EXHIBIT E

Assessment of Potential Environmental Effects of Modifying Water Quality Standards for Delta Ecoregion Streams within the Bayou Meto Basin Project

ASSESSMENT OF POTENTIAL ENVIRONMENTAL EFFECTS OF MODIFYING WATER QUALITY STANDARDS FOR DELTA ECOREGION STREAMS WITHIN THE BAYOU METO BASIN PROJECT

Introduction

The Bayou Meto Water Management District (BMWMD) is requesting a modification of the Arkansas Water Quality Standards (WQS) set forth in Regulation No. 2 of the Arkansas Pollution Control and Ecology Commission (APCEC). BMWMD requests modification of the chloride and sulfate criteria for forty-three water bodies in the Delta Ecoregion (Appendix 1) and presents this report in support of this modification request. BMWMD requests this WQS modification in order to operate an irrigation project in the Bayou Meto Basin that will pump water from the Arkansas River into a series of streams, tributaries, ditches, and canals in the Delta Ecoregion before delivering the water to individual farms. The levels of chlorides and sulfates in the Arkansas River are higher than the criteria for Delta Ecoregion streams but lower than federal standards for drinking water. Arkansas Department of Environmental Quality (ADEQ) has already stated that a change in mineral standards to allow this activity should not impair the designated uses of the Delta Ecoregion streams.

Designated uses for the Bayou Meto basin streams are propagation of fish and wildlife; recreation; and public, industrial, and agricultural water supply. Both the Arkansas River and Bayou Meto receiving streams currently support their designated uses and would continue to do so after implementation of the needed agricultural water supply component of the Bayou Meto Basin Project.

Background

Previous draft and final Environmental Impact Statements (EIS) for this project have assessed the effects of Arkansas River diversions on farmlands. Two of the main concerns of using Arkansas River water for irrigation were the accumulation of salt in the soil and mineral toxicity to plants. It was concluded in the EIS that Arkansas River water would be safe to use and of better overall quality than the alluvial well water that is currently being used to irrigate farmland. The EIS reported the Arkansas River water had mean concentrations of chlorides and sulfates that were higher than other project area streams; however the U.S. Environmental Protection Agency has not set formal limits for concentrations of chlorides or sulfates for the protection of aquatic life. As such, the EIS did not evaluate the impact of introducing higher levels of chlorides and sulfates from the Arkansas River on receiving streams and associated wetland communities in the Bayou Meto basin. Additional evaluations were performed after receipt of the conditional water quality certification to assess the potential effects of these higher chloride and sulfate concentrations on the project area's aquatic and wetland ecosystems.

Dr. Todd Tietjen, a Limnologist from Mississippi State University; Dr. Mickey Hietimeyer, a Bottomland Hardwood Ecologist, from the University of Missouri, Gaylord Memorial Laboratory; Dr. Jack Killgore, a Fishery Biologist from the U.S. Army Engineer Research and Development Center (ERDC), and Alan Kennedy, and Environmental Toxicologist, from ERDC

were consulted and provided assessments using data derived from the ADEQ water quality sampling program and other existing databases.

Arkansas River water has mean Chloride (Cl) and Sulfate (SO_4) levels of 90 mg/L and 50 mg/L, respectively. The lowermost reach of Bayou Meto has mean Cl and SO_4 levels of 25-30 mg/L and 15-20 mg/L, respectively. The concentrations of Cl and SO_4 resulting from the introduction of Arkansas River water would be expected to fall between these two ranges.

Discussion

Aquatic Life

The concentrations for Cl and SO_4 are well below both the chronic and acute toxicity levels for fish. Chronic toxicity refers to toxicity involving a stimulus that lingers or continues for a relatively long period of time and can be measured in terms of reduced growth, reduced reproduction, etc., in addition to lethality (APHA, 1992). Chronic, long-term levels for freshwater organisms are 230 mg/L for Cl and >300 mg/L for SO_4 (as published in Kennedy, *et al.*, 2003). Acute toxicity refers to relatively short-term lethal or other effect, usually defined as occurring within 4 days for fish and invertebrates (APHA, 1992). Acute toxicity concentrations for larval fish is approximately 860 mg/L for Cl and >1,000 mg/L for SO_4 (as published in Kennedy, *et al*., 2003).

Additionally, comparisons of fish species composition between the two basins were made using existing ERDC databases. Both of the basins are dominated by more tolerant fish species typical of lower Mississippi River tributary fish assemblages (*e.g.*, catfish, gizzard shad, minnows, suckers, and sunfishes). Every species of fish found in the Arkansas River basin occurs in the Bayou Meto Basin. As a group, darters were more common in Bayou Meto than in the Arkansas River Basin; this greater abundance is primarily due to the Bayou Meto Basin having more habitat preferred by the darters common to the Delta Ecoregion. Therefore the lower numbers of darters in the Arkansas River is reflective of poorer quality habitat and is not due to the higher levels of Cl or SO_4. The fisheries in the Bayou Meto basin would not be impacted by the relatively minor changes in Cl and SO_4 levels.

Aquatic freshwater invertebrates, such as the crustaceans (*Ceriodaphnia dubia* and *Hyalella azteca*) have been shown to be more sensitive to Cl or SO_4 than fathead minnows (*Pimephales promelas*) (Kennedy *et al*., 2003; Kennedy *et al.*, 2004; Kennedy *et al.*, 2005; Soucek and Kennedy, 2005). However the anticipated levels of Cl and SO_4 resulting from the introduction of Arkansas River water into the Bayou Meto Basin are well below these published values and would not negatively impact invertebrates found in this Delta Ecoregion (Kennedy, pers. comm.; Soucek, 2007).

Wetland Ecosystem

Chloride levels found in the Arkansas River are only a small fraction of the levels that could cause adverse impacts to wetland vegetation. Freshwater wetland vegetation is sensitive to elevated salinity/chloride levels but not until levels of 5,000 – 8,000 mg/L (or 5 - 8 ppt). Considerable data indicate baldcypress and water tupelo are capable of enduring sustained flooding by water with salinity levels up to 7,000 -8,000 mg/L (McLeod *et al*., 1996, Allen *et al*., 1997, Conner *et al*., 1997). Bottomland oaks are tolerant of salinity up to 5,000 – 6,000 mg/L

(Conner *et al*., 1998). Consequently, chloride levels of 95 mg/L are only a very small fraction of levels that might cause negative vegetation responses or community changes.

Bottomland hardwood (BLH) wetlands have naturally high sulfur levels (Hupp *et al*., 2005) due to an extremely large detrital decomposition base. The low-levels of SO_4 from introducing Arkansas River water into the Bayou Meto basin is minor compared to naturally occurring levels in BLH. Further, one of the most important values of forested wetlands is their ability to improve water quality by filtering or removing nutrients and pollutants from the water (Winger 1986). Forested wetland sediments are effective sinks for most metal and elemental contaminants (Kitchens *et al.*, 1975). This occurs because the forest floor detritus filters and transforms nutrients, removing the more toxic dissolved, inorganic ions and releases them as particulate organic material that is a food source for invertebrates and other higher trophic level consumers (*e.g.*, Brinson *et al*., 1984). In total, the maximum expected SO_4 concentrations of 45 mg/L are not unusual or problematic in BLH systems.

Conclusions

The Bayou Meto project has been thoroughly studied and the minor increases in chloride and sulfate levels have been demonstrated not to have a detrimental impact to aquatic life, sediment biochemistry, or bottomland hardwood wetland communities. In addition, the implementation of the project would increase fish habitat in the receiving streams due to the removal of excess sediment, pooling effect of weirs, and increased minimum flows. Furthermore, the modification of current Water Quality Standards would not impair any existing uses nor would it preclude the attainment of any designated uses.

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Appendix 1. List of Streams and Their Proposed Amended Mineral Concentrations for the Bayou Meto Basin Project

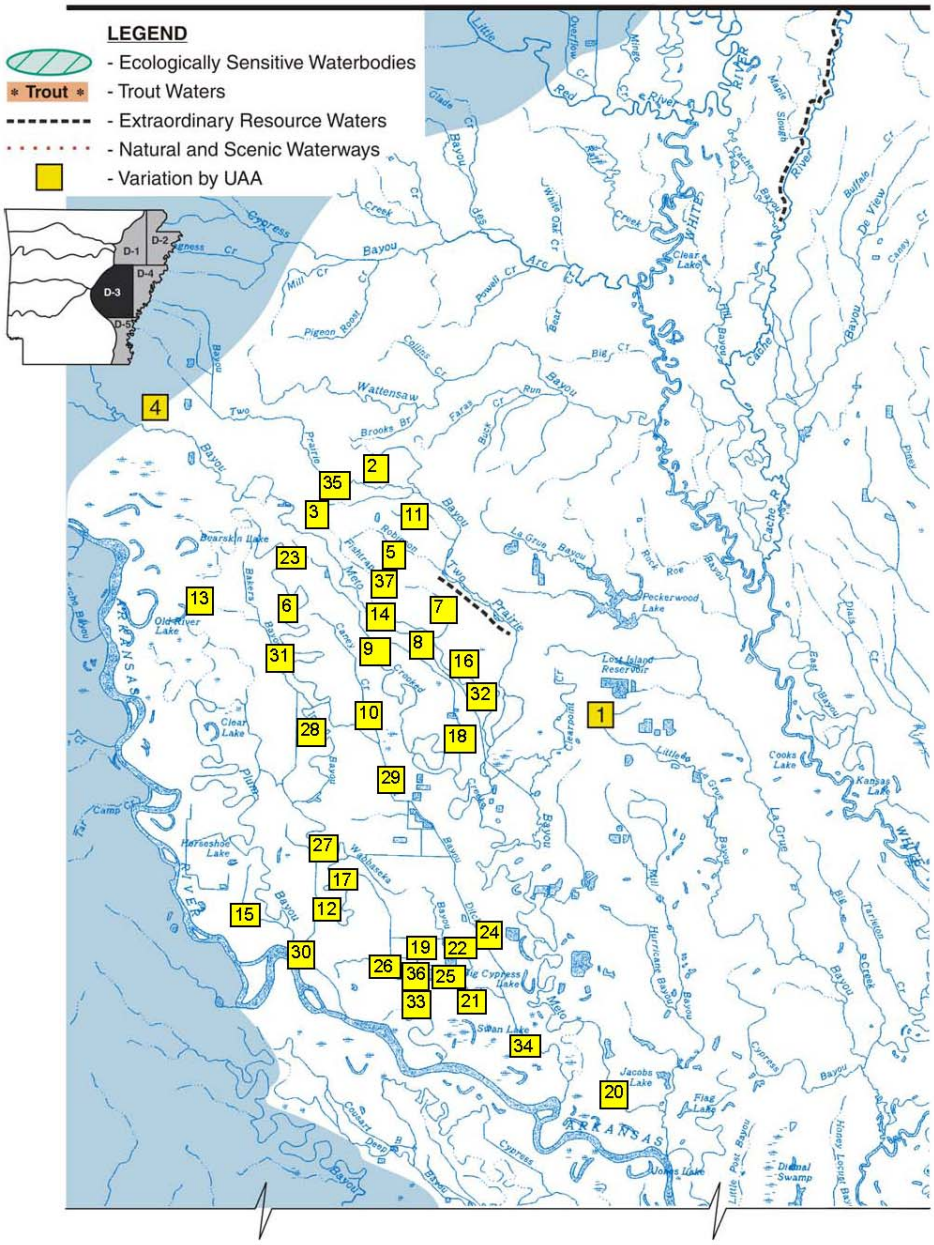
Pursuant to Section 2.306 of the APCEC Regulation No. 2, Section 3.4 of Regulation No. 8 and the Continuing Planning Process, Bayou Meto Water Management District is requesting the following modifications to Regulation No. 2; modify the dissolved mineral standards (sulfates from 37 mg/L to 45 mg/L and chlorides from 48 mg/L to 95 mg/L) for the reaches of the following streams that occur in the counties listed:

Waterbody Name	County/Counties Location	Plate D3 Identifier
1. Bakers Bayou	Lonoke	6
2. Bayou Meto*	Arkansas, Lonoke, Prairie	4
3. Bayou Two Prairie	Lonoke and Prairie	2
4. Bear Bayou	Jefferson	20
5. Big Ditch	Arkansas and Lonoke	8
6. Blue Point Ditch	Lonoke	7
7. Boggy Bayou	Jefferson	19
8. Bradley Slough	Jefferson	17
9. Brownsville Branch	Lonoke	35
10. Brushy Slough	Arkansas	23
11. Bubbling Slough	Arkansas	21
12. Buffalo Slough	Lonoke	32
13. Caney Creek	Lonoke	10
14. Caney Creek Ditch	Lonoke	10
15. Castor Bayou	Arkansas	26
16. Crooked Creek Ditch	Arkansas, Jefferson, and Lonoke	9
17. Cross Bayou	Arkansas	41
18. Dennis Slough	Lonoke	16
19. Eagle Branch	Lonoke	37
20. Fish Trap Slough	Lonoke	14
21. Five Forks Bayou	Arkansas and Jefferson	33
22. Flat Bayou	Jefferson	12
23. Flynn Slough	Lonoke	18
24. Government Cypress Slough	Arkansas	22
25. Hurricane Slough	Arkansas	24
26. Indian Bayou	Jefferson and Lonoke	28
27. Indian Bayou Ditch	Jefferson and Lonoke	31
28. Little Bayou Meto	Arkansas and Jefferson	34
29. Long Pond Slough	Arkansas	40
30. Main Ditch	Jefferson	15
31. Newton Bayou	Arkansas	25
32. Plum Bayou	Jefferson and Lonoke	30
33. Rickey Branch	Lonoke	2
34. Salt Bayou	Arkansas, Jefferson, and Lonoke	29

Waterbody Name	County/Counties Location	Plate D3 Identifier
35. Salt Bayou Ditch	Arkansas, Jefferson, and Lonoke	29
36. Shumaker Branch	Lonoke	11
37. Skinner Branch (Robinson Branch)	Lonoke	5
38. Snow Bayou	Lonoke	13
39. Tipton Ditch	Arkansas	38
40. Tupelo Bayou	Jefferson	36
41. Wabbaseka Bayou	Jefferson and Lonoke	27
42. West Bayou	Arkansas	39
43. White Oak Branch	Lonoke	3

* modify the dissolved mineral standards for Bayou Meto as follows: sulfates from 37 mg/L to 45 mg/L and chlorides from 64 mg/L to 95 mg/L

Plate D-3 (Delta)



From APECE Regulation No. 2.