

PROJECT 2 (REV'D DATES JAN 2007. APPROVED APRIL 2007)

PROJECT TITLE:

Monitoring in Support of TMDL Development in the Upper Kiamichi and Upper Little River Watersheds

AGENCY:

Oklahoma Water Resources Board (OWRB)

PRIORITY AREAS ADDRESSED:

Meets portions of all five priority areas:

1. Data to assist in the completion of several TMDL's, data to address data gaps, and the development of scientifically sound tools (addressed in the plan)
2. Addresses waters scheduled for TMDL's within the next 2 years and within high priority areas
3. May develop a model to assess naturally occurring conditions leading to low pH (addressed in the plan). Model may apply to ambient data.
4. Cost sharing will be available through the OWRB's BUMP program, and equipment sharing may be available through the USGS. Because of the short notice of the award, cooperative efforts with the USGS have not been fully explored and cannot be outlined in this document.
5. Project is ready to hit the ground running. Because of the BUMP monitoring network, most stations are active and in place. Stations not in the BUMP network have been visited and are accessible. Furthermore, the OWRB has the expertise to do the work outlined in the proposal and an excellent track record for delivering complete, useable products.

PROBLEM STATEMENT:

The Upper Little River and Upper Kiamichi River Watersheds are important natural resources for the state of Oklahoma. Located in southeastern Oklahoma in the Lower Red River Planning Basin, the two watersheds are not only naturally beautiful but offer many types of recreation including canoeing, kayaking and angling. Most of the streams and rivers in this area are designated as Outstanding Resource Water, and the Mountain Fork is an Oklahoma Scenic River. With mostly cool water, cobble/boulder substrates, and moderate to high gradients, the rivers and streams of the area offer a diverse habitat and support a rich aquatic community. They provide critical habitat for the threatened leopard darter (*Percina pantheria*).

In Oklahoma's 2002 Consolidated List- Category 5, a number of segments within the two watersheds are listed as impaired for various parameters related to the Fish and Wildlife Propagation Beneficial Use (Table 1). The impairment decisions are based on four years of data collection through the OWRB's Beneficial Use Monitoring Program and the Oklahoma Conservation Commission's (OCC) various non-point source monitoring programs.

Table 1. Category 5 river segments, variables listed, and TMDL schedule

Waterbody	OK Waterbody ID	Segment Length (mi)	Variables Listed (n)	Date of Scheduled TMDL Completion
Glover River	OK410210080010	34	Lead (n = 8), low Dissolved Oxygen (n = 39)	December 30 th , 2005
Kiamichi River	OK410310020010	29	Lead (n = 8), pH (n = 37)	December 30 th , 2005
Little River	OK410210020140	29	Silver (n = 8), Lead (n = 8), pH (n = 37)	December 30 th , 2005
Mountain Fork	OK410210060010	29	Lead (n = 8), pH (n = 37)	December 30 th , 2004
Pine Creek	OK410300030580	23	pH (n = ?)	December 30 th , 2008

When compared to criteria assigned in the Oklahoma Water Quality Standards (OWQS), a number of segments are listed as impaired because of pH values below the minimum screening level. Furthermore, some streams are impaired due to exceedances of some hardness-dependent metals criteria, including those for silver and lead. Historically, pH values throughout the watersheds have been low (< 6.8) during various times of the year, and hardness values are consistently below 100 ppm. Because streams have formed on sandstone and shale substrates, carbonates are not readily available, and the streams subsequently have a low buffering capacity. Because of this, they can not buffer against various acidic inputs including acidic soils, organic matter (e.g., pine needles), and acid rain deposition. Because of these described conditions, does impairment truly exist? Oklahoma's Use Support Assessment Protocols (USAP) require address chemical, physical and biological causes of impairment. To fully assess Fish/Wildlife support status, all applicable criteria must be considered. For example, if biological data shows a stream to be impaired, then the stream is not supporting. The same decision criteria applies to physical and chemical criteria such as pH or metals. Considering this, the answer to the question is slightly different for the two variables in question but in both cases will require looking at both the parameter in question and the aquatic community.

According to the OWQS, pH criteria (upper and lower) do not apply when naturally occurring conditions cause values to be outside the prescribed range of 6.5 – 9.0 units. To determine whether the low pH's are naturally occurring, a large enough data set must be collected over a range of conditions absent any point source inputs. By relating pH flux to changes in flow, sediment inputs, seasonality, and duration, the influence of naturally occurring conditions can be determined. Furthermore, pH has an assigned range within the water quality standards because of its effect on the physiological processes of aquatic organisms. Therefore, it is logical to determine the health of the aquatic community when considering whether a stream is fishable. By considering both types of data, an overall assessment of health can be made and the necessity of a TMDL can be determined (Table 2).

Table 2. Assessment decision matrix for pH according to application of USAP

Low pH caused by:	Condition of Biological Community	Support Status	Impairment Cause	TMDL Status
Conditions naturally occurring	Supporting	Not Impaired	N/A	unnecessary
Conditions naturally occurring	Not Supporting	Impaired	Not known	Necessary if impairment due to a pollutant
Conditions not naturally occurring	Supporting	Impaired	pH	Necessary for pH unless cause is by pollution such as acid rain deposition
Conditions not naturally occurring	Not Supporting	Impaired	pH	Necessary for pH

For metals listings, much of the same decision logic applies. Because of low hardness values, hardness-dependent criteria in the segments are in the parts per billion to trillion range. When the toxicity curves were developed for hardness-dependent metals such as lead and silver, criteria in this extremely low range of hardness were extrapolated from the middle portion of the curve. Therefore, these numbers may be suspect and a water effects ratio (WER) study may be necessary. From this study, site-specific criteria could be developed. However, this study is very expensive. In the near future, a more prudent approach may be to reassess the waterbodies for these constituents. Because the Oklahoma Water Quality Standards provides criteria for total recoverable metals, the BUMP program has not historically sampled for the dissolved metals fraction, but this fraction is what is available to aquatic organisms for uptake. To more accurately determine whether aquatic organisms are at risk, a resampling for dissolved constituents is necessary. In those instances where a criterion exceedance persists, an assessment of biological integrity would help to determine if the aquatic community is at risk. Similar to pH, a decision table can be formed to determine what next step should be (Table 3).

Table 3. Assessment decision matrix for metals according to application of USAP

Dissolved Metals	Condition of Biological Community	Support Status	Impairment Cause	WER Study	TMDL Status
Supporting	Supporting	Not Impaired	N/A	No	Unnecessary
Not Supporting	Supporting	Impaired	Metal (e.g., lead)	Yes	Necessary depending on results of WER study
Supporting	Not Supporting	Impaired	Not known	No	Necessary if impairment due to a pollutant
Not Supporting	Not Supporting	Impaired	Metal (e.g., lead)	Yes	Necessary for metals depending on results of WER study or if impairment is due to another pollutant

PROJECT LOCATION AND STUDY DESIGN:

pH Monitoring. An objective of this study is to determine if regionally low pH may be attributed to naturally occurring conditions. To supplement the historical data review, six segments located throughout the Kiamichi and Little River Watersheds will be continuously monitored over a 12 month period (Table 4). To ensure comparability of data, several considerations were made when selecting stations (Table 4). Priority is given to segments currently listed for pH as Category 5 on Oklahoma’s Consolidated List (Table 1). One unimpaired (pH-related) station is included in the study as control for non-point sources. Glover River is located on land managed similarly to the impaired stations in the study and should have a similar potential for non-point source impacts. Similar geography and land use was deemed important. All six segments are predominately or fully within the Omernick’s Ouachita Mountain Level III Ecoregion. Furthermore, land use is similar between all stations. The area is predominately evergreen or mixed forests with scattered cropland and pastureland. Impacts from known sources were eliminated. The Oklahoma Department of Environmental Quality (ODEQ) permits no point source discharger within each of the six segments. So that conclusions can potentially be extrapolated throughout the entire area of interest, streams of various sizes and gradients have been included (Table 4). Streams represent Strahler orders 2, 3, and 4, and stream slopes vary from 3-70 feet/mile.

Table 4. Stations to be continuously monitored for pH and/or DO.

Station Name	BUMP Station ID	County	Watershed	Strahler Order	Slope (ft/mile)

Glover River	AT337900	McCurtain	Upper Little River	4	3
Kiamichi River	AT335700	LeFlore	Upper Kiamichi River	2	17
Little River	AT337100	Pushmataha	Upper Little River	4	8
Mountain Fork River	AT338840	McCurtain	Upper Little River	4	18
Pine Creek	N/A	Pushmataha	Upper Kiamichi River	3	43

Data will be collected to fully determine use attainment and will include both biological collections and continuous pH monitoring. Additionally, water temperature, dissolved oxygen (DO), specific conductivity, and turbidity will be continuously monitored. Discharge data for the Kiamichi, Mountain Fork, and Glover Rivers will be obtained from the United States Geological Survey (USGS) stream gauges located at these sites. At the other three stations, a stage recorder will be deployed, and a stage/discharge rating will be developed and modeled over the 12 month period using acceptable methods. Climatological data will be obtained from various sources including the Mesonet, USGS, and National Weather Service.

Continuous monitoring will provide data for various areas of analysis. Primarily, the duration and seasonality of pH can be determined. By comparing trends across stations, flow regimes, and seasons, the influence of natural conditions can be determined. If no apparent trends occur and/or natural conditions are determined to not be an influencing factor, these data sets will assist in better defining the subsequent limits set by the TMDL's. Secondly, if trends are similar throughout the watersheds, a model can be developed that can be extrapolated to ambient data sets on other segments within the watersheds that meet the criteria described at the beginning of this section. Thirdly, specific conductance and turbidity data can provide information about pH flux. Because both parameters are influenced by runoff events and sediment loads, the effect of sedimentation on pH can be investigated. Lastly, relationship of trends to rainfall may indicate acid rain deposition. If so, cause of pH impairments may be determined to be from pollutants and the listings may be moved to category 4. The National Air Deposition Program does not maintain a station within the region, and rainfall chemistry will not be measured.

Dissolved Oxygen (DO) Monitoring. Because the Glover River is an excellent candidate for one of the unimpaired control stations, the Category 5 DO listing for the station can also be addressed. To address the impairment for low DO, the variable will be continuously measured for 12 months. Analysis of the data will determine if low DO problems are related to diurnal swings, seasonality, or natural conditions. If more funding for personnel becomes available, the monitoring may be extended to 18-24 months.

Metals Monitoring. Another objective of this study is to determine the extent of impairment related to metals for the segments in Table 1. To meet the data objective requirements in Oklahoma's USAP, the four segments will be monitored at two locations each (Table 5). The primary location for each segment will be at BUMP permanent monitoring station (bolded). A supplemental station will be positioned along the segment to more accurately account for distant tributaries. Instantaneous discharge and stage will be collected at each sampling event.

Stations will be monitored over a 12-month period beginning two months after the approval of the QAPP. The study is designed to account for both base and high flow conditions. Therefore, at a minimum, samples will be collected bi-monthly. This will meet the five sample requirement of USAP. Additionally, up to four supplemental samples may be taken to account for the base or high flow conditions. Parametric coverage includes, dissolved and total recoverable lead, dissolved and total recoverable copper (Little River), total hardness, other general water quality variables, and instantaneous flow.

Table 5. Stations to be continuously monitored for dissolved metals.

Station Name	BUMP Station ID	County	Segment position
Glover River near Bethel	N/A	McCurtain	Upper to Middle
Glover River near Glover	AT337900	McCurtain	Lower
Kiamichi River near Big Cedar	AT335700	LeFlore	Upper to Middle
Kiamichi River near Whitesboro	N/A	LeFlore	Lower
Little River near Nashoba	N/A	Pushmataha	Upper to Middle
Little River near Cloudy	AT337100	Pushmataha	Lower
Mountain Fork River near Hatfield, AR	N/A	Polk	Upper
Mountain Fork River near Smithville	AT338840	McCurtain	Middle to Lower

Biological Monitoring. Biological samples will be collected at the ten stations listed in Tables 4 and 5. These collections will be multi-assemblage and will include fish and benthic macroinvertebrates as well as certain measures of physical habitat. Fish and benthic macroinvertebrates will be collected in the early summer of 2004, and benthic macroinvertebrates will be collected in the winter of 2004. To determine stream health, data will be compared to several indices. Fish data will be compared to narrative biocriteria established in Oklahoma’s Use Support Assessment Protocols as well as reference conditions established by the OCC. Benthic macroinvertebrate data will be compared to OCC reference conditions. Furthermore, overall stream health will be determined by comparing data the index of biological integrity established by the OCC.

OBJECTIVES:

1. Review available historical data and determine analyze trends related to seasonality, rainfall, sediment, and flows.

2. Through continuous monitoring and trend analyses, determine the cause(s) of low pH values in Pine Creek and the Kiamichi, Little and Mountain Fork Rivers and if values are impairing the Fish/Wildlife Beneficial Use.
3. Through continuous monitoring and trend analyses, determine cause(s) of low DO values in the Glover River and if values are impairing the Fish/Wildlife Beneficial Use.
4. Determine if the concentrations of certain dissolved metals in segments of the Kiamichi, Little, Glover, and Mountain Fork Rivers are impairing the Fish/Wildlife Beneficial Use.
5. Collect biological data on all segments to determine health and impairment status of the Fish/Wildlife Beneficial Use.
6. In the event that impairment does exist, provide data to the ODEQ for development of the TMDL.

PROJECT TASKS:

Task 1. Development of Quality Assurance Project Plan (QAPP)

A QAPP will be written and submitted to EPA for approval.

Time frame: October 2003 to December 2005

Deliverables: Approved QAPP - Completed

Task 2. Installation of Minimonitors

Completion of this task will require several stages of planning. The initial stage of planning will be reconnaissance to determine station accessibility and best available placement of unit. The second stage will involve the development of a detailed installation workplan including materials needed, schematics, manpower needed, and work schedules. The third planning stage will be actual installation and testing for two to four week. At the completion of a successful test, the station will begin collecting useable, continuous data

Time frame: March 2006

Deliverables: NONE - Completed

Task 3. Monitoring of Selected Stations

Task 3a. Continuous Monitoring to determine cause(s) of pH impairments

Continuous monitoring will begin in February of 2004 and continue through March 2005. By extending data collection, seasons could be compared over two distinct hydrological years. At this time, data will not be collected for a full 2 years because of lack of available funding for personnel.

Task 3b. Continuous Monitoring to determine cause(s) of DO impairments

Continuous monitoring will begin in February of 2004 and continue through March 2005. Because large diurnal swings in DO may be more prevalent in the late spring and summer months, the study period may be accommodated so that 2 seasons can be measured. By extending data collection, seasons can be compared over two distinct hydrological years. At this time, data will not be collected for a full 2 years because of lack of available funding for personnel.

Task 3c. Monitoring to determine if dissolved metals values exceed water quality criteria listed in Fish/Wildlife Beneficial Use

Metals sampling will begin in January of 2004 and end in December of 2004. Sampling may extend into 2005 if supplemental base and/or high flow samples are needed.

Task 3d. Biological monitoring to determine Fish/Wildlife Beneficial Use is supported
Biological samples will be collected in the early summer and winter of 2005.
Time frame: February 2008
Deliverables: NONE

Task 4. Development of Secondary Data QAPP
A Secondary Data QAPP will be written and submitted to EPA for approval.
Time frame: March 2007
Deliverables: Approved Secondary Data QAPP

Task 5. Review of Secondary Data Sources
Secondary pH, DO, copper, and lead data as they relate to the segments and variables listed in Table 1 will be mined from historical monitoring programs. The data will be analyzed for trends related to seasonality, rainfall, flows, and sediments. **Time frame: December 2007**
Deliverables: None

Task 6. Quarterly Supplemental Water Quality Data Report on Mountain Fork River to ODEQ
Because the Mountain Fork TMDL has a scheduled completion date of December 2004, the OWRB will provide quarterly supplemental water quality data report on the Mountain Fork River for pH and metals to the ODEQ for the duration of the project. A copy of these reports will also be forwarded to the EPA.
Time frame: Quarterly
Deliverables: Quarterly Supplemental Water Quality Data Report on Mountain Fork River to ODEQ

Task 7. Water Quality Data Report to EPA for Review
The OWRB will compile a water quality data report addressing all monitoring activities for technical review by interested state entities and the EPA.
Time frame: June 2008
Deliverables: Water Quality Data Report including Historical Data Analysis to EPA for Review

Task 8. Final Water Quality Data Report to EPA
The OWRB will finalize the water quality data report addressing all monitoring activities and forward to interested state entities, particularly the ODEQ, and the EPA.
Time frame: September 2008
Deliverables: Water Quality Data Report including Historical Data Analysis to EPA for Review

EXPECTED ACCOMPLISHMENTS WITH MILESTONE DATES:

Task No.	Task Description	Implemented by:	Schedule Start	Schedule End
1.	Approved QAPP	OWRB	Oct-03	Dec 05
2.	Installation of Minimonitors	OWRB	Nov-03	Mar 06
3.	Monitoring of Selected Stations	OWRB	Mar-04	Feb 08
4.	Development of Secondary Data QAPP	OWRB	May-04	Mar 07
5.	Review of Secondary Data Sources	OWRB	Aug-04	Dec 07
6.	Quarterly Supplemental Water Quality Data Report on Mountain Fork River to ODEQ	OWRB	Mar-04	Quarterly
7.	Water Quality Data Report to EPA for Review	OWRB	July-05	Jun-08
8.	Final Water Quality Data Report to EPA	OWRB	Oct-05	Sept 08

OUTPUTS:

1.	Semiannual Progress Reports	
2.	Approved QAPP	December 2005 - Completed
3.	Installation of Minimonitors	March 2006 - Completed
4.	Monitoring of Selected Stations	February 2008
5.	Development of Secondary Data QAPP	March 2007
6.	Review of Secondary Data Sources	December 2007
7.	Quarterly Supplemental Water Quality Data Report on Mountain Fork River to ODEQ	Quarterly
8.	Water Quality Data Report including Historical Data Analysis to EPA for Review	June 2008
9.	Final Water Quality Data Report including Historical Data Analysis to EPA	September 2008

PROJECT MANAGEMENT:

The OWRB will manage this project and will provide oversight for all project activities.

PROJECT DURATION:

24 Months

AWARD AMOUNT WITH MATCH:

Table 6. Award Amount with State Match

Allocation of Funds	Monies
Environmental Protection Agency (95% of Total Cost)	\$117,198
State Matching Funds (5% of Total Cost)	\$6,168
TOTAL PROJECT COST =	\$123,366

BUDGET SUMMARY:

Table 7. General Budget for Project

1 Environmental Program Specialist II	0.75		\$23,010
Total Person Years =	0.75	Total Salary =	\$23,010
Benefits			
56.55% of Salaries for Indirect Costs			\$13,012
46.44% of salaries for Fringe Benefits			\$10,686
Laboratory Analysis (Contractual)			
110 Water Quality			\$2,700
Equipment			
Monitoring Equipment/Supplies			\$64,958
Supplies			
Supplies			\$8,000
Report Costs, Data Management & Printing Costs			\$1,000
TOTAL PROGRAM COSTS FOR PROPOSED TMDL ASSESSMENT =			\$123,366