WATER QUALITY

D.

D.1. BENEFICIAL USE ATTAINMENT

In a statewide survey conducted by resource management professionals, river basins were ranked in terms of intensive recreational use, bank or shoreline development, sand and gravel dredging, pollution, poor land use, intensive agricultural use, environmental intrusions, channels modification, and water withdrawals. The cumulative ranking of all categories ranked the Meramec River basin as second out of thirty-eight rivers in Missouri (Bachant et al. 1992). On a scale of 1-10 (10 being the highest), the recreational value was 9.2. Professional staff of resource management agencies ranked intensive recreational use, bank or shoreline development, and sand and gravel dredging as the top three problems facing the basin. As a result, survey participants expect the river to drop one rank in recreational worth in the future.

D.1.1 Beneficial Uses

According to MDNR Water Quality Standards, all streams within the basin are designated for aquatic life protection, fishing, and livestock and wildlife watering. From the mouth of Big River to Meramec State Park, residents use the Meramec River for drinking water supply and industrial uses. Drinking water is considered adequate and only small amounts of toxins remain after treatment. Whole-body contact recreation and boating use are designated on the Meramec River, Huzzah, and Courtois Creek systems. Also, coldwater sport fishing can be found in areas on the Meramec River (Highway 8 to Scott's Ford) and in Dry Creek (MDNR 1984).

The basin is ranked first out of thirty-six watersheds surveyed (332,224 fishing trips) in a statewide fishing pressure survey (Hanson 1980). In a 1979 survey, 8.5% of the visits and 5% of the total recreational-use hours were angling (pole-and-line method) in four sections: the upper segment of the Meramec River, Indian Creek to Highway 185, the lower 13 miles of the Huzzah Creek, and the lower 15 miles of the Courtois Creek (Fleener 1988). Gigging use was also high. Two thousand eight hundred giggers harvested more than 9,900 fish. In a 1980-81 survey of the 117-mile lower Meramec River segment, pole-and-line fishing made up 15% of the visits. Catch rates were 0.38 fish per hour (Fleener 1988). More recently, in a 1988 telephone survey, angler effort (days fished) was 158,522 (Weithman 1991).

D.1.2. Threats to Beneficial Uses

Current threats to beneficial uses are excessive discharge from sewage treatment plants, cattle in streams, and dioxin and chlordane levels in sport fish. Short segments of stream near sewage treatment plants at Rolla (1993) and Salem have experienced episodes of low dissolved oxygen (MNDR 1984, 1994). Improperly maintained septic systems in the upper and middle basin have been a concern. The upper river and tributary areas experience continued problems with livestock in streams, causing localized water quality problems.

Gravel mining by large operations causes turbidity and reduction of quality aquatic habitat on reaches of the lower Meramec River. Numerous active gravel mining sites throughout the basin contribute to the accelerated transport of sediments. Permits are issued by the Army Corps of Engineers to ensure water quality, some protection of instream habitat, and to document the absence of federally threatened and endangered species.

In the upper stream segments of the basin, a threat to attainment of beneficial uses is the failure of lead or iron tailings pond dams (MDNR 1984). A number of mines in the Washington County area that affect tributaries to the Meramec River are of concern. Failure of these tailings pond dams has the potential to cause heavy metal contamination of stream waters and sediments. In the event of contamination, severe reduction in quality of aquatic habitats from sediment deposition exists. At present, dams are inspected frequently, and a dam failure is rare. Finally, in the lower segment of the Meramec River, another threat to attainment of uses would be several point and non-point discharges (see Section D5 and D6; MDNR 1984).

D.2. WATER QUALITY

Overall, the streams in the Meramec River basin have well-sustained base flows during dry periods, except the Dry Fork watershed, which has subsurface flows (MDNR 1984). Below Maramec Spring, base flows are well sustained due to springs and major tributaries such as Huzzah Creek, Bourbeuse River, and Big River.

The lower basin in Jefferson and St. Louis counties has a very large and concentrated number of point-source discharges (MDNR 1984). Water quality violations are not apparent in the lower main stem of the Meramec River, except during extremely low-flow conditions where point-source discharges from domestic sources overload the system.

Water quality in the lower Meramec River has improved greatly in the last 20 years. In a 1964 survey, water quality of the lower Meramec River was high (Ryck 1971). The river was relatively unaffected by man's activities as there were no recommended limitations on whole-body contact. Only a few years later, however, a 1971 survey conducted in St. Louis County by the Missouri Department of Conservation (MDC) identified Meramec River water quality as at risk. MDC identified domestic sewage as the source of much of the degradation of the lower Meramec River and its tributaries. At that point, MDC considered the river moderately polluted.

In contrast to land use in the lower Meramec River watershed, upper and middle Meramec River watersheds are primarily used for agriculture. This area is thought to be responsible for the majority of the nutrient loading in the Meramec River (MDNR 1985). Cattle frequent riparian areas and stream channels areas for food and water, often leaving behind their wastes. In addition, between $1,000 and $2,000 of chemical fertilizers per year per farm are used in some counties (MASS 1995).

D.2.1. Springs

The Meramec River basin has many moderately mineralized springs (Figure 13). Calcium, magnesium, and bicarbonate are the predominant dissolved components, but sulfate and chlorine comprise a significant portion of the dissolved solids in the water. Dissolved solids range from 116-338 mg/l (Vineyard and Feder 1982). Spring Creek in the Dry Fork watershed and the middle portion of the Upper Meramec River watershed have the highest number of springs (Figure 13).

Thirteen springs with flow rates greater than two million gallons per day (mgd) are found in the Meramec River basin. Crawford, Phelps, Jefferson, Dent, Franklin, and Washington counties have the springs with the largest flow rates. Flow rates, representing records ranging from 1924-72, are found in Vineyard and Feder (1982).

Located in Phelps County, Maramec Spring (the spelling, *Maramac*, is of Indian origin) is the largest spring in the Meramec Basin and the seventh largest in Missouri. The average flow is 93 mgd (Vineyard and Feder 1982). Industrious individuals used Maramec Spring as a water power source for iron production in the 1800s. Today, the ironworks are part of Maramec Spring Park, which is owned by The James Foundation of New York and open to the public. MDC, in cooperation with The James Foundation, manages a trout hatchery at Maramec Spring, which is one of four trout parks in Missouri. Six major springs, Evans, James, Roaring, Westover, and unnamed spring, are located in Crawford County. The largest of these is Westover Spring, producing water at approximately 8.2 mgd. Finally, four springs that arise on private land, known as Blue Springs, have a combined flow estimated to be 4.5 mgd. These springs feed Blue Springs Creek. This part of Blue Springs Creek, near Highway N south of Bourbon, is a wild rainbow trout management zone contained partially within the Blue Springs Creek Conservation Area.

D.2.2. Chemical Composition of Stream

The Meramec River is monitored by 53 STREAM TEAMs, groups, teachers, schools, and/or individuals. The Missouri STREAM TEAM is a joint venture between the Conservation Federation of Missouri, a National Wildlife Federation affiliate, the Missouri Department of Conservation, and Missouri Department of Natural Resources. A Governor's Proclamation in February 1989 inaugurated the STREAM TEAM program (Lee and Ely 1990). Some STREAM TEAM groups are involved in water quality monitoring. They collect information on water color, odor, and clarity. Other parameters collected are temperature, dissolved oxygen, pH, nitrates and ammonia, total dissolved solids (TDS), phosphate, zinc, lead, fecal coliform, and stream flow.

To aid Stream Teams, selected water quality parameters (USGS 1995) for the Meramec River basin at the Paulina Hills, Jefferson County, USGS gage station are compared with Missouri State Water Quality 1995 Standards within designated uses I, II, VI, and VII (Table 11). This station is strongly influenced by the urban environment and may not represent average conditions in the basin.

D.3. FISH KILLS, CONTAMINATION LEVELS, AND HEALTH ADVISORIES

D.3.1. Fish Kills

Stream fish kills in the basin have not been excessive, but two fish kill investigations have been costly to the resource and the responsible party. An improper application of termite pesticide to a building in Steelville caused an estimated $7,355.62 of resource damage in Yadkin and Whittenburg creeks on March 21, 1994 (Duchrow 1995b). Investigations revealed 76,986 fish were destroyed in 3.7 miles of the two streams. In another incident within the basin, a fish kill occurred sometime before August 9, 1995, as reported by an unidentified angler, on a 1,075-foot stretch of Blue Springs Creek Wild Trout Management Area. The fish died from suffocation induced by clogged fish gills from fine sediment, released from a culvert replacement project at the Highway N crossing of Blue Springs Creek. The release of unwashed limestone and fresh concrete raised the pH of the water that injured fish gills, thus contributing to fish deaths. An estimated 2,775 fish were killed, including 65 wild trout (Czarnezki

1995). Enforcement settlement totaled $7,516.38, which included a civil penalty of $5,250.00 (Duchrow 1997).

D.3.2. Contamination Levels

Since the early 1980s, MDC has conducted contaminant surveys on fish and mussels. Few people eat freshwater mussels; however, freshwater mussels are better indicators of heavy metal contamination than fish. At some locations, mussels have as much as 1,000 times more lead than edible tissue fish samples from the same locations. Fish are better indicators than mussels of chlorinated hydrocarbons, such as chlordane. Based on fish sampling and analysis performed by the Missouri Department of Conservation, the Missouri Department of Health issues annual health advisories regarding the safety of eating fish harvested from Missouri streams and impoundments.

From 1980-83, MDC analyzed freshwater mussels for lead and cadmium concentrations, finding low lead levels in the Highway W (Jefferson County) to Steelville portion but high lead levels (below the Big River) at Times Beach. Four of the five sampled sites exceeded FDA action levels for lead. For many years, landowners used chlordane for termite and general insect pest control until it was banned in 1988. This allowed chlordane, a known carcinogen, to enter the river via storm water runoff. Consequently, in the late 1980s, Missouri Department of Conservation researchers found chlordane in fish tissue in the lower 22 miles of the Meramec River (MDC 1995). Because chlordane in fish exceeds Food and Drug Administration (FDA) action levels (see below), consumption of fish is not recommended in the lower 22 miles of the Meramec River.

River conditions have greatly improved since the 1980s. Missouri Department of Conservation personnel found lower levels of chlordane, metals (ppb/l), and PCBs in fish during 1994 (Buchanan 1995). FDA and the World Health Organization (WHO) had identified action levels for chlordane as 300 ppb/l, ITOT (sum of the chlordane isomers) as 100 ppb/l, lead as 300 ppb/l, cadmium as not determined, mercury as 1,000 ppb/l, and PCBs as 1,000 ppb/l. Fish contaminant tests performed in 1994 on spotted bass in Meramec River, Winter Park, St. Louis County identified respectively, 55 ppb/l lead, < 0.6 ppb/l cadmium, and 240 ppb/l mercury. Because of the relatively low statewide mercury levels in predators such as spotted bass, Missouri Department of Conservation biologists ceased predator sampling in 1995. Contaminant tests done at the same location on carp were 103 ppb/l chlordane, 28 ppb/l ITOT, 77 ppb/l lead, 5.5 ppb/l cadmium, 77 ppb/l mercury, and 126 ppb/l PCBs (Buchanan 1995).

In July 2001, the Missouri Department of Health issued a fish consumption advisory that incorporated the U.S. Environmental Protection Agency recommendation that lowered the action level for methylmercury to 300ppb in fish tissue to protect the health of consumers of noncommercial freshwater fish. The statewide advisory recommends that women who are pregnant, who may become pregnant, nursing mothers, and children 12 years of age or younger should not eat largemouth bass more than 12 inches in length. The Missouri Department of Conservation will be sampling and analyzing black bass as well as other predator species to determine the concentration of methylmercury in their flesh (Low 2001).

D.4. WATER USE

Water use refers to water used for any purpose (MDNR 1986). Water withdrawals refer to the straight employment of surface water and groundwater taken from its natural location. According to the MDNR Water Quality Atlas, in the lower Meramec River, municipal and industrial facilities are the highest

water consumers. No water withdrawals, as defined by the MDNR Basin Plan (1984), affect the upper Meramec River.

Water withdrawals, as defined by the MDNR (1984), affect the lower Meramec River. Maximum surface water withdrawal rates in two of the three public water supplies could significantly reduce water levels in the lower portions of the Meramec River. The South Water Treatment Plant (WTP) and the Meramec WTP, in St. Louis County, remove an average of 20.63 and 10.39 mgd, respectively . A lesser facility in Kirkwood removes 4.5 mgd (MDNR 1984, 1995a).

D.5. POINT SOURCE POLLUTION

Significant point-source water quality problems exist in southern St. Louis County and northern Jefferson County. Sewage treatment plant upgrading, elimination, and consolidation have been a top priority of the Missouri Department of Natural Resources Water Pollution Control Program for many years. A number of smaller inefficient treatment facilities were replaced by larger, less-polluting systems. The MDNR and local municipalities have progressed to create sub-regional treatment facilities to discharge directly in the Meramec River (Table 12). Within the lower Meramec River, the Northeast Public Sewer District in northern Jefferson County is an area of concern because of numerous small treatment systems and the local geology.

Areas from southern Jefferson to Phelps counties have several permitted discharges that are being managed to eliminate potential problems. Lead mine discharges in this area have the potential to affect receiving streams. The discharge from Viburnum Lead Mines No. 28, 29 and 35 has heavy metals and nutrients that may cause algae blooms. In addition, the AMAX Lead smelter discharges heavy metals. These non-municipal permitted discharges have settling ponds or tailings ponds. Management of these areas includes annual dam safety inspections. Latest surveys of these discharges indicate no problems with elevated levels of heavy metals (MDNR 1984, 1995a).

Seventy-five wastewater discharge facilities from the Lower Middle Meramec Watershed to the Upper Meramec River Watershed discharge from 0.1 to 10 million gallons of water per day. Grand Glaize and Fenton STP discharge directly or into a tributary to the Meramec, and water quality is good in this area (MDNR 1995a). Several wastewater facilities in the upper basin have the potential to affect water quality during low flow periods (Table 16). Steelville STP has a large discharge to Whittenburg Creek, affecting 0.1 miles of losing stream. These potential impacts can vary depending upon the extent of the facility malfunction and flow conditions. Low flow surveys were conducted in 1994 and planned for 1999 (MDNR 1995a).

D.5.1. Concentrated Animal Feedlots

As a result of the May 15, 1996, Missouri Clean Water Commission public meeting, amendments have been made to the Missouri Water Quality State Code that impact concentrated feedlot operations larger than 1,000 animal units (MDNR 1996). Sensitive areas as defined by the MDNR--watersheds of outstanding state water resources (Table E of 1996 Missouri Water Quality Standards) and watersheds of public drinking water (Table G of 1996 Missouri Water Quality Standards)--are excluded from permit consideration. Presently, only two poultry operations with nearly 30,000 animal units are found within the Meramec River basin.

D.6. NONPOINT SOURCE POLLUTION

Non-point source pollution comes from many sources in the Meramec River basin. Chlordane leaches into storm water runoff in urban areas. In addition, waste oil can cause elevated levels of dioxin in fish. Within the last 40-50 years, particularly following the construction of Interstate 44, an increasing amount of impervious surfaces has allowed more household and automobile wastes to wash into the river. Areas from southern Jefferson to Phelps counties are wooded and sparsely populated, thus non-point source pollution is small and considered as no effect. The Courtois and Huzzah watersheds in the upper end of the Meramec Basin have lead mines with tailings ponds that the MDNR monitors as point sources, having the potential to become non-point sources (Table 13). Numerous active gravel mining sites throughout the basin contribute to the accelerated transport of sediments. In Franklin County, Meramec Aggregates affects 0.2 miles of the Meramec River, while in Jefferson County, the Winter Bros. Sand and Gravel dredge in the floodplain of the river.

Significant non-point source water quality challenges exist in southern St. Louis and northern Jefferson counties (MDNR 1984, 1995a). Runoff from construction of roads, homes and businesses, and parking lots continue to affect stream habitats (MDNR 1995a). In addition, releases of toxic chemicals from landfills affect water supplies and fish. To compound the problem, losing streams in northern Jefferson County have affected groundwater. For example, tetra- and trichloroethylene (TCE), known carcinogens, already have contaminated the Meramec River alluvial aquifer at Valley Park and Kirkwood. The source is a dump at 3rd Street and Benton Street in Valley Park (MDNR 1995a).

Several other sites in St. Louis and Jefferson counties have dioxin-contaminated soils (Table 14). Times Beach is Missouri’s most well known dioxin site. The area became contaminated in 1971 when dioxin-contaminated oil was sprayed on the streets to control dust. In 1983, the federal government bought the land that is now owned by the Missouri Department of Natural Resources. The U.S. Environmental Protection Agency released a study in 1986 that recommended thermal treatment to destroy the dioxin. Subsequently, the MDNR began water monitoring in the Meramec River and soil sampling around Times Beach. They also installed wells to monitor the groundwater. Demolition of abandoned buildings took place after checking them for hazardous wastes. In October 1994, remediation of the contaminated streets was completed. In September 1995, an incinerator was constructed on site (Silver 1995). After EPA, MDNR, and health agencies reviewed results from the trial burn, the production burn began in February 1996 and was completed a year later.

Table 11. Selected water quality data for the Meramec River basin at Lat. 38 27'46", Long 90 24'53", Paulina Hills, Jefferson County, Hydrologic Unit #07140102, Gage station #07019280 for water years 1964, 1973, 1983, 1994 (USGS 1995; MDNR 1994, Code of Regulations 10 CSR 20.7).

Parameter	State Standard of Uses				Water Year			
	I	III	VI	VII	1964	1973	1983	1994
Water Temperature (ºC)	32.2º Max[1] 28.9º Max[2]				1-29.0	0-28.5	0.5-31	1.5-29.5
Turbidity (mg/l)	*Contaminants should cause turbidity difference from natural appearance.				5-460	--	--	--
Specific Conductance (us/cm)	---	--	--	--	225-485	212-430	260-418	283-471
O_2, Dissolved (mg/l)	5[1],6[2]	--	--	--	4.9-15.3	6.0-10.7	5.2-14	6.8-14.2
pH	*H_2O contaminants should not cause pH fall out of 6.5-9.0 range.				7.9-8.6	7.6-8.3	7.8-8.3	7.5-8.4
Hardness, Total (mg/l $CaCO_3$)	--	--	--	--	110-230	95-190	140-210	160-200
Calcium, Dissolved (mg/l as Ca)	--	--	--	--	26-46	22-40	31-43	36-43
Magnesium, Dissolved (mg/l as Mg)	--	--	--	--	12-27	9.7-21	15-27	18-23
Fluoride, Dissolved (mg/l as Fl)	--	4	--	4	0-0.6	24-15	0-0.1	<0.1-0.2
Sulfate, Dissolved (mg/l as SO_4)	--	250	--	--	18-29	<0.1-0.3	18-25	17-23

Nitrogen, Total Ammonia (mg/l as NH_4)	--	--	--	--	--	2.0-5.6	--	2.4-4.4
Nitrate-N (mg/l N)	--	10	--	10	--	0.0-0.97	0.07-0.75	0.07-0.4
Phosphorus, Total P (mg/l as PO_4)	--	--	--	--	--	0.27-0.04	<0.05-0.16	0.03-0.1
Coliform, Fecal (colonies/100 ml)	--	--	200	--	--	--	22-440	9-510
Streptococci, fecal (colonies/100ml)	--	--	--	--	--	--	--	11-160
Dissolved solids (mg/l)	1000	200	--	300	134-262	116-213	173-221	188-217
Iron Dissolved (mg/l FE)	--	--	--	--	--	<10-230	<20-140	<3-21

I: Protection of aquatic life.

III: Drinking water supply.

VI: Whole-body-contact recreation.

VII: Groundwater

[1]For warm-water fisheries.

[2]For cold-water fisheries.

Table 12. Major sewage (<0.19 million/gallon/day) and water treatment plants in the Meramec River basin (Table 1-49, 1-52, MDNR 1995a).

Facility	Flow[1]	Receiving Stream	County
Grand Glaize WWTF*	15.64	Meramec River	St. Louis
Eureka STP (3 Lagoons)	0.50	Flat Creek	St .Louis
Eureka STP (HTank)	0.50	Flat Creek	St .Louis
Baumgartner Lagoon	3.20	Meramec River	St. Louis
MSD-Fenton WWTP*	2.44	Meramec River	St. Louis
MSD-Lower Meramec*	2.30	Trib. to Meramec River	St. Louis
MSD-Friendship Village STP	2.02	Trib. to Meramec River	St. Louis
Rolla SE WWTP	2.00	Burgher Br.	Phelps
Pacific WWTF	0.89	Meramec River	Franklin
Salem WWTF	0.63	Spring Branch	Dent
Viburnum Lagoon	0.20	Trib. to Indian Creek	Iron
Sylvan Manor- Sunset Acres	0.30	Trib. to Meramec River	Franklin
Steelville WWTF	0.19	Whittenburg Creek	Crawford

*** Subregional treatment facilities**

[1] Million gallons per day

Table 13. Crawford, Washington, and Iron counties mines with tailings ponds that are monitored as non-point sources in the Meramec River basin (Table 49-1, MDNR 1995a).

Site*	Tailing/Spoil (acres)	Stream
Parole Barite Mine	71/98	Stringtown Branch
Howell Barite Mine	63/222	Ishmael Branch
Palmer Barite Mine	146/233	Hazel Creek
Politte Barite Mine	87/336	Little Indian Creek
Joe Smith Barite Mine	5/35	Tributary to Little Indian Creek
Doe Run, Viburnum Lead Mine	235/0	Tributary to Crooked Creek, Indian Creek
Hobo Iron Mine	0.33/4	Tributary to Meramec River
Pea Ridge Iron Ore Co.	Not Available	Mary's Creek, Tributary to Little Courtois Creek

* See map

Table 14. Major sites in St. Louis and Jefferson counties with dioxin-contaminated soils in the Meramec River basin (Table 52-1, unpublished MDNR 1995a).

Site	Description	County
Times Beach	Soil - incineration	St. Louis
Saddle & Spur Stable	Reclamation site - 1989 <1 ppb	Jefferson
Romine Creek Areas	Sediment removed 1989	Jefferson
Bubbling Springs Ranch	Soil - incineration	Jefferson
Minker-stout Area	Reclamation site	Jefferson
Sontag Road Swim Club	Soil erosion to streams, reclamation site	St. Louis
Manchester Methodist	Driveway - paved	St. Louis

Figure 13. Location of springs in the Meramec River watershed.

Data elements from the Missouri Department of Conservation Fisheries Research Section.