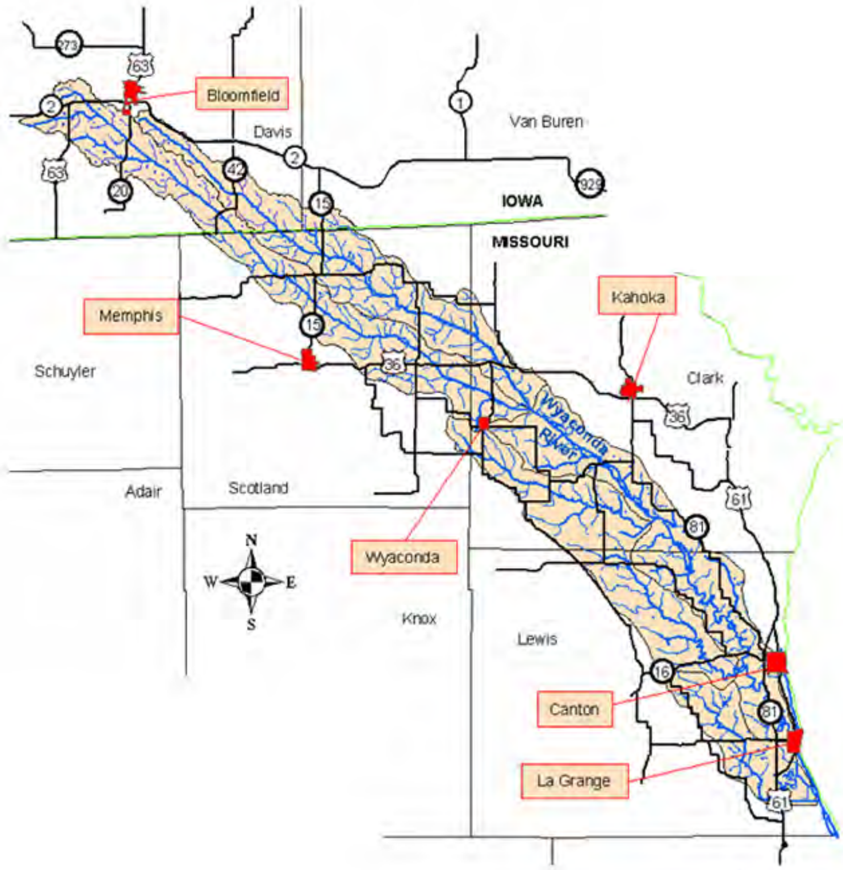

Wyaconda River

Watershed and Inventory Assessment, January 2005

Chris Williamson and Brian Todd

Missouri Department of Conservation 500 South Halliburton, Kirksville, MO 63501

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Executive Summary

The Wyaconda River basin is located in the Glaciated Plains Natural Division of southeast Iowa and northeast Missouri. The basin drains 458 square miles of land, of which 336 square miles lie within the state of Missouri. The Wyaconda River, a fifth order stream, is the largest within the basin and enters the Mississippi River above LaGrange, MO. There are 18 third order and larger streams within the basin.

The upper basin differs to some extent from the lower basin. The upper basin is characterized by soils from the Deep Loess and Drift general soil associations and the topography is rolling to hilly with some wide, nearly level ridge tops and bottom land. The lower basin is characterized by soils from the Central Mississippi Valley Wooded Slopes and the topography is dominated by more rugged hills and broad floodplains. Stream gradients are fairly low throughout the basin, with the exception of a few small tributaries in the lower basin.

When the first settlers arrived in the basin, approximately 50% of the land was tall grass prairie. Agriculture became the dominated land use and continues to this day. Forty-two percent of the basin is currently used for croplands, while 40% of the basin remains in grasslands. The impact of agriculture on basin streams is significant. Channelization of streams and sedimentation from poor land practices continue to be the major management problems in the basin. Excessive sediment from non-point sources is the main water quality concern, with no significant impact from point sources. Both channelization and sedimentation reduce aquatic habitat and disrupt ecological processes within these streams.

Forty-five species of fish were found in recent surveys from 1988. The dominant fish families were the minnows (17 species), catfishes (7 species), sunfishes (7 species), suckers (6 species), and perches (5 species). The most common and abundant species collected in recent surveys were the red shiner *(Cyprinella lutrensis)* and bigmouth shiner *(Notropis dorsalis).* Sportfish (13 species that provide angling opportunity) comprised approximately 3% of all fish collected in basin streams. Channel catfish *(Ictalurus punctatus),* probably the most popular game species, occurred at 40% of all sites, but accounted for only 1% of the total fish collected. Three species found in the basin prior to 1988 and not found in recent surveys include the following: Mississippi silvery minnow *(Hybognathus nuchalis),* bluntnose darter *(Etheostoma chlorosomum),* and ghost shiner (*Notropis buchanani),* which were all last found in 1941. All three species have likely been extirpated from the basin. No threaten or endangered species have been collected in recent surveys.

Due the highly altered state of the upper basin streams, public use is minimal. Habitat reductions from channelization and excessive sedimentation have made the fish community less appealing to anglers. Boaters are scarce due to the same channel alterations. Opportunities for improvement do exist by working with landowners on a watershed scale to reduce sedimentation and channelization. Other management opportunities include: acquiring new and develop existing stream access areas to increase public use, passively restoring riparian areas on MDC areas, assisting landowners with corridor restoration, long-term aquatic community monitoring, fishery research needs assisting citizen-led watershed conservation efforts, and educating youth.

Acknowledgements

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Location

Both the North Wyaconda River and South Wyaconda River begin in Davis County, Iowa, just south of Bloomfield (Watershed Map). They flow in a southeasterly direction for approximately 45 miles before they join, forming the Wyaconda River. The river continues to flow in the same direction for 47 miles, where it enters the Mississippi River north of La Grange, Missouri at river mile 337. Seventy-three percent of the watershed is within Missouri, which drains portions of Clark, Lewis, and Scotland counties. The basin is only 5 to 8 miles wide along its 70 mile length. Major tributaries (3rd order or larger) to the Wyaconda River include the Little Wyaconda, Sugar Creek, Ramsey Branch, Little Sugar Creek, Crooked Creek, Hickory Creek, Derrahs Branch, and one unnamed tributary. Major tributaries to the North Wyaconda River include Billups Branch and three unnamed tributaries. The South Wyaconda River has three major tributaries including Allen Creek and two unnamed tributaries.

Watershed Area

The basin drains 458 square miles (293,120 acres), of which 336 square miles (215,040 acres) lie within Missouri. Both the North Wyaconda River and South Wyaconda River drain approximately 80 square miles each, composing 38% of the basin in total. The Wyaconda River is the only fifth order stream within the basin.

Stream Orders

Streams were identified on USGS 7.5- minute topographic maps and ordered according to Strahler (1957). There are 18 third-order and larger streams within the basin (Appendix A). The Wyaconda River is the largest (fifth-order) and longest (47 miles) stream within the basin. The North, South, Little Wyaconda and Sugar Creek are the only fourth-order streams within the basin. All remaining streams are third-order or smaller.

Appendix A. Wyaconda watershed stream miles, percent channelization, and gradient.

Stream Name	Location of Mouth Sec. Tnshp. Rnge.	Total Miles	% Channelized	Gradient (ft/mile) overall per order
Wyaconda River	30 61n 05w	49.2	1	2.7 all 5th order
North Wyaconda River	26 65n 09w	47	43	5.6 4/4.3 3/4.8
South Wyaconda River	26 65n 09w	47.4	86	6.9 4/4.7 3/10.0
Little Wyaconda River	05 63n 07w	25	0	6.6 4/5.0 3/6.2
Sugar Creek	32 62n 06w	26.4	0	7.8 4/5.4 3/7.5
Ramsey Branch	08 62n 07w	4.7	0	19.4 3/14.9
Little Sugar Creek	23 62n 07w	5.9	0	19.5 3/11.1
Unnamed tributary	23 61n 06w	3.8	0	38.4 3/33.3
Crooked Creek	07 62n 06w	7.1	0	17 3/12.0
Derrahs Branch	26 63n 07w	5.6	0	20.7 3/11.4
Hickory Creek	33 64n 08w	6.5	0	15.3 3/7.5
Unnamed tributary	26 65n 09w	4.9	0	23.6 3/15.6
Allen Branch	14 65n 10w	9.7	0	12.8 3/10.4
Unnamed	18 66n 10w	3.4	0	26.2

Stream Name	Location of Mouth Sec. Tnshp. Rnge.	Total Miles	% Channelized	Gradient (ft/mile) overall per order
tributary				3/14.0
Unnamed tributary	11 66n 11w	5.4	0	19.4 3/16.4
Unnamed tributary	28 66n 11w	2.9	0	36.6 3/22.7
Billups Branch	32 67n 11w	7.1	0	11.9 3/9.2
Unnamed tributary	19 68n 13w	8.4	0	15.5 3/12.5

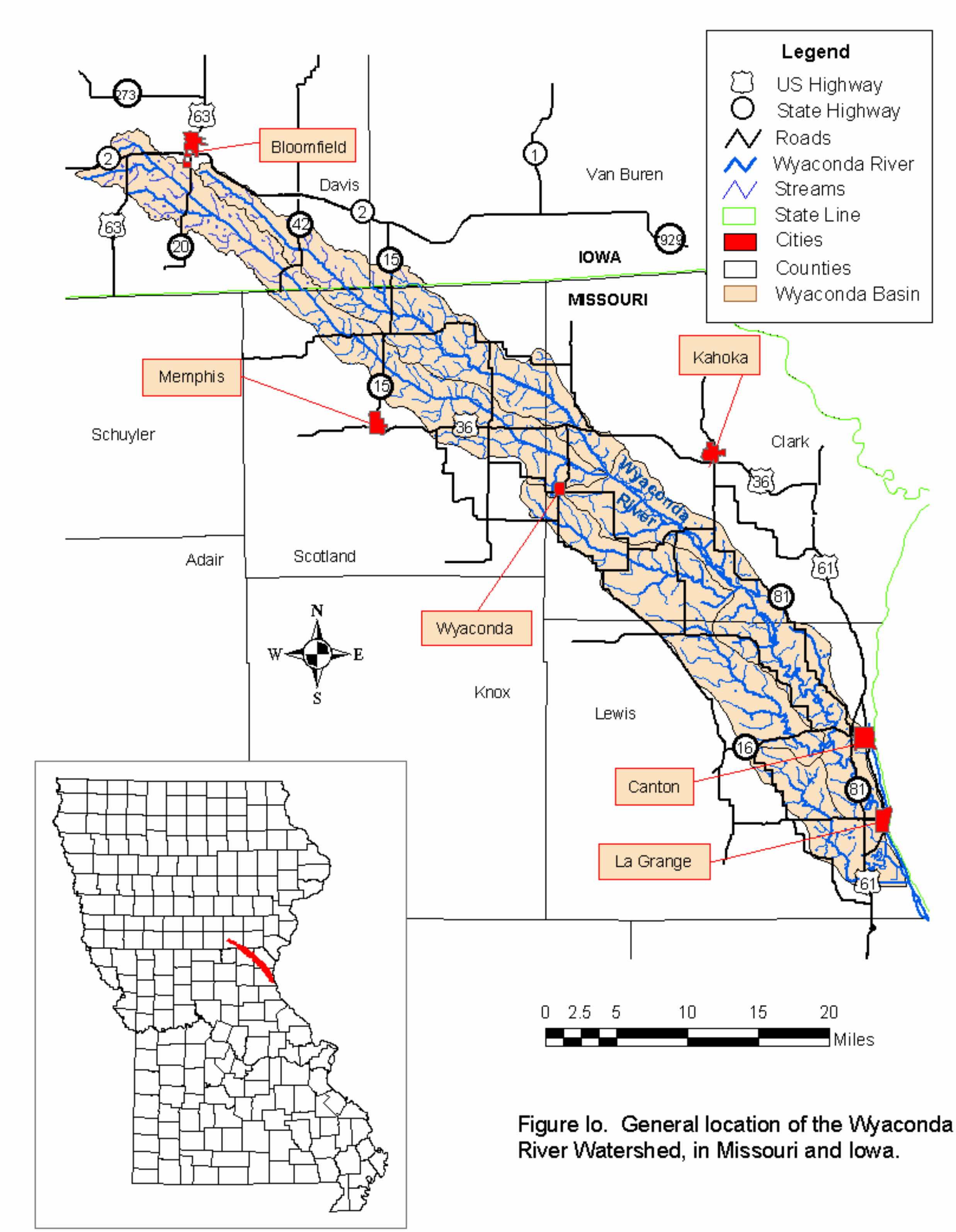

Figure lo. General location of the Wyaconda River Watershed, in Missouri and Iowa.

Geology/Geomorphology

Physiographic Region/Geology/Soils

The Wyaconda River basin lies within the eastern section of the Glaciated Plains Natural Division (Thom and Wilson 1980), also known as the Dissected Till Plains (Fenneman 1938). These plains were formed by glaciers that deposited glacial till which consisted of mostly clay and some rock. Over time, wind-blown soil (loess) was deposited atop of these soils left by the receding glaciers. Across most of the basin, this loess ranges from zero to eight feet deep, atop 100-200 feet of glacial till. Pennsylvanian aged rock lies beneath the soils of the upper basin and it shifts to Mississippian aged rock in the lower basin (MDNR 1984). This stratification of layers limits the amount of water that infiltrates into groundwater. The large amount of clay and many shale and coal deposits also limits the vertical movement of water within the basin (MDNR 1984). Therefore, most of the stream flow within in the basin is only supported by surface run-off. Also, there are no significant springs within the basin, causing poor baseflow during extended dry periods.

Because of the glacial till, the soils in the upper basin differ dramatically from the lower basin. The upper basin is characterized as the Deep Loess and Drift general soil association (Algood and Persinger 1979). The topography is rolling to hilly with some wide, nearly level ridge tops and bottom land adjacent to streams. The soils were formed under mostly tall grass prairie vegetation and are of the Edina, Kilwinning, Lamoni, or Armster soil associations. These soils range in slope from 0-20 percent with clayey subsoils and are all highly susceptible to erosion (SCS 1975). The lower basin soils are characterized as the Central Mississippi Valley Wooded Slopes (Algood and Persinger 1979). The uplands in this area have soils from the Winfield, Lindley, and Keswick soil associations, which are deep, well drained, and gently sloping to steep (SCS 1992). These upland soils are also highly susceptible to erosion. Soils in the floodplains are from the Arbela, Fatima, and Blackoar soil associations and are deep, nearly level, and poorly to moderately drained.

Stream Channel Gradients

Stream channel gradients (slopes) were determined for all third-order and larger streams by using USGS 7.5-minute topographic maps and digitizing software (Appendix A). The overall gradient in the Wyaconda River was very low at 2.7 ft/mile. The North and South Wyaconda rivers had a somewhat higher gradient at 5.6 and 6.9 ft/mile, respectively. The average gradient of fourth order streams in the basin was 4.85 ft/mile and ranged from

4.3 to 5.4 ft/mile. Third order streams in the basin had an average gradient of 12.9 ft/mile and ranged from 4.8 to 33.3 ft/mile. The highest gradient stream was an unnamed tributary that enters just upstream of the mouth of the Wyaconda River and drains higher uplands in the Central Mississippi Valley Wooded Slopes. Most of the lower gradient streams were in the upper and middle reaches of the basin.

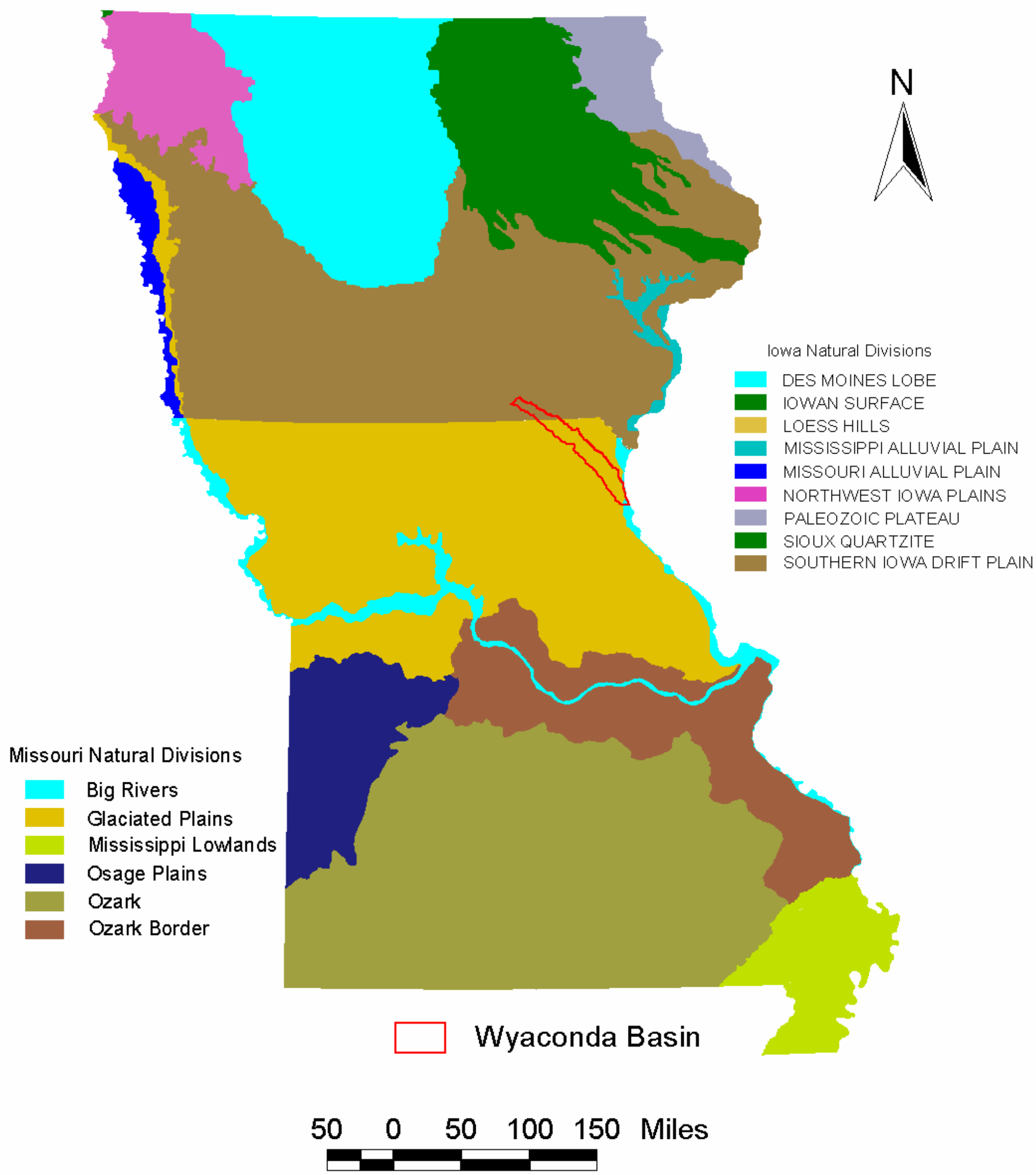

Figure nd. Location of the Wyaconda River Basin within the natural divisions of Missouri and Iowa.

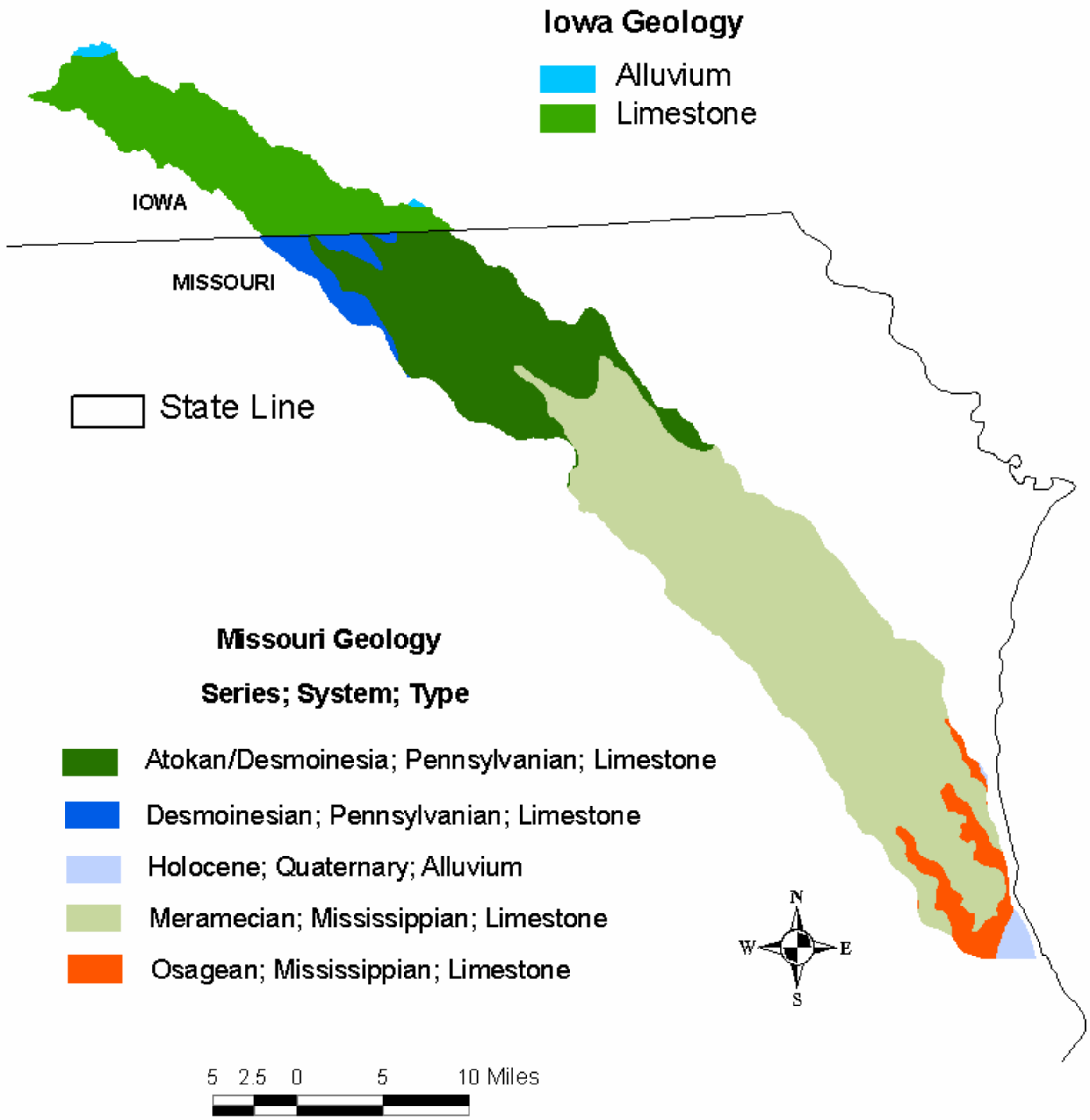

Figure ge. Geological formations of the Wyaconda River Basin, in Missouri and Iowa.

Land Use

Historical Land Use

The Missouri, Fox, Osage, and Sac Tribes were some of the early inhabitants of the Wyaconda River basin. It was a favored hunting ground among the tribes. In 1795, a Frenchman named Godfrey LeSeur established a trading post near the mouth of the Wyaconda River, which was abandoned during winter months (SCS 1992). As settlers moved west, a series of treaties claimed the lands for the United States. The first permanent settlement was located just south of La Grange, Missouri in 1819. Settlers from Kentucky and Virginia continued to inhabit lands near the Mississippi River hills and later moved into the interior of the basin (SCS 1992). Farming corn and winter wheat on the highly fertile land provided the economic base for the region. Human populations continued to increase in the basin counties until the early 1900's.

Most of the landcover of the basin was prairie before settlers began farming (Schroeder 1982). The percentage of prairie land ranged from 42 to 51 in Lewis, Clark, and Scotland Counties. The prairies of the basin were located along the narrow uplands or ridge tops and were usually very elongated situated between the parallel flowing streams. The river floodplains were usually very wet prairie, sometimes considered "swampy" (Schroeder 1982). The steeper hillsides shifting from upland prairies to wet prairies were often wooded.

Modern Land Use

Modern land use and cover of the basin was characterized with data from Missouri Resource Assessment Partnership (2003). Croplands cover approximately 114,000 acres (42%) of the basin, while grasslands covered nearly 107,500 acres (40%). Forest lands only accounted for 17% (46,400 acres) of the land cover within the basin. Less than 1% of the land in the basin is considered swamp or marsh (1,200 acres). Of the cultivated crops, soybeans are grown on the most acreage within the three Missouri counties of the basin (Missouri Agricultural Statistics Service 1998). Corn is the second most planted crop. Cattle are the most numerous livestock, followed by hogs (Missouri Agricultural Statistics Service 1998).

Soil Conservation Projects

Under the authority of the Watershed Protection and Flood Prevention Act (PL-83-566), the Natural Resources Conservation Service (NRCS) administers two soil conservation projects within the watershed. The Little Wyaconda-Sugar Creek Project was started in 1983 and is now completed. The main purpose of this project was to control erosion. The second project, South Wyaconda River Watershed Project in Iowa, began in 1957 and was completed in 1979. These two projects affect 135,000 acres and 46% of the watershed. A larger PL-566 was proposed for the mainstem Wyaconda River below the confluence of the North and South Wyaconda Rivers in 1987. However, there was little economic justification for the project and it was terminated in 1991 (U.S. Army Corps of Engineers 1992). There are currently no EARTH or SALT (Special Area Land Treatment) projects within the watershed.

There are four Missouri Department of Conservation areas within the Wyaconda watershed totaling 509 acres (Table 4). Only two areas, Wyaconda Crossing Conservation Area and Sunnyside School Access provide public access to the Wyaconda River. However, neither of these areas have a concrete boat ramp for boat launching.

Wyaconda Crossing Conservation Area and Neeper Conservation Area provide primitive camping sites. There are no public areas in Iowa's portion of the watershed. There are no United States Army Corps of Engineers or United States Fish and Wildlife Service lands within the watershed.

Table 4. Lands owned by the Missouri Department of Conservation within the Wyaconda watershed.

Area	County	Acres	Developments
Sunnyside School Access	Lewis	114	None
Wyaconda Crossing Conservation Area	Lewis	148	1 Parking Lot 1 Primitive Camping site
Clark Conservation Area	Clark	20	None
Neeper Conservation Area	Clark	227	2 Parking Lots 3 Primitive Camping Sites

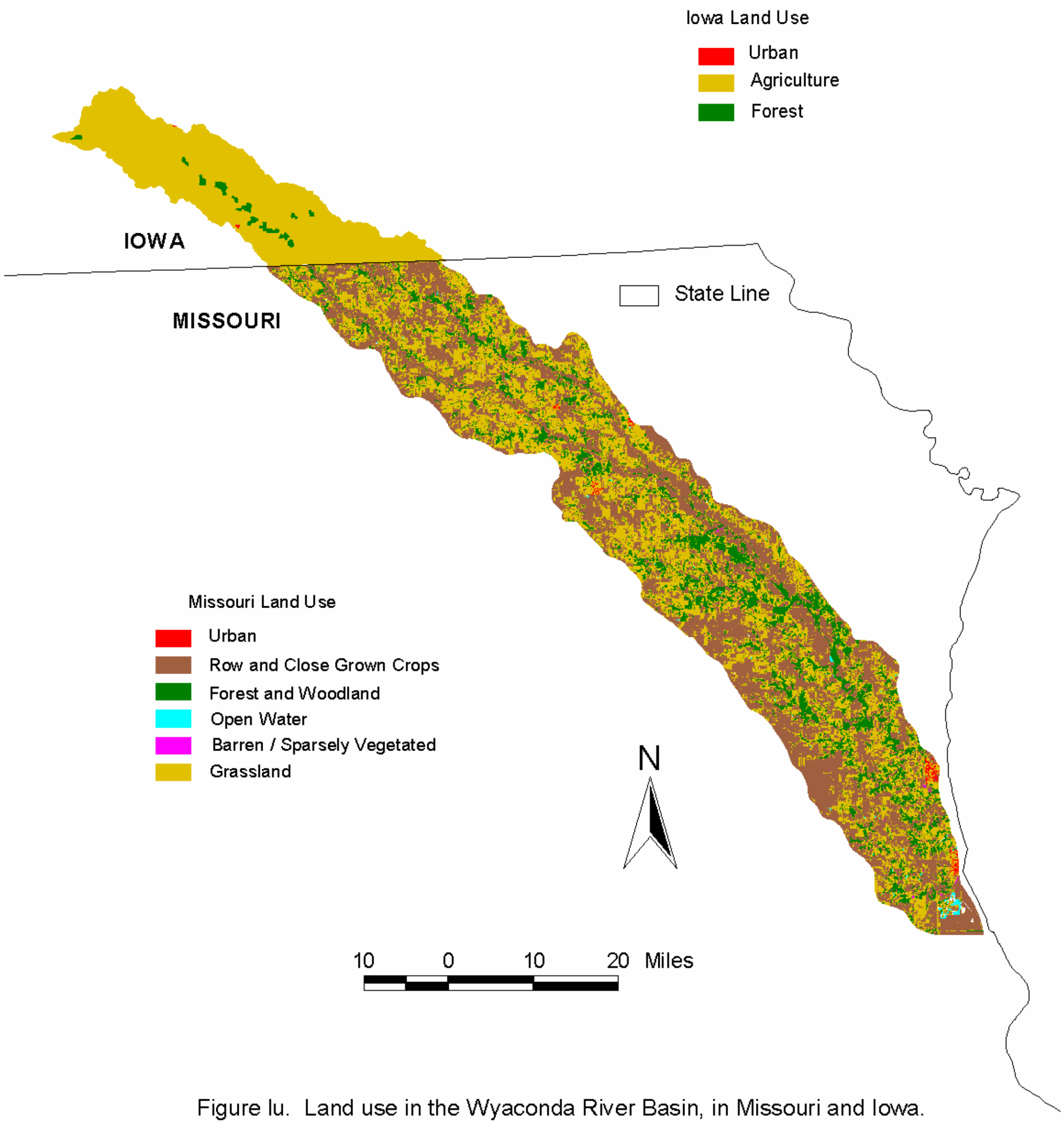

Figure lu. Land use in the Wyaconda River Basin, in Missouri and Iowa.

Hydrology

Precipitation

Average annual precipitation in the basin ranges between 36 and 37 inches (Vandike 1995).

USGS Gaging Station

There is one active gaging station on the Wyaconda River above Canton, MO (USGS 2001) (Table 1). There is no water quality monitoring station within the basin.

Permanence of Flow and Average Annual Discharge

Average annual discharge at the gaging station is 265 cfs (Table 1). The highest recorded instantaneous peak flow at this site occurred on June 30, 1933 at 17,700 cfs. There have been many years when the there was no flow. However, all of the Wyaconda River and the lower 10 miles of both the South Wyaconda and North Wyaconda rivers are classified at streams containing permanent flow (MDNR 1986a).

Baseflow and Low-Flow Frequencies

Baseflows throughout the basin is not sustained by groundwater inflow during dry weather due to the low conductivity of the underlying clays and rock. Seven-day periods of no flow occur every 5 years (Skelton 1976) (Table 2). Also, stream discharge can be zero for up to 60 days or longer every 20 years (Table 2).

Flow Duration

Flow duration statistics reflect the stream discharge that is exceeded for specified proportion of time. Median discharge (flow exceeded 50% of the time) for the Wyaconda River above Canton, MO is 31 cfs (USGS 2001) (Table 1). The ratio of the flow that is exceeded 90% of the time to the flow exceeded 10% of the time (90:10 ratio) is indicative of the flashiness or variability of the stream flow. The 90:10 ratio calculated for the Wyaconda River indicates that stream flows are highly variable (Table 1). Small precipitation events cause rapid increases in stream flow; most water runs off quickly due to the low permeability of the underlying soils.

Flood Frequency

Alexander and Wilson (1995) determined through multiple regression techniques that drainage area and main-channel slope can be used to estimate flood frequency flows for unregulated streams in Missouri (Table 3). The generalized least squares regression equations are as follows:

- $Q_2=69.4A^{0.703}S^{0.373}$
- $Q_5=123A^{0.690}S^{0.383}$
- $Q_{10}=170A^{0.680}S^{0.378}$
- $Q_{25}=243A^{0.668}S^{0.366}$
- $Q_{50}=305A^{0.660}S^{0.356}$
- $Q_{100}=376A^{0.652}S^{0.346}$
- $Q_{500}=569A^{0.636}S^{0.321}$

where, Q_t=estimated discharge in cubic feet per second per time interval (t=years), A=drainage area in square miles, S=main channel slope in feet per mile

Dam and Hydropower Influences

There are no major dams or hydropower influences at this time, except that the regulation of Pool 21 of the Upper Mississippi River by the Corps of Engineers can affect water level and flow in the lower portions of the Wyaconda River.

Major Water Users

The city of Wyaconda, Missouri has an eight acre water-supply reservoir near the South Wyaconda River. The city also pumps water from the South Wyaconda River to supplement their water supply (Vandike 1995, Center for Agricultural, Resources, and Environmental Systems 2004). Within the basin, irrigation is used on less than 50 acres and there are no large industrial users of water (MDNR 1986a).

Table 1. Stream discharge (cfs) for the period of record at the gage location on the Wyaconda River above Canton, MO (from USGS 2001).

Instantaneous Peak Flow	Instantaneous Low Flow	Mean	10% Exceeds	50% Exceeds	90% Exceeds	90:10 Ratio
17,700	0	265	550	31	2.1	1:262

Table 2. One through 60-day low flow discharges (cfs) at 2, 5, 10, and 20 year recurrence intervals for the Wyaconda River USGS gaging station above Canton, MO. (from Skelton 1976)

Drainage Area (sq. miles)	Period (d)	Recurrence interval (years)			
		2	5	10	20
393	7	0.9	0	0	0
	14	1.2	0	0	0
	30	2.2	0.3	0	0
	60	4.5	0.9	0.1	0

Table 3. Predicted flood discharges for 2 to 500 year intervals at USGS Gaging Station on the Wyaconda River above Canton, MO. (From Alexander and Wilson 1995.)

Drainage Area (sq. miles)	Main Channel Gradient (ft/mile)	Flood discharge (cfs) for interval (years)						
		2	5	10	25	50	100	500
393	4.5	5,600	9,200	11,800	15,300	18,100	100	500

Water Quality

Designated Beneficial Uses

At the recommendation of the Department of Natural Resources, the Missouri Clean Water Commission determines the quality of water necessary to attain designated "beneficial uses" on Missouri streams. Only the lower eight miles of the Wyaconda River are designated for public drinking water supply (MDNR 1986a). All basin streams are designated for livestock and wildlife watering and protection of aquatic life. No streams in the basin are classified for whole-body contact recreation.

The primary deterrents to recreational use in the basin are high turbidity and siltation, which are direct results of poor soil management (MDNR 1986b). Excessive turbidity and siltation have not only decreased the abundance and diversity of aquatic life and habitat (Missouri Department of Conservation 1978), but have also made boating and canoeing more difficult due the locally heavy sedimentation. Stream channelization has also drastically reduced the amount and quality of aquatic habitats in parts of the basin, and has affected recreational use by creating high banks and steep-sided channels where access is difficult. The lack of public access points to streams in the basin also limits recreational use.

Chemical Quality of the Stream Flow

Water quality data have not been routinely collected because there is no USGS water quality monitoring station within the basin. One reach of the South Wyaconda River and one section of the lower Wyaconda River are considered impaired by the Missouri Department of Natural Resources due to high levels of manganese. These two reaches are on the 303(d) list of impaired waters submitted to the United States Environmental Protection Service. The manganese is derived from natural sources and considered a low priority. The South Wyaconda River also exceeds total maximum daily loads of sediment and silt and is listed as a 303(d) impaired water. This is due to poor land management practices and extensive channelization within the basin.

Non-Point Source Pollution

Sedimentation and excessive turbidity continue to be the basin's most severe water quality problems. Channelization, intensive row-crop farming, and livestock grazing on highly erodable soils have caused much of the problems. Anderson (1980) estimates sheet and rill erosion rates as high as 18 tons/acre/year on tilled land within the basin. Rates on permanent pasture vary between 9 and 13 tons/acre/year.

Agricultural run-off, which includes fertilizer, insecticides, herbicides, and animal waste, also poses a significant threat to water quality in the basin. Although fish kills in the basin are uncommon, they usually can be attributed to low dissolved oxygen concentrations or high levels of ammonia entering the stream from animal feedlots or sewage lagoons.

Point Source Pollution

Point source pollution in the basin is considered insignificant (MDNR 1984). The city of Wyaconda water treatment center discharges into Railroad Slough (MDNR 1976). Two other small privately-owned sewage systems lie within the basin.

Concentrated Animal Feeding Operations

There are no CAFOs within the Missouri portion of the Wyaconda basin (Center for Agricultural, Resources and Environmental Systems 2004). In the Iowa portion of the basin, there are approximately eight permitted confinement operations and eight non- permitted confinement operations. The impact of these facilities is not known; however, it is unlikely they are benefits to the water quality in the basin.

Habitat Conditions

Channel Alterations and Habitat Problems

Channelization not only includes straightening the stream, but also bank clearing, and widening of the channel. This results in a loss of total stream area and quality habitat, increased streambank and streambed erosion, and a homogenous habitat that supports far less aquatic life. The South Wyaconda River is the most heavily channelized river in the watershed, followed by the Wyaconda River and the North Wyaconda River (Appendix A). These measures have resulted in severe headcutting in the upper reaches. Even on reaches of stream not impacted by channelization, accelerated streambank erosion occurs where protective forested corridors have been removed. In such cases, vertical banks up to 15 feet high have developed. Maintaining diversity of water depth is difficult, if not impossible, in areas where streambanks are unstable.

Stream fish habitat in many tributaries has been severely degraded by grazing livestock that trample streambanks and streambeds, increasing turbidity and erosion and destroying instream cover. Problems stemming from instream sand and gravel removal are locally significant but minor compared with problems resulting from stream channelization and watershed wide erosion. All of these factors limit the ability of the watershed to support quality aquatic life.

Unique Riparian Habitats

Even though all the streams in the basin have been degraded by agricultural encroachment, some still provide quality aquatic habitat. Anderson (1983) classified a stretch of the Wyaconda River from its mouth to about two miles upstream as a statewide significant aquatic area. The undisturbed cliffs along the river support many species of plants that are not commonly found in other areas of the basin.

Habitat Conservation Projects

Most of the stream-related projects in the Wyaconda watershed have been channelization projects not aimed at habitat conservation. We have no record of any habitat conservation projects on the Wyaconda River.

Corps of Engineers Jurisdiction

The Wyaconda River basin in under the jurisdiction of the Rock Island District of the United States Army Corps of Engineers (COE). Most activities involving the deposition or stockpiling of material in stream channels require a Section 404 permit from COE. As of December 20, 2004, applications for 404 permits should be sent to: Clock Tower Building, P.O. Box 2004, Rock Island, IL 61204-2004, attention NCROD-S. Phone (309)794-4200.

Biotic Community

Fish Community

Fish community data were collected by Missouri Department of Conservation staff from 15 sites throughout the basin during 1988 and five sites we resampled in 1998 (Table 5). Additional sampling was conducted in 1994 and 2002 as part of the Resource Assessment and Monitoring program (RAM). Fish were collected using a seine 15 or 25 feet long with 1/8" mesh. Kick seine methods were used to sample riffles. A boat- mounted electrofishing unit was used where

possible to sample deep pools. Large fish were identified on site and returned to the water. Small fish were preserved and later identified in the laboratory. Data collected prior to 1988 were obtained from the Missouri Department of Conservation fish database.

A total of 53 species from 11 families have been collected in the Wyaconda River basin (Table 6). Fifty-one species were found in recent surveys. The fish community of the basin was generally dominated by more tolerant, wide-ranging species and includes fishes representative of the Prairie, Lowland, Ozark, and Big River faunal regions (Pflieger 1997). The dominant families were the minnows (20 species), catfishes (7 species), sunfishes (7 species), suckers (7 species), and perches (5 species). The most common and abundant species collected in recent surveys were the red shiner *(Cyprinella lutrensis)* and bigmouth shiner (Notropis dorsalis). Red shiners comprised 28% of the total sample in the basin and were found at 93% of all sites.

Bigmouth shiners comprised 20% of the total fish sample in the basin and occurred at 87% of all sites. Both species are tolerant of high turbidity and siltation that persists throughout much of the basin. Other commonly occurring species (found in at least 60% of all sites) include: johnny darter *(Etheostoma nigrum),* creek chub *(Semotilus atromaculatus),* quillback *(Carpiodes cyprinus),* white sucker *(Catostomus commersoni),* sand shiner *(Notropis ludibundus),* bluntnose minnow *(Pimephales notatus),* suckermouth minnow *(Phenacobius mirabilis),* central stoneroller (*Campostoma pullum*), orangespotted sunfish *(Lepomis humilis),* and green sunfish *(Lepomis cyanellus).*

Sportfish (13 species that provide angling opportunity) comprised approximately 3% of all fish collected in basin streams. These fishes were under-represented numerically because larger individuals were not fully vulnerable to our sampling gear. Green sunfish were the most abundant species in this group and were found at 87% of all sites. Channel catfish *(Ictalurus punctatus),* probably the most popular game species, occurred at 40% of all sites, but accounted for only 1% of the total fish collected. Largemouth bass *(Micropterus salmoides)* and bluegill *(Lepomis macrochirus)* were collected at 27 and 13% of all sample locations, respectively.

Two species found in the basin prior to 1988 but not found in recent surveys include the bluntnose darter *(Etheostoma chlorosomum)* and ghost shiner *(Notropis buchanani),* which were both last found in 1941. Both species ha ve likely been extirpated from the basin. Similar declines of these species have occurred in other northeast Missouri streams. Reasons for the declines are not well understood; however, these species prefer clear water and are intolerant of turbidity and siltation (Pflieger 1997). The Mississippi silvery minnow *(Hybognathus nuchalis) was* thought to be extirpated; however, three individuals were collected in 2002.

The Wyaconda River yielded the most species (40), followed by Sugar Creek (20), North Wyaconda River (16), and Little Wyaconda River (15). We also found a higher average number of species per site in the lower Wyaconda River. Thirty-nine species were collected from one site in the lower Wyaconda River at Sunnyside School Access. This higher diversity is likely due to its close proximity to the Mississippi River and the higher diversity of habitats in larger streams.

Threatened and Endangered Species

Of the species collected since 1988, none are considered state or federal rare or endangered. The Mississippi silvery minnow is listed as a species of conservation concern by the Missouri Department of Conservation. It is not considered endangered, but a species of long-term concern due to its rarity in parts of the state.

Fish Stockings

The Missouri Department of Conservation has not stocked the Wyaconda River; however, many of the ponds and lakes within the watershed have been stocked for fishing.

Aquatic Invertebrates

Buchanan (1992) sampled seven northeast Missouri rivers (Fox, Honey, Wyaconda, North Fabius, Middle Fabius, South Fabius, and North) to determine the distribution of the endangered winged mapleleaf mussel *(Quadrula fragosa).* Although he did not sample this species within the Wyaconda watershed, he did find 21 species of mussels (Table 7), the most species found in the seven northeast Missouri rivers sampled. The catch rate in the Wyaconda River was 10 mussels/hour, the second lowest rate in the seven rivers sampled. The white heelsplitter *(Lasmigona complanata)* was the most abundant, composing 27% of all mussels sampled. The mapleleaf *(Quadrula quadrula)* was the second most abundant, composing 21% of all mussel sampled.

Only one crayfish species is known to inhabit basin streams or grasslands (B. DiStefano, Missouri Department of Conservation, personal communication). This species is the Northern crayfish *(Orconectes virilis);* the most widely distributed of Missouri crayfish.

Individuals from the RAM project sampled aquatic insects as part of their standardized monitoring program. Samples were taken from the same sites that fish were sampled. Eighty- seven taxon were collected from the four sites (Table 8). Insects from the order Diptera (true flies) were the most abundant, with 42 taxons present, followed by the mayflies (Ephemeroptera).

Wyaconda River 1988 Complete Survey Sample Sites			
Stream Name	Site Number	Legal Description	County
North Wyaconda River	1	67n11w19se4	Scotland
North Wyaconda River	2	66n11w03nw4	Scotland
North Wyaconda River	4	66n09w31nw4	Clark
Wyaconda River	5	65n09w26se4	Clark
South Wyaconda River	6	66n12w02se4	Scotland
South Wyaconda River	7	66n11w36ne4	Scotland
Allen Creek	10	65n10w15w2	Scotland
Wyaconda River	11	64n08w09nw4	Clark
Wyaconda River	16	62n06w07nw4	Lewis
Wyaconda River	18	61n06w15ne4	Lewis
Little Wyaconda River	19	64n09w16sw4	Clark
Little Wyaconda River	20	64n08w32nw4	Clark
Little Wyaconda River	23	63n07w06sw4	Clark
Sugar Creek	25	62n07w09nw4	Lewis
Sugar Creek	27	61n06w06ne4	Lewis

Wyaconda River 1988 Partial Survey Sample Sites			
Stream Name	Site Number	Legal Description	**County**
North Wyaconda River	2	66n11w03nw4	**Scotland**
South Wyaconda River	7	66n11w36ne4	**Scotland**
Wyaconda River	18	61n06w15ne4	**Lewis**
Little Wyaconda River	23	63n07w06sw4	**Clark**
Sugar Creek	**25**	**62n07w09nw4**	**Lewis**

Wyaconda River 1994 and 2002 RAM Sample Sites			
Stream Name	Site Number	Legal Description	**County**
Wyaconda River	9510	61n06w15sec	**Lewis**
Sugar Creek	9532	62n07w36sec	**Lewis**
South Wyaconda	9535	65n10w4sec	**Scotland**
Little Wyaconda	**9537**	**64n08w30sec**	**Clark**

Table 6. Fish species collected from the Wyaconda River watershed.

Common Name	Collected Prior to 1988	Collected during 1988 Complete Survey	Collected during 1994 RAM Survey	Collected during 1998 Partial Survey	Collected during 2002 RAM Survey	Current Status
Shortnose gar		X	X	X		LA
Longnose gar	X	X			X	U
Gizzard shad		X	X	X	X	LA
Smallmouth buffalo		X				U
Quillback		X	X	X		U
River carpsucker	X	X	X		X	LA
Highfin carpsucker					X	U
White sucker	X	X	X	X	X	LA
Golden redhorse		X	X			U
Shorthead redhorse	X	X	X			U
Common carp	X	X	X	X	X	C
Goldfish		X				U
Creek chub	X	X	X	X	X	C
Bigeye shiner					X	U
Bigmouth shiner	X	X	X	X	X	C
Emerald shiner	X	X	X	X		C
Ghost shiner	X					E
Golden shiner	X	X	X	X	X	LA
Red shiner	X	X	X	X	X	C
Redfin shiner	X	X	X	X	X	C
River shiner			X			U
Sand shiner	X	X	X	X	X	C

Common Name	Collected Prior to 1988	Collected during 1988 Complete Survey	Collected during 1994 RAM Survey	Collected during 1998 Partial Survey	Collected during 2002 RAM Survey	Current Status
Spotfin shiner		X	X	X		U
Bluntnose minnow	X	X	X	X	X	C
Brassy minnow			X			U
Bullhead minnow	X	X	X	X		LA
Mississippi silvery minnow	X				X	U
Fathead minnow	X	X	X	X	X	LA
Suckermouth minnow	X	X	X	X	X	U
Central stoneroller	X	X	X	X	X	C
Channel catfish	X	X	X	X	X	C
Black bullhead	X	X	X	X	X	LA
Yellow bullhead	X	X	X	X	X	LA
Flathead catfish		X				LA
Stonecat				X		U
Tadpole madtom	X	X		X		U
Slender madtom	X	X	X	X	X	U
White bass			X			U
Mosquitofish		X		X	X	LA
Slenderhead darter	X	X	X	X	X	LA

Common Name	Collected Prior to 1988	Collected during 1988 Complete Survey	Collected during 1994 RAM Survey	Collected during 1998 Partial Survey	Collected during 2002 RAM Survey	Current Status
Johnny darter	X	X	X	X	X	C
Bluntnose darter	X					E
Orangethroat darter		X				U
Fantail darter	X	X		X	X	LA
Smallmouth bass		X				U
Largemouth bass		X	X	X		LA
Green sunfish	X	X	X	X	X	C
Orangespotted sunfish	X	X		X		LA
Bluegill		X	X	X	X	LA
Black crappie		X				U
White crappie	X	X		X	X	LA
Brook silverside		X				U
Freshwater drum		X	X	X		LA
Flathead catfish		X				LA
Stonecat				X		U
Tadpole madtom	X	X		X		U
Slender madtom	X	X	X	X	X	U
White bass			X			U
Mosquitofish		X		X	X	LA
Slenderhead darter	X	X	X	X	X	LA

Common Name	Collected Prior to 1988	Collected during 1988 Complete Survey	Collected during 1994 RAM Survey	Collected during 1998 Partial Survey	Collected during 2002 RAM Survey	Current Status
Johnny darter	X	X	X	X	X	C
Bluntnose darter	X					E
Orangethroat darter		X				U
Fantail darter	X	X		X	X	LA
Smallmouth bass		X				U
Largemouth bass		X	X	X		LA
Green sunfish	X	X	X	X	X	C
Orangespotted sunfish	X	X		X		LA
Bluegill		X	X	X	X	LA
Black crappie		X				U
White crappie	X	X		X	X	LA
Brook silverside		X				U
Freshwater drum		X	X	X		LA

Table 7. Species of mussels found dead or alive in the Wyaconda River watershed during 1991. (From Buchanan 1992)

Common Name	Scientific Name	Number of Live Collected
Giant Floater	*Pyganodon grandis*	3
White Heelsplitter	*Lasmigona complanata*	20
Pistolgrip	*Tritogonia verrucosa*	7
Mapleleaf	*Quadrula quadrula*	15
Wartyback	*Quadrula nodulata*	1
Threeridge	*Amblema plicata*	1
Threehorn Wartyback	*Obliquaria reflexa*	2
Fragile Papershell	*Leptodea fragilis*	8
Pink Heelsplitter	*Potamilus alatus*	10
Pink Papershell	*Potamilus ohiensis*	1
Lilliput	*Toxolasma parvus*	2
Yellow Sandshell	*Lampsilis teres*	2
Pimpleback	*Quadrula pustulosa*	0
Wabash Pigtoe	*Fusconaia flava*	0
Deertoe	*Truncilla truncate*	0
Pondmussel	*Ligumia subrostrata*	0
	Truncilla donaciformis	0
	Ligumia recta	0
	Lampsilis radiate	0
	Lampsilis ventricosa	0
	Strophitus undulates	0

Table 8. Aquatic insects collected from the Wyaconda River watershed. Numbers in parentheses are the average number collected per site.

Order Coleoptera	Order: Diptera	Order: Ephemeroptera	Order: Hemiptera	Order: Odonata	Order: Trichoptera
Helichus (37)	Ceratoponinae (137)	Acerpenna (1)	Corixidae (8)	Hetaerina (8)	Cheumatopsyche (203)
Dubiraphia (67)	Forcipomyiinae (39)	Fallceon (38)	Trichocorixa (1)	Argia (390)	Hydropsychidae (14)
Macronychus (19)	Chaoborus (144)	Procleon (37)	Rheumatobates (14)	Enallagma (36)	Hydroptila (3)
Stenelmis (1292)	Ablabesmyia (178)	Baetisca (9)	Trepobates (3)	Corduliidae (1)	Oxythira (8)
Berosus (155)	Chironomus (200)	Brachycerus (9)	Hebrus (4)	Epitheca (5)	Nectopsyche (118)
Enochrus (1)	Cladopelma (3)	Caenis (2909)	Hydrometra (4)	Perithemis (5)	Oecetis (154)
Scirtes (171)	Cladotanytarsus (742)	Hexagenia (6)	Mesovelia (8)	Dromogomphus (3)	Triaenodes (3)
	Clinotanypus (5)	Stenacron (96)	Neoplea (1)	Progomphus (11)	Chimarra (14)
	Coelotanypus (9)	Stenonema (137)	Microvelia (12)	Hydracarina (128)	Neureclipsis (9)
	Corynoneura (4)	Tricorythodes (573)			
	Cricotopus (7)	Paraleptophlebia (190)			
	Cryptochironomus (233)				
	Cryptotendipes (4)				
	Dicrotendipes (332)				
	Glypotendipes (82)				
	Labrundinia (28)				
	Microchironomus (1)				

Order Coleoptera	Order: Diptera	Order: Ephemeroptera	Order: Hemiptera	Order: Odonata	Order: Trichoptera
	Nanocladius (3)				
	Nilothauma (5)				
	Pagastiella (1)				
	Parachironomus (13)				
	Paracladopelma (18)				
	Paratanytarsus (18)				
	Paratendipes (1)				
	Polypedilum convictum (41)				
	Polypedilum halterale (2568)				
	Polypedilum illinoense (51)				
	Polypedilum scalaenum (521)				
	Procladius (51)				
	Pseudochironomus (1)				
	Stelechomyia (5)				
	Stempellina (18)				
	Stempellinella (7)				
	Stenochironomus (10)				
	Stichtochironomus (43)				
	Tanytarsus (411)				
	Thienemannimyia (189)				
	Tribelos (9)				
	Anopheles (20)				

Order Coleoptera	Order: Diptera	Order: Ephemeroptera	Order: Hemiptera	Order: Odonata	Order: Trichoptera
	Culex (92)				
	Sciomyzidae (3)				
	Tipula (2)				

Opportunities for Stream Fishery Conservation

The following perspectives on problems and opportunities for watershed management will guide MDC management priorities and activities for the foreseeable future. We realize we are only one of many partners whose joint efforts will be needed to protect and restore stream ecosystem integrity in the Wyaconda River watershed.

Managing MDC Riparian Ownerships

Stream Access Acquisition

MDC has purchased small tracts of land along streams in order to provide public access for recreation and to establish an ownership stake that may strengthen our position in resisting system-wide threats to riparian habitat integrity. In the past, statewide planners have assumed that a desirable spacing was approximately ten stream miles between access areas. Experience suggests that it takes much longer to float and/or fish a typical reach of prairie stream than an equivalent length of Ozark stream. Because of slower currents and more frequent channel obstructions in the prairie region, we should seek to shorten the distance between access areas to five to seven miles on floatable, unchannelized prairie streams with high public use potential.

In order to provide a stream access system with optimal one-day trip distances, MDC should acquire at least one additional access site in the Wyaconda River watershed. Optimal location of this access would be near the Lewis-Clark county border, approximately five to seven miles above Wyaconda Crossing Conservation Area. Above this proposed site, the river is heavily channelized, making the recreational opportunities limited.

Stream Access Development

Because of fiscal restraints, planned developments have not been completed on all existing stream access areas in the Northeast Region. Developments must be completed so citizens can experience the quality recreational opportunities that will build their individual commitment to helping preserve and restore streams in this and other watersheds. As a matter of strategic priority, MDC will put a higher priority on completing planned developments on existing areas than acquiring additional areas.

Both Wyaconda Crossing Conservation Area and Sunnyside School Access should have a concrete boat ramp and 5-car parking lot for stream access. These structures would provide increased opportunity for boaters and stream enthusiasts.

Site-Specific Stream Restoration

Although stream ecosystem health is almost entirely dependent upon processes occurring upstream and downstream of any given ownership, Department of Conservation riparian areas should serve as model of good stream stewardship. In the Wyaconda River watershed, streambank erosion and forested corridor deficiencies are minor at MDC owned access areas. In areas where the forested corridor is too narrow, passive restoration is being used to increase corridor width.

Public Use Information

Public use of Wyaconda River watershed streams is low to moderate, partially because most people may have stereotyped northern Missouri streams as turbid, unattractive ditches that contain primarily non-game fish. While this may be true for some parts of the Wyaconda River, lower sections contain unique habitats and pleasing scenery.

MDC could increase public use and appreciation of the Wyaconda River watershed streams by developing a brochure describing stream recreational opportunities. Such a brochure would include colored pictures, simple stream maps with mileages, access sites and camping areas clearly marked, descriptions of other local attractions, and fishing opportunities/regulations.

Statewide news releases and an article in the Conservationist magazine might also help to inform potential users of the opportunities awaiting them in the Wyaconda River watershed.

Conservation of Aquatic Communities

Statewide, the Department of Conservation has developed a long-term Resource Assessment and Monitoring program (RAM). The objective is to establish standardized sampling methods for several stream ecosystem attributes, especially biotic communities that will allow scientists to provide an accurate, legally defensible portrayal of conditions and trends. Sampling is occurring at random and fixed sites to allow statewide or individual watershed assessments. Information gathered from this effort may be used to prioritize watersheds for conservation.

Long-Term Fish Community Monitoring

Long-term monitoring to assess stream fish community trends has not been conducted in the Wyaconda River watershed. Although some sites within the basin may be included in the statewide RAM program, extensive sampling within that framework is not likely to occur for several years. In the meantime, in order to monitor trends in fish community composition and population levels, the Department of Conservation should conduct fish community surveys at sites randomly selected from among those surveyed during 1988 at least every ten years.

Fishery Management and Research Needs

As in most northeastern Missouri streams, fish communities in the Wyaconda River watershed seem to be imbalanced. Recognizing that our sampling methods may under represent large fishes, surveys in some basin streams still suggests the existence of relatively few fish-eating predators (flathead catfish, black bass or walleye), but large numbers of invertebrate-eating bottom feeders (channel catfish, river carpsuckers, freshwater drum, common carp, and a variety of minnow species). Non-game fishes are represented mostly by species tolerant of the shallow depths and shifting substrates caused by excessive watershed erosion and subsequent stream channel sedimentation. Shifting substrates dramatically reduce biological productivity, so in channelized streams the large populations of invertebrate-eating fish are almost entirely dependent upon terrestrial inputs or whatever invertebrate production occurs on in-channel woody debris. There are not enough predatory fish to manage the abundant insect-eating fish. Degraded habitat may be the main factor limiting fish-eating predator abundance and thereby preventing ecosystem balance.

Monitoring Contaminants in Fish

The entire basin has been included in a limited consumption advisory issued by the Missouri Department of Health for fish species with a high proportion of fat in their edible tissues (catfish, carp, buffalo, drum, suckers). Levels of concern for chlordane were reported in the early 1990s for catfish in this and neighboring watersheds and the Mississippi River. This advisory was lifted in 2001 due to declining chlordane levels. However, another consumption advisory was issued in 2001 due to mercury contamination. The advisory recommends that pregnant or nursing women, women of childbearing age, and children 12 years of age or younger not eat largemouth bass 12 inches long or longer from anywhere in Missouri.

Long-Term Mussel Community Monitoring

Mussels are found in low densities in most reaches of basin streams. Extensive, basin-wide surveys have not been conducted. The Department of Conservation needs to assess species diversity and abundance by conducting a carefully designed, system-wide survey. Survey sites and sampling periodicities should be consistent with RAM and other fish survey protocols.

Supporting Other Agencies and Organizations

The Missouri Department of Conservation works with many other governmental agencies and private conservation organizations in the process of managing stream resources. The following formal or traditional interactions are among the most significant in frequency and scope, and they should be continued.

Missouri Department of Natural Resources (DNR)

MDC assists DNR by periodically recommending water quality standard classifications for stream reaches of special concern and assisting in water pollution investigations whenever an event results in the loss of aquatic life. In such cases, MDC's role is to document the number of dead fish and other aquatic organisms and report to DNR the estimated value of animals lost according to formulas established by the American Fisheries Society. MDC should continue its coordination efforts with DNR to ensure efficient use of state government resources in the conservation of streams in the Wyaconda River watershed.

Missouri Department of Health (DOH)

by periodically collecting fish from select streams and preparing tissue samples for analysis of pesticide and heavy metal contaminants. We also cooperate with DOH in advising anglers about precautions to take in the consumption of fish.

U.S. Army Corps of Engineers (COE)

MDC joins several other agencies in commenting to COE and DNR about activities in streams that require permit and certification under Sections 404 and 401, respectively, of the Federal Clean Water Act. COE requires a Section 404 permit for operators who propose to deposit or stockpile material in stream channels; and DNR requires a Section 401 certification for any activity that could significantly degrade water quality. MDC biologists also help to disseminate information about streambed and bank stabilization and stream-friendly sand and gravel removal practices to county commissions, contractors, and landowners.

MDC personnel are often the first agency representatives contacted by neighbors when individuals or public entities engage in what appears to be unpermitted and destructive practices in and along streams. MDC biologists should remain vigilant advocates for the interests on all riparian residents, upstream and downstream, who may be adversely affected by the activities of those few who knowingly violate Sections 404 or 401 of the Clean Water Act.

MDC recognizes that regulations are necessary to protect streams and their watersheds. Watershed management must be approached in a balanced, market-based manner that falls somewhere in the continuum between regulatory protection and voluntary conservation efforts.

Conservation Federation of Missouri (CFM)

MDC facilitates and promotes Stream Team, a program initiated by CFM that seeks to enlist volunteers in the stream conservation effort. One Team has adopted a segment of stream in the Wyaconda River watershed; however, they report little to no activity. Far more citizen activity will be needed for any significant stream improvements to occur within the watershed.

Assisting Citizen-Led Watershed conservation Efforts

We are convinced that the watershed conservation approach will work only if there is widespread recognition that social, economic, and environmental values associated with streams are compatible. If that can be achieved, success will depend upon local initiatives to form diverse partnerships of committed groups and individuals under the leadership of landowners and other local interests.

Watershed restoration is essential to restoring the primary processes that create and maintain fish habitat in healthy stream ecosystems. The most critical and affordable first step in watershed restoration is passive restoration–the cessation of human activities that are causing degradation or preventing recovery (e.g., channelization, riparian corridor clearing, indiscriminate gravel dredging, and streamside livestock grazing). Active restoration (e.g., tree revetments and riparian corridor plantings) should be considered only if recovery fails to occur over a reasonable period of time while using passive techniques (e.g., livestock exclusion and natural regeneration of woody plants). Because restoring degraded stream ecosystems is more costly and risky than simply protecting fully functional sites, we suggest that protecting and preserving intact riparian ecosystems be the highest priority of watershed-scale restoration efforts.

Protecting Healthy Riparian Corridors–Stream Stewardship

A program aimed at conserving healthy forested stream corridors by placing them into permanent easements using Stream Stewardship Agreements (SSA) was piloted in Marion County between 1992 and 1995. That effort resulted in the permanent conservation of 88 acres of 100- to 200-foot-wide forested corridor on four ownerships along 2.4 miles of the South Fabius River. Although there are no SSA in the Wyaconda River watershed, the infrastructure now exists for MDC to facilitate the permanent conservation of healthy stream corridors, but measurable impact will require funding from a variety of sources. Enrollment of streamside lands in continuous CRP (Conservation Reserve Program) will not substitute for enrollment in SSA or other permanent easement programs because healthy forested corridors cannot be enrolled in CRP, and land enrolled in CRP buffers may be converted back to crop production at the end of the short-term contract periods (10 to 15 years). However, CRP may provide viable first step for landowners on the long path toward converting eroding floodplain crop fields or pastures into functional riparian corridors.

Passively Restoring Mildly Degraded Riparian Corridors–Livestock Exclusion

The activity of livestock can degrade physical aspects of water quality and habitat by causing streambank erosion, resulting in turbidity and stream channel sedimentation. Chemical aspects of water quality can be degraded by livestock waste. In some situations, streambank stabilization, corridor reforestation, and improved water quality can be achieved simply by excluding livestock from stream corridors. For fencing to be attractive to landowners, an alternative source of livestock water must be available (e.g., upland ponds, or shallow floodplain wells tapped by nose pumps or solar-powered pumps). Some landowners may have potential alternative water sources on their property, but may not have the money or the technical support to adopt new technology. Cost-share money for fencing and alternative watering may be available through a variety of federal and state programs. Department of Conservation biologists are available to assist landowners in selecting a practical alternative to instream watering of livestock.

Educating Future Watershed Stewards

Educating our youth about the complexities of watershed processes and problems will be critically important in advancing the science and art of watershed conservation. Today's youth are more technologically oriented and therefore likely to embrace complex information systems. And because of changes in classroom teaching strategy, they are likely to work effectively in problem-solving teams once they become adults.

MDC has found that students in and around the 6th grade are particularly receptive to messages about stream conservation because they can understand most concepts and evaluate new ideas with relatively little social or cultural bias. Classroom teachers may find helpful lesson-planning materials in Missouri's Stream Team Curriculum, a watershed-based curriculum developed by teachers, for teachers, that will help students to meet environmental education goals in the Missouri Performance Standards.

Junior high and high school students in vocational agricultural programs may also be prime candidates for watershed conservation education because they are more likely than others to become landowners and other important members of rural communities. Involving these students in hands-on stream conservation activities may contribute to the creation of a new generation of landowners committed to stream ecosystem integrity.

Citizen Primer to Leadership in Watershed Conservation

This section is included as a starting point for citizens who wish to lead or contribute significantly to watershed-based stream conservation efforts. The proliferation of information about watershed planning can be intimidating to individuals or groups who have decided that they have a problem they wish to fix. To facilitate that process, we recommend that potential leaders and contributors to watershed conservation efforts first familiarize themselves with a summary of lessons learned over the past decade about what works and what does not. The list in Table 9 combines the Top 10 Watershed Lessons Learned published by the United States Environmental Protection Agency with the ten principles for effectively coordinating watershed- based programs listed by Turner (1997). These documents are highly recommended reading.

Citizens determined to develop and implement watershed conservation plans can also obtain critically important information about organizing and funding such projects by visiting the Internet websites listed in Table 10. These sites contain convenient links to many other sites that, in the aggregate, provide enough information about the watershed conservation process to help any individual or group get started in an informed and effective manner.

Table 9. Ten useful watershed conservation principles.*

1. For watershed conservation approach to work, there must be widespread recognition that social, economic, and environmental values are compatible.
2. Successful watershed conservation requires the formation and support of diverse partnerships under the authority of landowners and other local interest.
3. Leadership is critical in the watershed approach to conservation.
4. A good coordinator is key to successful watershed conservation projects.
5. The best plans have clear visions, goals, and action items.
6. Good tools (planning guides, technical assistance, and funding sources) are available to help watershed groups achieve their goals.
7. It is important to start small and demonstrate success before working on larger scales, celebrating even minor success as it occurs.
8. Plans are most likely to succeed in implemented on a manageable scale.
9. Public awareness, education and involvement are keys to building and maintaining support for watershed conservation efforts.
10. Measuring and communicating progress is essential to the success of watershed conservation efforts.

*For EPA Publication 840-F-97-001, call the National Center for Environmental Publications and Information at 1-800-490-9198.

Table 10. Internet websites containing important information for Missouri watershed planners.

- **Conservation Technology Information Center -** www.ctic.purdue.edu CTIC is a non-profit, public-private partnership equipping agriculture with realistic, affordable, and integrated solutions to environmental concerns.
- **EPA Watershed and Wetlands -** www.epa.gov/OWOW This site, created and maintained by the federal Environmental Protection Agency, is a good starting point for information about watersheds and water quality.
- **Funding Sources for Watershed Conservation -** http://www.epa.gov/owow/funding.html This site contains a comprehensive listing of private and public sources of watershed project funding, with links to many individual sites and references to many useful publications.

- **Know Your Watershed -** http://www.ctic.purdue.edu/KYW/ This initiative works to encourage the formation of local, voluntary partnerships among all watershed stakeholders for the purpose of developing and implementing watershed plans based upon shared visions of the future.
- **Missouri Stream Team -** http://www.mostreamteam.org/ This site provides specific information on activities, programs, and funding sources for volunteers who have adopted Missouri streams or otherwise committed themselves to conserving stream resources in Missouri.
- **Missouri Watershed Information Network -** http://outreach.missouri.edu/mowin/ This site serves as a clearinghouse for information about Missouri watersheds.
- **River Network -** http://www.rivernetwork.org/ This organization supports development of local watershed partnerships through its Watershed Assistance Grants Program. They seek to fund projects in diverse geographies that have demonstration value on a national scale.

Angler Guide

Due to extensive channelization and sedimentation in the upper reaches of the watershed, most deep-water habitats that once held large fish have been replaced by long, shallow, sandy runs. These runs provide inadequate habitat for game fishes, making good fishing opportunities limited within these reaches. Anglers can expect to find a few green sunfish in these upper reaches of the watershed, but overall sportfishing is poor.

The lower reaches of the Wyaconda River provide a more appealing area for fishing. Downstream of the Lewis-Clark County line, the river is still impacted by upstream reaches, but is not channelized. Deep-water habitats with large woody debris that provide good fish habitat can still be found within this reach of river. Anglers can expect to find flathead catfish, channel catfish, common carp, and drum within the lower Wyaconda River. During certain times in the spring, other species from the Mississippi River can be found in the extreme lower Wyaconda River, providing good angling opportunity.

Anglers and boaters can access the Wyaconda River at Wyaconda Crossing Conservation Area and Sunnyside School Access in Lewis County. Significant reaches of the Wyaconda River can be floated by canoe or small jon boat much of the year. Under low flow conditions, there is a more frequent need to drag watercraft over riffles and debris than in Ozark streams. But unlike the Ozarks, anglers will experience isolation within the forested river corridor, in addition to good fishing for a wide variety of species. Detailed float trip information and maps highlighting public stream access areas can be obtained by calling the Hannibal office of the Missouri Department of Conservation at 573-248- 2530.

Glossary

Alluvial soil: Soil deposits resulting directly or indirectly from the sediment transport of streams, deposited in river beds, flood plains, and lakes.

Aquifer: An underground layer of porous, water-bearing rock, gravel, or sand.

Benthic: Bottom-dwelling; describes organisms which reside in or on any substrate.

Benthic macroinvertebrate: Bottom-dwelling (benthic) animals without backbones (invertebrate) that are visible with the naked eye (macro).

Biota: The animal and plant life of a region.

Biocriteria monitoring: The use of organisms to assess or monitor environmental conditions.

Channelization: The mechanical alteration of a stream which includes straightening or dredging of the existing channel, or creating a new channel to which the stream is diverted.

Concentrated animal feeding operation (CAFO): Large livestock (ie. cattle, chickens, turkeys, or hogs) production facilities that are considered a point source pollution, larger operations are regulated by the MDNR. Most CAFOs confine animals in large enclosed buildings, or feedlots and store liquid waste in closed lagoons or pits, or store dry manure in sheds. In many cases manure, both wet and dry, is broadcast overland.

Confining rock layer: A geologic layer through which water cannot easily move.

Chert: Hard sedimentary rock composed of microcrystalline quartz, usually light in color, common in the Springfield Plateau in gravel deposits. Resistance to chemical decay enables it to survive rough treatment from streams and other erosive forces.

Cubic feet per second (cfs): A measure of the amount of water (cubic feet) traveling past a known point for a given amount of time (one second), used to determine discharge.

Discharge: Volume of water flowing in a given stream at a given place and within a given period of time, usually expressed as cubic feet per second.

Disjunct: Separated or disjoined populations of organisms. Populations are said to be disjunct when they are geographically isolated from their main range.

Dissolved oxygen: The concentration of oxygen dissolved in water, expressed in milligrams per liter or as percent.

Dolomite: A magnesium rich, carbonate, sedimentary rock consisting mainly (more than 50% by weight) of the mineral dolomite $(CaMg(CO_3)_2)$.

Endangered: In danger of becoming extinct.

Endemic: Found only in, or limited to, a particular geographic region or locality.

Environmental Protection Agency (EPA): A Federal organization, housed under the Executive branch, charged with protecting human health and safeguarding the natural environment — air, water, and land — upon which life depends.

Epilimnion: The upper layer of water in a lake that is characterized by a temperature gradient of less than 1° Celsius per meter of depth.

Eutrophication: The nutrient (nitrogen and phosphorus) enrichment of an aquatic ecosystem that promotes biological productivity.

Extirpated: Exterminated on a local basis, political or geographic portion of the range.

Faunal: The animals of a specified region or time.

Fecal coliform: A type of bacterium occurring in the guts of mammals. The degree of its presence in a lake or stream is used as an index of contamination from human or livestock waste.

Flow duration curve: A graphic representation of the number of times given quantities of flow are equaled or exceeded during a certain period of record.

Fragipans: A natural subsurface soil horizon seemingly cemented when dry, but when moist showing moderate to weak brittleness, usually low in organic matter, and very slow to permeate water.

Gage stations: The site on a stream or lake where hydrologic data is collected.

Gradient plots: A graph representing the gradient of a specified reach of stream. Elevation is represented on the Y-axis and length of channel is represented on the X- axis.

Hydropeaking: Rapid and frequent fluctuations in flow resulting from power generation by a hydroelectric dam's need to meet peak electrical demands.

Hydrologic unit (HUC): A subdivision of watersheds, generally 40,000-50,000 acres or less, created by the USGS. Hydrologic units do not represent true subwatersheds.

Hypolimnion: The region of a body of water that extends from the thermocline to the bottom and is essentially removed from major surface influences during periods of thermal stratification.

Incised: Deep, well defined channel with narrow width to depth ration, and limited or no lateral movement. Often newly formed, and as a result of rapid down-cutting in the substrate

Intermittent stream: One that has intervals of flow interspersed with intervals of no flow. A stream that ceases to flow for a time.

Karst topography: An area of limestone formations marked by sinkholes, caves, springs, and underground streams.

Loess: Loamy soils deposited by wind, often quite erodible.

Low flow: The lowest discharge recorded over a specified period of time.

Missouri Department of Conservation (MDC): Missouri agency charged with: protecting and managing the fish, forest, and wildlife resources of the state; serving the public and facilitating their participation in resource management activities; and providing opportunity for all citizens to use, enjoy, and learn about fish, forest, and wildlife resources.

Missouri Department of Natural Resources (MDNR): Missouri agency charged with preserving and protecting the state's natural, cultural, and energy resources and inspiring their enjoyment and responsible use for present and future generations.

Mean monthly flow: Arithmetic mean of the individual daily mean discharge of a stream for the given month.

Mean sea level (MSL): A measure of the surface of the Earth, usually represented in feet above mean sea level. MSL for conservation pool at Pomme de Terre Lake is 839 ft. MSL and Truman Lake conservation pool is 706 ft. MSL.

Necktonic: Organisms that live in the open water areas (mid and upper) of waterbodies and streams.

Non-point source: Source of pollution in which wastes are not released at a specific, identifiable point, but from numerous points that are spread out and difficult to identify and control, as compared to point sources.

National Pollution Discharge Elimination System (NPDES): Permits required under The Federal Clean Water Act authorizing point source discharges into waters of the United States in an effort to protect public health and the nation's waters.

Nutrification: Increased inputs, viewed as a pollutant, such as phosphorous or nitrogen, that fuel abnormally high organic growth in aquatic systems.

Optimal flow: Flow regime designed to maximize fishery potential.

Perennial streams: Streams fed continuously by a shallow water table an flowing year-round.

pH: Numeric value that describes the intensity of the acid or basic (alkaline) conditions of a solution. The pH scale is from 0 to 14, with the neutral point at 7.0. Values lower than 7 indicate the presence of acids and greater than 7.0 the presence of alkalis (bases).

Point source: Source of pollution that involves discharge of wastes from an identifiable point, such as a smokestack or sewage treatment plant.

Recurrence interval: The inverse probability that a certain flow will occur. It represents a mean time interval based on the distribution of flows over a period of record. A 2-year recurrence interval means that the flow event is expected, on average, once every two years.

Residuum: Unconsolidated and partially weathered mineral materials accumulated by disintegration of consolidated rock in place.

Riparian: Pertaining to, situated, or dwelling on the margin of a river or other body of water.

Riparian corridor: The parcel of land that includes the channel and an adjoining strip of the floodplain, generally considered to be 100 feet on each side of the channel.

7-day $Q^{10:}$: Lowest 7-day flow that occurs an average of every ten years.

7-day Q^{2}: Lowest 7-day flow that occurs an average of every two years.

Solum: The upper and most weathered portion of the soil profile.

Special Area Land Treatment project (SALT): Small, state funded watershed programs overseen by MDNR and administered by local Soil and Water Conservation Districts. Salt projects are implemented in an attempt to slow or stop soil erosion.

Stream Habitat Annotation Device (SHAD): Qualitative method of describing stream corridor and instream habitat using a set of selected parameters and descriptors.

Stream gradient: The change of a stream in vertical elevation per unit of horizontal distance.

Stream order: A hierarchical ordering of streams based on the degree of branching. A first order stream is an unbranched or unforked stream. Two first order streams flow together to make a second order stream; two second order streams combine to make a third order stream. Stream order is often determined from 7.5 minute topographic maps.

Substrate: The mineral and/or organic material forming the bottom of a waterway or waterbody.

Thermocline: The plane or surface of maximum rate of decrease of temperature with respect to depth in a waterbody.

Threatened: A species likely to become endangered within the foreseeable future if certain conditions continue to deteriorate.

United States Army Corps of Engineers (USCOE) and now (USACE): Federal agency under control of the Army, responsible for certain regulation of water courses, some dams, wetlands, and flood control projects.

United States Geological Survey (USGS): Federal agency charged with providing reliable information to: describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect the quality of life.

Watershed: The total land area that water runs over or under when draining to a stream, river, pond, or lake.

Waste water treatment facility (WWTF): Facilities that store and process municipal sewage, before release. These facilities are under the regulation of the Missouri Department of Natural Resources.

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