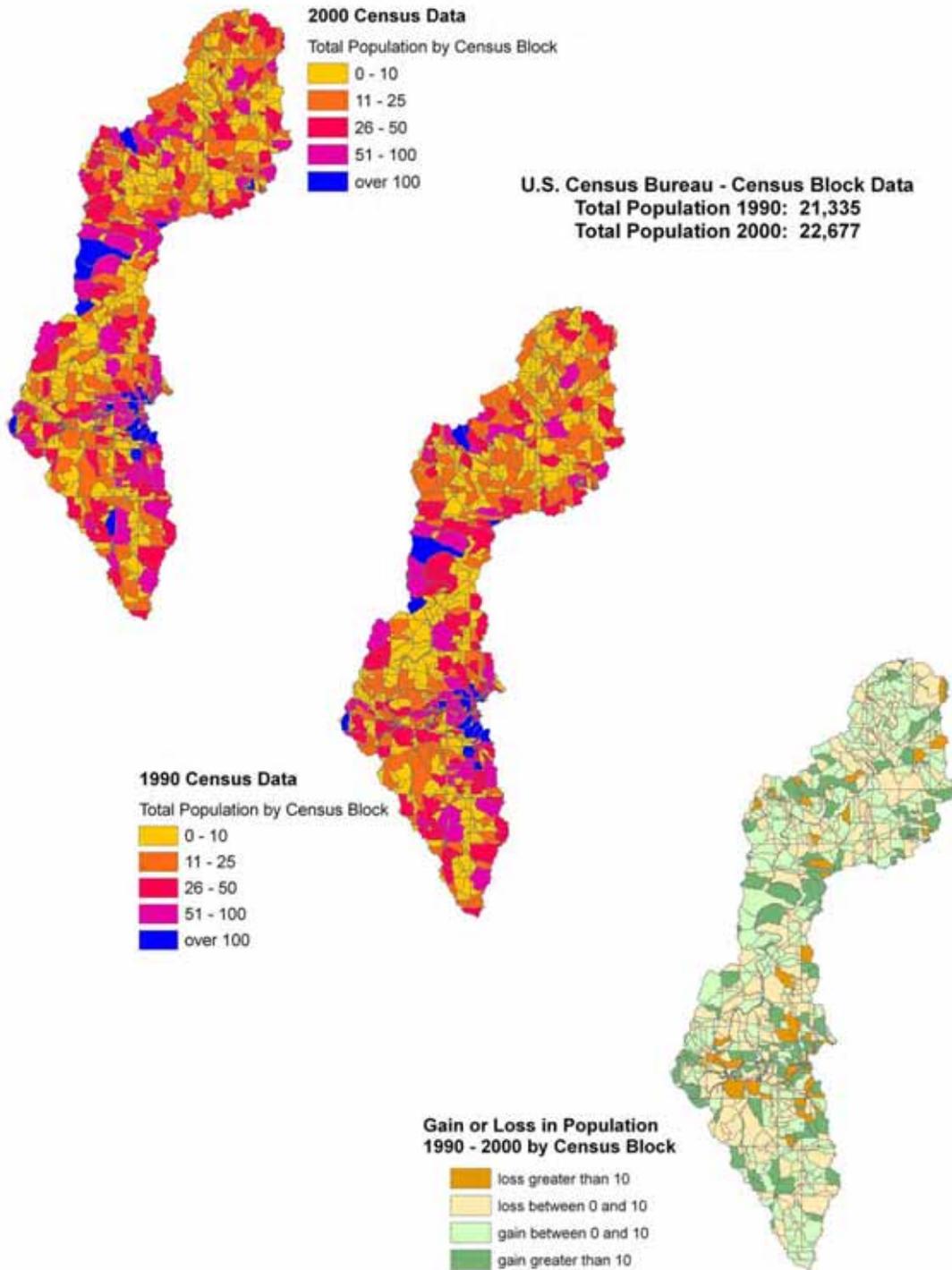
Census Data

This map is based on 2000 U.S. Census Block data. It distributes the population evenly over the entire area of a block.

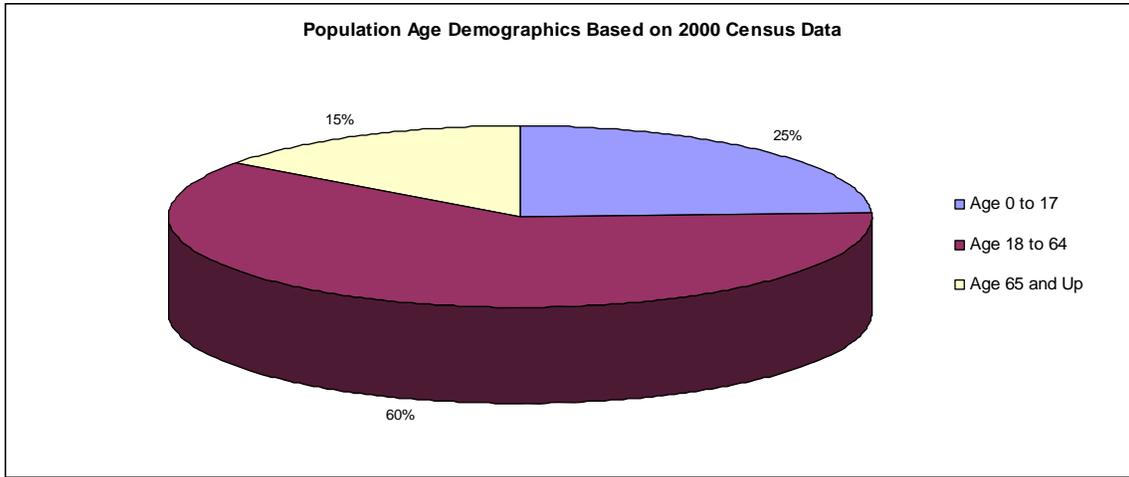
As expected, the higher density areas appear where urban areas are located. In this case, the highest population per square mile occurs where the town of Rolla is located. Other areas of high population (100 – 400 per square mile) are centered on the towns of Doolittle and Owensville, and near the towns of Linn and Dixon.

The least dense areas are on the north end of the watershed in the area of US Highway 50, the middle section of the watershed towards the northern end of Maries County, and the southern end of the watershed near the town of Edgar Springs and the Mark Twain National Forest.

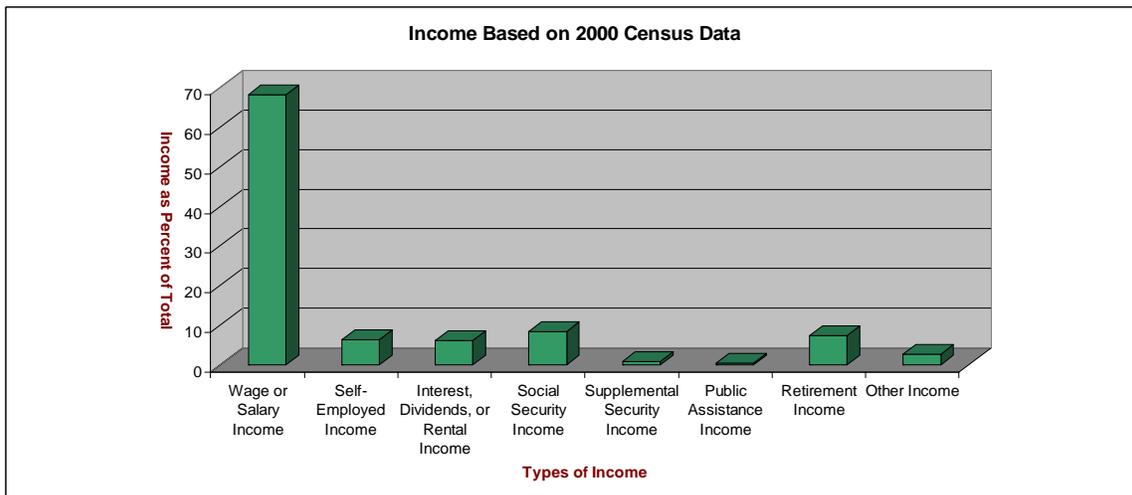
Census Data – Continued



Census Data – Continued

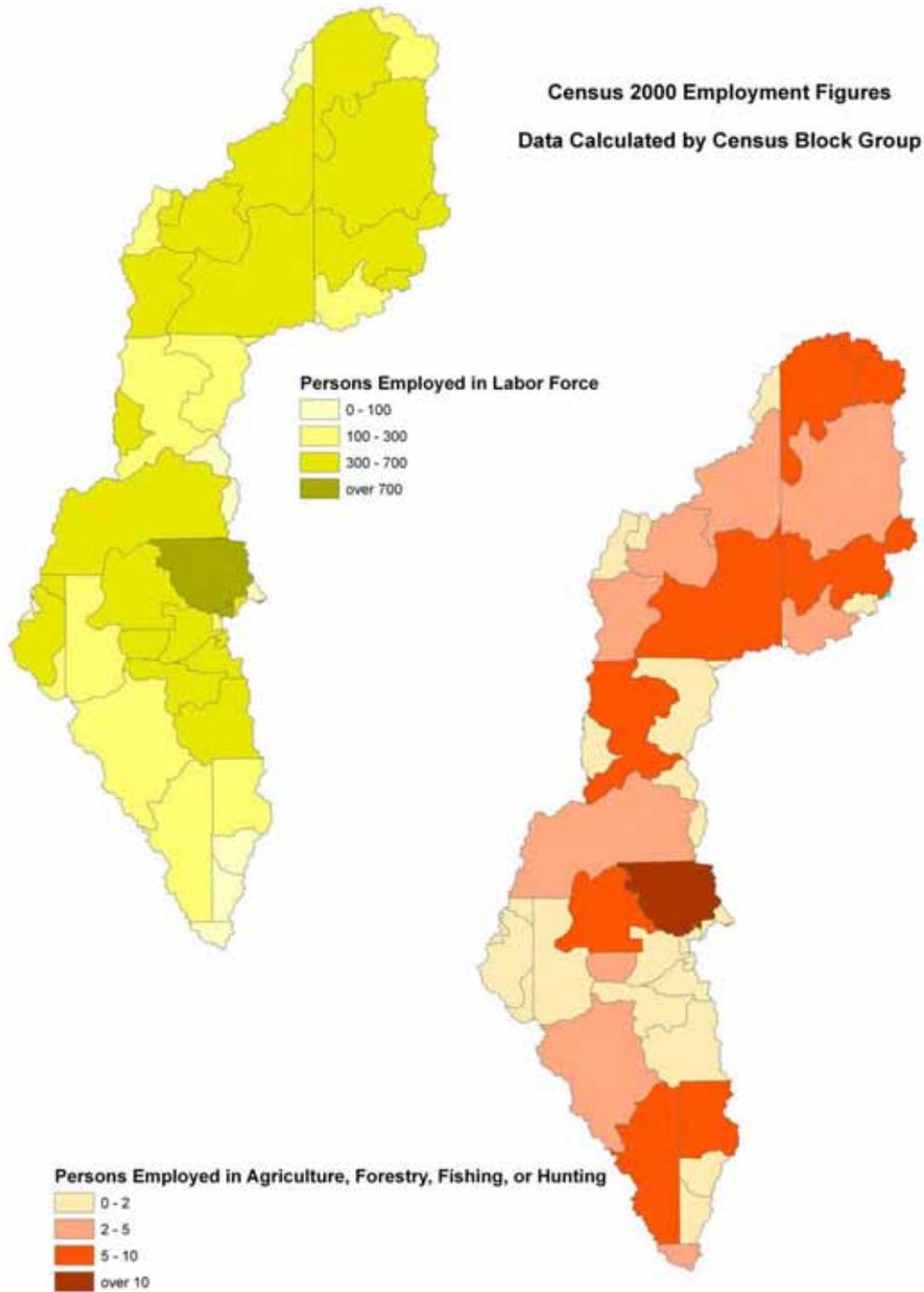


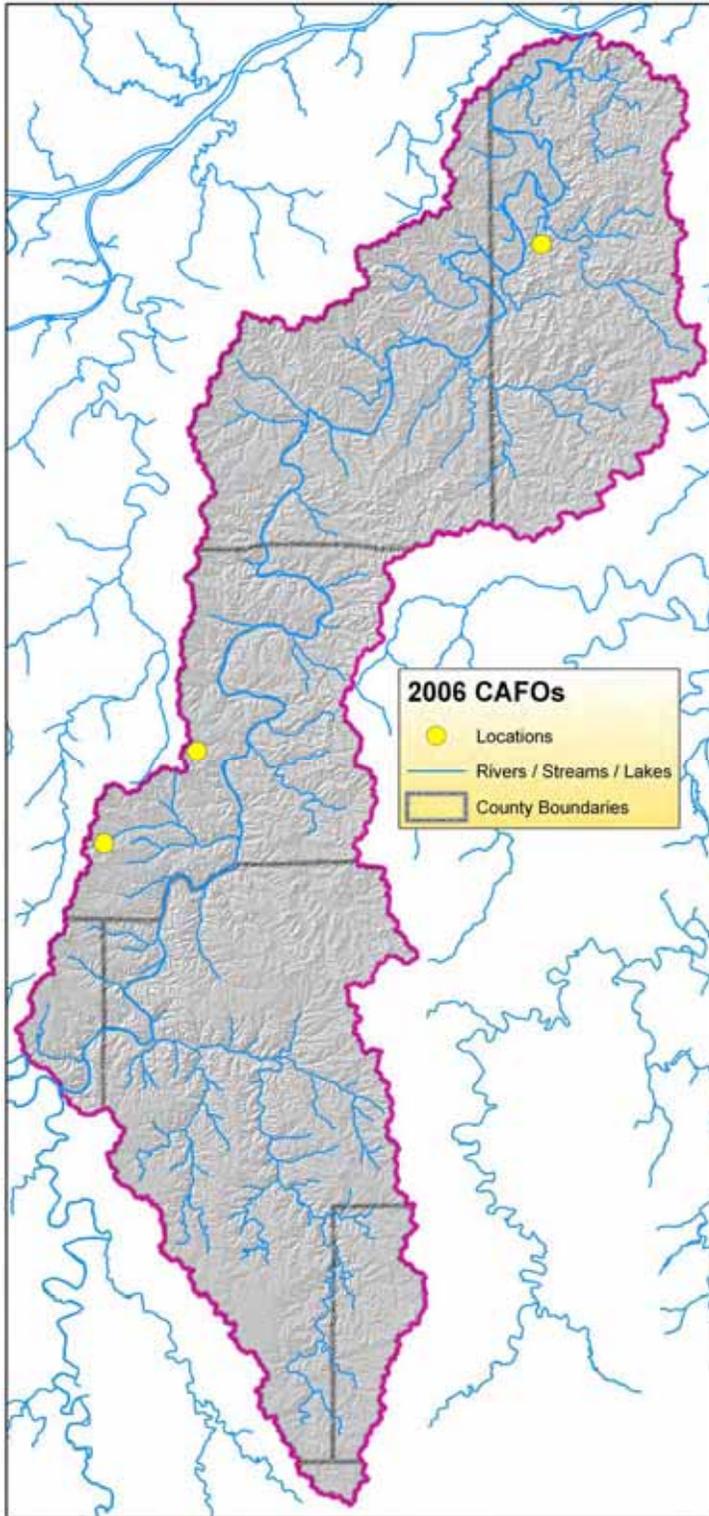
According to the Census Bureau, well over half of the population in the watershed falls between the ages of 18 and 65. Additionally, most of the income earned in this watershed comes from wages or salaries.



Agriculture income is not separated from other types of income in this graph. Farmers who own and work their own farms or ranches are included as Self-Employed. Farm hands and others who do not work their own land, and are paid employees are included as Wage and Salary Income.

Census Data – Continued





Confined Animal Feeding Operations

Confined Animal Feeding Operations (CAFOs) are special agriculture facilities that consist of large numbers of animals that are housed and fed in a confined space for a limited period of time. The official definition of a CAFO is as follows:

An operating location where animals have been, are, or will be stabled or confined and fed or maintained for a total of forty-five (45) days or more in any twelve (12)-month period, and a ground cover of vegetation is not sustained over at least fifty percent (50%) of the animal confinement area and meets one (1) of the following criteria: A.) Class I operation; or B.) Class II operation that discharges through a man-made conveyance or where pollutants are discharged directly into waters of the state which originate outside of and pass over, across or through the operation or otherwise come into direct contact with the animals confined in the operation.

With only three permitted CAFOs in the watershed, concentration is not a concern at this time.

Confined Animal Feeding Operations - Continued

Definition of Animal Units:

1 Animal Unit =					
1	Beef feeder or slaughter animal	2.5	Swine weighing over 55 lbs.	30	Chicken laying hens
0.5	Horse	15	Swine weighing less than 55 lbs.	60	Chicken layer pullets
0.7	Dairy cow	10	Sheep	55	Turkeys
				100	Broiler chickens

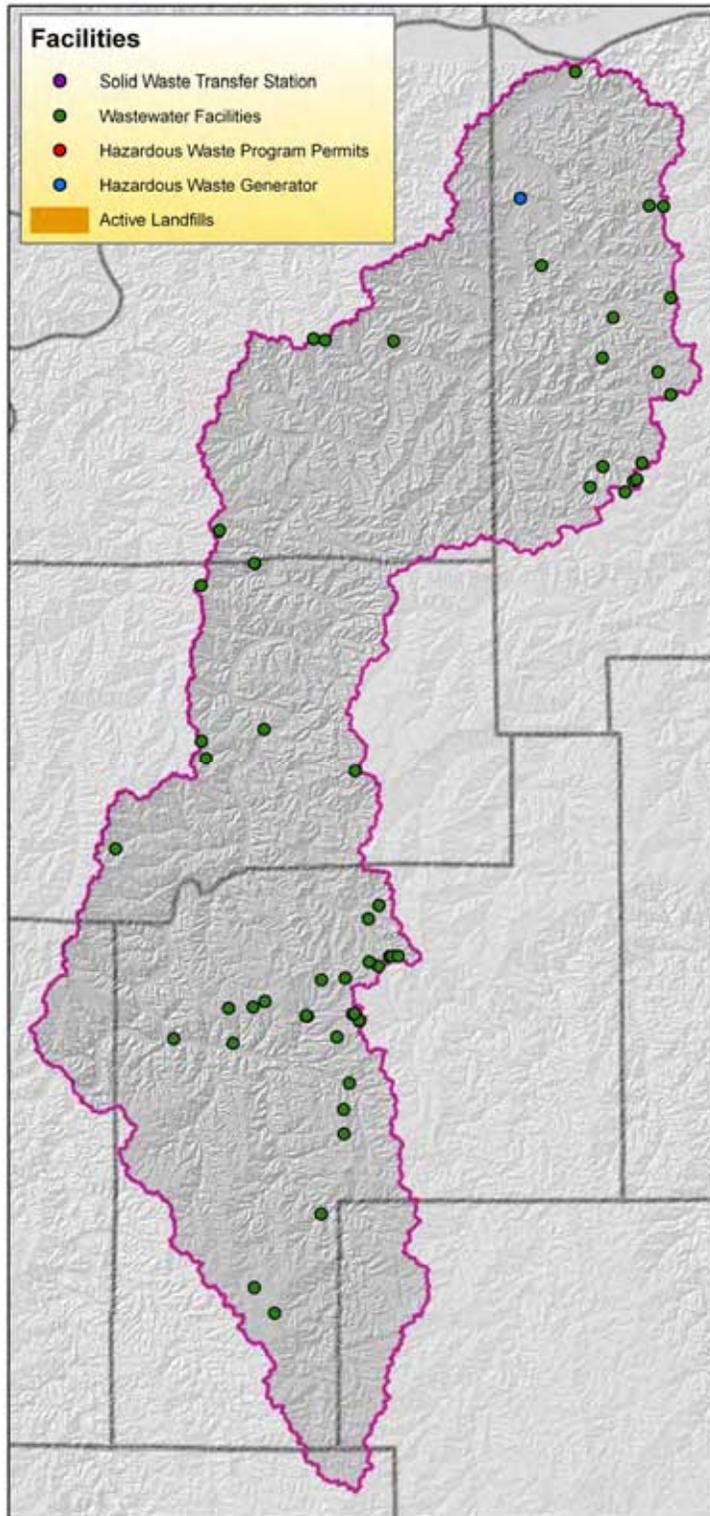
CONFINED ANIMAL FEEDING OPERATIONS - MISSOURI CAFO PERMIT - 2006			
	Animal Type	No. of Permitted Farms	No. of Permitted Animal Units
	Dairy	1	229
	Feedlot		
	Poultry		
	Swine	2	1600
	Other		

State Regulations restrict where CAFOs can be located, based on setbacks from dwellings and wells. These setbacks are also based on the total number of animal units housed at each facility.

Facility Setback:			
Feature	Facility Size	Requirement	Regulating Authority
Dwelling (Non-Owned)	1000 to 2999 AU 3000 to 6999 AU 7000 AU or more	1000 feet 2000 feet 3000 feet	State of Missouri
Well	All	100 feet (poultry litter) 300 feet (other)	State of Missouri

Additional Setbacks:

Of the seven counties that contribute area to the Lower Gasconade River sub-basin, none have additional restrictions as imposed by county health ordinance.



Solid Waste and Wastewater Facilities

Solid waste management permitting, monitoring and enforcement efforts can prevent illegal dumping and other factors that may cause long-term social, economic and environmental problems.

Solid Waste Transfer Station: active solid waste transfer stations in Missouri.

Wastewater Facility: outfall locations of wastewater facilities with Missouri National Pollutant Discharge System (NPDES) Operating Permits.

Hazardous Waste Program Permits: sites permitted to treat, store or dispose of hazardous waste and facilities that are certified for resource recovery. Some of the permitted sites have known or suspected hazardous contamination.

Hazardous Waste Generator: large quantity hazardous waste generators registered in Missouri.

Active Landfills: permitted active landfills in Missouri.

Solid Waste and Wastewater Facilities – Continued

Permitted Facilities		
	Facility Type	Total
	Hazardous Waste Generators	1
	Hazardous Waste Program Permits	0
	Wastewater Facilities	57
	Solid Waste Transfer Stations	0
	Active Landfills	0

Drinking Water

Ground Water (Public Wells)	
Total population served by public wells	28611
Community population served by wells	25889
Non-community, non-transient population (schools, factories)	145
Non-community, transient population (campgrounds, state parks)	2577
Total wells	2386
Public wells	39
Community wells	25
Non-community, non-transient population	2
Non-community, transient	10
Private wells	2347

Of the total population served by public wells, over 90 percent are using community wells.

Surface Water (Reservoir Used for Public Drinking)	
Total population served by surface water	0
Community population served by surface water	0
Non-community, non-transient population (schools, factories)	0
Non-community, transient population (campgrounds, state parks)	0
Total number of intakes	0

None of the population is served by surface water.

Resource Concerns

Endangered and Threatened Species

THREATENED AND ENDANGERED SPECIES LISTED FEDERALLY AND BY STATE		
State or Federally listed	Species	Endangered Status
State / Federal	Hine's Emerald - <i>Insect</i>	State - Endangered / Federal - Endangered
State / Federal	Running Buffalo Clover - <i>Plant</i>	State - Endangered / Federal - Endangered
State / Federal	Scaleshell - <i>Mollusk</i>	State - Endangered / Federal - Endangered
State / Federal	Bald Eagle - <i>Bird</i>	State - Endangered / Federal - Threatened
State / Federal	Pink Mucket - <i>Mollusk</i>	State - Endangered / Federal - Endangered
State / Federal	Gray Bat - <i>Mammal</i>	State - Endangered / Federal - Endangered
State	Snuffbox - <i>Mollusk</i>	Endangered
Federal	Spectaclecase - <i>Mollusk</i>	Candidate
State	Northern Harrier - <i>Bird</i>	Endangered
State	Bachman's Sparrow - <i>Bird</i>	Endangered
State	Black-tailed Jackrabbit - <i>Mammal</i>	Endangered
State / Federal	Indiana Bat - <i>Mammal</i>	State - Endangered / Federal - Endangered
State	Eastern Hellbender - <i>Amphibian</i>	Endangered

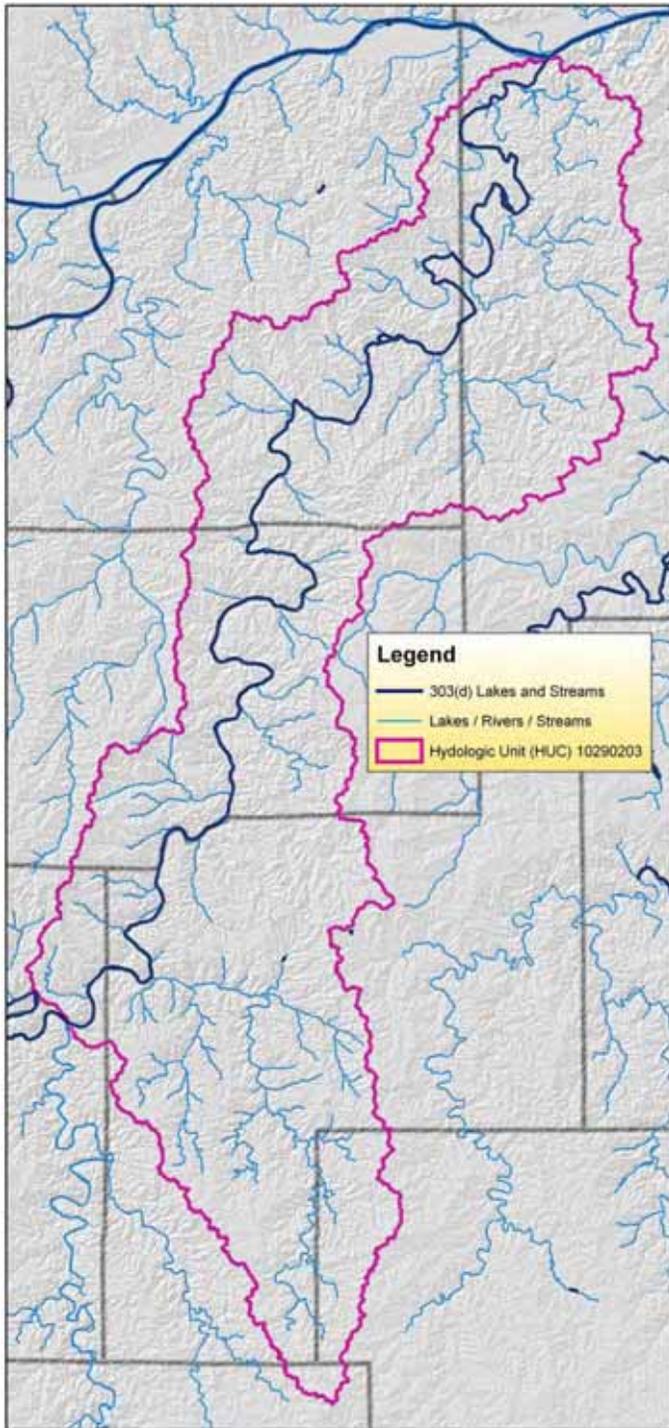
Listed by U.S. Fish and Wildlife Listed by Missouri Department of Conservation

Several of the endangered and threatened species listed at the state and federal levels are dependent upon water.

Stream Flow Data

STREAM FLOW DATA		Total Avg. Yield	2,978 CFS
		May - Sept. Yield	2,654 CFS
	USGS 06934000 Gasconade River near Rich Fountain, MO as recorded 1923-2006	Total Avg. Yield	2,586 CFS
		May - Sept. Yield	2,234 CFS
	USGS 06933500 Gasconade River at Jerome, MO as recorded 1903-2006	Total Avg. Yield	163 CFS
		May - Sept. Yield	148.4 CFS

Resource Concerns – Continued



303(d) Listed Lakes and Streams

The only 303(d) listed streams or lakes in the Lower Gasconade River sub-basin are the Gasconade River as it stretches from the confluence of the Big Piney and Gasconade Rivers to the Missouri River just west of Hermann, and a short section on the north end of Little Beaver Creek between the towns of Rolla and Doolittle in Phelps County.

303(d) listed waters are named from Section 303(d) of the federal Clean Water Act. This Act requires that each state identify waters that are not meeting water quality standards, and for which adequate water pollution controls have not been required.

Additional information on 303(d) listed waters, Impaired Waters, and Total Maximum Daily Loads (TMDL) can be found on the Missouri Department of Natural Resources website at:

<http://www.dnr.mo.gov/env/wpp/tmdl/index.html>

STREAM DATA		Miles	Percent
	Total Miles - Major Streams	507	100%
	303(d) Listed Streams	179	35%

Resource Concerns – Continued

Local Stakeholder Meetings

Meetings with local stakeholders were held at three locations – Belle, Rolla and Vienna – within the Lower Gasconade Watershed (see following table). These locations were chosen to obtain as widest as possible set of venues that would be convenient for local stakeholders to meet and provide the information needed from them. The information obtained consisted of crops grown in the area, cropping practices, conservation practices and natural resource issues. Two meetings have been held and a third is scheduled (See following table). These meetings are described below.

Attendance at Rapid Watershed Assessment Meetings – Lower Gasconade Watershed

Initial Meeting			Invitees*	Second Meeting		
Date	Location	Attendees		Date	Location	Attendees
2 - 22	Vienna	11	49	4 - 2	Vienna	15
1 - 17	Rolla	9	32	4 - 10	Rolla	8
1 - 18	Belle	15	24	3 - 21	Belle	15

* Invitees with verified addresses

Initial meeting – A small group (8 – 12) of key landowners were identified by SWCD and NRCS personnel and invited to attend these meetings. SWCD and agency staff was also invited. At this initial meeting, following a presentation describing the project, we asked attendees to identify other key landowners in the larger watershed so we might invite them to another meeting within a month or so to obtain the information described above.

Following this meeting, mailing addresses were obtained from several sources on the World Wide Web. Letters of invitation were mailed approximately two weeks prior to the actual meeting.

Second meeting - At this second meetings, University of Missouri Extension Water Quality Program personnel facilitated a discussion with the group to elicit crops grown, crop yields, cropping/grazing practices, conservation practices applied, resource concerns and resource issues within the watershed.

Final meeting – In March and April of 2008, another series of meetings were held in Vienna, Rolla, and Belle where findings were reported back to the groups as a check for accuracy and their opinions regarding the overall utility of the information gathered.

Resource Concerns – Continued**Cropping Practices**Belle –

A. Rotations

- Corn/soybeans rotation on bottom ground
- Very little upland cropped
- 2nd bottom: milo and soybeans
- 2nd bottom: milo-wheat or barley
- Cash crop: small grain-wheat-barley

B. Tillage

- Complete tillage is in decline
- Reduced tillage – 75%
- Some participants indicated they no till everything
- Some indicated no till at 20%

C. Fertilizer

- Most participants indicated they fertilize with commercial – 85% - 90%
- Split application fall/spring
- 10 to 15% manure applied- cattle, dairy, poultry
- Pasture: single application

D. Herbicides

- Soybeans - RoundUp
- Corn – atrazine base, Dual, 2-4 D, RoundUp corn

E. Pesticides-insecticides - not many using insecticides

- Poncho - corn inoculated (Poncho 250 or 1250)
- Herculex (yield guard) – bred into corn seed
- Gaucho – corn
- Cruiser Max - soybeans

Rolla – some crops grown on Gasconade Bottoms

A. Species

1. Corn: 70-150 bushels per acre (some used for silage)
2. Soybeans: 25-50 bushels/acre
3. Wheat: 30-70 bushels/acre; 50 average
4. Maries County - corn-beans-wheat rotation
 - Milo: grown in conservation areas for wildlife

B. Tillage Practices

1. Most use conventional till
2. No-till – some in Maries County
3. Soybeans are no-tilled
4. Chisel and disk used in the spring

C. Fertilization

1. Mainly commercial – N-P-K
 - Mostly ammonium nitrate in the watershed
 - Some anhydrous ammonia in Maries County

Resource Concerns – Continued

D. Soil Test

1. 3-4 years
2. Use to determine nutrient requirements
3. Rate depends on cost of fertilizer

E. Lime

1. Liming depends on soil test
2. Test when work up the ground – mostly on grasslands

F. Herbicides

1. Soybeans: most are Round-Up ready
2. Corn: Atrazine, Lasso, 2-4-D
3. Milo: Atrazine, Lasso, 2-4-D
4. Wheat: No herbicide

G. Seed treatment

1. Seeds come already treated with a fungicide
2. Soybean – seeds are not treated

Vienna –

A. Types/Yields

1. Corn: 80-100 bu/ac; 125 bu/ac in creek bottoms (continuous)
2. Soybeans: 30-40 bu/ac (continuous)
3. Milo: 100 bu/ac
4. Wheat: 50 bu/ac
5. Barley: 50 bu/ac
6. Oats (Hay):
7. Rye (Hay):
8. Pumpkins-Ornamentals: grown in corn

B. Tillage

1. Corn: Conventional
2. Wheat: No-till
3. Soybeans: Conventional

C. Fertilize

1. Soil test for N-P-K for commercial fertilizer
* Also use turkey manure in Miller County
2. Lime according to soil test
3. Test about every 5 years

D. Herbicide

- Soybeans: Round-Up ready beans
- Seed treatment: Inoculate seed
- Fungicide: Not sure of use

Resource Concerns – Continued**Pastures/Hay**Belle –

- A. Forage: fescue, clover, Lespedeza - for hay
- B. Fertilize: most all open acres are fertilized spring/ fall or both
- C. Lime: applied as believed it is needed/ some depend on soil test to determine application frequency

Rolla –

- A. Species
 1. Fescue: some is inter-seeded with legumes (Ladino, red clover, white clover, and lespedeza)
- B. Fertilizer
 1. Most use commercially applied N-P-K
 2. Based on soil test - 5-10 years
- C. Hay – depends on amount of fertilizer applied
 1. Fescue: 1 ton/acre with light fertilization (30-30-30)
 2. Orchard grass: 2 tons/acre
 3. Timothy: 1 ½ tons/acre (reseed at 5 years with good weather)
 4. Brome: 2 tons/acre
 5. Reed canary grass: 1 ton/acre (fertilized by Rolla's waste water)
- D. Warm Season Grasses
 1. Switchgrass, Big bluestem, Indiangrass, Eastern gamma grass, (good yield is 2 tons/acre)
 2. Alfalfa: 3 tons/ acre, 3-4 cuttings
 3. Millet: some saved for hay
 4. Sudan: used in field renovation

Vienna –

- A. Species
 1. Fescue: inter-seeded with legumes – Ladino clover, Lespedeza
 - 4-5 big bales/ac
 - 3-4 tons/ac (2-3 tons per acre in bad year)
 2. Orchard grass: same as fescue
 3. Alfalfa: harvest 3 to 4 times/year sometimes
 4. Brome: 4 - 5 tons/ac
 5. Clover
 6. Timothy: 3-5 tons/ac
 7. Big bluestem: 4 tons/ac
 8. Bermuda grass: 3-5 tons/ac
 9. Indiangrass: 3-5 tons/ac
 10. Warm season grass lasts about 7 years

Resource Concerns – Continued**B. Fertilizer**

1. Spread both in spring and fall (sometimes with wheat in fall and nitrogen in spring)
2. According to soil test

C. Lime

1. According to soil test

Grazing**Belle** –

- A. Stocking rate: depends on rainfall- normally 3 acres/cow/year
- B. Rotation- graze for a period of time, then take hay or fescue when ready
 - 5 to 10% of intensive rotation- outside of watershed
 - Little non-intensive rotation grazing
- C. Alfalfa - chop alfalfa as forage
 - Some small grains are chopped for silage
- D. Supplements
 - Range cubes
 - Protein tubs
 - Dry Distillers Grains
 - Corn gluten
 - Wet-pressed brewer's grains
 - Soybean meal, oil, hulls
 - Corn
- E. Species
 - Fescue
 - Orchard grass
 - Timothy
 - Brome
 - Alfalfa
 - Grasses will have a clover or lespedeza component
 - Warm season grasses – switchgrass – less common; used for wildlife cover
- F. Fertilize
 - Nearly all forages are commercial
 - Most is applied in the spring

Rolla –

- A. Continuous grazing: most common
- B. Rotation grazing: becoming more popular, 3-4 pastures grazed
 1. Rotation - April 10 have range grass to stay ahead of the cows
 2. Stocking rate - 3-5 acres/cow
 3. Early January- most run out of grass
 4. Cattle removed when grass is grazed from the pasture – February/March

Resource Concerns – Continued

- C. Intensive grazing: small paddocks, least common, used by few full time farmers
- D. Big bale will feed 40 cows for 1 ½ days with fall calving
- E. Water sources
 - 1. Most have ponds - some improved
 - 2. Springs, creeks
 - 3. Wells
 - 4. Public water – emergency use only
- I. Nutrient management plans
 - 1. One plan written for beef cattle/ feed in confinements for 3 months (80 head)
 - 2. Dairies: Maries, Phelps Counties
 - 3. Beef operation: Maries County
 - 4. Confinement hogs- Maries County

Vienna –

- A. Hay first then graze
 - 1. Hay around late-May to mid-June
 - 2. Mostly cow/calf pairs – some back grounding
 - About 3-4 acres/pair on hills, continuous graze
 - 3. Rotational grazing - some
 - 45 animal units (pairs) per 100 acres in 9-10 paddocks
- B. Water
 - 1. Wells
 - 2. Springs
 - 3. Ponds
 - 4. Streams – mostly open to livestock
 - 5. Public water

Resource Concerns – Continued**Conservation Practices**Belle –

- Most traditional farmers do not get involved in CRP
- Field borders – absentee owners and hobby farmers
- Terraces
- Grassed waterways
- Diversions
- Ponds
- Grass/legume seeding
- Woodland fencing
- Wetland management
- Retention basins
- Dry hole detaining basins
- Animal waste management
- Grazing systems
- Spring development / groundwater
- Nutrient management - commercial or animal waste
- Wildlife food plots
- Forestry management - TSI, stewardship planning, hunting-lease, firewood lots
- No-till, reduced till
- Crop rotation
- Filter strips around water bodies
- Prescribed burning
- Glade restoration/savannas
- Bio-fuels - little used-10% ethanol blend used more; E-85 available in Hermann - not used much

Rolla –

- Woods
 - Some management - TSI
 - Some plans written by the conservation forester
 - Red oak borer has complicated management
- Field borders
- Edge Feathering for wildlife
- Riparian buffers
- Grassed waterways
- Rotational grazing
- Food plots for wildlife
- Pasture seeding
- Warm season grass conversion
- Woodland fencing
- Fescue conversion

Resource Concerns – Continued

- Stream bank stabilization
- Well closings
- Burn warm season grasses

Vienna –

- Ponds
- Spring development
- Rotational grazing
- Fencing off woodlands
- Timber Stand Improvement (TSI)
- Pasture/hay land planting
- Well decommissioning
- Food plots
- Critical area treatments
- Existing terraces
- Grassed waterways

Natural Resource Issues**Belle** –

- Stream bank erosion - high priority for 40 years/ #1 in 1996
- Gravel removal from streams is an issue
- Soil erosion / sheet, rill, gullies
- Gasconade flooding
- Municipal waste – cities. homes
- On site sewage -Gasconade County Health Ordinance
- Club houses -development on Gasconade River
- Invasive species –
- Multi-flora rose
- Serecia lespedeza
- Weeds
- Locust
- MO Department of Transportation spraying ditch banks
- Contributes to ditch bank erosion
- Change herbicides to allow for some ground cover; 2-4D doesn't kill grass
- Population growth/urban sprawl
- Non-resident taxpayers
- Forest land worth more than pasture –nonresident taxpayers
- Loss of farmland as a result of non-resident taxpayers
- Agriculture cannot compete with land values rising as a result of recreational development
- Mitigation of wetlands
- Aging of owner/operator
- Fewer agricultural product suppliers
- Recreation issues - four-wheelers, trespassing, soil erosion