UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 7
901 NORTH 5TH STREET
KANSAS CITY, KANSAS 66101

DEC 23 2010

Mr. John Madras
Director, Water Protection Program
Water Protection and Soil Conservation Division
Missouri Department of Natural Resources
1101 Riverside Drive
Jefferson City, Missouri 65101

Dear Mr. Madras:

Re: Approval of Tributary to Pond Creek TMDLs

This letter responds to the Missouri Department of Natural Resources (MDNR) submission of a Total Maximum Daily Load (TMDL) document which contains cadmium, lead and zinc in sediment (S), dissolved cadmium, lead and zinc and inorganic sediment TMDLs for Tributary to Pond Creek segment 2128. The document was originally received by the United States Environmental Protection Agency (EPA), Region 7, on August 3, 2010. Revisions were made to the original submittal and the final version was resubmitted on December 20, 2010.

Tributary to Pond Creek was identified on the EPA-approved 2008 Missouri § 303(d) List as impaired for inorganic sediment. This submission fulfills the Clean Water Act statutory requirement to develop TMDLs for impairments listed on a state's § 303(d) List. The specific impairments (water body segment and pollutants) are:

Water Body Name	WBID	Pollutants
Tributary to Pond Creek	MO_2128	cadmium (S), lead (S) and zinc (S); dissolved cadmium, dissolved lead and dissolved zinc; and inorganic sediment

EPA has completed its review of the TMDL document with supporting documentation and information. By this letter, EPA approves the submitted TMDLs. Enclosed with this letter is the EPA Region 7 TMDL Decision Document summarizing the rationale for EPA's approval of the TMDLs. EPA believes the separate elements of the TMDL document, described in the enclosed form adequately address the pollutants of concern, taking into consideration seasonal variation and a margin of safety. Although EPA does not approve the monitoring plan submitted by the state, EPA acknowledges the state's efforts. EPA understands that the state may use the

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monitoring plan to gauge the effectiveness of the TMDL document and determine if future revisions are necessary or appropriate to meet applicable water quality standards.

EPA is currently in consultation under Section 7 of the Endangered Species Act with the United States Fish and Wildlife Service regarding the Tributary to Pond Creek TMDLs. While we are approving these TMDLs at the present time, we may decide that changes to the TMDL document are warranted based upon the results of the consultation when it is completed.

We appreciate the thoughtful effort that MDNR has put into these TMDLs. We will continue to cooperate with and assist, as appropriate, in future efforts by MDNR to develop TMDLs.

Sincerely,

for William A. Spratlin
Director
Water, Wetlands and Pesticides Division

Enclosure

cc: Mr. John Hoke
Missouri Department of Natural Resources

Mr. Gerald Babao
American Canoe Association

Mr. Paul Sanford
American Canoe Association

Mr. Scott Dye
Sierra Club

Mr. John Simpson
KS Natural Resource Council

EPA Region 7 TMDL Review

TMDL ID: MO_2128 **State:** MO

Document Name: POND CREEK, TRIBUTARY TO

Basin(s): UPPER MISSISSIPPI-MERAMEC (BIG RIVER BASIN)

HUC(s): 07140104, 7140104

Water body(ies): POND CREEK TRIB., POND CREEK, TRIB. TO, POND CREEK, TRIBUTARY TO, TRIBUTARY TO POND CREEK

Tributary(ies):

Pollutant(s): CADMIUM, INORGANIC SEDIMENT, LEAD, ZINC

Submittal Date: 8/3/2010 **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 for Pond Creek (formerly known as Tributary to Pond Creek) was formally submitted by the Missouri Department of Natural Resources (MDNR) in a letter received by the United States Environmental Protection Agency (EPA), Region 7, on August 3, 2010. Revisions to the TMDL document were sent by email on October 13, 2010 and December 20, 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.

Pond Creek (WBID 2128) in Washington County has historically been misnamed in Missouri's WQS and 303(d) Lists as "Tributary to" Pond Creek. Effective for MDNR on October 30, 2009, the name, as listed in 10 CSR 20-7.031, Table H, was changed to Pond Creek in order to agree with the stream as identified in the U.S. Geological Survey's Geographic Name Information System. Future Missouri 303(d) Lists will reflect this correction.

Another modification from previous 303(d) listings is a change by EPA on the 2004/2006 and 2008 303(d) Lists to include the entire classified segment length of one mile as impaired instead of the previous listing of only the upper 0.5 mile. In the 2008 303(d) List, the one-mile upper segment of Pond Creek (WBID 2128) is listed as impaired by inorganic sediment eroded from barite mine tailings.

Before modern mechanization, it was common in Washington County for people to hand-mine lead on their family property. Barite was thrown to the side along with other non-lead "waste." Barite, or barium sulfate, also known as "tiff," is a mineral. A barite tailings dam was originally identified as the source of Pond Creek's impairment. Old barite mining dams, such as those in the Pond Creek watershed, were built prior to the enactment of current safety laws administered by MDNR's Dam and Reservoir Safety Program. The barite mining companies were allowed to keep adding coarse rock to the top of the dams as a means of building up dam height to increase the size of the settling ponds. Due to the nature of the material used to build the dams, the dams themselves always seep water. The seeping water will often appear oily-looking due to bacteria metabolism of organics in clay. Portions or all of the downstream face of these dams remain barren even after decades, not necessarily because they are toxic, but because they lack the soil, nutrients and water retention needed to support plant life in the upper layers. When mining was active, water from a tailings pond was reused at the barite washer. Over time large deposits of red clays and gravels developed behind these dams, often as a deep layer the consistency of thick pudding. Barite tailings dams were not required to have both primary and

secondary spillways. If wash water went over the spillway before the suspended clay had time to settle out, overflows could contain suspended clay material that would subsequently be deposited in the bottom of receiving streams. If the open channels, which often served as the only spillway, experienced erosion, clays and gravels would be deposited downstream from that source as well. If the lake impounded by King Arthur's Dam was used for barite washing, both unsettled wash water and spillway erosion could be the source of the problem sediment when MDNR first added Pond Creek (as "Tributary to" Pond Creek) to the 1998 303(d) List.

Inorganic Sediment

The upper segment of Pond Creek was included on EPA-approved 1998 and 2002 Missouri 303(d) Lists for sediment and nonvolatile suspended solids (NVSS), respectively. The change from sediment to NVSS was to specify that the problem was due to mineral solids (e.g., silt, sand and gravel) coming from eroding mine waste materials and stockpiles. On the 2004/2006 and 2008 303(d) Lists, the pollutant, NVSS, was replaced with "inorganic sediment." Since NVSS and inorganic sediment have essentially the same meaning, the listing was changed to inorganic sediment to better characterize the impairment.

The water quality condition addressed in this TMDL includes sedimentation. The stream was placed on the 1998 Missouri 303(d) List primarily based on MDNR's multiple observations of instream conditions violating narrative water quality criteria in the form of sediments being deposited into the stream. Inorganic sediment is composed of mineral particles such as clay, silt, sand, assorted-sized rocks and other non-organic materials. These particles enter the stream via erosion of soils or other materials within the watershed. The deposited red clays constitute the inorganic sediment that impair Pond Creek. When these solids enter into a stream, they settle onto the bottom, smothering natural substrates (and interstitial spaces associated with that habitat), aquatic invertebrates and fish eggs.

Pond Creek Site #2 had significantly greater relative coverage of fine sediment than did the controls. Approximately 90 percent of the bedrock substrate at Site #2 was covered with a thin coating of fine sediment that seemed to be a reddish, clay-like material. Although the fine sediment coverage was much lower downstream at Pond Creek # 1, it was still higher than the controls. The quantity of fine sediment may have altered the macro invertebrate community in the upstream station and is considered a potential contributor to the assessed impairment.

When water quality criteria are expressed as a narrative, a measurable indicator of a pollutant may be selected to express the narrative as a numeric value. There are many quantitative indicators of sediment, such as total suspended solids (TSS), turbidity and bedload sediment, which are appropriate to describe sediment in rivers and streams. A concentration of TSS was selected to represent the numeric target for this TMDL because it enables the use of the highest quality available data and is included in permit requirements and monitoring data. This target was derived based on a reference approach by targeting the 25th percentile of all available measurements in the Ozark/Meramec ecological drainage unit (EDU) in which Pond Creek is located. Using this data, the 25th percentile of total suspended solids concentrations is 5 milligrams per liter (mg/L). This concentration is used as a numeric translator for the narrative inorganic sediment TSS standard.

The target for TSS was based on a load duration curve (LDC), which determines the TMDL for that parameter at every flow probability. The reduction in sediment protects the warm water aquatic life use of the stream, and the TMDL should result in WQS attainment.

A second target for inorganic sediment was developed as percent fine sediment. A percent fine sediment target of 15 percent was developed using the median of the 75th percentiles from each of the control sites on the reference streams of Shoal Creek and the West Fork of Huzzah Creek, which were similar in size and found to be fully supporting of aquatic life (i.e., meeting WQS), as measured by macroinvertebrate counts. The LC was developed based on the mass of fine sediment that could be contained within a bottom sediment sample of a given mass.

At the 50 percent flow exceedence, the LC for TSS inorganic sediment is 19.92 pounds per day (lb/day). For a 100 milligram (mg) bottom sediment sample, the LC would be less than 15 mg fine sediment.

Metals

The biological impairment of Pond Creek can also be attributed to elevated metals concentrations associated with fine sediment and water concentrations generated by the barite mining activities within the watershed. Concentrations of metals in the sediment and dissolved metals will also be targets for the Pond Creek TMDL.

While Pond Creek is not currently on the 303(d) List for cadmium, lead and zinc, MDNR recognizes that these metals in sediment (S) are causing or contributing to toxicity issues in the waterbody. Therefore, TMDLs for cadmium, lead and zinc in sediment and dissolved cadmium, lead and zinc in the water column are also included in this TMDL document.

Dissolved metals whether in the water column or in the sediment pores, pose a significant risk to aquatic life. Like other states, Missouri has not developed numeric criteria for bedded sediment. In order to understand the extent to which sediment toxicity could be contributing adverse effects to the aquatic environment in the Pond Creek watershed, equilibrium partitioning methodology was applied to estimate potential exposures in the water

column. These principles generally state that when a metal resides in sediment, it exists in equilibrium with pore water, and when physical-chemical properties are known, the partitioning behavior of the metal between the solid (sediment) and aqueous (pore water) phase can be predicted. Pore water is important because it is known that the majority of toxicity from dissolved lead and cadmium in an aquatic environment occurs in pore water.

Pore water in the sediment was also analyzed relative to Threshold Effect Concentrations (TECs). The TEC is the concentration of a substance below which adverse effects are not expected to occur. As such, TECs can provide an accurate basis for predicting the absence of sediment toxicity. For lead and zinc at both sampling sites, the results from Pond Creek indicate excursions over existing sediment quality guidelines. This is because, in the absence of promulgated numeric criteria for these metals in sediment, these concentrations exceed the consensus TECs.

Water column samples that were analyzed for dissolved lead all yielded concentrations of less than 1 microgram per liter (μg/L), which indicates a probability of low interaction between pore water and surface water. However, elevated pore water concentrations of heavy metals found represent significant risks for benthic organisms.

Bed sediment metal TMDLs for Pond Creek were developed using the results of the percent fine sediment LC curve and the metals equilibrium partitioning methodology. LCs were calculated based on the percent of a given sediment sample mass that could be composed of cadmium, lead and zinc such that the TEC levels for these metals was not exceeded. Because metals contamination in sediment is typically associated with the fine sediment fraction, the maximum LC for bed sediment metals should not be more than the allowable percentage of fine sediment in a given sample. To arrive at an acceptable concentration of bed sediment metals within a given sample, the fine sediment TMDL curve was multiplied by the metal-specific TEC.

The resulting bed sediment LC curves for cadmium, lead, and zinc represent the maximum amount of those metals allowed in a given sample where the entire allowable fine sediment fraction are fine sediment metals. As with the percent fine sediment load capacity, the bed sediment load capacity values for cadmium, lead, and zinc apply on any given day.

Pond Creek LDC were also developed for dissolved cadmium, lead and zinc. To best represent the average condition, the WQS for dissolved cadmium, lead and zinc were multiplied by the median daily flow across all flow conditions.

At the 50 percent flow exceedance, the LC for dissolved cadmium is 0.0014 lb/day, for dissolved lead is 0.00167 lb/day and for dissolved zinc is 0.6064 lb/day. The maximum amount of a metal in a 100 mg bottom sediment sample using the bed sediment LC curves are 1.485 X 10-6 mg for cadmium, 5.37 X 10-5 mg for lead and 0.001815 mg for zinc.

With these TMDL targets, WQS should be attained.

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.

Pond Creek (WBID 2128) has the following beneficial uses:
Livestock and Wildlife Watering
Protection of Warm Water Aquatic Life
Protection of Human Health (Fish Consumption)
Whole Body Contact Recreation - Category B

Use that is impaired:
Protection of Warm Water Aquatic Life

Inorganic Sediment

The impairment of Pond Creek is based on exceedence of the general, or narrative, criteria contained in Missouri's water quality rules at 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.

And from 10 CSR 20-7.031(4)(H):
(H) Solids. Water contaminants shall not cause or contribute to solids in excess of a level that will interfere with beneficial uses. The stream or lake bottom shall be free of materials which will adversely alter the composition of the benthos, interfere with the spawning of fish or development of their eggs or adversely change the physical or chemical nature of the bottom.

When water quality criteria are expressed as a narrative, a measurable indicator of a pollutant may be selected to express the narrative as a numeric value. A concentration of TSS was selected to represent the numeric target for this TMDL because it enables the use of the highest quality available data and is included in permit requirements and monitoring data.

The TSS target was derived based on a reference approach by targeting the 25th percentile of all available measurements in the Ozark/Meramec EDU in which Pond Creek is located. A percent fine sediment target of 15 percent was developed using the median of the 75th percentiles from each of the control sites on the reference streams. The LC relationship was developed based on the mass of fine sediment that could be contained within a bottom sediment sample of a given mass.

Metals
Toxic effects of metals on the biological community in Pond Creek are a violation of the general criteria at 10 CSR 20-7.031(D) that states:

(D) Waters shall be free from substances or conditions in sufficient amounts to result in toxicity to human, animal or aquatic life.

Also the WQS specific criteria for toxic substances found at 10 CSR 20-7.031(4)(B)1 states:

(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.

Current cadmium, lead and zinc criteria for the protection of aquatic life use are expressed in dissolved form in units of µg/L. These criteria are hardness dependent and calculated from the formulas shown below from Table A of 10 CSR 20-7.031 where "e" is the base of the natural logarithm (~2.718) and "ln" is the natural logarithm:

Dissolved Cadmium

Acute $= e^{(1.0166*\ln(\text{Hardness}) - 3.062490)} * (1.136672 - (\ln(\text{Hardness})*0.041838)) = \mu g/L$

Chronic $= e^{(0.7409*\ln(\text{Hardness}) - 4.719948)} * (1.101672 - (\ln(\text{Hardness})*0.041838)) = \mu g/L$

Dissolved Lead

Acute $= e^{(1.273*\ln(\text{Hardness}) - 1.460448)} * (1.46203 - (\ln(\text{Hardness})*0.145712)) = \mu g/L$

Chronic $= e^{(1.273*\ln(\text{Hardness}) - 4.704797)} * (1.46203 - (\ln(\text{Hardness})*0.145712)) = \mu g/L$

Dissolved Zinc

Acute $= e^{(0.8473*\ln(\text{Hardness}) + 0.884211)} * 0.978 = \mu g/L$

Chronic $= e^{(0.8473*\ln(\text{Hardness}) + 0.785271)} * 0.986 = \mu g/L$

The dissolved metals criteria are hardness dependent and the 25th percentile hardness value must be used to calculate hardness dependent dissolved metals criteria per 10 CSR 20-7.031(1)(Y) that states:

(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 quartile (twenty-fifth 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.

Using available hardness data with this formula results in the 25th percentile of hardness in the Pond Creek watershed being 160 mg/L.

LCs were calculated based on the percent of a given sediment sample mass that could be composed of cadmium, lead, and zinc such that the TEC levels for these metals was not exceeded. To calculate the acceptable concentration of bed sediment metals within a given sample, the fine sediment TMDL curve was then multiplied by the metal-specific TEC.

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.

Inorganic sediment

All inorganic sediment TMDL targets were set using established links. The TMDL links the narrative WQS to reductions in TSS and fine sediment.

When water quality criteria are expressed as a narrative, a measurable indicator of a pollutant may be selected to express the narrative as a numeric value. There are many quantitative indicators of sediment, such as TSS, turbidity and bedload sediment, which are appropriate to describe sediment in rivers and streams. A concentration of TSS was selected to represent the numeric target for this TMDL because it enables the use of the highest quality available data and is included in permit requirements and monitoring data. When narrative criteria are targeted for an impaired segment, a reference approach is used. Currently, Missouri does not have a numeric criterion for inorganic sediment. Because a measurement of TSS concentration is the sum of all organic and inorganic suspended solids, inorganic sediment concentration in the water column is at most equal to that of TSS. Assuming the ratio of inorganic sediment to TSS is constant for a particular watershed and during a specific event, any reduction in one would parallel that of the other. TSS concentration may be used as the target for the inorganic sediment impairment.

This TSS target was derived based on a reference approach by targeting the 25th percentile of all available measurements in the Ozark/Meramec EDU in which Pond Creek is located. EDUs are delineated drainage units that are described by physiographic and major riverine components. Similar size streams within an EDU are expected to contain similar aquatic communities and stream habitat conditions. Comparisons of biological, physical and chemical results between test streams and similar size reference streams within the same EDU should then be appropriate. In the case of Pond Creek, data from the Ozark/Meramec Ecological Drainage Unit (No. 25) was used. Using this data, the 25th percentile of total suspended solids concentrations is 5 mg/L. This concentration is used as a numeric translator for the narrative inorganic sediment TSS standard.

The target for TSS was based on a LDC, which determines the TMDL for that parameter at every flow probability. The reduction in sediment protects the warm water aquatic life use of the stream and the TMDL should result in WQS attainment.

A secondary target for inorganic sediment was developed as percent fine sediment. The fine sediment target of 15 percent was developed using the median of the 75th percentiles from each of the control sites on the reference streams. The LC curve was developed based on the mass of fine sediment that could be contained within a bottom sediment sample of a given mass.

At the 50 percent flow exceedence, the LC for inorganic sediment (i.e., TSS) is 19.92 lb/day. For a 100 mg bottom sediment sample, the LC would be less than 15 mg fine sediment.

Metals

The biological impairment of Pond Creek can also be attributed to elevated metals concentrations associated with fine sediment generated by the barite mining activities within the watershed. Concentrations of metals in sediment and dissolved metals will also be targets for the Pond Creek TMDL.

Established LCs were calculated based on the percent of a given sediment sample mass that could be composed of cadmium, lead and zinc such that the TEC levels for these metals was not exceeded. To calculate the acceptable concentration of bed sediment metals within a given sample, the fine sediment TMDL curve was then multiplied by the metal-specific TEC.

Examples of Bottom Sediment TMDL at 100 mg Mass of Sample

Mass of Sample (mg)	TMDL Mass Fine Sediment (mg)	TMDL Mass Cadmium (mg)	TMDL Mass Lead (mg)	TMDL Mass Zinc (mg)
100	15	0.00001485	0.000537	0.001815

Pond Creek LDC using a direct relationship to existing WQS were also developed for dissolved cadmium, lead and zinc. To best represent the average condition, the WQS for dissolved cadmium, lead and zinc were multiplied by the median daily flow across all flow conditions. Values for cadmium, lead, and zinc apply on any given day.

At the 50 percent flow exceedence, the LC for dissolved cadmium is 0.0014 lb/day, for dissolved lead is 0.00167 lb/day and for dissolved zinc is 0.6064 lb/day. The maximum amount of a metal in a 100 mg bottom sediment sample using the bed sediment LC curves are 0.00001485 mg for cadmium, 0.000537 mg for lead and 0.001815 mg for zinc.

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.

Point Sources

There are currently no permitted dischargers (facilities, storm water outfalls or concentrated animal feeding operations [CAFOs]) within the Pond Creek watershed that cause or contribute inorganic sediment or metals to the impaired segment. However, active and abandoned mine areas can be classified as point sources due to the nature of mining and milling activities, regardless if they are currently covered by a discharge permit. The abandoned mine land (AML) areas in the watershed may collectively be considered a point source even though there is no longer a State Operating Permit issued.

AML: A search of MDNR's records did not produce a record of this area or dams ever being under permit by the Missouri State Operating Permit program. While barite mining activities have ceased and the area is not under permit, the entire barite mining area is considered a point source of the pollutants of concern. Inclusion of the abandoned barite mining areas in the point source and WLA sections of the Pond Creek TMDL does not give these areas permission to discharge. Mine tailings historically released from Blue Heron Dam and possibly King Arthur's Dam, are thought to have been the main contributor of inorganic sediment to the impaired water body segment. This belief is reflected in Missouri's 303(d) lists that identify a "barite tailings pond" as the source of Pond Creek's impairment. Eroded sediment from King Arthur's Dam itself may also have contributed to the impairment. As a result, this TMDL includes an assessment of the dams as to their past and current state-permitted status, as well as their condition and stability.

Blue Heron Dam (Dam Safety Identification No. MO 30478; Permit R-282) currently impounds a 37-acre lake in the uppermost headwaters of Pond Creek. The dam, located almost due east of the town of Mineral Point, was first started in 1946, to facilitate the washing of locally-mined barite. The crest of the dam continued to be built higher in elevation until 1969. Should Blue Heron Dam discharge, which is unlikely considering the shallow nature of the impoundment, it would do so almost immediately downstream into the reservoir impounded by King Arthur's Dam. As a result, any load from the Blue Heron Dam would be included in loads from the downstream reservoir impounded by King Arthur's Dam.

King Arthur's Dam, also known as Pond Creek Dam (Dam Safety ID No. MO 31825; Registration Permit No. R-283), is the lower of the two dams in Pond Creek's headwaters, and currently impounds a 33-acre lake. The dam is located a little more than a mile east of the town of Mineral Point. The dam embankment was built in 1980 to impound water to be used for wash water and as a settling basin to support the local barite mining operation.

The primary cause of the inorganic sediment and metals impairment to Pond Creek was originally identified on Missouri's 303(d) lists as a barite tailings dam. Mining in the area may have stopped over 20 years ago and King Arthur's Dam upper slope and spillways were reworked in 2003. There are still bare areas associated with the lower dam slope and the areas to either side of the dam. As a result, AMLs are still thought to be one of the contributors to the continued impairment.

Nonpoint Sources

In addition to the point sources of inorganic sediment described above, pollutant sources associated with present and historic abandoned mine areas could be causing or contributing to the impairment of Pond Creek. These areas include storm water runoff from public and private roads and driveways, home construction sites and any areas where local soils are barren of vegetation.

Significant inorganic sediment suspension and re-deposition can occur during and immediately following high-flow storm events. This process allows previously unavailable inorganic sediment to enter the water column and become a water quality concern as a secondary source of contamination. It is probable that sediment loading of the stream occurs mainly during high flow events that have not been captured by water quality sampling.

Onsite wastewater treatment: Onsite wastewater treatment systems (e.g., individual home septic systems) are considered potential nonpoint sources of pollution. When onsite wastewater treatment systems are properly designed and maintained, they should not serve as a source of contamination to surface waters. When these systems fail hydraulically (surface breakouts) or hydrogeologically (inadequate soil filtration), there can be adverse effects to surface water quality. Failing septic systems are sources of nutrients that can reach nearby streams through both surface runoff and ground water flows. They are not known to be large contributors of inorganic sediment or metals to local streams and therefore is insignificant and will not be addressed in this TMDL.

Urban storm water runoff: Storm water runoff from urban areas can be a significant source of inorganic sediment. There are no urban centers within the Pond Creek watershed. The land use map for the Pond Creek watershed does portray 3 percent of the land use being urban, but these areas are likely represented by roads, private homes and other buildings and impervious surfaces associated with the homes in the watershed. True urban areas are not contributing to Pond Creek's impairment for either inorganic sediment or metals.

Agricultural nonpoint sources: Another potential source of the inorganic sediment impairment to Pond Creek is runoff from agricultural nonpoint sources. Anywhere land is exposed, soil is vulnerable to erode and can be carried by storm water into a stream, resulting in increased turbidity and inorganic sediment concentrations. Cropland is particularly vulnerable to erosion. However, since only 0.7 percent (20 acres) of land use in the watershed is in cropland, it is not believed to be a significant contributor to the inorganic sediment impairment of Pond Creek. Agricultural activities generally do not contribute metals to runoff so it is believed it is not a significant contributor.

Countywide data from the National Agricultural Statistics Service (NASS) were combined with the size of the Pond Creek watershed to estimate that there could be up to 60 cattle in the watershed. The cattle that exist are most likely located on the approximately 218 acres (7.6 percent of land use) of grassland and pastureland in the watershed. There were over 1,000 horses and ponies in Washington County as well; Their grazing densities also have the potential to influence inorganic sediment entering the stream.

Although there are no state-permitted CAFOs in the watershed, the presence of lower density livestock populations must be considered as a possible source of the inorganic sediment load in Pond Creek. Livestock tend to concentrate near feeding and watering areas causing those areas to become barren of plant cover, thereby increasing the possibility of erosion during a storm event. Overland runoff during rain events can easily carry inorganic sediment to the stream from any areas made barren by livestock related activities.

AFOs and unpermitted CAFOs are considered under the LA because we do not currently have enough detailed information to know whether these facilities are required to obtain NPDES permits. This TMDL does not reflect a determination by EPA that such facility does not meet the definition of a CAFO nor that the facility does not need to obtain a permit. To the contrary, a CAFO that discharges or proposes to discharge has a duty to obtain a permit. If it is determined that any such operation is an AFO or CAFO that discharges, any future WLA assigned to the facility must not result in an exceedance of the sum of the WLAs in this TMDL as approved.

Any CAFO that does not obtain a national pollutant discharge elimination system (NPDES) permit must operate as a no discharge operation. Any discharge from an unpermitted CAFO is a violation of Section 301. It is EPA's position that all CAFOs should obtain an NPDES permit because it provides clarity of compliance requirements, authorization to discharge when the discharges are the result of large precipitation events (e.g., in excess of 25-year and 24-hour frequency/duration) or are from a man-made conveyance.

Riparian: Well-vegetated riparian areas act as buffers and are a vital functional component of stream ecosystems and are instrumental in the detention, removal and assimilation of sediment, excess nutrients and other pollutants before they reach a stream. A stream with a well-vegetated riparian corridor is better protected from the impacts of storm water laden with sediment, nutrients and pesticides than is a stream with a poorly

vegetated corridor. Wooded riparian corridors can also provide shade that reduces stream temperatures, which can increase the dissolved oxygen saturation capacity of the stream and provide tree roots that stabilize stream banks and resist bank erosion more effectively than grasses, row crops or shrubbery. Almost 56 percent of the land in the upper Pond Creek riparian corridor is classified as grassland, which could include pasture areas. Grassland provides limited benefits in riparian corridors compared to wooded corridors and, since it may be grazed, can also be associated with livestock activities that could contribute inorganic sediment to the stream. Forest and woodland comprise 84.2 percent of the land use. Open water and wetlands is 3.9 percent and barren is 0.2 percent of the land use in this watershed. A lack of good riparian corridor conditions is not likely a major contributor to the water quality problem in Pond Creek.

Storm water runoff: Nonpoint pollution sources could include storm water runoff from public and private roads and driveways, home construction sites and any areas where local soils are barren of vegetation. The most likely possible nonpoint sources of inorganic sediment entering Pond Creek include: Local "Tiff" soil series and Washington County roads.

Local Tiff soil series
These deep, red soils are ubiquitous in the area and regardless of past mining activity, provide a continuous source of erodible material. A certain amount of sediment enters the stream naturally due to normal fluvial processes and accounts for a natural background level of inorganic sediments. The existing, ubiquitous soil type is prone to erosion and transport.

Washington County roads
Many of the local roads in the watershed, whose associated ditches eventually drain into Pond Creek, remain unpaved. These roads are built of local soils and materials, much of which is vulnerable to erosion. Pond Creek Road, which crosses Pond Creek just downstream (north) of King Arthur's Dam, is presently blacktopped. The small, county road that runs along the east side of King Arthur's Dam to the current landowner's residence and to a local cemetery, is not blacktopped. This road begins at Pond Creek Road (County Road 425), just east of the Pond Creek Road bridge. It travels up a steep hill along the east side of the dam and past the landowner's home. Storm water carrying red sediment has been observed running down and off this road into the Pond Creek road ditches and into Pond Creek, both upstream and downstream of the Pond Creek Road bridge. In the process, fine particles settled out on the road surface where they are vulnerable to washing into the creek during the next precipitation event. The steepness of the roads and the material on which they are built both contribute to vulnerability to erosion during precipitation events. Additionally, Washington County road maintenance practices on this unpaved road include addition of a mixture of rock and clay to the top of the road two to three times per year. Although the clay fraction of the material used may have been reduced in the northern part of Washington County, the current landowner of the King Arthur's Dam property reports that the added material turns to a two- to four-inch layer of mud when it rains, and the sediment-loaded storm water routinely enters Pond Creek above and below Pond Creek Road bridge. The road ditches can carry locally eroded soil material from the roads themselves, as well as from any local land disturbance activities, directly to Pond Creek. Regardless of whether or not the roads are surfaced, periodic county road maintenance includes opening up the ditches that run along both sides of the roads. Although the majority of the removed material is trucked away, it exposes freshly turned over deposits of clay soils to storm water erosion and may serve as another source of this material.

As described in the preceding sections, abandoned barite mine areas and the ubiquitous Tiff soil series are considered the primary source of inorganic sediment and metals loading resulting in the impairment of Pond Creek. Because historic distributions of abandoned mine areas and the Tiff soil series cannot be definitively determined, these areas are collectively lumped into the point source WLA portion of the TMDL. In addition, any activities within the watershed that may disturb, redisturb, redistribute or reuse either the barite mine tailings or Tiff soils will be considered to be part of the point source wasteload allocation for TMDL purposes.

In the absence of an NPDES permit, the discharges associated with sources were applied to the LA, as opposed to the WLA, for purposes of this TMDL. The decision to allocate these sources to the LA does not reflect any determination by EPA as to whether these discharges are, in fact, unpermitted point source discharges within this watershed. In addition, by establishing these TMDLs with some sources treated as LAs, EPA is not determining that these discharges are exempt from NPDES permitting requirements. If sources of the allocated pollutant in this TMDL are found to be, or become, NPDES-regulated discharges, their loads must be considered as part of the calculated sum of the WLAs in this TMDL. WLA in addition to that allocated here is not available.

All known sources have been considered.

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.

Inorganic sediment
The TSS target was derived based on a reference approach by targeting the 25th percentile of all

available measurements in the Ozark/Meramec EDU in which Pond Creek is located. A percent fine sediment target of 15 percent was developed using the median of the 75th percentiles from each of the control sites on selected reference streams. The LC relationship was developed based on the mass of fine sediment that could be contained within a bottom sediment sample of a given mass.

At the 50 percent flow exceedance, the LC for inorganic sediment (i.e., TSS) is 19.92 lb/day. For a 100 mg bottom sediment sample, the LC would be less than 15 mg fine sediment.

Metals

Pond Creek LDC using a direct relationship to existing WQS were also developed for dissolved cadmium, lead and zinc. To best represent the average condition, the WQS for dissolved cadmium, lead and zinc were multiplied by the median daily flow across all flow condition values for cadmium, lead and zinc apply on any given day.

Established LCs were calculated based on the percent of a given sediment sample mass that could be composed of cadmium, lead and zinc such that the TEC levels for these metals was not exceeded. To calculate the acceptable concentration of bed sediment metals within a given sample, the fine sediment TMDL curve was multiplied by the metal-specific TEC.

At the 50 percent flow exceedance, the LC for dissolved cadmium is 0.0014 lb/day, for dissolved lead is 0.00167 lb/day and for dissolved zinc is 0.6064 lb/day. The maximum amount of a metal in a 100 mg bottom sediment sample using the bed sediment LC curves are 0.00001485 mg for cadmium, 0.000537 mg for lead and 0.001815 mg for zinc.

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.

Due to the minor contribution of inorganic sediment and metals from nonpoint sources within the watershed, it is reasonable to allocate the entire LC to point sources. The WLA for bedded sediment and metals in sediment must be met at any point in each segment. Since the identified point sources are historic AML properties, they do not have current NPDES permit numbers.

Inorganic sediment

For percent fine sediment cover in the stream bed, the anticipated WLA reduction from the point source (AMLs) was calculated by subtracting the median of the 75th percentile for cover in the control streams from the central median percent cover in Pond Creek (61 percent). However, while a WLA was calculated for the unpermitted AML, any allocation given does not reflect an authorization to discharge from an unpermitted point source.

TSS (10 percent MOS)
WLA (4.36 lb/day) = TMDL (4.85 lb/day) – MOS (0.49 lbs/day) – LA (0.0 lb/day)

Fine sediment (implicit MOS) for a 100 mg bottom sediment sample
WLA (15 mg) = TMDL (15 mg) - LA (0.0 mg)

Metals

Established LCs were calculated based on the percent of a given sediment sample mass that could be composed of cadmium, lead and zinc such that the TEC levels for these metals was not exceeded. To calculate the acceptable concentration of bed sediment metals within a given sample, the fine sediment TMDL curve was then multiplied by the metal-specific TEC.

For example at the 90 percent flow exceedance WLAs for dissolved metals are:

Cadmium (implicit MOS)
WLA (0.0003 lb/day) = TMDL (0.0003 lb/day) – LA (0.0 lb/day)

Lead (implicit MOS)

WLA (0.0041 lb/day) = TMDL (0.0041 lb/day) – LA (0.0 lb/day)

Zinc (implicit MOS)
WLA (0.1477 lb/day) = TMDL (0.1477 lb/day) – LA (0.0 lb/day)

It should be noted, that while a WLA has been calculated for point sources, including any unpermitted abandoned mines, 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 MDNR's permit application and antidegradation processes and will be evaluated in light of this TMDL.

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 is zero for inorganic sediment, fine sediment, metals in sediment and dissolved cadmium, lead and zinc due to negligible nonpoint source loading of these pollutants.

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.

This TMDL relies on both implicit and explicit MOS derived from a variety of calculations and assumptions.

Inorganic sediment

Due to the lack of available inorganic sediment data, an explicit MOS of 10 percent was applied when deriving the inorganic sediment TMDL. The margin of safety for percent fine sediment was also implicit because the WLA percent reduction targets the 75th percentile of the reference population frequency distribution.

Metals

In deriving the cadmium, lead and zinc in sediment TMDLs, an implicit MOS was applied by using the TEC for these metals in sediment. TECs should be used to identify sediments that are unlikely to be adversely affected by sediment-associated contaminants. In contrast, the Probable Effects Concentration (PEC) should be used to identify sediments that are likely to be toxic to sediment dwelling organisms. TEC for metals toxicity in sediment was chosen over PEC because it is a level below which no toxicity should occur and is thus protective of chronic and sub-chronic exposure. The conservative assumptions and factors used in this method should account for any uncertainties in the loading calculations.

In deriving the dissolved cadmium, lead and zinc TMDLs, an implicit MOS was applied by using chronic water quality criteria for these metals and using the resulting values for both water column and interstitial water (porewater) targets.

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.

Federal regulations at 40 CFR §130.7(c)(1) require TMDLs take into consideration seasonal variation in applicable standards. The impairment of Pond Creek is due to inorganic sediments and associated metals being carried into the water body through storm water runoff. These conditions are more likely to occur during seasonal periods having significant precipitation. The TMDL LDC represents flow under all possible stream conditions. The advantage of a LDC approach is that it avoids the constraints associated with using a single flow critical condition during the development of the TMDL. Because the TMDL is applicable under all flow conditions, it is also applicable for all seasons. Seasonal variation is therefore implicitly taken into account within the TMDL calculations.

Annual low-flow conditions in Missouri typically occur between July 1 and September 15. When flow is at its lowest, and there is effectively no flow from nonpoint sources, point source discharges would have the greatest impact on stream integrity. Significant inorganic sediment suspension and re-deposition can occur during and immediately following high-flow storm events. This process allows previously unavailable inorganic sediment to enter the water column and become a water quality concern as a secondary source of contamination. It is probable that sediment loading of the stream occurs mainly during high flow events that have not been captured by water quality sampling.

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)].

EPA regulations require that TMDLs be subject to public review (40 CFR 130.7). The comment period for the Pond Creek TMDL, was open for 45 days, from June 8 to July 23, 2010, by placing a Public Notice, the draft TMDL and the associated TMDL Information Sheet on MDNR's Website, making them available to anyone with access to the Internet. Public notices to comment on the draft TMDL were also distributed via mail and electronic mail to stakeholders in the watershed or other potentially impacted parties. Two comments were received and the TMDL was adjusted accordingly.

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].

A sediment and biological monitoring study was completed for Pond Creek in the spring of 2009. MDNR intends to conduct follow up biological monitoring on Pond Creek to confirm the status of the macroinvertebrate community. Biomonitoring is scheduled for both segments of this stream for the 2011 State Fiscal Year, along with monitoring for heavy metals in sediment. Any additional water quality data that is collected in the Pond Creek watershed will be evaluated in light of this TMDL.

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.

EPA believes that point source permitting authority and nonpoint source measures discussed in the implementation plan provides reasonable assurances that the TMDL allocations can be achieved.

Increased reductions in nonpoint source loads are not being required in lieu of less stringent WLAs. There are no permitted point source discharges of inorganic sediment and heavy metals within the Pond Creek watershed. The abandoned barite mine lands are considered a point source for the purposes of this TMDL. WLAs to improve water quality may be incorporated into any future Missouri State Operating Permit (either site specific industrial or storm water) or other appropriate enforceable document.

MDNR has the authority to issue and enforce state operating permits. Inclusion of effluent limits into a state operating permit and requiring that effluent and instream monitoring be reported to MDNR should provide reasonable assurance that instream WQS will be met. Section 301(b)(1)(C) requires that point source permits have effluent limits as stringent as necessary to meet WQS. However, for WLAs to serve that purpose, they must themselves be stringent enough so that (in conjunction with the water body's other loadings) they meet WQS. This generally occurs when the TMDL's combined nonpoint source LAs and point source WLAs do not exceed the WQS-based LC and there is reasonable assurance that the TMDL's allocations can be achieved. Discussion of reduction efforts relating to nonpoint sources can be found in the implementation section of the TMDL.

Past barite mining in the Pond Creek watershed left a legacy of related land disturbance, including creation of barite tailings dams. When it rains, the water suspends the fine particles of sediment and metals and carries them to the waterways in the watershed. These particles impair aquatic life due to metals toxicity and/or through loss of habitat due to excessive sedimentation. The following implementation strategies should be considered to ensure the improvement of water quality within the Pond Creek watershed addressed by this TMDL.

Pond Creek is in the Washington County Lead District – Potosi National Priority Listing (Superfund) site. The site encompasses an area greater than 45 square miles in the eastern portion of Washington County, Missouri. Soil and/or groundwater are contaminated with arsenic, barium, cadmium and lead resulting from mining, milling and smelting activities. A Remedial Investigation (RI) was initiated in January 2008. The RI will characterize

the numerous tailings ponds and streams, determine the extent of groundwater contamination and characterize the residential surface soil. Superfund remedial actions may impact Pond Creek.

Local unpaved roads are constructed in the ubiquitous Tiff soil type and are thus potential sources of the sediment in Pond Creek. The county is encouraged to continue to follow BMPs when conducting road maintenance involving the Tiff soil series in order to minimize disturbance and subsequent contributions of sediment to Pond Creek.

Nonpoint source reductions are currently not necessary to reduce pollutant loading of inorganic sediment and metals to the Pond Creek watershed. Reductions obtained by implementing the WLAs found in this TMDL should restore water quality in Pond Creek. However, BMPs employed within the watershed must continue to be implemented to ensure antidegradation requirements are met. Further nonpoint source reductions in the watershed may be implemented in the future through BMPs funded wholly or in part by Section 319 grants or various cost-share opportunities available through MDNR's Soil and Water Conservation Program and the federal Natural Resources Conservation Service.

Field observation and inventory of the area would be needed to determine whether or not all grassland areas in the watershed are grazed, the condition of that grassland, and if the extrapolated rate of 0.28 cattle per acre is accurate. However, physically canvassing an entire watershed would likely require manpower and landowner consent beyond MDNR's means. The information needed to make this assessment may or may not be available through the local Soil and Water Conservation District (SWCD) or Natural Resources Conservation Service office. This only applies if landowners voluntarily enrolled and participated in the available programs and adopted associated best BMPs to reduce soil loss using cost-share. Considering the soil type in the immediate watershed, adoption of BMPs to ensure adequate erosion control in grazing areas would be prudent.