WATER QUALITY AND USE

Beneficial Use Attainment

Most permanently-flowing basin streams are suitable for: aquatic life protection and fishing, livestock and wildlife watering (MDNR 1996). However, due to the fish consumption advisory on Big River fish, MDNR classifies the lower 93 miles of Big River as not suitable for aquatic life protection and fishing or livestock and wildlife watering (J. Madras, personal communication). Lower Flat River (lead and zinc from mine waste and low dissolved oxygen and high ammonia from waste water discharge) is classified as non-attainment waters. Outside of these areas all of Big River and Sunnen Lake, and portions of Mineral Fork, Terre Bleue Creek, and Old Mines Creek are designated for whole body contact (MDNR 1986). Recreation and irrigation is approved on Big River (RM 0-52). No basin streams are designated for drinking water.

Recreational Use and Citizen Involvement

Despite its lack of statewide notoriety, Big River is a popular resource. Bachant et al. (1982) found Missourians ranked Big River fifth out of 38 major Missouri watersheds in recreational value. Bachant et al. (1982) noted that few people are familiar with Big River on a statewide basis, but local users highly value it and that many Missourians perceive Big River to be polluted (i.e. lead) and highly urbanized (i.e. club houses). A 1983-85 telephone survey found that recreational use on Big River ranked 10th out of 46 watersheds (Weithman 1987). Anglers annually spent an average of 36,602 days fishing Big River from 1983-88 (Weithman 1991). Fleener (1988) found that Missourians spent over 1.6 million hours recreating on and around Big River (including 129,000 hours fishing) in 1980. In 1996, anglers spent 13,571 hours fishing Big River from RM 40 to RM 59, with over 70% of angling effort coming from Jefferson County residents (unpublished data, K. Meneau, MDC).

Boating is popular on Big River, especially with anglers below RM 60. During 1992 and 1993, 61% of anglers fishing from RM 40 to RM 59 used a boat or canoe (unpublished data, K. Meneau, MDC). About 75% of boat anglers used outboard motors. Canoeing's popularity is demonstrated by the presence of six canoe liveries (mostly in Jefferson County) that currently serve Big River. Mineral Fork supports spring and early summer canoeing. Bank and wade fishing are popular where access is good. Bank fishing takes place at boat ramps and below mill dams. Wade fishing is popular in upper Big River (above RM 93) and tributary streams like Mineral Fork, but little public bank fishing access exists.

The STREAM TEAM program is well represented within the basin with portions of five streams being adopted by 18 TEAMs. A STREAM TEAM association was formed by Big River TEAMS, in 1996, to improve communication. Basin STREAM TEAMs are active in tree planting, water quality monitoring, and trash pick up. In 1992, STREAM TEAMs incorporated Big River into Operation Clean Stream (annual Meramec River basin trash pick-up). In 1995, Big

River STREAM TEAMs removed 6,180 pounds of trash and 1,033 tires during Operation Clean Stream (J. Wacker, personal communication).

In 1995, a 30-minute film documenting Big River's lead pollution problems was produced by two TEAMs. This was the second film made by these TEAMs to educate and urge action on Big River lead issues.

In 1998, Big River TEAMs constructed 1.5-miles of trails along Big River in Washington State Park (B. Stewart, personal communication). These included spur trails to gravel bars to improve fishing access.

Water Quality

Water chemistry and benthos samples indicate that Big River basin streams generally have good water quality (Missouri Water Pollution Board 1964; Ryck 1973; Miller et al. 1974; Mills et al.1978; MDC 1995d). Data collected from USGS gaging stations also indicate good water quality (Appendix 5). However, some localized problems exist. About eight miles of basin streams are chronically impacted (excessive algal growth, low oxygen, odor) by discharges from sewage treatment facilities (MDNR 1994a). Ryck (1974a) found depressed aquatic invertebrate populations and listed 1.5 miles of Spring Branch (near Bonne Terre) as seriously polluted from municipal sewage effluent. Recent facility upgrades have greatly reduced these impacts (MDNR 1994a).

In addition to affecting aquatic habitat, mine waste affects the water quality of some basin streams. Ryck (1974b) categorized 10.5 miles of Mill Creek and four miles of Flat River as seriously polluted from mine waste and listed four other basin streams that were affected. Kramer (1976) found elevated levels of lead, zinc, cadmium, and copper in Flat River water. Zachritz (1978) and Czarnezki (1987) found elevated lead and zinc concentrations in Big River water samples taken below the Leadwood and Desloge tailings piles and the confluence of Flat River. Schmitt and Finger (1982) found elevated copper, iron, lead, and zinc levels in Big River, especially during periods of high flow. They felt the majority of copper, lead, and iron was tied to sediment movement, while zinc was transported in liquid form. USGS has detected copper, iron, lead, and zinc from samples of Big River (Richwoods) water (Appendix 5). However, copper, iron, and lead levels were below those observed by Schmitt and Finger (1982) and Missouri State Water Quality Standards (MDNR 1994).

Cattle watering is a common practice in basin streams, though not intensive enough to present significant problems. Cattle activity increases organic pollution, bank erosion and subsequent sedimentation within the basin. Also, trampling and grazing by cattle destroys riparian vegetation.

Fish Kills, Contaminant Levels, and Consumption Advisories

Fishkill data (Table 6) indicate localized, but recurring problems with livestock manure and liquid fertilizer spills, as well as lead and barite mine waste erosion (MDC 1995a). Since 1966,

20 fishkills have involved releases of livestock manure from farms or liquid fertilizer leaks from the Williams Brothers pipeline in Jefferson County. The worst documented event occurred in Calico Creek (Washington County) on 9/6/77, when an ammonium nitrate (liquid fertilizer) pipeline leaked, killing 62,589 fish.

Lead and barite mine waste releases have negatively affected the biota of many basin streams. Some mine waste releases occur daily; 16 major releases have been documented since 1966. Fishkills have occurred with many of these. Depression or extirpation of invertebrate populations and loss of habitat have also occurred (Ryck 1974; Duchrow 1976; Kramer 1976; Zachritz 1978; Buchanan 1980; Jennett et al. 1981; MDNR 1984).

In 1975, a barite pond dam failed near Blackwell, sending an undetermined amount of clay into Mill Creek and causing an extensive fishkill in the 11.5 miles of Mill Creek and Big River immediately below the dam (Duchrow 1976). The red-colored runoff increased turbidity of Big River for 73 miles to its confluence with the Meramec River and depressed invertebrate populations for up to 264 days in Mill Creek.

Though the most dramatic results of mine waste releases are felt locally, the effects are often seen far downstream. Elevated lead levels have been found in fish (Kramer 1976; Czarnezki 1985; Schmitt and Finger 1982; Missouri Department of Health 1999), mussels (Schmitt and Finger 1982; Czarnezki 1987), plants, and crayfish (Schmitt and Finger 1982) up to 75 miles downstream from mine waste releases.

Lead concentrations in Big River fish have been monitored since 1979 (Table 7). Lead levels in fish tissue were high enough (≥ 300 ppb) to issue a consumption advisory against eating carp, redhorse, and suckers from Desloge to Washington State Park in 1980 (Missouri Department of Health 1999). In 1992, the advisory was updated to include catfish and the remaining 58 miles of Big River (93 miles total) to the Meramec River. Re-analysis of the data caused catfish to be removed from the advisory in 1993. Sunfish (longear, green, and bluegill) were added to the advisory in 1994. Subsequent testing (unpublished data, K, Meneau, MDC) showed Big River black bass (spotted, smallmouth, and largemouth bass), rock bass, and catfish lead levels to be safe for human consumption. Mill Creek bleeding shiners and rainbow darters showed high lead levels in 1996 tests, but sunfish suckers, and rock bass levels were well below Federal standards (unpublished data, K. Meneau, MDC).

The fish consumption advisory prevents beneficial use classification of aquatic life from MDNR, negatively affects some anglers' fishing enjoyment, and causes some Missourians to doubt Big River's value. This advisory is likely to continue as lead-ladened sediment (from previous mine waste releases) continues its way through Big River.

Water Use

Only one public water supply withdrawal (Jefferson County PWSD No. 2 on Big River, RM 8) uses significant amounts (0.75 million gallons/day) of basin surface water (MDNR 1984 and 1986). Additionally, 10 wells with a maximum pumping capacity of 24.5 million gallons/day operate within the basin (MDNR 1994a).

Point Source Pollution

The basin contains 102 point sources of pollution (Figure ps), including five stormwater sources from landfills and quarries and 16 mining sources (MDNR 1994a).

About eight miles of basin streams are impacted (excessive algal growth, low oxygen, odor) by discharges from municipal sewage facilities (primarily lagoons). There are no permitted discharges of heavy metals or toxic organic materials.

Non-point Source Pollution

The Big River basin receives non-point source pollution from 65 documented sites, mainly runoff from intensive poultry farms or mines which affect 188 miles of basin streams. Mining (mostly near Big River) is responsible for 98% of the basin's non-point source pollution, primarily sediment influx (MDNR 1994a).

Chat and tailings piles are difficult to stabilize and subject to wind and water erosion. At times, this erosion can be very serious. The worst case happened in 1977, when a lead tailings pile near Desloge (RM 105.6) collapsed and discharged about 50,000 cubic yards of tailings into Big River. Runoff and erosion from barite processing ponds and dams affect nine basin streams, but this could be corrected by enlarging and rock lining emergency spillways and stabilizing dams (MDNR 1994a).

Sediment and water samples showed negative effects of mining activity. Zachritz (1978) and Czarnezki (1987) found high lead and zinc concentrations in Big River sediment and water samples. Elevated zinc, sulfate, cobalt, lead, and nickel were found in Big and Flat river water and sediment (MDNR 1994a). Kramer (1976) found elevated levels of lead, zinc, cadmium, and copper levels in Flat River sediment, water, and biota (minnows and crayfish). In 1980, due to sedimentation from mine waste, 15 miles of Big River (from Desloge to Bonne Terre) was the only segment in the entire Meramec River system found to be devoid of mussels (MDNR 1984).

Sheet erosion on watershed lands is responsible for about 3 tons of eroded soil/acre/year (Anderson 1980). Gully erosion is considered moderate, 0.16-0.32 tons of soil/acre/year (Anderson 1980). Runoff from sheet, gully, streambank, and urban erosion contribute 77%, 15%, 3%, and 3% of annual streams sediment yield, respectively (Anderson 1980). Localized erosion (especially around tailings and chat piles) has greatly reduced the quality of some aquatic habitat.

Livestock is not heavily concentrated within the basin (MDNR 1984). The total number of hogs and cattle in the basin was estimated to be equal to 512,100 PE (human population equivalents). However, during summer, cattle spend much time near or in streams, which results in increased organic and bacterial loads, bank erosion, turbidity, trampling of the riparian corridor, and locally-high concentrations of algae. Though not a basin-wide problem, livestock activity has decreased the quality of some local habitat.

In 1983, 15 confined animal farming operations (mostly poultry) generated about 42,100 PE of waste, which were stored in "no discharge" lagoons (MDNR 1984). In 1994, MDNR (1994a) listed 18 operations existed within the basin.

Appendix 5. Water quality data for Big River basin streams taken from USGS gaging stations (USGS,1993).

<u>Station</u>	<u>Parameter</u>	Sample Size	<u>Max</u>	<u>Min</u>	<u>Mean</u>
RICHWOODS at Big River (1986 to present)	Specific conductance (us/cm)	51	598	194	419
	рН	51	8.5	7.3	8.0
	Oxygen, dissolved (mg/l)	44	17.0	5.6	10.0
	COD (mg/l)	42	126	63	91
	Fecal coliform (c/100ml)	43	5500	1	412
	Total hardness (mg/l)	22	310	170	247
	NO2+NO3, total (mg/l)	43	0.9		0.3
	Nitrogen, ammonia (mg/l)	42	0.11		0.03
	Phosphorus, total (mg/l)	43	0.18	0.01	0.04
	Copper, total (ug/l)	22	4.0		2.0
	Copper, dissolved (ug/l)	10	6.0	1	2.7
	Iron, total (ug/l)	15	790	30	255
	Iron, dissolved (ug/l)	10	100	4	23
	Lead, total (ug/l)	15	89	8	31
	Lead, dissolved (ug/l)	32	9.0		3.7

Appendix 5 continued

	Zinc, dissolved (ug/l)	10	47	4	20
IRONDALE at Big River (1986)	Specific conductance (us/cm)	7	378	245	305
	pН	7	8.1	6.3	7.5
	Hardness, total (mg/l)	7	210	130	167
	Alkalinity (mg/l)	7	209	109	152
	Copper, dissolved (ug/l)	7			
	Iron, dissolved (ug/l)	7	12.0	4.0	7.4
	Lead dissolved , (ug/l)	7			
St. Francois State Park at Coonville Creek (1992 to present)	Specific conductance (us/cm)	6	420	155	344
	pН	6	8.1	7.3	7.9
	Oxygen , dissolved	6	13.8	8.4	10.9
	COD (mg/l)	6	36		<10
	Fecal coliform (c/100ml)	6	3600	34	861
	Hardness, total (mg.l)	3	270	190	233
	NO2+NO3, total (mg/l)	6	0.13	0.04	0.07
	Nitrogen, ammonia (mg/l)	6	0.03	<0.01	0.02
	Phosphorus, total (mg/l)	6	0.04	<0.01	0.02
	Copper, total (ug/l)	3	1.0	<1.0	<1.0
	Copper, dissolved (ug/l)	7	1.0	1.0	1.0
	Iron, total (ug/l)	3	39	7	20
	Iron, dissloved (ug/l)	7	93	7	26
	Lead, total (ug/l)	3	27	5	15
	Lead, dissolved (ug/l)	3	3.0	3.0	3.0
	Zinc, dissolved (ug/l)	7	110	70	93

--below detection

Table 6. Fishkills reported in the Big River basin, 1966-94 (MDC 1995a).

	No. of Fish Est.				
<u>Date</u>	<u>Stream</u>	<u>County</u>	<u>Killed</u>	<u>Value</u>	<u>Cause/Source</u>
8-7-66	Big River	St. Francois	NA	NA	Gravel Washing/A. M. Mount Gravel
6-8-68	Mill Cr.	Washington	U	U	Diesel Fuel/Buckman Labs
5-5-70	Belew Cr.	Jefferson	U	U	Hog Lagoon
8-28-70	Mill Cr.	Washington	200	U	Farm/Hog Manure Lollar
3-10-71	Fountain Farm Cr.	Washington	NA	NA	Turbid water/Dresser Minerals
5-24-71	Flat River	St. Francois	NA	NA	Sewage/Bismark STP
5-25-71	Fountain Farm Cr.	Washington	NA	NA	Turbid water/Pfizer & Co.
7-13-71	Mine a Breton Cr.	Washington	U	U	Road Oil/County Hwy. Dept
9-28-71	Mineral Fork Cr.	Washington	NA	NA	Gravel Washing/ Concrete Aggregate
4-30-72	Reid Cr.	Iron	NA	NA	Acid Spill/Truck Accident
8-8-72	Big River	Washington	NA	NA	Gravel Washing/Mount S&G Co.
3-25-74	Bass Cr.	Washington	U	U	Fuel oil/St. Joe Lead Co.
12-11-74	Big River Trib.	Jefferson	NA	NA	Turbid Discharge/ Dresser Minerals
2-6-75	Flat River	St. Francois	NA	NA	Sewage Solids/Flat River STP
3-2-75	Mine a Breton Cr.	Washington	2,230	195.00+	Fuel Oil/Purcell Tire
8-15-75	Mill Cr.	Washington	U	U	Tailings Discharge/ Dresser Min
8-15-75	Big River	Washington	824+	U	Tailings Discharge/ Dresser Min.
8-18-76	Big River	St. Francois	NA	NA	Tailings/Valley Mineral
10-29-76	Mine a Breton Cr.	Washington	7,988	742.40	Gasoline/Transport Del. Co.

Table 6 continued

8-5-77	Big River	St. Francois	NA	NA	Lead Tailings/City of Desloge
9-6-77	Calico Cr.	Jefferson	62,589	5790.00	Ammonium Nitrate/ Williams Pipe
5-18-78	Terre Bl. Trib.	St. Francois	NA	NA	Chicken Manure/ Gremminger Farm
7-26-78	Big River	St. Francois	7,820	3390.00	Unknown
9-14-78	Keesling Cr.	Iron	10,904	1207.00	Chicken Manure/ Atchison Farm
4-10-79	Trib. Cedar Cr.	Iron	320	30.00	Chicken Manure
7-3-79	Dry Cr.	St. Francois	NA	NA	Chicken Manure/ Thompson Farm
11-27-79	Old Mines Cr.	Washington	NA	NA	Barite Tailings/General Barite
1-12-80	Big River	Jefferson	NA	NA	Dresser Plant/Leak-Red Clay
5-22-80	Cedar Cr.	Washington	NA	NA	Red Paint/MO Hwy. Dept
7-17-80	Terre Bl. Trib.	St. Francois	9,520	992.99	Chicken Manure/ Gremminger Farm
2-15-82	Mine a Breton	Washington	NA	NA	Gasoline/Hoskcer Oil
	Cr.				
2-23-82	Shaw Branch	St. Francois	NA	NA	Lead Tailings/St. Joe SP
3-12-82	Mine a Breton Cr.	Washington	NA	NA	Oil & Trans. Fluid/Borer Auto
4-24-82	Heads Cr.	Jefferson	NA	NA	Asphalt/Pruitt & Campbell
5-28-82	Big River	Jefferson	NA	NA	Barite Tailings/Dresser Minerals
7-3-82	Big River	St. Francois	1,150	990.50	Unknown
7-31-82	Turkey Cr.	St. Francois	104	76.06	Sewage/Bonne Terre STP
8-13-82	Cedar Cr.	Iron	578	82.56	Chicken Manure/Byerley Farm
10-30-82	Hazel Run Cr.	St. Francois	1,062	121.20	Chicken Manure/Yeager Farm
2-9-83	Cedar Cr.	Iron	NA	NA	Chicken Manure/Byerley Farm

Table 6 continued

7-12-83	Pond Cr.	Washington	U	U	Red Clay/IMCO Services
8-25-83	Mine a Breton Cr.	Washington	2,397	157.31	Diesel Fuel/Purcell Tire
3-11-84	Coonville Cr.	St. Francois	NA	NA	Oil/Bonne Terre Sunoco
5-3-84	Turkey Cr.	St. Francois	NA	NA	Sewage/Bonne Terre STP
10-5-84	Small Cr.	Washington	NA	NA	Hog Manure/Jim Dicus Farm
3-8-85	Cedar Cr.	Iron	NA	NA	Chicken Manure/Byerley Farm
4-5-85	Big River	St. Francois	NA	NA	Lead Tailings/St. Joe Minerals
8-13-85	Wallen Cr.	Washington	33,642	3815.00	Chicken Manure/Silvey Farm
9-6-85	Big River	Washington	NA	NA	Dredging Silt/Politte Ready Mix
10-7-85	Ditch Trib. to Big River	Jefferson	NA	NA	Diesel Fuel/U-Gas Station
1-3-86	Dry Cr.	St. Francois	NA	NA	Chicken Manure/Unknown
1-16-86	Terre Bl. Trib.	St. Francois	100	U	Chicken Manure/Robert Hoehn Farm
2-4-86	Big River	Jefferson	NA	NA	Lqd. Fertilizer/Williams Bros
3-3-86	Trib Big River	Jefferson	NA	NA	Fuel Oil/Speigel Oil Co.
3-18-86	Terre Bl. Trib.	St. Francois	300	U	Chicken Manure/Robert Hoehn Farm
5-7-86	Big River	St. Francois	NA	NA	Sewage Sludge/Bonne Terre STP
11-15-86	Cadet Cr.	Washington	NA	NA	Indust. Chemicals/ Buckman Labs
7-6-87	Big River	St. Francois	NA	NA	Lead Tailings/St. Joe Minerals
3-30-88	Big River	St. Francois	NA	NA	Lead Tailings/St. Joe Minerals
6-24-89	Mine a Breton Cr.	Washington	NA	NA	Gasoline Pump Handle
6-30-89	Skullbones Cr.	Jefferson	NA	NA	Waste Oil/Jeff. Co. Hwy. Dept.
8-16-89	Shaw Branch	St. Francois	NA	NA	Lead Tailings MHTD

Table 6 continued

4-24-90	Flat River	St. Francois	211	21.53	Sewage/Flat River STP
5-2-90	Mine a Breton Cr.	Washington	NA	NA	Hydraulic Fluid/Purcell Tire
7-25-90	Turkey Cr.	St. Francois	NA	NA	Sodium Fluorocein Dye
12-1-90	Big River	Jefferson	NA	NA	Suspended Sed./ Norman Goad
3-14-91	Big River	St. Francois	1	0.08	Hydraulic Fluid/Resco Products
4-25-91	Mill Cr. Trib	Washington	NA	NA	Chicken Manure/Silvey Farm
5-19-91	Trib Terre BI	St. Francois	8,919	1438.00	Chicken Manure/Robert Hoehn Farm
11-29-93	Big River	St. Francois	NA	NA	Lead Tailings/St. Joe Minerals
3-10-94	Mine a Breton Cr.	Washington	NA	NA	Gasoline/Wallis Oil Company
3-14-94	Mine a Breton Cr.	Washington	374	33.62	Gasoline/CooperOil Company
6-9-94	Big River	Washington	NA	NA	Land Clearing/Richard Dix
8-1-94	Big River	Washington	NA	NA	Diesel/Politte Ready Mix
	Total Number of Fish Killed		151,233+		
	Total Estimated Value		\$19,083.25+		

U - Undetermined

NA - Not available

Table 7. Lead levels in fish from Big River, MDC Mammoth Access, Jefferson County, 1979-1994 (unpublished data, J. Czarnezki, MDC).

<u>Species</u>	<u>Lead Level (ppb)</u>	<u>Year</u>
Redhorse species	450	1994
	670	1993
	550	1992
	870	1991
	400	1990
	43	1987
	440	1986
	280	1984
	320	1983
	270	1982
	415	1980
	395	1979
Channel catfish	74	1994
	51	1993
	150	1992
	160	1991
	66	1990
	225	1980
	216	1979
Flathead catfish	30	1992
	1700	1993
Sunfish species	340	1994
	440	1987
	170	1986

Table 7 continued

	180	1980
	174	1979
Rock bass	360	1994
Largemouth bass	160	1994
Smallmouth bass	40	1987
	91	1986
	150	1980
	138	1979
Carp	440	1991
	380	1987
	370	1986
-	520	1980

^{*} FDA action level = 300 parts per billion

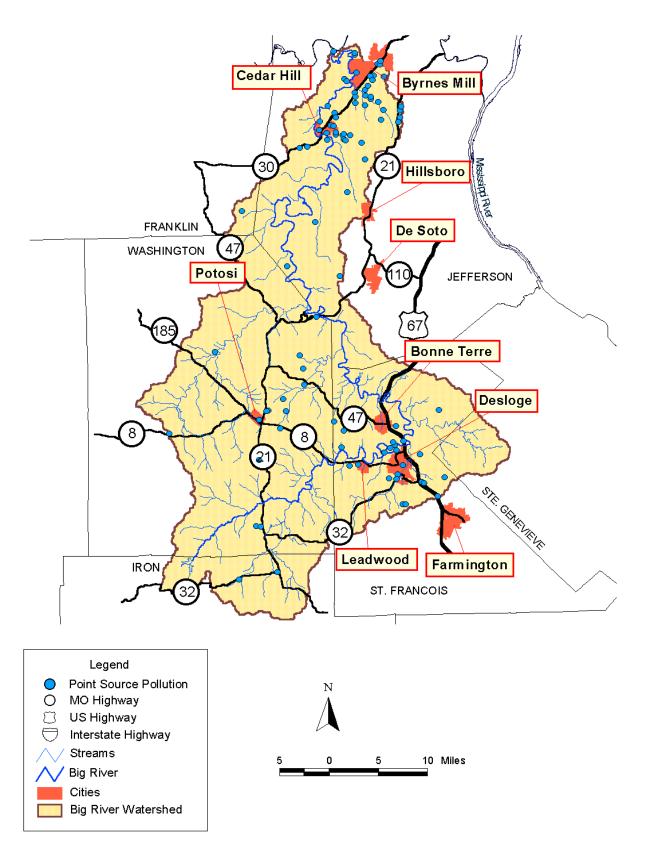


Figure ps. Point source pollution sites in the Big River basin, Missouri.