Land Use

Historical and Recent Land Use

Changes in stream morphology have taken place within the Bourbeuse River watershed as well as the entire Ozarks. 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. Also described in Jacobson and Primm (1994) is the practice of free-range grazing that impacted stream corridors in first and second order streams (valley bottoms) and whose subsequent decline permitted gravel to be released causing pulses of gravel in medium-sized streams. Corridor vegetation decline was a significant land cover change that reduced streambank stability.

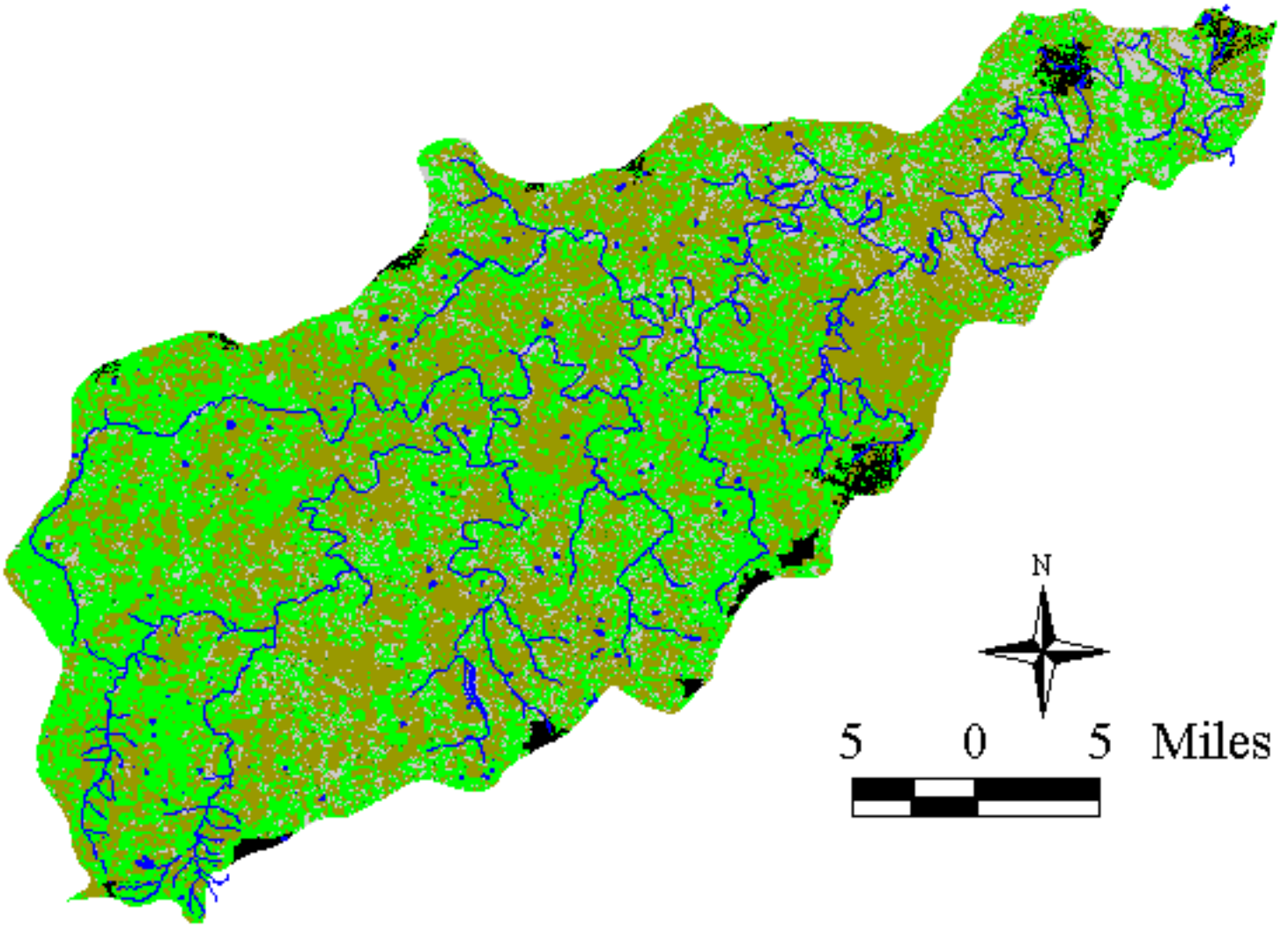
Recent Ozark land-use practices (1960-present) include greatly reduced intentional burning. Cultivated fields and total improved land have decreased over this period (Jacobson and Primm 1994). Grazing has increased in upland areas, and valley bottom lands are still being cleared for pasture. Logging operations on valley slopes and uplands are better managed than during the Timber Boom and Post-timber Boom periods, but upland areas and valley slopes still have a slight increase in annual runoff, storm runoff, and upland sediment yield as compared to pre-settlement conditions (Jacobson and Primm 1994).

The MORAP land use / land cover (LU/LC) spatial data set uses the Missouri Phase II Land Cover Classification Scheme to delineate land uses in the Bourbeuse River watershed (MORAP 1999). Satellite images were obtained from years 1991 to 1993. Phase II relied on an extensive ground truth effort to verify cover classes. Grassland (pasture) and row crops are major portions of the land use, representing 42.54% and 3.74% respectively of the total 8-digit hydrologic unit (HU) acreage (Table 3). Most (53.4%) of the Boone Creek land use is grassland (pasture). These areas are found primarily within the stream floodplains (Figure 2). The largest land use type with 50.77% of the total land area within the watershed is forest and woodland. Most of the urban land uses are found in the Lower Bourbeuse River, Spring Creek, and the Boone Creek 11-digit HU (Figure 2). The old field complexes are rather small in total acreage (0.59% in the entire 8-digit watershed), reflecting the high grazing rates and hay production in the watershed. Brush Creek has the largest percentage old field complex relative to its total acreage.

A comparison of the MORAP Phase II Land Cover with the 1:250,000 scale GIRAS land use / land cover spatial data set (EPA 1994), which uses the Anderson Level 2 Classification system (Anderson et al. 1976), indicates that some of the categories have the same percentages. The satellite imagery used by the EPA has quadrangles from years 1977 to 1980. More detailed information on scene dates specific to the Bourbeuse River watershed could not be found. In the GIRAS LU/LC data set, cropland and pasture represented 45% of the total watershed acreage. Fifty-one percent (51.22%) of the total land area within the watershed is deciduous forest, representing the largest category. Other forest types are evergreen and mixed forest land with 1.68% and 0.14%, respectively. The combined urban categories of the GIRAS LU/LC are 1.33% (0.73% as residental) of the total watershed acreage. Although it is difficult to draw

Figure 2. Bourbeuse River watershed land use / land cover.

Data Originator: MoRAP, June 1999



Legend

Bourbeuse River major streams

Phase II Land Use / Cover Classification

- Urban
- Cropland
- Deciduous Upland Forest
- Other Evergreen-Deciduous Forest
- Woodland
- Grassland
- Wetland complex
- Open Water
- Glade complex
- Barren land
- No data

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

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

Table 3. Bourbeuse River watershed land use / land cover within each of the 11-digit hydrologic units.
Data source: 30-meter resolution Thematic Mapper satellite imagery. Source: MORAP, 1999.

Land Use / Land Cover	Acreage	Percentage
8-digit Hydrologic Unit		
Entire Bourbeuse River watershed		
Urban	9901	1.84%
Row & Close Crown Crops	20179	3.76%
Forest & Woodland*	272806	50.77%
Young Oldfield Complex	3195	0.59%
Grassland	228600	42.54%
Open Water	2074	0.39%
Barren/Sparsely Vegetated	573	0.11%
Total Acreage	537328	100.00%
11-digit Hydrologic Units		
	Lanes Fork	
Urban	41	0.13%
Row & Close Crown Crops	59	0.19%
Forest & Woodland*	12438	39.91%
Young Oldfield Complex	205	0.66%
Grassland	18356	58.90%
Open Water	65	0.21%
Barren/Sparsely Vegetated	0	0.00%
Total Acreage	31164	100.00%
	Upper Bourbeuse	
Urban	1091	2.10%
Row & Close Crown Crops	334	0.64%
Forest & Woodland*	25669	49.48%
Young Oldfield Complex	243	0.47%
Grassland	24282	46.81%

Open Water	226	0.44%
Barren/Sparsely Vegetated	34	0.07%
Total Acreage	51878	100.00%
	Brush Creek	
Urban	928	1.97%
Row & Close Crown Crops	648	1.37%
Forest & Woodland*	26672	56.54%
Young Oldfield Complex	415	0.88%
Grassland	18102	38.37%
Open Water	369	0.78%
Barren/Sparsely Vegetated	42	0.09%
Total Acreage	47175	100.00%
	Dry Fork	
Urban	214	0.29%
Row & Close Crown Crops	1040	1.40%
Forest & Woodland*	32925	44.23%
Young Oldfield Complex	674	0.91%
Grassland	39291	52.78%
Open Water	221	0.30%
Barren/Sparsely Vegetated	80	0.11%
Total Acreage	74447	100.00%
	Little Bourbeuse	
Urban	306	0.81%
Row & Close Crown Crops	516	1.36%
Forest & Woodland*	19031	50.27%
Young Oldfield Complex	328	0.87%
Grassland	17590	46.47%
Open Water	86	0.23%
Barren/Sparsely Vegetated	0	0.00%

Total Acreage	37855	100.00%
	Red Oak Creek	
Urban	377	0.93%
Row & Close Crown Crops	3134	7.77%
Forest & Woodland*	21502	53.28%
Young Oldfield Complex	237	0.59%
Grassland	14917	36.97%
Open Water	145	0.36%
Barren/Sparsely Vegetated	44	0.11%
Total Acreage	40353	100.00%
	Boone Creek	
Urban	1459	4.38%
Row & Close Crown Crops	905	2.72%
Forest & Woodland*	12787	38.42%
Young Oldfield Complex	238	0.72%
Grassland	17771	53.40%
Open Water	88	0.26%
Barren/Sparsely Vegetated	35	0.11%
Total Acreage	33282	100.00%
	Spring Creek	
Urban	2217	6.47%
Row & Close Crown Crops	967	2.82%
Forest & Woodland*	20588	60.05%
Young Oldfield Complex	101	0.29%
Grassland	10334	30.14%
Open Water	29	0.08%
Barren/Sparsely Vegetated	46	0.13%
Total Acreage	34283	100.00%
	Middle Bourbeuse River	

Urban	181	0.16%
Row & Close Crown Crops	5705	5.01%
Forest & Woodland*	63600	55.90%
Young Oldfield Complex	689	0.61%
Grassland	43079	37.86%
Open Water	315	0.28%
Barren/Sparsely Vegetated	211	0.19%
Total Acreage	113780	100.00%
	Lower Bourbeuse River	
Urban	3087	4.22%
Row & Close Crown Crops	6871	9.40%
Forest & Woodland*	37594	51.42%
Young Oldfield Complex	65	0.09%
Grassland	24878	34.03%
Open Water	530	0.72%
Barren/Sparsely Vegetated	81	0.11%
Total Acreage	73108	100.00%

***(including forested wetlands)**

Table 4. Population trends in counties within the Bourbeuse River watershed (OSEDA 1999).

Total Population		Percent Change
Crawford County, Missouri		
	1900 12,959	1900_90 48.0%
	1970 14,828	1970_80 23.0%
	1980 18,300	1980_90 5.0%
	1990 19,173	1990_97 15.0%
	1997 22,011	
Franklin County, Missouri		
	1900 30,581	1900_90 164.0%
	1970 55,127	1970_80 29.0%
	1980 71,233	1980_90 13.0%
	1990 80,603	1990_97 13.0%
	1997 90,997	
Gasconade County, Missouri		
	1900 12,298	1900_90 14.0%
	1970 11,878	1970_80 11.0%
	1980 13,181	1980_90 6.0%
	1990 14,006	1990_97 5.0%
	1997 14,763	
Maries County, Missouri		
	1900 9,616	1900_90 slight decline
	1970 6,851	1970_80 10.0%
	1980 7,551	1980_90 6.0 %
	1990 7,976	1990_97 5.0%
	1997 8,331	
Osage County, Missouri		
	1900 14,096	1900_90 slight decline
	1970 10,994	1970_80 9.0%

	1980 12,014	**1980_90 0%**
	1990 12,018	**1990_97 4.0%**
	1997 12,529	
Phelps County, Missouri		
	1900 14,194	**1900_90 148.0%**
	1970 29,567	**1970_80 14.0%**
	1980 33,633	**1980_90 5.0%**
	1990 35,248	**1990_97 9.0%**
	1997 38,464	

conclusions, the MORAP Phase II LU/LC spatial data set shows 1.84% as urban land use in the Bourbeuse River watershed (Table 3).

Population Trends

As the human population grew in size, more land clearing took place. Since 1900 Missouri's population has seen a 64.7 percentage increase (OSEDA 1999). The 1900 population census found Crawford, Franklin, Gasconade, Maries, Osage, and Phelps counties with 12,959, 30,581, 12,298, 9,616, 14,096, and 14,194 people, respectively (Table 4). The largest increase in population since the 1990 census has been in Franklin County (164%). This urban sprawl into Franklin County from St. Louis, which brought with it some development within the vicinity of Union, is mainly outside the Bourbeuse River watershed near the City of Washington. The second largest population size increase since the 1990 census was Phelps County (148%). Portions of the Upper Bourbeuse River lie within a few miles of the City of Rolla. Two counties, Maries and Osage, have experienced slight declines in population size. Recent population size increases from 1990-97 in Crawford County are generally outside the watershed.

The general trend toward rising rural populations is expected to continue until 2010 within Missouri. Counties within the watershed are projected to have as much as 8% increase in population. For perspective, Missouri's population increased by 241,719 between 1990 and 1996 – a 4.7% increase (OSEDA 1999). The population living inside the city limits of incorporated places increased from 3,360,399 to 3,438, 564 – an increase of 78,165 (2.3% growth rate). In 1996 about 64% of Missouri's population lived in a town or city. The remaining 36% lived in the open country. Since 1990 the rate of increase in open-country populations has been more rapid than for town populations.

Farming

The search for productive soils to farm attracted many early settlers to this region. Floodplains are more fertile areas than upland areas, making them desirable for farming. By the early 1800s, the land within the Bourbeuse River watershed was being cleared for crops and the wood was used as timber for home construction, fences, and firewood.

Early settlers removed tree stands by girdling, cutting, and burning to open the landscape to crop and cattle production. Within Franklin and Gasconade counties the principal agricultural crop production in 1880 was barley, buckwheat, Indian corn, oats, rye, and wheat (Goodspeed 1888). Also, since the early 1800s, because the climate favored its production, wine has been produced in Crawford County. In 1850, Franklin and Crawford counties had 42,674 and 26,910 acres of improved land, respectively; by 1910, wheat was by far the most widely grown crop on 66,000 acres. By 1958, Franklin, Crawford, Gasconade, Maries, and Osage counties, had an estimated 111,424, 81,545, 46,155, 31,143, and 637 acres of cropland (USDA 1966). The most common crop rotation was corn, wheat, and clover, which is a rotation still practiced today in Franklin County (SCS 1989).

One of several grist mills in the region, Noser Mill remains a testimony to the early agricultural production of the Bourbeuse River watershed. Grist mills were important public utilities in the 1800's and a nucleus of frontier communities. Marrying agriculture and industry, these mills were also places to socialize and trade. Today, Noser Mill is a popular fishing spot.

Livestock in the watershed have always been an important aspect of agriculture. A 1850 census recorded substantial numbers of horses, dairy cows, cattle, sheep, and swine (USDA 1966). In the early 1900s, use

of land to raise livestock was one of the principal sources of income in the watershed. By 1958, Franklin County had 55,569 acres of land in pasture (USDA 1966).

According to the NRCS 1992 broad land use estimates, approximately 16,600 acres of Bourbeuse River farmland are cultivated, and another 59,100 acres of farmland are uncultivated. Farmers are producing mostly hay (Missouri Agricultural Statistics Service (MASS) 1995). In fact, land for hay production and grazing are major components of the agricultural land use in the Bourbeuse River watershed. According to the NRCS 1992 broad land use estimates, 140,900 acres are pasture. Several of the larger counties within the watershed do not produce sizable amounts of wheat or corn (MASS 1995). Because of this low cash crop production, use of herbicides such as 2,4-D and Atrazine is generally low.

Comparison of the average farm size and the number of farms by county within the watershed show that the largest county, Franklin, has the smallest farm size and the largest number of farms (OSEDA 1999). According to the USDA Census of Agriculture in 1992 and 1997, Franklin, Crawford, Gasconade, Maries, and Osage counties, had an average farm size of 187 and 182, 297 and 264, 241 and 247, 287 and 280, 271 and 266 acres, respectively. The number of farms for 1992 and 1997 was 1,586 and 1592, 680 and 691, 816 and 762, 813 and 817, and 1,171 and 1147, by county respectively.

Mining

The Mineral Belt of Franklin County (lead, iron, copper) is in townships 40, 41, 42, part of 43 and ranges 1 East to 1 West. Several historical mines are within this vicinity, including Virginia Lead Mines, Mount Hope Mine, and Evans Mines (Goodspeed 1888). Other counties in the watershed had small mining operations upon small deposits. Coal was mined in Gasconade County for a number of years. Deposits of fire clay and white sand were mined in and around Union in Franklin County.

Mineral production is still a high-dollar industry in the Meramec River watershed, where Lead, iron ore, zinc, sand and gravel, crushed stone, clays and shale, limestone, and barite are still being produced. By comparison, only active fire clay pits and in-stream sand and gravel mining are found throughout the Bourbeuse River watershed.

Several mineral mines were active in the 1930-40s. It is doubtful these mines negatively impact stream water quality today, given that the Missouri Department of Natural Resources Water Pollution Program does not currently include these as point or non-point source discharges (MDNR 1984, 1996). Iron ore from the mines (Taylor Iron Mine, Preston Iron Mine, Varrison Iron Mine) in the Brush Creek watershed was likely mined for limonite (iron oxide) and pyrite (iron sulfide) in the 1930-40s.

Numerous fire clay pits are still active today near Owensville and north of Cuba. The Dry Fork subwatershed contains a series of clay pits. Several of the abandoned pits are now very turbid ponds but pose minimal water quality problems (MDNR 1984, 1996). An unnamed tributary of the Bourbeuse River, a tributary of Fenton Creek, and Fenton Creek receive discharge from quarries currently operating within their watersheds (MDNR 1996).

Compared to the Meramec River watershed, the Bourbeuse River watershed does not have a long history of sand and gravel mining. Historical sand and gravel mining was limited to a few small non-commercial excavations for building use. Until recently, the lower watershed area had no history of sand and gravel mining, but the upper watershed in Gasconade and Phelps counties has one or two operations with a 30-40 year history of commercial sand and gravel mining (Smith, Michael, personal communication).

Gravel bars are being mined within the Bourbeuse River, Robinson Creek, Little Bourbeuse River, Big River Creek, and Spring Creek (Table 5). Thirteen COE 404 General Permits, two COE Individual Permits, and one DNR Land Reclamation Permit have been issued for the watershed. Proper mining practices at these sites should include the use of vegetative and waterline buffer zones to reduce mining impacts on streams. There are several unpermitted sites (Smith, Michael, personal communication).

Logging

The expansive Ozark Plateau had two land-use periods known as the Timber Boom (1880-1920) and the Post-timber Boom (1920-1960) that affected uplands, valley slopes, and valley bottoms. Cutover valley slopes during the Timber Boom were converted to pasture and seasonally burned. From 1880-1920, timber was cut for a variety of uses. Several portable sawmills existed for local use. Because of the limited supply of shortleaf pine, builders used hardwoods for railroad ties, flooring, barrel staves, and fuel. Franklin, Crawford, and Gasconade counties had predominately hardwood species such as scrub oak, white oak, post oak, and red oak in the hills and black walnut, hickory, maple, ash, birch, and sycamore in bottom lands (Goodspeed 1888). By 1880, approximately two thirds of Franklin County was yet to be logged. The Post-timber Boom was a time of economic depression and migration out of the Ozarks. This economic depression was due to reduction in logging and the attractive wages in factories. The Great Depression placed increased pressure on the valley bottoms and uplands for subsistence farming (Jacobson and Primm 1994). Residents in the Ozarks at this time attempted to extract a living from an already impacted land resource, which caused further disturbances to the uplands, valley slopes, and valley bottoms.

Recreation

Angling and float fishing are popular recreational activities in the Bourbeuse River watershed. Angler catch rate on the Bourbeuse River in fish per hour was higher than the Big River, Huzzah and Courtois creeks but below that of the Lower Middle Meramec River as shown on Table 25, Biotic Section. The catch rate for the lower 147 miles of Bourbeuse River was 0.29 fish/hour compared to 0.44 in the lower 117 miles of the Meramec River (Fleener 1988).

During the mid-1980s, Allan S. Weithman conducted a statewide survey by telephone to estimate angler effort and success in Missouri waters (Weithman 1991). Angler effort in the Bourbeuse River watershed compared favorably to other river systems of equal or larger size over the five year period (Table 6).

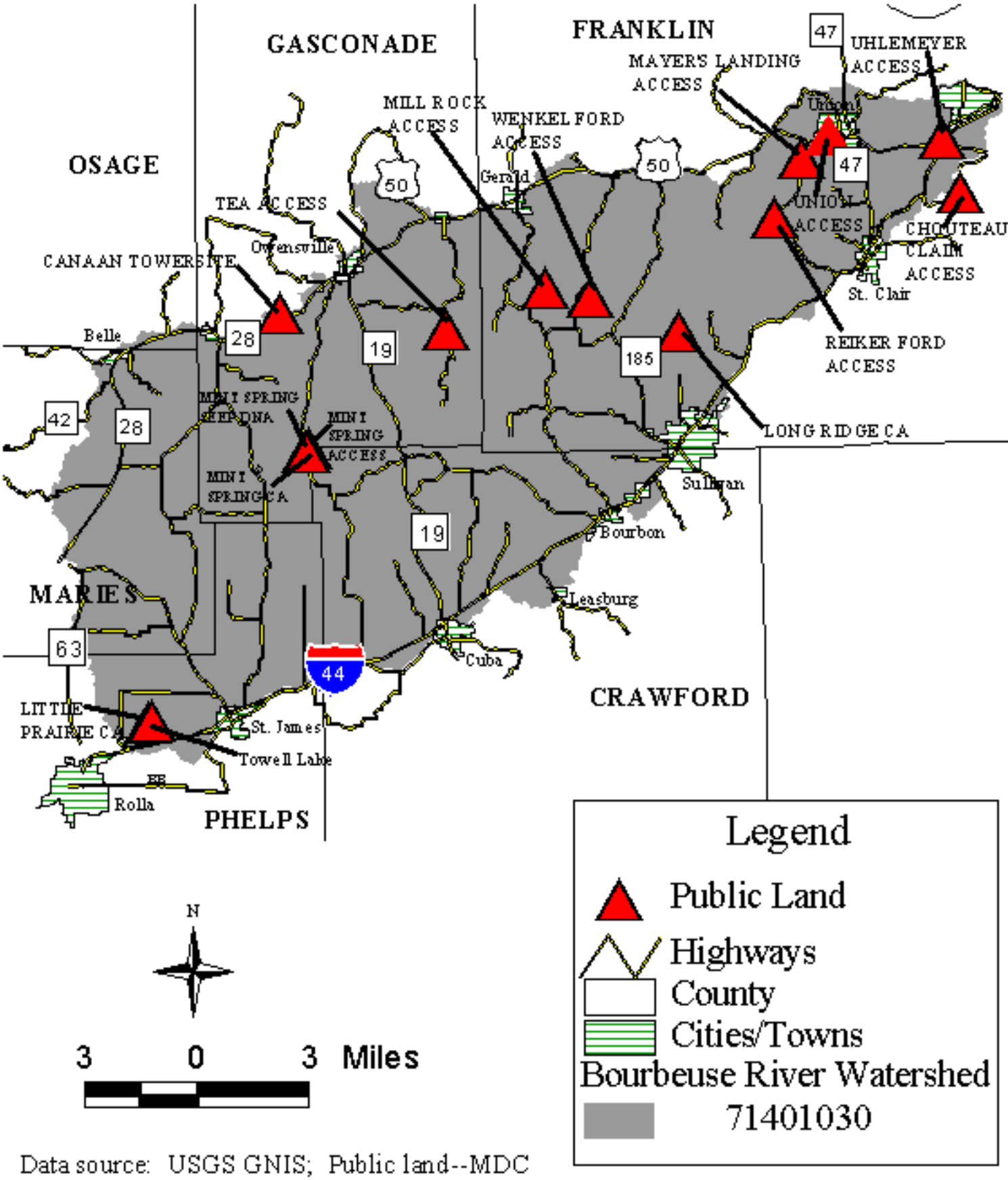
Natural Resources Conservation Service Projects

According to Paul Freeze of the NRCS, no Wetland Reserve Program (WRP) Farm Plans exist within the Bourbeuse River watershed. Clarence Buel (personal communication, NRCS) estimates that the Bourbeuse River watershed has approximately 2,000 - 2,500 acres of land in the Conservation Reserve Program (CRP). A total of 5,618 acres of land for Gasconade and Franklin counties are in CRP (MDC 1998).

Public Areas

Public land in the watershed is composed of numerous river accesses, a few natural areas, and conservation areas (Figure 3). Long Ridge Conservation Area is found in the Spring Creek watershed and has 1,816 acres of predominantly upland forest. The area is managed for multiple uses and ecological diversity. Mint Spring Conservation Area is a 36.9 acre tract of land near the Bourbeuse River. Both the

Figure 3. Public lands in the Bourbeuse River watershed.



Data source: USGS GNIS; Public land--MDC Policy Coordination

Map Production: Todd Blanc, Missouri Department of Conservation, December 1998

Table 5. Sand and gravel permitted sites in the Bourbeuse River watershed (from the East Central Region Stream Environmental Review Database). Permit issue date and expiration date are given.

Streamname	County	Township/Range/Section	Permit Type	Issue Date	Expiration Date
Bourbeuse River	Phelps	39N-06W-8SWNWNW	GP	03/05/96	12/17/00
Robinson Creek	Phelps	38N-06W-5SENESE	GP	03/04/96	12/17/00
Robinson Creek	Phelps	38N-06W-5SENESE	GP	03/04/96	12/17/00
Bourbeuse River	Phelps	39N-06W-4	GP	06/16/97	12/17/00
Bourbeuse River	Phelps	39N-06W-4	GP	06/16/97	12/17/00
Little Bourbeuse Creek	Phelps	39N-06W-6, Site #1	GP	12/17/97	12/17/00
Little Bourbeuse Creek	Phelps	39N-06W-6, Site #2	GP	12/17/97	12/17/00
Little Bourbeuse Creek	Phelps	39N-06W-6, Site #3	GP	12/17/97	12/17/00
Little Bourbeuse Creek	Phelps	39N-06W-6, Site #4	GP	12/17/98	12/17/00
Big River Creek	Gasconade	40N-05W-4	IP	3/09/99	00/00/00
Big River Creek	Gasconade	40N-05W-9	IP	3/09/99	00/00/00
Spring Creek	Phelps	38N-08W-5	GP	07/17/97	12/17/00
Spring Creek	Phelps	38N-08W-5	GP	07/17/97	12/17/00
Spring Creek	Phelps	38N-08W-8	GP	07/17/97	12/17/00
Spring Creek	Phelps	38N-08W-8	GP	07/17/97	12/17/00
Bourbeuse River	Franklin	42N-01W-2	LR	12/04/96	00/00/00

GP--COE 404 General Permit; LR--DNR Land Reclamation Permit; IP-Individual Permit.

Table 6. Estimates of days fished per total watershed area in acres on the Bourbeuse 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.

Mint Spring Seep Natural Area and the Mint Spring Access are adjacent to this site. The spring on the natural area has created an unique seep forest.

Stream Access

Nine Missouri Department of Conservation stream accesses to the Bourbeuse River are available for public use (Figure 3). Some distances between accesses are quite long, particularly when coupled with the river's relatively low gradient.

Corps of Engineers 404 Jurisdiction

The entire Bourbeuse River watershed is under the jurisdiction of the St. Louis District of the U.S. Army Corps of Engineers. Section 404 regulation permitting, inquiries, and violation reports should be directed to the St. Louis Office: 1222 Spruce Street, St. Louis, MO 63103-2833 or call (314) 331-8575.