



EPA Region 7 TMDL Review

TMDL ID:MO_3118

State: MO

Document Name: BUFFALO DITCH

Basin(s): ST. FRANCIS-LITTLE RIVER DITCHES RIVER BASIN

HUC(s): 08020204, 8020204

Water body(ies): BUFFALO DITCH

Tributary(ies):

Pollutant(s): BIOCHEMICAL OXYGEN DEMAND, LOW DISSOLVED OXYGEN,
TOTAL NITROGEN, TOTAL PHOSPHORUS, TOTAL SUSPENDED SOLIDS

Submittal Date:1/12/2010

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.

This TMDL document was formally submitted by the Missouri Department of Natural Resources (MDNR). The United States Environmental Protection Agency (EPA) received this document by mail on January 12, 2010. Revisions to this document were received by email on February 23, 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.

The Buffalo Ditch TMDL was developed to address the low dissolved oxygen (DO) impairment of Buffalo Ditch segment MO_3118. A TMDL is needed for Buffalo Ditch because it is not meeting the water quality criterion for DO. Low DO is an issue because concentrations have been measured at less than the water quality criterion of 5 milligrams per liter (mg/L). DO in streams may be affected by several factors including water temperature, the amount of decaying organic matter in the stream, turbulence at the air-water interface, and the amount of photosynthesis occurring in plants within the stream. Organic matter can come from wastewater effluent as well as agricultural and urban runoff, and the rate at which it decays and consumes oxygen is typically measured instream as biochemical oxygen demand (BOD). Nitrogen and phosphorus can also contribute to low DO problems because they can accelerate algae growth in streams. Algae growth in streams is most frequently assessed based on the amount of chlorophyll a in the water. The algae consume DO during respiration at night and have the potential to remove large amounts of DO from the stream. The breakdown of dead, decaying algae also removes oxygen from water.

Pollutants which result in oxygen concentrations below saturation are fine particle size bottom sediment, high nutrient levels (nitrogen and phosphorus), and suspended particles of organic matter. Because these three pollutants vary to a large extent based on anthropogenic influences, they are appropriate targets for a TMDL written to address an impairment of low DO.

To address nutrient levels, the EPA nutrient ecoregion reference concentrations were used. For the ecoregion where Buffalo Ditch is located, the reference concentration for total nitrogen (TN) is 0.82 mg/L, and the

reference concentration for total phosphorus (TP) is 0.125 mg/L. This TMDL will not specifically target chlorophyll a, but will use a linkage between nutrient concentrations and chlorophyll a response to achieve the ecoregion reference concentrations.

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. TSS was selected as one of the numeric targets for this TMDL because it enables the use of the highest quality data available, including permit conditions and monitoring data.

The TMDLs for TN, TP, and TSS were determined using load duration curves (LDCs). These reductions in nutrients and sediment protects the warm water aquatic life use of the stream and the TMDLs should result in WQS attainment. The LC for TN and TP is defined by a LDC set at the ecoregion reference concentrations. The LC for TSS is defined by a LDC set at the 25th percentile of TSS measurements available in the ecological drainage unit (EDU). The LCs for TN, TP, and TSS at the 60 percent flow exceedance are 20.75 pounds per day (lbs/day), 3.14 lbs/day, and 846.45 lbs/day, respectively.

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.

The water quality criterion for DO for all Missouri streams, except cold water fisheries, is a daily minimum of 5 mg/L (10 CSR 20-7.031 Table A).

The designated beneficial uses of Buffalo Ditch are:

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

The use that is impaired is Protection of Warm Water Aquatic Life.

To address nutrient levels, the EPA nutrient ecoregion reference concentrations were targeted. To address TSS the 25th percentile of TSS measurements available in the EDU were targeted. The TMDL LDC's represent 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 and is applicable under all flow conditions. The LCs for TN, TP, and TSS at the 60 percent flow exceedance are 20.75 lbs/day, 3.14 lbs/day, and 846.45 lbs/day, respectively.

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 data available suggests that high nutrient loads are contributing to excessive algal growths in Buffalo Ditch. The excessive algal growths, in turn, are causing low DO to occur late at night when the algae are consuming but not producing oxygen. Large amounts of algae may also be contributing to low DO when the plants die and decay. The Kennett Wastewater Treatment Plant (WWTP) is contributing to the high nutrient loads but there might also be contributions from other upstream sources. To address nutrient levels, the EPA nutrient ecoregion reference concentrations were used. For the ecoregion where Buffalo Ditch is located, the reference concentration for TN is 0.82 mg/L, and for TP is 0.125 mg/L. The LC for TN and TP is defined by LDCs set at the ecoregion reference concentrations. An established link between nutrient concentrations and chlorophyll a response was used to achieve the ecoregion reference concentrations and define this TMDL as a numeric value.

Another essential component of developing a TMDL is establishing a relationship between the source loadings and resulting water quality. For this TMDL, the relationship between the source loadings of BOD and nutrients

on DO is generated by the water quality model QUAL2K. The processes employed in QUAL2K address nutrient cycles, algal growth, and DO dynamics. The WLA for BOD was derived from the QUAL2K modeling run that resulted in meeting WQS.

A TMDL establishing an allocation for suspended solids was developed. In cases where sufficient pollutant data for the impaired stream is not available a reference approach is used. In this approach, the target for pollutant loading is the 25th percentile of the EDU condition calculated from all data available within the EDU in which the water body is located. The LC for TSS is defined by a LDC set at the 25th percentile of TSS measurements available in the EDU. An established link between TSS and sediment was used to define this TMDL as a numeric value.

The WLA, LA, and MOS for all pollutants are set to not exceed the LC. Reductions in concentration for all pollutants should ensure the DO WQS of 5 mg/L is met.

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.

There are seven facilities in the Buffalo Ditch watershed that have national pollutant discharge elimination system (NPDES) permits through the state of Missouri. Two of the permits within the watershed are site specific, one is a general permit, and four are storm water permits.

PERMITS		
Facility	Permit Number	Design Flow Million Gallons/Day
Kennett WWTP	MO0028568	1.40
Senath WWTP	MO0048666	0.256
Kennett Water Plant Settling Basin	MOG640095	General Permit
Kennett MS4	MOR040069	Storm Water Permit
Producers Mid-South	MOR12A030	Storm Water Permit
Manac Trailer USA Inc	MOR203401	Storm Water Permit
UAP Mid-Senath	MOR240473	Storm Water Permit

Illicit straight pipe discharges of household waste are potential point sources in agricultural areas. These are discharges straight into streams or land areas and are different than illicitly connected sewers. There is no specific information on the number of illicit straight pipe discharges of household wastes in the Buffalo Ditch watershed.

Failing septic systems are sources of nutrients that can reach nearby streams through both surface runoff and ground water flows. The exact number of onsite wastewater systems in the Buffalo Ditch watershed is unknown. An estimate was made based on approximately 770 people in the rural watershed area with 2.4 persons per household gives 320 systems potentially.

Storm water runoff from urban areas can be a significant source of nutrients and oxygen consuming substances. Lawn fertilization can lead to high nutrient loads, and pet wastes can contribute both nutrient loads and oxygen-consuming substances. Phosphorus loads from residential areas can be comparable to or higher than loading rates from agricultural areas. Warmer storm runoff from urban areas such as parking lots and buildings can lead to higher water temperatures that lower the DO saturation capacity of streams. Excessive discharge of suspended solids from urban areas can also lead to streambed siltation problems. Since approximately six percent of the Buffalo Ditch watershed is classified as urban, including the area immediately upstream of the impaired segment, urban storm water runoff is considered a potentially significant source of substances and conditions contributing to low DO. Kennett's municipal separate storm sewer system (MS4) permit accounts for 9.1 percent of the watershed. Most of the nonpoint source urban runoff within the watershed likely comes from Senath municipal area and from roads outside the Kennett incorporated area. Approximately ten percent of the riparian corridor is within urban areas.

Lands used for agricultural purposes can be a source of nutrients and oxygen-consuming substances. Accumulation of nitrogen and phosphorus on cropland occurs from decomposition of residual crop material, fertilization with chemical and manure fertilizers, atmospheric deposition, wildlife excreta, and irrigation water. The land use/land cover data indicates that approximately 91 percent of the watershed consists of cropland and nearly 86 percent of the riparian corridor along Buffalo Ditch is classified as cropland. Since cropland covers a significant portion of the watershed, runoff from these areas could be an important source of the oxygen-consuming substances. All other types of land use (e.g., barren, herbaceous, open water, forest, and wetland) make up less than one percent of the watershed land uses and 2.5 percent of the riparian corridor.

Riparian areas can be sources of natural background material that could possibly contribute to the low DO problem. Leaf fall from vegetation near the water's edge, aquatic plants, and drainage from organically rich areas like swamps and bogs are all natural sources of materials that consume oxygen.

There are no state-permitted concentrated animal feeding operations (CAFOs) in the watershed, but the presence of lower density livestock populations could be contributing to the nutrient and sediment loads in Buffalo Ditch. The cattle are most likely located on the approximately 726 acres of grassland/pastureland in the watershed, and runoff from these areas can be potential sources of nutrients and oxygen-consuming substances. Animals grazing in pasture areas deposit manure directly upon the land surface and, even though a pasture may be relatively large and animal densities low, the manure will often be concentrated near the feeding and watering areas in the field. These areas can quickly become barren of plant cover, increasing the possibility of erosion and contaminated runoff during a storm event. Grassland makes up two percent of the watershed landuse and riparian corridor.

Based on the information before us, the states decision to apply the discharges associated with unpermitted sources to the LA, as opposed to the WLA for purposes of this TMDL, is acceptable. 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 approving 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 WLA in this TMDL. WLA in addition to that allocated here is not available.

Any CAFO that does not obtain an 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. However, many large CAFOs (mostly the poultry and swine sectors) contend that they do not discharge nor propose to discharge therefore are not required to obtain an NPDES permit. It is EPA's opinion that many of the "no discharge" CAFOs do not have adequate land application area to ensure the agronomic uptake of land applied waste or are not designed, constructed, operated, or maintained so that they do not discharge or propose to discharge. Furthermore, there are many animal feeding operations (AFOs) that meet the definition of a medium CAFO (i.e., discharge via a man-made conveyance) but are unpermitted and have not limited their impact on waters by applying Best Professional Judgment to effluent reductions.

Any permitted CAFOs identified in this TMDL would have been assigned WLA. 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.

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.

The LC for TN, TP, and TSS at the 60 percent flow exceedance are 20.75 lbs/day, 3.14 lbs/day, and 846.45 lbs/day, respectively. For TN, TP, and TSS: the MOS is implicit, the LAs are zero at low flow, and the sum of the WLA and LA do not exceed the LC.

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 WLAs for TN, TP, and TSS were derived from the load duration curves at low flow, when inputs are set at the Kennett WWTP design flow of 2.17 cubic feet per second.

The TN WLA for the city of Kennett's WWTP is 8.90 lbs/day at all flow conditions. The TN sum WLA for all other permits is 1.61 lbs/day. The TN WLA for the city of Kennett's MS4 varies with flow. As an example, at the 60 percent flow exceedance the MS4 WLA is 0.93 lbs/day.

The TP WLA for the city of Kennett's WWTP is 1.35 lbs/day at all flow conditions. The TP sum WLA for all other permits is 0.24 lbs/day. The TP WLA for the city of Kennett's MS4 varies with flow. As an example, at the 60 percent flow exceedance the MS4 WLA is 0.14 lbs/day.

The TSS WLA for the city of Kennett's WWTP is 362.92 lbs/day at all flow conditions. The TSS sum WLA for all other permits is 65.56 lbs/day. The TSS WLA for the city of Kennett's MS4 varies with flow. As an example, at the 60 percent flow exceedance the MS4 WLA is 38.04 lbs/day.

The BOD WLA for the city of Kennett's WWTP is set at 58.5 lbs/day. The WLA for BOD was derived from the QUAL2K modeling that resulted in meeting WQS.

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 LAs for the Buffalo Ditch TMDL are for all nonpoint sources of TN, TP, and TSS. The LAs were calculated based on the total of all headwater and lateral inflow loads used in the QUAL2K model for the allocation scenario model run. The LAs are intended to allow the DO target to be met at all locations within the stream.

As an example, at the 60 percent flow exceedance the LA for TN is 9.31 lbs/day, for TP is 1.41 lbs/day, and for TSS 379.93 lbs/day. During critical conditions when flow is at its lowest, and there is effectively no flow from nonpoint sources, the LAs for all targeted pollutants is 0 (zero) lbs/day.

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.

An implicit MOS was incorporated into the TMDL based on conservative assumptions applied to the QUAL2K model and used in the development of the TMDL LDCs. Conservative assumptions included targeting the 25th percentile of TSS concentrations and establishing WLAs for Kennett WWTP under critical low flow conditions.

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 impairment of Buffalo Ditch is low DO partially due to the city of Kennett's WWTP. The critical condition

would be during low flow conditions. Low DO can also occur due to increased nutrients and organic sediments being carried into the water body through storm water runoff. These conditions are more likely to occur during seasonal periods having significant precipitation. Seasonal variation has been implicitly taken into account within the TMDL calculations. Using QUAL2K for TMDL development during these conditions will be protective, therefore, the TMDL LDC represents flow under all possible stream conditions and seasons, and avoids the constraints associated with using a single-flow critical condition.

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)].

This water quality limited segment of Buffalo Ditch is included on the EPA-approved 2008 303(d) List for Missouri. The public notice period for the draft Buffalo Ditch TMDL was from October 2, 2009, to November 1, 2009. Additional time was allowed for public notice from December 11, 2009, to December 28, 2009. Since Buffalo Ditch flows into the state of Arkansas, public notice announcements were also sent to the Arkansas Department of Environmental Quality and the Arkansas Natural Resources Commission. The public notice, the TMDL Information Sheet, and this document were posted on the MDNR Web site, making them available to anyone with Internet access. The public notice announcement was also sent to a variety of interest groups. Comments received, and MDNR's response to those comments, have been placed in the Buffalo Ditch administrative record file. One comment was received and responded to.

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].

Post-TMDL monitoring will be scheduled and carried out by MDNR three years after the TMDL is approved, following the compliance schedule outlined in the permit and the application of any new effluent limits. The Missouri State Operating Permit (MSOP) for the city of Kennett's WWTP expired on May 16, 2007, and will be reissued with new permit limits based on the WLA developed in this TMDL. The permit currently requires instream monitoring both upstream and downstream of the WWTP and this requirement will be retained in order to provide additional data with which to assess the impact of the revised permit limits on Buffalo Ditch. Instream data, currently collected monthly in Buffalo Ditch, includes DO, ammonia, and flow. Permittee instream monitoring data will be used for screening purposes, to compare the stream's current condition with post-TMDL conditions.

MDNR will routinely examine physical habitat, water quality, invertebrate community, and fish community data collected by other state and federal agencies in order to assess the effectiveness of TMDL implementation. One example is the Resource Assessment and Monitoring Program administered by the Missouri Department of Conservation. This program randomly samples streams across Missouri on a five to six year rotating schedule.

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.

Reasonable assurances are not required within this TMDL because all permitted point sources have received a WLA that is set to meet WQS. MDNR has the authority to issue and enforce MSOPs. Inclusion of effluent limits derived from TMDL WLAs into a state permit, and at least quarterly monitoring of the effluent reported to MDNR, should result in compliance with WQS. MDNR will work with the city of Kennett to discuss treatment plant upgrades and funding options, and will issue a permit reflective of the WQS that must be met.

With cropland accounting for roughly 91 percent of the land area in the watershed, agricultural runoff is likely to be a chief component of any potential nonpoint source contributions. To further reduce the loading and effect of nutrients and organic sediment on Buffalo Ditch, efforts encouraging farmers to adopt best management practices (BMPs), should be explored. The concept of BMPs is one of a voluntary and site-specific approach to water quality problems. In the Buffalo Ditch watershed, agricultural BMPs should focus on irrigation and water management, nutrient management, riparian buffers, and erosion control. MDNR may work with the Natural Resources Conservation Service and the local Soil and Water Conservation District to encourage area farmers to implement these practices on their land. An additional approach may also be to work with these organizations to form a watershed group comprised of local stakeholders with a common interest in protecting water quality in

Buffalo Ditch.