



EPA Region 7 TMDL Review

TMDL ID: MO 2074
Document Name: BIG RIVER

State: MO

Basin(s): BIG RIVER, UPPER MISSISSIPPI-MERAMEC (BIG RIVER BASIN)
HUC(s): 07140104
Water body(ies): BIG RIVER, FLAT RIVER CREEK, SHAW BRANCH
Tributary(ies): BIG RIVER (2074), BIG RIVER (2080), FLAT RIVER CREEK (2168), SHAW BRANCH (2170)
Pollutant(s): LEAD, SUSPENDED SEDIMENT/SILTATION, ZINC

Submittal Date: 10/1/2008

Approved: Yes

Submittal Letter

State submittal letter indicates final Total Maximum Daily Load(s) (TMDL) for specific pollutant(s)/water(s) were adopted by the state, and submitted to EPA for approval under section 303(d) of the Clean Water Act [40 CFR § 130.7(c)(1)]. Include date submitted letter was received by EPA, date of receipt of any revisions, and the date of original approval if submittal is a phase II TMDL.

The TMDL document (eight TMDLs) for Big River, Flat River Creek, and Shaw Branch was formally submitted by the Missouri Department of Natural Resources (MDNR) in a letter received by the United States Environmental Protection Agency (EPA) on October 1, 2008. Revisions to the TMDL document were received from MDNR by e-mail on December 24, 2008, March 25, 2009, and February 10, 2010.

Water Quality Standards Attainment

The water body's loading capacity (LC) for the applicable pollutant is identified and the rationale for the method used to establish the cause-and-effect relationship between the numeric target and the identified pollutant sources is described. TMDL and associated allocations are set at levels adequate to result in attainment of applicable water quality standards (WQS) [40 CFR § 130.7(c)(1)]. A statement that WQS will be attained is made.

Metals:

The impairment of these water bodies for lead and zinc are based upon the exceedance of the Missouri WQS for metals, 10 CSR 20-7.031(4)(B)1.

"Water contaminants shall not cause the criteria in Tables A and B to be exceeded. Concentrations of these substances in bottom sediments or waters shall not harm benthic organisms and shall not accumulate through the food chain in harmful concentrations, nor shall state and federal maximum fish tissue levels for fish consumption be exceeded."

In addition, Missouri WQS specifies how hardness will be calculated, 10 CSR 20-7.031(1)(Y).

"(Y) Water hardness. The total concentration of calcium and magnesium ions expressed as calcium carbonate. For purposes of this rule, hardness will be determined by the lower 25th percentile value of a representative number of samples from the water body in question or from a similar water body at the appropriate stream flow conditions."

Table A states:

"Current lead and zinc standards for the protection of aquatic life use are expressed in dissolved form. They are hardness dependent and calculated from the formulas shown below:

Dissolved Lead (DPb)

Acute = $e^{(1.273 \cdot \ln(\text{hardness}) - 1.460448)} \cdot (1.46203 - (\ln(\text{hardness}) \cdot 0.145712)) = \text{micrograms per liter (ug/L)}$

Chronic = $e^{(1.273 \cdot \ln(\text{hardness}) - 4.704797)} \cdot (1.46203 - (\ln(\text{hardness}) \cdot 0.145712)) = \text{ug/L}$

Dissolved Zinc (DZn)

Acute = $e^{(0.8473 \cdot \ln(\text{hardness}) + 0.884211)} \cdot 0.978 = \text{ug/L}$

Chronic = $e^{(0.8473 \cdot \ln(\text{hardness}) + 0.785271)} \cdot 0.986 = \text{ug/L}$ "

Using the hardness value of 200 mg/L determined from the 25th percentile of 262 hardness records taken in the Big River Watershed, the criteria for dissolved lead and zinc are as follows:

Lead: 136 and 5 ug/L for acute and chronic respectively.

Zinc: 211 and 193 ug/L for acute and chronic respectively.

The TMDL target for metals will be based on the chronic criteria of 5 ug/L for dissolved lead and 193 ug/L for dissolved zinc. The chronic criteria was selected because the lower target will protect aquatic life from acute and chronic toxicity.

NVSS:

The impairment of these water bodies for NVSS are based upon the exceedance of the Missouri WQS general or narrative criteria, 10 CSR 20-7.031(3)(A), (C) and (G).

"(A) Waters shall be free from substances in sufficient amounts to cause the formation of putrescent, unsightly or harmful bottom deposits, or prevent full maintenance of beneficial uses.

(C) Waters shall be free from substances in sufficient amounts to cause unsightly color or turbidity, offensive odor, or prevent full maintenance of beneficial uses.

(G) Waters shall be free from physical, chemical, or hydrologic changes that would impair the natural biological community."

Fifty-three TSS records collected in the upper watershed above all known tailings from May 1976 to September 1989 were used as reference data. They were assumed to represent the natural background of the watershed. The 75th percentile of the TSS reference data was 5 mg/L where any data below detection levels were assigned half the corresponding detection level. Therefore, for the purpose of this TMDL, the TSS target is set at 5 mg/L.

The beneficial uses of these water bodies are as follows:

Big River (WBID 2074):

- Irrigation
- Livestock and Wildlife Watering
- Protection of Aquatic Life (Warm-Water Fishery)
- Human Health Protection (Fish Consumption)
- Cool Water Fishery
- Whole Body Contact Recreation – A
- Secondary Contact Recreation
- Industrial

Big River (WBID 2080):

- Livestock and Wildlife Watering
- Protection of Aquatic Life (Warm-Water Fishery)
- Human Health Protection (Fish Consumption)
- Whole Body Contact Recreation – A
- Industrial

Flat River Creek (WBID 2168) and Shaw Branch (WBID 2170):

- Livestock and Wildlife Watering
- Protection of Aquatic Life (Warm-Water Fishery)
- Human Health Protection (Fish Consumption)
- Whole Body Contact Recreation – B

These water bodies are designated as impaired for the following:

- Protection of Aquatic Life (Warm-Water Fishery), all four segments
- Human Health Protection (Fish Consumption), all segments except Shaw Branch.

On the 2002 Clean Water Act (CWA) § 303(d) List, the impairment of sediment was changed to NVSS. On the 2004/2006 CWA § 303(d) List, the impairment of NVSS was changed to inorganic sediment.

Pollutant(s) of concern

An explanation and analytical basis for expressing the TMDL through surrogate measures (e.g., parameters such as percent fines and turbidity for sediment impairments, or chlorophyll-a and phosphorus loadings for excess algae) is provided, if applicable. For each identified pollutant, the submittal describes analytical basis for conclusions, allocations and margin of safety (MOS) that do not exceed the LC. If submittal is a phase II TMDL there are refined relationships linking the load to WQS attainment. If there is an increase in the TMDL there is a refined relationship specified to validate the increase in TMDL (either load allocation (LA) or waste load allocation (WLA)). This section will compare and validate the change in targeted load between the versions.

The modeling approach for the impaired segments contained within these watersheds consisted of creating a load duration curve (LDC) at the outlet of each of the four impaired segment's watersheds and determining the TMDL for each pollutant of concern at every flow probability. Existing load was calculated from flow and concentration records for the same day and site. Baseflow for this TMDL document was estimated using an automated baseflow program. When flow was not reported with water quality data, a synthetic outlet flow value was calculated using flow data from the United States Geological Survey (USGS) gaging station, USGS 07018500, at Byrnesville, Missouri.

Metals:

The LC is defined by the numeric water quality criteria for lead and zinc which are hardness dependent. The endpoint for dissolved lead and zinc are the chronic criteria for any flow. Because lead and zinc standards are hardness dependent and hardness varies over time and location, a unique hardness value was selected to determine the endpoints. The hardness value of 200 milligrams per liter (mg/L) was determined from the 25th percentile of 262 hardness records taken in the Big River Watershed.

Non-Volatile Suspended Solids (NVSS):

When the WQS is expressed as a narrative value, a measurable indicator of the pollutant may be selected to express the narrative as a numeric value. There are many quantitative indicators of sediment appropriate to describe sediment in rivers and streams such as total suspended solids (TSS), turbidity, and bedload sediment.

TSS was selected as the numeric target for NVSS because there are no NVSS data, but there are 461 records of TSS collected in the watershed. Theoretically, TSS equals volatile (organic) suspended solids (VSS) plus NVSS (mineral, non-volatile). Assuming that the ratio of VSS to NVSS is constant, then NVSS parallels TSS in amplitude, i.e., as TSS increases, so does NVSS. Therefore, for the purpose of this TMDL, TSS was used as a surrogate target for NVSS.

Table 1: Loading Capacity and Percent Reductions Needed to Reach the Loading Capacity in Each of the Four Watersheds at the 50th Percentile of Flow

Impaired Water Body	Flow (cfs)	Pollutant of Concern	TMDL (kg/day)	Required Reduction
Big River (WBID 2074)	433	Dissolved lead	5.3	86%
Big River (WBID 2080)	305	Dissolved lead	3.74	85%
Big River (WBID 2080)	305	TSS	3736	99%
Flat River Creek (WBID 2168)	15.4	Dissolved zinc	7.28	100%
Flat River Creek (WBID 2168)	15.4	Dissolved lead	0.189	97%
Flat River Creek (WBID 2168)	15.4	TSS	188.65	96%
Shaw Branch (WBID 2170)	1.69	Dissolved lead	0.02	98%
Shaw Branch (WBID 2170)	1.69	TSS	20.8	98%

cfs = cubic feet per second, TMDL = LC, kg/day = kilograms per day, WBID = Water body identification number, TSS = total suspended solids

If the LC is met, these reductions will result in the protection of Warm Water Aquatic Life Fishery in Big River, Flat River Creek, and Shaw Branch, and human health protection for fish consumption in Big River and Flat River Creek.

Numeric Target(s)

Submittal describes applicable WQS, including beneficial uses, applicable numeric and/or narrative criteria. If the TMDL is based on a target other than a numeric water quality criterion, then a numeric expression, site specific if possible, was developed from a narrative criterion and a description of the process used to derive the target is included in the submittal.

A LDC was created at the outlet of each of the four impaired segments' watersheds to determine the TMDL for each pollutant of concern at every flow probability. A TMDL is the product of the pollutant of concern in mg/L, the expected flow at the corresponding probability as cubic feet per second (cfs) and a conversion factor (2.45) with the resulting load expressed in kilograms (kg) per day (1 kg = 2.2 pounds). Existing load is calculated from flow and concentration records from the same day and site and is plotted against the TMDL curve based on their flow probability. Baseflow for this TMDL was estimated using an automated baseflow program. When flow was not reported with water quality data, a synthetic outlet flow value was calculated using flow data from the USGS gaging station, USGS 07018500, at Byrnesville, Missouri.

Metals:

The target is the numeric water quality criteria for chronic toxicity of dissolved lead and zinc for aquatic life. There is a direct link between the target and each numeric criterion. Lead and zinc standards are hardness dependent and hardness varies over time and location. A representative hardness value of 200 mg/L was used to calculate the lead and zinc targets. This value was derived from the 25th percentile of 262 hardness measurements taken in the Big River Watershed. Basing the TMDL for metals on the chronic criteria will protect aquatic life use from both acute and chronic toxicity.

There are no numeric water quality criteria for lead and zinc associated with the Protection of Human Health – Fish Consumption designated use in the WQS. There are, however, fish tissue concentrations for these pollutants that have associated consumption advisory levels established by the Missouri Department of Health and Senior Services. Reductions in the quantity of suspended and dissolved lead and zinc within Big River and its tributaries is expected to decrease the concentrations of these metals available to bioaccumulate within resident aquatic species. Implementation of the reductions found in this TMDL to protect the aquatic life designated use are expected to reduce the magnitude and frequency of fish consumption advisories within the Big River Watershed over time.

NVSS:

The TMDL establishes a link to the narrative standard for the NVSS impairment of the aquatic life use. NVSS reduces aquatic habitat quality by smothering natural substrates (materials in the streambed), fish eggs, and aquatic invertebrate animals such as water insects, mussels, and crayfish.

TSS was selected as the numeric target for NVSS because there is no NVSS data, but there are 461 records of TSS collected in the watershed. Theoretically, TSS equals VSS (organic) plus NVSS (mineral, non-volatile). Assuming the ratio of VSS to NVSS is constant, then NVSS parallels TSS in amplitude, i.e., as TSS increases, so does NVSS. Therefore, for the purpose of this TMDL, TSS was used as a surrogate target for NVSS.

Fifty-three TSS records collected in the upper watershed above all known tailings from May 1976 to September 1989 were considered reference data and assumed to represent the natural background of the watershed. All values below detection were assigned half the value of the detection level. The 75th percentile of the TSS reference data is 5 mg/L, and was the value used to represent the natural background of the watershed. In addition, MDNR Environmental Services Program and the USGS collected most of the data to assess this watershed, and their laboratories use detection limits that are equal to or higher than 5 mg/L. This target is meant to represent suspended clean sediment free of any pollutants including metals.

Source Analysis

Important assumptions made in developing the TMDL, such as assumed distribution of land use in the watershed, population characteristics, wildlife resources, and other relevant information affecting the characterization of the pollutant of concern and its allocation to sources, are described. Point, nonpoint and background sources of pollutants of concern are described, including magnitude and location of the sources. Submittal demonstrates all significant sources have been considered. If this is a phase II TMDL any new sources or removed sources will be specified and explained.

The Big River Mine Tailings/St. Joe Minerals Corporation site was placed on the EPA Superfund National Priorities List (NPL) in October 1992. Superfund non-time-critical removal actions are in various stages of planning and construction. Time-critical removal actions have been ongoing for several years.

The Big River, Shaw Branch, and Flat River Creek TMDL will be revised by MDNR in 2010 (*per MDNR website and email*) to incorporate new pollutants identified on Missouri's 2004/2006 303(d) List. The allocation of pollutant loads to particular sources, for the abandoned mine lands will be re-evaluated at that time.

Lead and/or zinc contamination is common in soils, groundwater, surface water and sediments on and surrounding lead and zinc mines, mills, and smelter sites, other process areas, and near transportation corridors from large surface piles of mine or mill wastes, underground mine workings that penetrate the shallow aquifer, dust fallout, and fugitive emissions.

Nonpoint sources are diffuse sources of pollutant loading that typically cannot be identified as entering a water body at a single location. These sources involve runoff from non-mining areas and may contribute lead and zinc to surface waters as a result of runoff-producing storm events. Some examples include off-site haul and access roads not constructed of waste rock or spent ore from mining areas. When compared to the mine land areas within the Big River watershed, nonpoint sources of lead, zinc, and TSS loading are expected to be minor. Undisturbed and vegetated areas within the watershed are expected to be insignificant sources of lead, zinc, and TSS to the impaired segments.

While nonpoint sources of dissolved lead and zinc are minor or negligible under critical low-flow conditions, historic and legacy lead and zinc within the stream system can be sources of these metals, especially during higher flows. As conservative pollutants, these metals do not degrade and historic lead and zinc can become re-suspended into the water column and carried downstream via natural fluvial processes. Significant metals suspension and re-deposition can occur during and immediately following high-flow storm events. This process allows previously unavailable lead and zinc to enter the water column and become a water quality concern as a secondary source of metals contamination.

Historic mining activity has left abandoned mine workings and tailings piles throughout the Big River Watershed. These locations constitute discrete areas of point source delivery of TSS, zinc and lead to the impaired segments. The following areas are known to contribute pollutant laden runoff of sediment and metals to the impaired segments:

- Erosion of lead tailings from the Federal tailings pond (St. Joe State Park)
- Erosion of lead tailings from the National pile, which adjoins the Flat River Glass Company
- Erosion of tailings and discharge of dissolved zinc from the Elvins pile
- Erosion of tailings directly from the Leadwood and Desloge tailings piles and tailings entering from Flat River Creek impair Big River
- Erosion of tailings from the Bonne Terre pile

Seepage of dissolved metals from the tailing piles listed above represent another potential secondary source of metals contamination to the impaired water bodies. As precipitation infiltrates tailing piles and moves through the subsurface, metals may become dissolved and enter gaining streams within the watershed via the groundwater recharge pathway. At present, the amount and extent of seepage as a secondary source of metals contamination is unknown.

The primary cause of impairment to these four water bodies has been identified as erosion from tailings. These tailings accumulate in pools within the water bodies which creates secondary sources of contaminated sediment. Big River is impaired by erosion of tailings directly from the Leadwood and Desloge piles and by tailings entering from Flat River Creek. Flat River Creek is impaired by erosion from the following erosion of tailings: the Federal tailings pile (St. Joe State Park), the National pile (which adjoins the Flat River Glass Company), and discharge of dissolved zinc from the Elvins pile.

One hundred and forty-three (143) National Pollutant Discharge Elimination System (NPDES)-permitted facilities are located within the watershed. These include 33 general permits (MOG), 12 storm water permits (MOR)- including two Municipal Separate Storm Sewer Systems (MS4s), 92 domestic wastewater treatment facility (WWTF) permits, and 6 site-specific, non-domestic wastewater treatment permits in the Big River Watershed (Table 2).

In addition, there are two (2) MDNR-established Applicable or Relevant and Appropriate Requirements (ARARs) for the Doe Run, Leadwood – Eaton Tailings Dam (MO-ARAR011) and Doe Run, Lead Belt Material

Company (MO-ARAR012) discharges. These ARARs only authorize discharges of storm water from these facilities under the Missouri Clean Water Law and NPDES. The remedial measures being taken are non-time critical removal actions under a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) consent order.

The submittal demonstrates that all known potential sources have been considered.

Table 2: NPDES Permits by Watershed WBID, MDNR NPDES Permit Number, Facility Name, and Design Flow (cfs). Facilities without design flows are labeled N/A or not applicable.

Watershed WBID	MDNR Permit #	Facility Name	Design Flow (cfs)
2170	MO0097993	MDNR, ST JOE STATE PARK	8.64
2168	MO0022942	BISMARCK WWTF	0.25
2168	MO0053180	TOWN AND COUNTRY MHP	0.015
2168	MO0092134	RUSTIC ACRES	0.007
2168	MO0092941	SUGAR MAPLE COURT MOBILE	0.008325
2168	MO0097993	MDNR, ST JOE STATE PARK	0.01
2168	MO0098647	FLAT RIVER GLASS OPERATION	1.2
2168	MO0103560	PARK HILL WWTF	2.05
2168	MO0123633	NEW HOPE RESIDENTIAL	0.002
2168	MOG640065	PARK HILLS WTP	N/A
2168	MOG821108	W M PUMPING	N/A
2168	MOR040004	FARMINGTON SMALL MS4	N/A
2168	MOR23A113	NPC BIDCO	N/A
2080	MO0001422	VESELL MINERAL PRODUCTS	0.5
2080	MO0035700	TERRE DU LAC NORTH	0.24
2080	MO0049000	BISMARCK W STORMW	VARIES
2080	MO0057312	TERRE DU LAC SOUTH LAGOON	0.004
2080	MO0058378	COUNTRY HILL MHC	0.011
2080	MO0083810	SHIRLEY SCHOOL	0.00043
2080	MO0084395	GRANDVIEW PLAZA MHP	0.007
2080	MO0085111	BELLEVIEW R-3 SCHOOL	0.004
2080	MO0086240	BELGRADE R-6 ELEM SCHOOL	0.003
2080	MO0087025	POTOSI ELKS CLUB #2218	0.001
2080	MO0087181	ROUGE CREEK UTILITIES, INC	0.03
2080	MO0087921	KINGSTON K-14 SCHOOL	0.005652
2080	MO0089745	SERENITY MHP	0.002
2080	MO0089893	WHISPERING PINES MHP	0.001
2080	MO0090522	SUMMIT ACRES MHP	0.007
2080	MO0090913	LAKE KINIPPI SUBDIVISION	0.005
2080	MO0094242	BELLEVIEW VALLEY NURSING	0.014
2080	MO0095311	TERRE DU LAC OXIDATION DI	0.25
2080	MO0099431	POTOSI WWTP #1	0.683
2080	MO0099732	POTOSI WWTF #2	0.21
2080	MO0100706	BONNE TERRE NW WWTF	0.61
2080	MO0101184	BUCKMAN LABORATORIES INC	N/A
2080	MO0104256	LEADWOOD WWTF	0.15
2080	MO0108774	ST FRANCOIS CO ENVIR CORP	1.2
2080	MO0109568	IRONDALE WWTF	0.06
2080	MO0110035	THUNDERBIRD MHP	0.004
2080	MO0120260	EAGLE ESTATES	0.031
2080	MO0121321	BONNE TERRE NE WWTP	0.9
2080	MO0121371	HUNTER'S RIDGE SUBDIVISION	0.025

2080	MO0123544	BATES CREEK BAPTIST CAMP	0.00806
2080	MO0123765	VILLAGE TRAILER COURT	0.003
2080	MO0125083	WEST ST. FRANCOIS CO R-IV	0.012
2080	MO0127388	MOORE RECIRCULATING FILTR	0.000975
2080	MO0127922	YMCA OF THE OZARKS	N/A
2080	MO0128571	CALEDONIA WWTF	0.02
2080	MOG010259	DAVID, KEN	N/A
2080	MOG010372	DAVID, JOHN W	0.069825
2080	MOG490214	LEAD BELT MATERIALS - QUA	VARIES
2080	MOG490230	BIG RIVER MINE TAILINGS	VARIES
2080	MOG490356	POLITTE READY MIX	N/A
2080	MOG490439	POLITTE READY MIX	N/A
2080	MOG490736	EGYPTIAN CONCRETE COMPANY	N/A
2080	MOG490805	BASE ROCK MINERALS INC.	N/A
2080	MOG490807	WASHINGTON CO. AGGREGATES	N/A
2080	MOG490947	CIMBAR PERFORMANCE MINERA	N/A
2080	MOG500110	WA CO MATERIALS	N/A
2080	MOG821031	HAWK'S BACKHOE SERV, INC.	N/A
2080	MOG821067	JONES PLUMBING SERVICE	N/A
2080	MOG821072	RIDDLE SEPTIC CLEANING	N/A
2080	MOG821108	W M PUMPING	N/A
2080	MOG821117	WM PUMPING	N/A
2080	MOR22A137	REED LUMBER COMPANY, LLC	N/A
2080	MOR23A062	ORICA USA	N/A
2080	MOR240061	R & M FEED	N/A
2080	MOR240227	DICKEY FARM SUPPLY INC.	N/A
2080	MOR80C018	BSC TRUCK INC.	N/A
2080	MOR80H010	GILLIAM TRANSFER SOLID WA	N/A
2074	MO0040461	MO AMERICAN, CEDAR HIL L L	0.164
2074	MO0043818	GRANDVIEW R-2 SCHOOL DIST	0.013
2074	MO0044571	COUNTRY AIRE MANOR MHP	0.022
2074	MO0044580	HSSC, NORTHWEST HIGH SCH	0.075
2074	MO0045446	LAKES OF DEERWOOD SUBD	0.005
2074	MO0049441	STARLIGHT APTS.	0.001
2074	MO0053163	OUR LADY QUEEN OF PEACE	0.005
2074	MO0053708	LAKE ADELLE SEWER DIST	0.05
2074	MO0084450	CREST MANOR MHP	0.048
2074	MO0085383	HILLSBORO WW RECLAMATION	0.5
2074	MO0086363	SYCAMORE GREEN ACRES MHP	0.005
2074	MO0086576	BEL AIR ESTATES MHP	0.012
2074	MO0086932	FISHER COMMERCIAL AREA	0.001
2074	MO0088951	TRANSFORMATION CAMP	0.002
2074	MO0089354	LAKE TAMARAC SUBD	0.027
2074	MO0090051	PARADISE ESTATES MHP WWTF	0.003
2074	MO0090395	EL CHAPARREL EST SUBD ASO	0.017
2074	MO0090905	COUNTRY LIFE ACRES SUBD	0.003
2074	MO0090948	GREEN ACRES MHP	0.009
2074	MO0092584	GOLDEN ACRES MHP	0.024
2074	MO0092738	MAPLE GROVE ELEM SCHOOL	0.01
2074	MO0098302	CEDAR HILL FPD	0.001
2074	MO0099091	ELDERLY HOUSING PRTRNSHP	0.008
2074	MO0099473	RAINTREE PLANTATION	0.064

2074	MO0099635	JEFFERSON CO PWSD #2	0.092
2074	MO0099635	JEFFERSON CO PWSD #2	0.05
2074	MO0100374	HSSC, HOUSE SPGS MID SCH	0.016
2074	MO0100668	HSSC, ECHO VALLEY EST	0.018
2074	MO0101893	CAMP SUNNYHILL ADVENTURE	0.0108
2074	MO0101958	JEFFERSON COUNTY LIBRARY	0.012
2074	MO0103233	HSSC, BEAR CREEK ESTATES	0.0421
2074	MO0103438	HSSC, WOODRIDGE ESTATES	0.018
2074	MO0103446	COUNTRY TRAIL ESTATES MHP	0.006545
2074	MO0103551	AUSTIN TRAILS	0.002
2074	MO0103799	MO AMERICAN, SAND CREEK F	0.075
2074	MO0105201	HSSC, PINE GROVE MANOR	0.004
2074	MO0105597	SECLUDED FOREST SUBD	0.009
2074	MO0105856	BYRNES MILL MHP	0.125
2074	MO0105970	WEDGEWOOD VILLAGE-PLAT 2	0.023
2074	MO0106577	SENNAWOOD VILLAGE SUBD	0.026
2074	MO0106909	HSSC, MEADOW BROOK ESTATE	0.09
2074	MO0108642	HSSC, SYCAMORE SPGS MHP	0.048
2074	MO0109304	HSSC, CEDAR SPGS ELEM SCH	0.012
2074	MO0110019	PINE FORD VILLAGE MHP	0.03
2074	MO0111457	FEED MY PEOPLE	0.001
2074	MO0113191	SUNRISE ACRES SUBDIVISION	0.002
2074	MO0115223	SEVEN SPRINGS/TWIN LAKES	0.049
2074	MO0115428	BYRNES MILL SOUTH WWTP	0.5
2074	MO0120600	ST MARTIN'S UNITED CHURCH	0.0011
2074	MO0123561	MEADOWBROOK VALLEY ESTATE	0.01
2074	MO0124788	HSSC, MILLER CROSSING WTF	0.025
2074	MO0126926	HSSC, FISHER RD	0.1
2074	MO0127345	WACO LANDFILL	2.3
2074	MO0129097	PHILLIPS PROPERTY WWTF	0.0006
2074	MOG490169	HOUSE SPRINGS QUARRY	N/A
2074	MOG490359	ARNOLD READY MIX-CEDAR HI	N/A
2074	MOG490390	CONCRETE RESOURCES INC -	N/A
2074	MOG490532	AAA ZOELLNER MATERIALS IN	N/A
2074	MOG490998	DRY CREEK MATERIALS INC.	N/A
2074	MOG500086	DRY CREEK MATERIALS, INC.	N/A
2074	MOG821017	KING SEPTIC SERVICE	N/A
2074	MOG821026	WALLACH SEPTIC SERV, INC.	N/A
2074	MOG821055	IMPERIAL PUMPING	N/A
2074	MOG821074	O'BRIEN EXCAVATING	N/A
2074	MOG821096	RITE NOW SEPTIC CLEANING	N/A
2074	MOG821116	AA QUICK SEWER	N/A
2074	MOG821123	BONACKER FARMS	N/A
2074	MOG822125	DITTMER MEAT PACKING COMP	N/A
2074	MOG821126	DON ROBINSON TRACT	N/A
2074	MOR040052	JEFFERSON CO SMALL MS4	N/A
2074	MOR60A080	BIG 3 AUTO PARTS & SALVAG	N/A
2074	MOR80C333	NORTHWEST R-1 SCHOOL DIST	N/A
2074	MOR80C429	DURHAM SCHOOL SERVICES	N/A

MHP = Mobile Home Park, WWTP = Wastewater Treatment Plant

Allocation - Loading Capacity

Submittal identifies appropriate WLA for point, and load allocations for nonpoint sources. If no point sources are present the WLA is stated as zero. If no nonpoint sources are present, the LA is stated as zero [40 CFR § 130.2 (i)]. If this is a phase II TMDL the change in LC will be documented in this section.

Metals:

The LC is defined by LDCs at the outlet of each of the four impaired segments' watersheds set at the chronic criteria of 5 ug/L for lead, and 193 ug/L for zinc, at a hardness value of 200 mg/L.

NVSS:

The LC is defined by LDCs at the outlet of each of the four impaired segments' watersheds and set at the TSS target of 5 mg/L. The TSS target is the representative value for the naturally occurring background concentrations set from the 75th percentile of reference data collected in the upper watershed above all known tailings.

WLA Comment

Submittal lists individual WLAs for each identified point source [40 CFR § 130.2(h)]. If a WLA is not assigned it must be shown that the discharge does not cause or contribute to WQS excursions, the source is contained in a general permit addressed by the TMDL, or extenuating circumstances exist which prevent assignment of individual WLAs. Any such exceptions must be explained to a satisfactory degree. If a WLA of zero is assigned to any facility it must be stated as such [40 CFR § 130.2(i)]. If this is a phase II TMDL any differences in phase I and phase II WLAs will be documented in this section.

The WLA for these TMDLs is set to the lesser of applicable water quality based or technology based effluent limits (TBELs).

In addition to the calculation of LDCs, MDNR calculated the largest percent reductions of existing loading necessary to meet TMDL loading targets within Big River (WBIDs 2074 & 2080), Flat River Creek (WBID 2168) and Shaw Branch (WBID 2170). These percent reductions are the largest calculated values for a given pollutant of concern from the LDCs, and it is expected that these reductions will be protective of WQS under all flow regimes (Table 3).

Table 3. Required Reductions of Existing Loading from LDCs for each Water Body

Water Body (WBID)	Pollutant of Concern	Required Reduction
Big River (WBID 2074)	DPb	86%
Big River (WBID 2080)	DPb	85%
Big River (WBID 2080)	TSS	99%
Flat River Creek (WBID 2168)	DZn	100%
Flat River Creek (WBID 2168)	DPb	97%
Flat River Creek (WBID 2168)	TSS	96%
Shaw Branch (WBID 2170)	DPb	98%
Shaw Branch (WBID 2170)	TSS	98%

DPb = dissolved lead, TSS = Total suspended solids, DZn = dissolved zinc

Existing inspection data for the 33 general and 12 storm water permits within the Big River Watershed suggest these permits are protective of the NVSS, lead, and zinc impairments. Because general and storm water permits within the watershed are not significantly contributing to the water quality impairments, the WLA for these permits is a zero percent net reduction in loading. WLAs for individual facilities covered by general and storm water permits within the watershed are set at current permit limits and conditions.

Included within the 12 storm water permits are two (2) MS4s with outfalls: Jefferson County Small MS4 (MO-R040052) discharges to Big River (WBID 2074), and City of Farmington Small MS4 (MO-R040004) discharges to Flat River Creek (WBID 2168). Existing inspection data indicate the outfall locations for these MS4 permits do not currently contribute pollutants of concern to the impaired water body segments. Should future inspection, assessment, or monitoring data indicate these MS4s contribute pollutants of concern to the impaired water body segments, the MS4 permits will be reopened to include requirements sufficient to characterize and reduce impacts from these discharges.

Currently there are 92 domestic WWTFs in the Big River Watershed. Mechanical WWTF standard secondary treatment permit limits are not to exceed a weekly average TSS concentration of 45 mg/L and a monthly average TSS concentration of 30 mg/L. Equivalent to secondary treatment for trickling filters is limited to a weekly average TSS concentration of 65 mg/L and monthly average TSS concentration of 45 mg/L, and for lagoons a weekly average of 120 mg/L and monthly average of 80 mg/L (10 CSR 20-7.015 (8)). However, treated domestic discharge is not considered to cause or contribute to the impairment of the water bodies addressed by this TMDL. Thus, the WLA for domestic facilities remains unchanged for NVSS and corresponds to zero percent net reduction in sediment load.

Six (6) site-specific, non-domestic wastewater treatment permits have been issued in the Big River Watershed (WBID 2074). Four (4) facilities are relevant to this study as they discharge pollutants of concern to the impaired water body segments. Transport of fine mineral sediment high in lead and zinc from the St. Francois County Environmental Corporation facility (a.k.a. Desloge tailings pile) and St. Joe State Park (a.k.a. Federal tailings pile) account for much of the point source metals and sediment loading to the impaired segments. The Vessel Mineral Products and Flat River Glass Operation facilities do not appear to be contributing appreciable amounts of metals and sediment. Federal regulations, 40 CFR 122.45(c), require that all permit limits for metals be expressed as total recoverable (TR) metals even though instream water quality targets may be expressed as dissolved metals.

All permitted facilities that are identified to contribute sediment and metals loading to impaired segments shall adopt appropriate best management practices (BMPs) to reduce such loading from their storm water outfalls. These facilities must also measure in-stream pollutant concentrations to determine the efficacy of the control measures.

During low-flow conditions, it is reasonable to allocate the entire LC of a pollutant as a WLA because of the lack of pollutant contributions from precipitation induced surface water runoff. If the facility WLA calculated as a percent reduction (Table 3) is greater than that required by the TMDL LDC during critical low-flow conditions, i.e., 95% flow exceedance, the greater reduction necessary to meet WQS was used.

Table 4: Non-Domestic Site-Specific Permits with Design Flow and Daily WLA for Each Site-specific, Non-domestic Wastewater Treatment Facility

Watershed WBID	Facility Name	MDNR Permit Number	Design Flow (MGD)	TSS (kg/day)	PB TR (kg/day)	ZN TR (kg/day)
2080	Vessel Mineral Products	MO0001422	0.5	Shared 1,115 [1]	Zero percent net reduction	N/A
2080	St. Francois County Environmental Corporation	MO0108774	6.6		1.11	N/A
2168	Flat River Glass Operation	MO0098647	1.2	26	Zero percent net reduction	Zero percent net reduction
2170	MDNR, St. Joe State Park	MO0097993	8.6	LDC (see below)		N/A

MGD = million gallons per day, TSS = total suspended solids, PB TR = total recoverable lead, ZN TR = total recoverable zinc

[1] Because the Vessell Mineral Products and St. Francois County Environmental Corporation facilities both discharge TSS to Big River, the two facilities should share the loading capacity for TSS during low-flow conditions.

Vessell Mineral Products and Flat River Glass Operation are not significant contributors to lead and zinc; therefore, the lead and zinc WLAs for these facilities results in a zero percent net reduction in loading.

For the MDNR, St. Joe State Park facility, the TMDL LDC during critical low-flow conditions, i.e., 95% flow exceedance, were used to set WLAs in order to meet WQS. The MDNR, St. Joe State Park facility encompasses the entire Shaw Branch watershed and is the only permitted facility in the Shaw Branch watershed. Because all precipitation induced storm water runoff discharged into Shaw Branch is generated by and from the facility, the TMDL allocates the entire LC for dissolved lead and TSS to the MDNR, St. Joe State Park facility as WLAs under all flow conditions. For example, at the 50th percentile of flow, the WLA for dissolved lead is 0.02 kg/day and for TSS is 20.8 kg/day.

The ARARs established for the Doe Run, Leadwood – Eaton Tailings Dam and Doe Run, Lead Belt Material Company discharges require once per month monitoring for TSS, total recoverable and dissolved lead and total recoverable and dissolved zinc, but sampling has not yet occurred. MDNR has requested Doe Run Corporation initiate sampling under the terms of the established ARARs and submit the results to the MDNR Water Protection Program. If the sampling results indicate the ARAR facilities discharge pollutants of concern at levels that will cause or have the reasonable potential to cause or contribute to an in-stream excursion above WQS, WLAs will be included in the ARARs to ensure protection of designated uses. WLA development will target the TMDL target water quality criteria.

While a WLA has been calculated for point sources, including any unpermitted abandoned mines or tailings piles, any allocation does not reflect an authorization to discharge from an unpermitted point source. Discharging pollutants to waters of the state without a permit is a violation of both state and federal Clean Water Law. Should it become necessary to permit currently unpermitted abandoned mines or tailings piles, those areas must follow the Department's permit application and antidegradation processes and will be evaluated in light of this TMDL.

These WLAs will ensure the permitted facilities will not cause or contribute to the NVSS, lead, or zinc impairment.

LA Comment

Includes all nonpoint sources loads, natural background, and potential for future growth. If no nonpoint sources

are identified the LA must be given as zero [40 CFR § 130.2(g)]. If this is a phase II TMDL any differences in phase I and phase II LAs will be documented in this section.

The LA for all impaired water body segments and pollutants of concern is set at the remainder of the LC after the WLA is subtracted. Where no permitted facilities exist within the watershed that will contribute to the impairment, the WLA is zero and the entire LC for that pollutant was allocated as a LA. Because the MDNR, St. Joe State Park facility encompasses the entire Shaw Branch watershed, all precipitation induced storm water runoff is generated by and from the facility. Therefore, the entire LC for each pollutant was allocated to the MDNR, St. Joe State Park facility as WLAs under all flow conditions.

Table 5: Example LA at the Load Duration Curve 50th Percentile Flow Probability for Each Impaired Water Body and Pollutant of Concern

Water Body (WBID)	Pollutant of concern	Flow (cfs)	TMDL (kg/d)	WLA (kg/d)	LA (kg/d)
Big River (WBID 2074)	DPb	433	5.3	0	5.3
Big River (WBID 2080)	DPb	305	3.74	1.11	2.63
Big River (WBID 2080)	TSS	305	3736	1115	2621
Flat River Creek (WBID 2168)	DZn	15.4	7.28	0	7.28
Flat River Creek (WBID 2168)	DPb	15.4	0.189	0	0.189
Flat River Creek (WBID 2168)	TSS	15.4	188.65	26.0	162.65
Shaw Branch (WBID 2170)	DPb	1.69	0.02	0.02	0
Shaw Branch (WBID 2170)	TSS	1.69	20.8	20.8	0

DPb = dissolved lead, DZn = dissolved zinc

Margin of Safety

Submittal describes explicit and/or implicit MOS for each pollutant [40 CFR § 130.7(c)(1)]. If the MOS is implicit, the conservative assumptions in the analysis for the MOS are described. If the MOS is explicit, the loadings set aside for the MOS are identified and a rationale for selecting the value for the MOS is provided. If this is a phase II TMDL any differences in MOS will be documented in this section.

For the eight TMDLs contained within this TMDL document, the MOS is implicit and derived from the following conservative assessments. The first conservative assessment during the TMDL calculations was that the downstream watershed outlet flow was assigned to any water quality site missing flow data. This results in an over-estimation of load since load is a product of flow and concentration, and flow at the downstream assigned watershed outlet is greater than what the actual unrecorded flow would have been. The second conservative assessment is the LDC targets the chronic criteria for lead and zinc which will protect for acute and chronic toxicity of aquatic life. The third conservative assessment is that when establishing WLA and LAs, the greater percent reduction required for the water body or TMDL loading was used to set allocations in order to meet WQS.

Seasonal Variation and Critical Conditions

Submittal describes the method for accounting for seasonal variation and critical conditions in the TMDL(s) [40 CFR § 130.7(c)(1)]. Critical conditions are factors such as flow or temperature which may lead to the excursion of WQS. If this is a phase II TMDL any differences in conditions will be documented in this section.

The LDC represents flow under all possible stream conditions which accounts for seasonal variations. Seasonal variation is therefore implicitly taken into account within the TMDL calculations. The advantage of this approach is that it avoids the constraints associated with using a single-flow critical condition.

While there is significant seasonal variation in the amplitude of the average flow and concentrations of the parameters of concern (see TMDL, Table 19), such variation would not require special consideration in these TMDLs because implementation to reduce loading would be applicable all year round.

Public Participation

Submittal describes required public notice and public comment opportunity, and explains how the public comments were considered in the final TMDL(s) [40 CFR § 130.7(c)(1)(ii)].

The TMDL document was first placed on a 30-day public notice from December 20, 2006, through January 19, 2007. Comments were received from EPA and the Missouri Coalition for the Environment. In response to these comments, MDNR made several changes to the document. Because of substantial revisions, the TMDL was placed on another 30-day notice from September 24 to October 24, 2007. Groups that received the public notice announcement included the Missouri Clean Water Commission, the four facilities with site specific permits, the Water Quality Coordinating Committee, the new citizen's Big River watershed group, 137 Stream Team volunteers in the watershed and 11 state legislators representing the Big River Watershed. Also, the public notice, Information Sheets, and the TMDL were posted on the MDNR Web site making them available to anyone with access to the Web. Any comments received and MDNR's response to those comments have been placed in the Big River TMDL file.

Monitoring Plan for TMDL(s) Under Phased Approach

The TMDL identifies a monitoring plan that describes the additional data to be collected to determine if the load reductions required by the TMDL lead to attainment of WQS, and a schedule for considering revisions to the TMDL(s) (where phased approach is used) [40 CFR § 130.7].

Currently, USGS conducts water quality monitoring on Big River near Richwood (USGS 07018000). USGS monitoring includes daily average discharge, twice a year sampling for metals, and six times a year sampling for water chemistry. MDNR considers the monitoring frequency and analytes collected by the USGS sufficient to characterize water quality in Big River and should be continued. In addition to monitoring conducted by USGS, MDNR will continue monitoring the impaired waters covered by this TMDL for pollutants of concern. Additional monitoring of sediments and pore water may be conducted to determine the effectiveness of sediment BMPs and to assess water quality trends against probable effects levels, general criteria [10 CSR 20-7.031(3)], and water quality criteria for lead and zinc.

Facilities that have been determined to cause or contribute to sediment and/or metals loading to impaired segments will be required to measure in-stream pollutant concentrations to determine the effectiveness of their control measures. Facilities covered by ARARs must monitor and report analytical results for all pollutants of concern identified in the ARAR document. Entities covered by MS4 permits shall monitor and report the loading of pollutants of concern from their discharges.

Reasonable Assurance

Reasonable assurance only applies when less stringent WLAs are assigned based on the assumption of nonpoint source reductions in the LA will be met [40 CFR § 130.2(i)]. This section can also contain statements made by the state concerning the state's authority to control pollutant loads.

No reasonable assurance is required because there is not a required reduction in LA to account for the prescribed WLA. Within the Big River Basin there are currently 143 NPDES-permitted discharging facilities for which MDNR has authority to write and enforce State Operating Permits, and two ARARs where MDNR has reviewed state laws and regulations in order to determine and establish the ARARs. Sufficient WLAs have been assigned to those point sources discharging pollutants of concern to account for their point source contributions to metals and sediment. Inclusion of effluent limits (determined from the WLA established by the modeling) into a state permit, and at least quarterly monitoring of the effluent reported to MDNR, will result in compliance with WQS met.