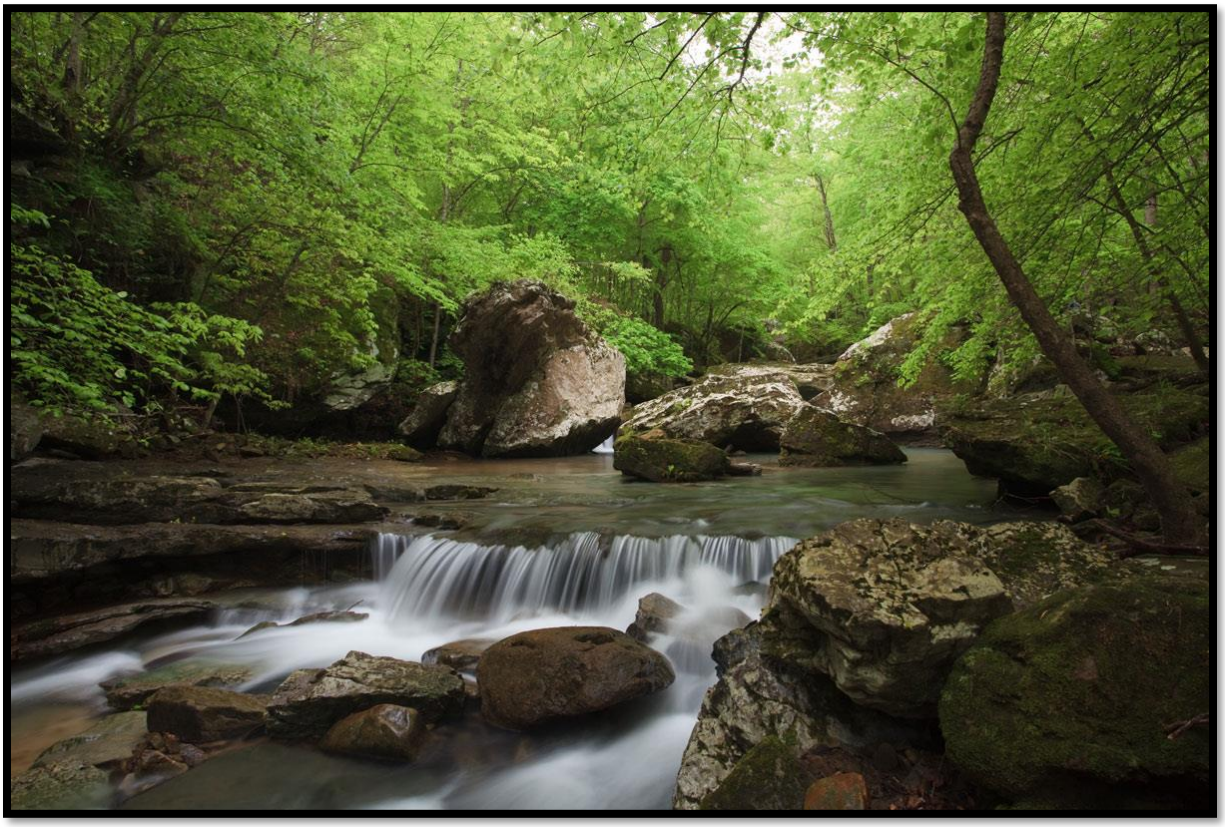
Integrated Water Quality Monitoring Assessment Report

Prepared pursuant to Section 305(b) and 303(d) of the Federal Pollution Control Act



2022

ARKANSAS DEPARTMENT OF ENERGY AND ENVIRONMENT

ARKANSAS
ENERGY & ENVIRONMENT

"To Protect, Enhance, and Restore

the

Natural Environment

for the

Well-being of all Arkansans."

This report is maintained by:

Arkansas Department of Energy and Environment

Division of Environmental Quality

Office of Water Quality

Prepared pursuant to Sections 305(b) and 303(d)
of the
Federal Water Pollution Control Act

Associate Director Office of Water Quality: Alan York,

Physical Address: 5301 Northshore Drive, North Little Rock, AR 72118

DEQ Helpline: (501) 682-0923

http://www.adeq.state.ar.us/water

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Abbreviations and Acronyms

ADA-NRD	Arkansas Department of Agriculture - Natural Resource Division
ADH	Arkansas Department of Health
AGFC	Arkansas Game and Fish Commission
AGWN	Arkansas Groundwater Monitoring Network
APC&EC	Arkansas Pollution Control and Ecology Commission
AU	Assessment Unit
AWAPCA	Arkansas Water and Air Pollution Control Act
AWQMN	Ambient Water Quality Monitoring Network
BMP	Best Management Practice
BOD5	Biochemical Oxygen Demand (5 day)
CBA	Cost/Benefit Analysis
CBOD5	Carbonaceous Biochemical Oxygen Demand (5 day)
C.F.R.	Code of Federal Regulations
CPP	Continuing Planning Process
CWA	Clean Water Act
DEQ	Arkansas Department of Energy and Environment, Division of Environmental Quality
DIM	Dresser Industries-Magcobar
DLG	Digital Line Graph
DMR	Discharge Monitoring Report
DO	Dissolved Oxygen
E&E	Arkansas Department of Energy and Environment
EIP	Environmental Improvement Project
EMP	Effectiveness Monitoring Plan
EPA	Environmental Protection Agency
EPT	Ephemeroptera/Plecoptera/Trichoptera
ERW	Extraordinary Resource Waters
ESW	Ecologically Sensitive Waterbody
HBI	Hilsenhoff Biotic Index
HESI	Halliburton Energy Services, Inc.
HUC	Hydrologic Unit Code
ICIS	Integrated Compliance Information System
IGP	Industrial Stormwater General Permit
IR	Integrated Report
IRWP	Illinois River Watershed Partnership
IWC	Instream Waste Concentration
LWQMN	Lakes Water Quality Monitoring Network
MAW	Monitoring and Assessment Workgroup

MOA	Memorandum of Agreement
MS4	Municipal Separate Storm Sewer System
NFH	National Fish Hatchery
NH3-N	Ammonia Nitrogen
NHD	National Hydrography Dataset
NLCD	National Land Cover Database
NOEC	No Observed Effect Concentration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPS	Non-Point Source
NRCS	Natural Resources Conservation Service
NRSA	National Rivers and Streams Assessment
NSPAR	Nonpoint Source Pollution Assessment Report
NSW	Natural and Scenic Waterways
ORW	Outstanding Resource Waters
OWQ	Office of Water Quality
PCB	Polychlorinated biphenyl
POR	Period of Record
PWS	Public Water Suppliers
PWSSP	Public Water Supply Supervision Program
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance / Quality Control
RADD	Remedial Action Decision Document
RF3	River Reach File
SI	Site Investigation
SIC	Standard Industrial Code
SOP	Standard Operating Procedure
SRAC	Selected Remedial Alternative Combination
SWMP	Stormwater Management Plan
SWPPP	Stormwater Pollution Prevention Plan
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
TRE	Toxicity Reduction Evaluation
TSS	Total Suspended Solids
USACE	United States Army Corp of Engineers
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
W/A	Watershed to Lake Area Ratio
WBP	Watershed Based Plan

WER	Water Effects Ratio
WET	Whole Effluent Toxicity
WIP	Watershed Improvement Plan
WMP	Watershed Management Plan
WPS	Watershed Protection Strategy
WQMP	Water Quality Management Plan
WQP	Water Quality Portal
WQS	Water Quality Standards

Acknowledgements

Appreciation is given to all those individuals, agencies, and groups who provided information and/or data for the development of this report.

PART A: INTRODUCTION

Section 305(b) of the Clean Water Act (CWA) requires states to perform a comprehensive assessment of the State's water quality, which is to be reported to Congress every two years. In addition, Section 303(d) of the Clean Water Act requires states to prepare a list of impaired waters on which Total Maximum Daily Loads (TMDL) or other corrective actions must be implemented. Current U.S. Environmental Protection Agency (EPA) guidance recommends producing an integrated report (IR) combining requirements of the Clean Water Act for Sections 305(b) reporting and 303(d) submissions. The combined report is the Integrated Water Quality Monitoring and Assessment Report. This report is prepared using the Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b), and 314 of the Clean Water Act (EPA 2005) and supplements (EPA 2006, 2009, 2011, 2013, 2015, 2017, and 2021).

All states use specific guidance developed by EPA to aid in making water quality standards (WQS) and designated use attainment determinations. This guidance provides national consistency in the assessment process. However, to be meaningful, assessments must take into account the variations in ecology and WQSs within a state, as well as data type, quantity, and quality. Accordingly, the Assessment Methodology should address federal requirements and reflect each state's individual reference conditions and water quality objectives and goals.

The Department of Energy and Environment, Division of Environmental Quality's (DEQ) water quality monitoring networks database is the primary database used for this assessment in Arkansas. Data are gathered for inclusion into DEQ's database through several monitoring networks. The Ambient Water Quality Monitoring Network (AWQMN) comprises approximately 165 stations sampled monthly or bi-monthly for chemical parameters and flow when available. The AWQMN focuses on characterizing big river systems, potentially problematic nonpoint source areas, and least-disturbed reference streams. Samples are collected year round as appropriate for each network and parameter.

Special projects also comprise part of DEQ's database. Special project area and sampling parameters are project specific. Parameters can be physical, chemical, and biological. Among other special projects this cycle, DEQ continues work on new or revised criteria development that has rotated through Arkansas's ecoregions two to three years at a time. See part C.1 for a full list of special projects for this cycle.

The Lake Water Quality Monitoring Network (LWQMN) comprises ~90 publically owned lakes that are sampled on a 3-year rotational cycle. Between 20 and 30 lakes are selected every 3 years and sampled quarterly. The LQWMN focuses on identifying potential reference lakes, verifying reference lakes, and developing WQSs for lakes.

The Ambient Ground Water Quality Monitoring Network (GWQMN) comprises approximately 200 stations sampled triennially for major ions, metals, nutrients, total organic carbon, and pesticides at selected sites. The GWQMN focuses on characterizing major aquifers and documenting natural background conditions.

In addition to the data gathered by DEQ's Office of Water Quality (OWQ), all readily available data are solicited from other DEQ offices, state and federal agencies, universities, public, and private entities. All data received are evaluated against the acceptability requirements outlined in Arkansas's Assessment Methodology as described in Appendix C.

Data included in the database described above and outside data with DEQ accepted quality assurance /quality control (QA/QC) protocols are compared against Arkansas Pollution Control and Ecology Commission's (APC&EC or the Commission) Rule No. 2 (Rule 2) and Arkansas's Assessment Methodology in order to make water quality criteria and designated use attainment decisions.

Exact estimates and percentages for waterbodies meeting all designated uses cannot be extrapolated to all waters of the state for the following reasons:

(a) designated uses and assigned water quality criteria depend on specific parameters or waterbody features. A waterbody may not attain one use, but may attain other uses.

(b) a large number of the water quality monitoring stations were historically selected in areas known or suspected of having water quality contamination. This results in a higher percentage of areas of concern being monitored, thereby skewing results toward the impaired use category.

(c) some parameters require a more intensive sampling effort and their collection may not be evenly distributed throughout the state.

(d) although fish consumption is not a statutory or a WQS designated use, EPA guidelines suggest this be evaluated. Waters with restricted fish consumption advisories as per Arkansas Department of Health (ADH) are evaluated as impaired.

Previously, overall use support was based on the full support of all designated uses; if one designated use is unable to be assessed, the stream segment was not counted as supporting all uses. New guidance requires tabulation of waters supporting all *assessed* uses; therefore, if one or more uses were not assessed, but all assessed uses were fully supported, the water is counted as "supporting all assessed uses."

Potential impacts to water quality could include point and nonpoint sources. The National Pollutant Discharge Elimination System (NPDES) program, delegated to the State by the EPA,

manages Arkansas's point source discharge controls. This program is guided by the State's Water Quality Management Plan (WQMP) and the State's Surface WQSs. Enforcement activities are based on non-compliance as reported through the NPDES permitting system, with monitoring data compiled through discharge monitoring reports and inspections of NPDES facilities. Additionally, Section 401 (water quality certification) is utilized to review all federal licenses or permits, including but not limited to Section 404, which may result in any discharge of dredged or fill materials into navigable waters. Such certification is determined on the basis of protection of designated uses and the antidegradation requirement of the State's WQSs.

Nonpoint source impacts to water quality are managed through non-regulatory activities. The formation of watershed groups and educational outreach programs has encouraged the implementation of watershed restoration activities that address nonpoint source issues through the voluntary implementation of watershed management plans.

PART B: BACKGROUND

B.1 TOTAL WATERS

The State of Arkansas covers approximately 53,155 square miles of land. Land use and land cover were summarized for the state using the National Land Cover Database (NLCD) 2019 (www.mrlc.gov/data). Agriculture is the most prominent land use in Arkansas, comprising 33.5% of the state's land cover. Cultivated crops (20.3%) and pastures for hay and livestock (13.2%) are the primary agricultural land uses in the state. The vast majority of cultivated crops are in the Mississippi Alluvial Plain ecoregion (94.4% of row crop in the state), but crop lands are also found to lesser extents near the Red River in the South Central Plains ecoregion (2.7%) and in the Arkansas Valley ecoregion (1.6%). Pastures for hay and livestock are found throughout the state, but are most concentrated in the Ozark Highlands ecoregion (32.9% of pasture land in the state), the Arkansas Valley ecoregion (28.4%), and the western South Central Plains ecoregion (17.4%).

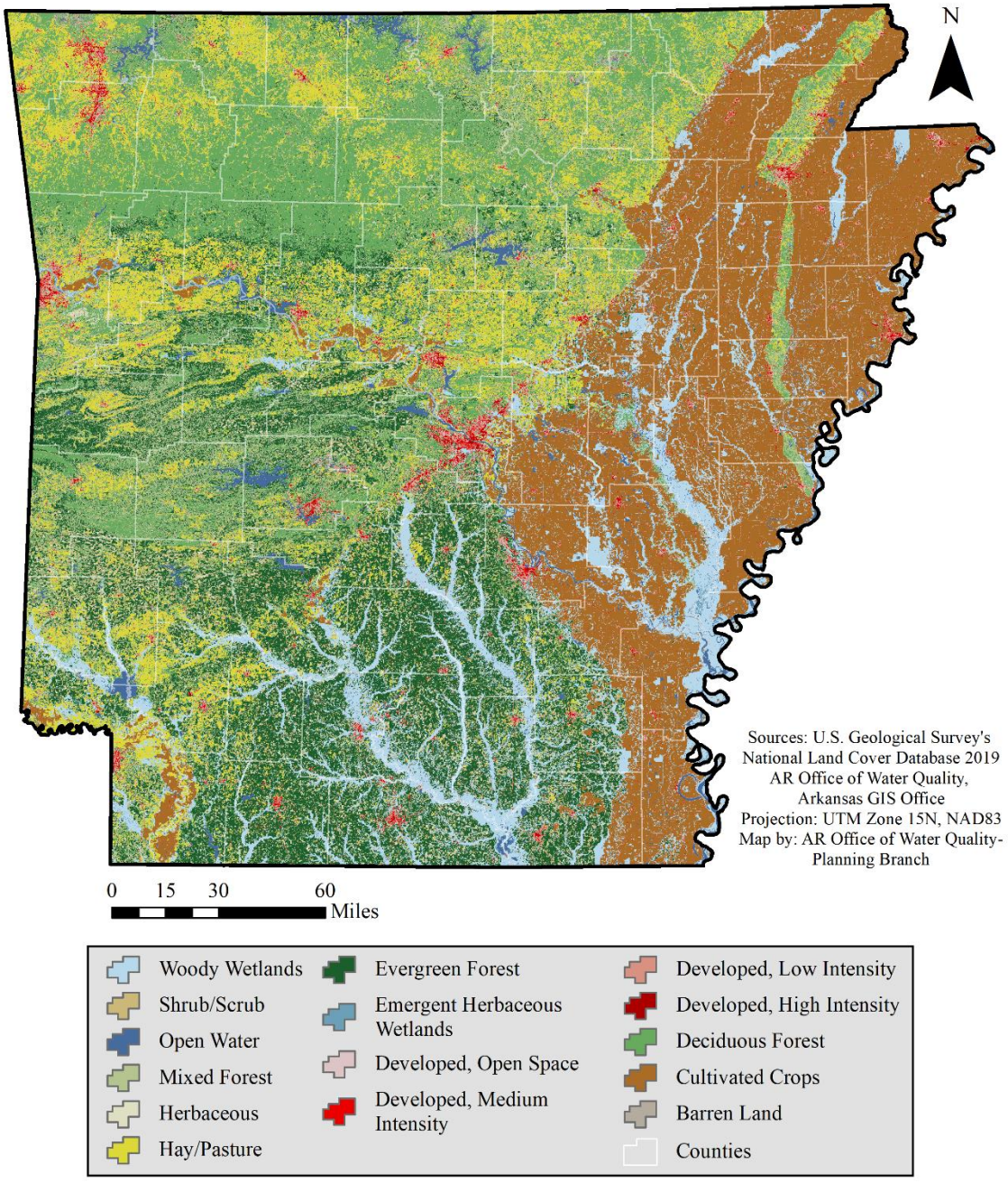
Though agriculture is the prominent land use in Arkansas, forested land (42.2%) comprises a higher proportion of land cover. Deciduous forest (19.1%) and evergreen forest (16.3%) make up most of Arkansas's forested land, followed by mixed forests (6.8%). Deciduous forests are most prominent in the Ozark Highlands, Boston Mountains, and the southern ranges of the Ouachita Mountains, with evergreen forests dominating the South Central Plains and northern ranges of the Ouachita Mountains. Silviculture practices are not directly quantified by the NLCD; however, the NLCD Land Cover Change Index (www.mrlc.gov/data) can provide estimates of forest changes through time. From the Land Cover Change Index, we calculated approximately 10.3% of forest cover in the state transitioned from one type of forest to another from 2001 to 2019. The change in forest vegetation is the largest category of land cover change in the state (2001-2019) and can be attributed to expanding Silviculture concentrated in the southern region of the state.

Following forested cover and agricultural use, wetland areas and herbaceous grassland areas (not used to support livestock) comprise approximately 15.5% of the state. Woody wetlands (10.1%) make up the majority of this land cover group, followed by shrub and scrubland (2.6%), herbaceous grasslands (2.3%), and emergent herbaceous wetlands (0.5%). The lowland areas of the state harbor most of the wetlands, with the South Central Plains and Mississippi Alluvial Plain ecoregions containing 95.7% of the state's wetland areas. The state's herbaceous grassland areas that not used to support livestock are primarily concentrated in the South Central Plains (46.0% of grassland areas in the state) and Ozark Highlands (13%) ecoregions.

Developed land use in Arkansas makes up approximately 6.2% of the state's land area. Most of this developed land use exists as open space (3.2% of the state's land area), like parking

lots, followed by low-intensity development (2.0%), medium-intensity development (0.8%), and high-intensity development (0.2%). Medium and high-intensity development tends to be concentrated in urban centers and areas of intense industry, with low-intensity development, like rural residential areas and town centers, being more diffuse throughout the landscape. Figure 1-B depicts overall land use in the State.

Figure 1-B: Land Use in Arkansas



Ecoregions

The original ecoregion survey (ADPC&E 1987) identified six distinct ecoregions (Level III Ecoregions, Figure 2-B) in the State Classification of the State's waters by ecoregion not only categorizes them by physical, chemical, and biological features, but separates major pollution concerns, most of which are related to land use.

Water quality in the Mississippi Alluvial Plain ecoregion is primarily influenced by nonpoint source runoff from agricultural areas. The vast majority of waterways within this region form a network of extensively channelized drainage ditches. Government programs have been used to develop this highly productive agricultural land. In contrast, many of the practices utilized in making this land more productive actually impair designated water quality uses. Most agency work within this region indicates that, in the majority of these waters, the best that can be expected in terms of a fishery is an altered fishery. Once a natural stream is channelized, only those organisms that do not require in-stream cover and can exist in highly turbid waters will flourish and/or survive. Within these systems, the fishable goal of the CWA is being met, even though the aquatic life communities have been substantially altered.

The South Central Plains ecoregion of southern Arkansas exhibits site specific impacts due to historic resource extraction activities including the extraction of petroleum products, brine, bromine, barite, gypsum, bauxite, gravel, and other natural resources. Timber is the major resource harvested in this area as well as the primary land use. Water quality impacts occur from the extraction, storage, transport, and processing of resources.

The Ouachita Mountain ecoregion is a recreational region with exceptionally high quality water. The predominant land use is silviculture, both in private timber companies and national forest holdings. Additional concerns have been voiced by various groups and organizations regarding potential erosion and siltation as a result of management practices used in timber harvest. Potential impairments to waters in this region include land clearing for pasture without protective riparian zones, in-stream gravel removal, resource extraction remediation areas, and existing areas of confined animal production.

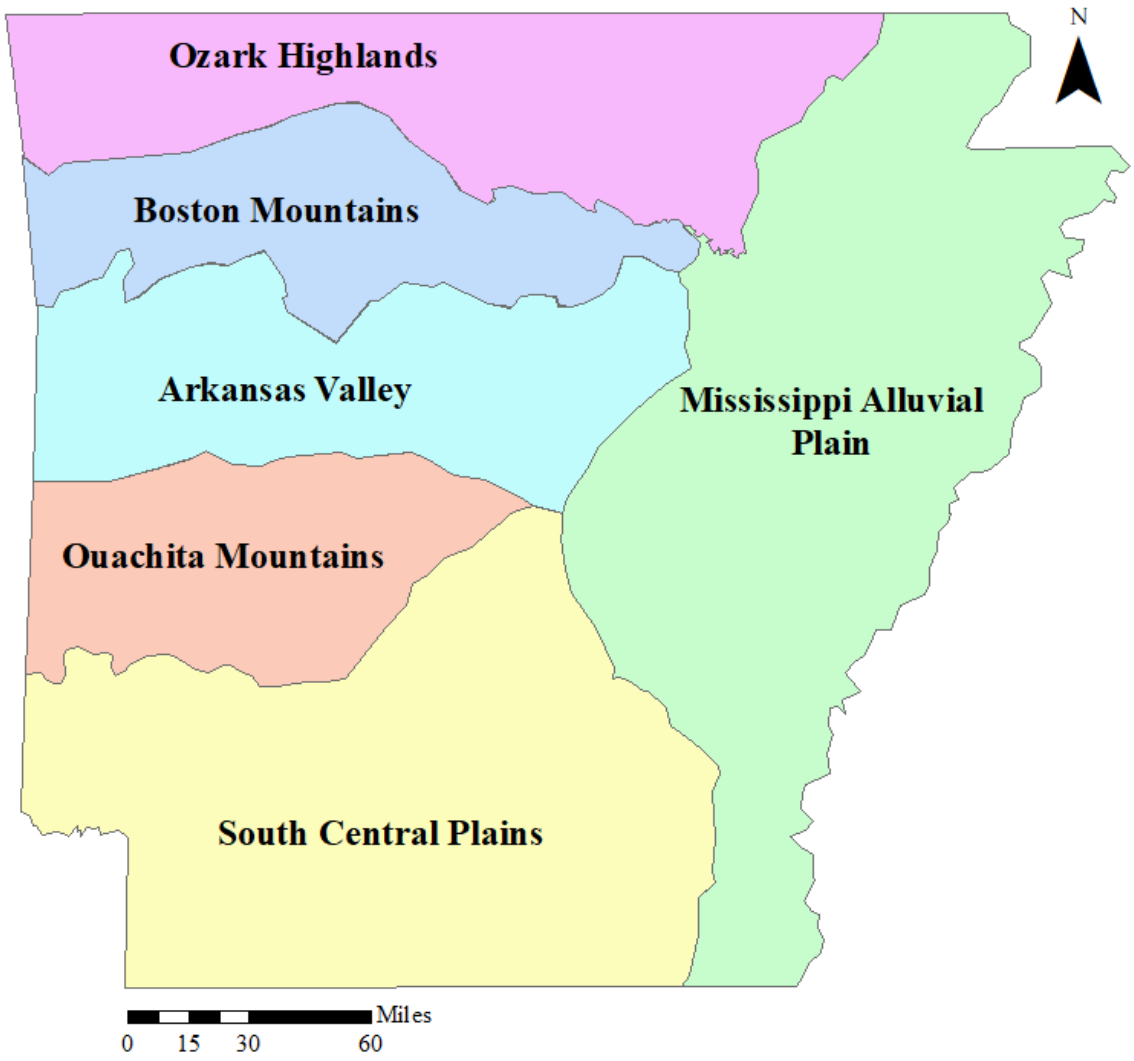
The Arkansas Valley ecoregion exhibits distinct seasonal characteristics of its surface waters with zero Flow common during summer critical conditions. Peak runoff events from within this region tend to introduce contaminants from the predominantly agricultural land uses, which are primarily pasture lands with increasing poultry production. Exploitation of natural gas deposits has resulted in some site-specific water quality degradation. Soil types in much of this area are highly erosive and tend to stay suspended in the water column, thus causing long-lasting, high turbidity values.

The Boston Mountains ecoregion, located in north central Arkansas, is a sparsely populated area. The dominant land use is silviculture and much of the region is located within the Ozark

National Forest. It is a high recreational use region with exceptionally high quality water. Many of the streams from this region are designated as extraordinary resource waters (ERW). Major concerns about potential water quality degradation include: 1) conversion of hardwood timberland to improved pastures, 2) confined animal operations, 3) even-aged timber management, and 4) localized natural gas production.

The Ozark Highlands ecoregion, located in extreme northern Arkansas, is noted for its mountainous terrain with steep gradients and fast-flowing, spring-fed streams. Many of the streams from within this region are designated as ERWs. The fractured limestone and dolomite lithology of the region allows a potential direct linkage from surface waters to groundwater. The water quality concerns within this region are primarily related directly to land use. The large human population increase in this area also has the potential to result in increased water contamination from infrastructure development as well as surface erosion from construction activities. This region has some of the highest population growth and animal production rates in the State. Additionally, removal of gravel from the banks and beds of streams is a frequent activity that causes direct habitat degradation and greatly accelerates siltation within the streams.

Figure 2-B: Arkansas's Ecoregions



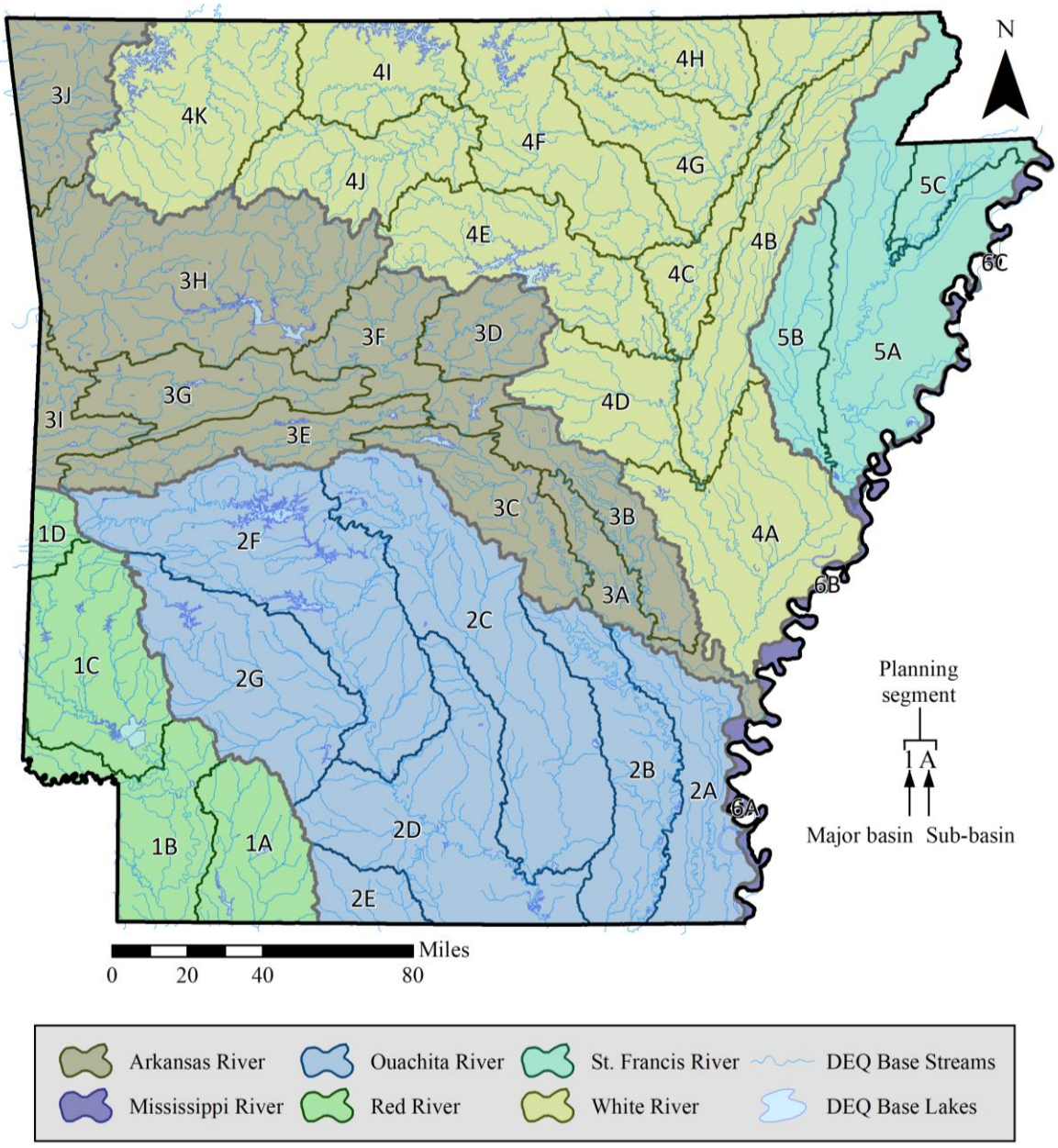
River Basins / Total River Miles

Arkansas is divided into six major river basins: Red River, Ouachita River, Arkansas River, White River, St. Francis River, and the Mississippi River. Arkansas has ~18,000 miles of rivers and streams digitized in the DEQ Water Base Layer. The DEQ Water Base Layer is a record of spatial metadata including assessment unit (AU), watershed size, reach length, etc. and was created from the High Resolution (1:24,000-scale) National Hydrography Dataset (NHD) (Dewitz and USGS, 2019). In 2018, DEQ began using high resolution NHD for determination of AU mileages. Several AUs got longer due to more accurately defined headwaters. Others got shorter due to high resolution NHD not naming some upper headwaters as the main body of the AU.

The NHD combines elements of the Digital Line Graph (DLG) and EPA River Reach File (RF3): spatial accuracy and comprehensiveness from the DLG and network relationships, names, and a unique identifier (reach code) for surface water features from RF3. The NHD supersedes DLG and RF3 by incorporating them, not by replacing them. Arkansas has ~223,703 miles of rivers and streams digitized in the high resolution NHD.

The six river basins are subdivided into thirty-eight (38) planning segments (Figure 3-B) based on hydrological characteristics, human activities, geographic characteristics, and other factors. The planning segments are further broken down into almost 1,600 smaller watersheds, based on discrete hydrological boundaries as defined by the United States Geological Survey (USGS) 12-digit hydrologic unit codes (HUC).

Figure 3-B: DEQ Planning Segments



Publically Owned Lakes and Reservoirs

A discussion of lakes and reservoirs is included in Part C.3, and includes a map and list of Arkansas's significant publicly owned lakes and reservoirs and their trophic status. Arkansas has ~330,000 acres digitized on the DEQ Base Lakes Layer (the DEQ base lakes layer does not delineate sections of Lake Felsenthal) The USGS High Resolution NHD identifies total of ~1,506,107 acres of lakes, ponds, and other impounded waters in the State. This value is calculated on waterbody segments that range from 1 to 34,041 acres. This total value is significantly larger than the EPA RF3/DLG calculation of 515,635 acres due to the increased accuracy and detail of the USGS High Resolution NHD.

Summary of Classified Uses

Waters of the State are classified for specific designated uses. Rule 2.302 (APC&EC 2020) defines designated uses:

> Extraordinary Resource Waters (ERW) (Figure 4-B) – This beneficial use is a combination of the chemical, physical, and biological characteristics of a waterbody and its watershed which is characterized by scenic beauty, aesthetics, scientific values, broad scope recreation potential, and intangible social values.
>
> Ecologically Sensitive Waterbody (ESW) (Figure 5-B) – This beneficial use identifies stream segments known to provide habitat within the existing range of threatened, endangered, or endemic species of aquatic or semi-aquatic life forms.
>
> Natural and Scenic Waterways (NSW) (Figure 6-B) – This beneficial use identifies stream segments which have been legislatively adopted into a state or federal system.
>
> Primary Contact Recreation – This beneficial use designates waters where full body contact recreation is involved.
>
> Secondary Contact Recreation – This beneficial use designates waters where secondary activities like boating, fishing, or wading are involved.
>
> Aquatic Life – This beneficial use provides for the protection and propagation of fish, shellfish, and other forms of aquatic life and is further subdivided in these following categories:
>
> - Trout
> - Lake and Reservoir
> - Stream
>   - Ozark Highlands

- Boston Mountains
- Arkansas River Valley
- Ouachita Mountains
- Typical Gulf Coastal
- Spring water-influenced Gulf Coastal
- Least-altered Delta
- Channel-altered Delta

Domestic Water Supply – This beneficial use designates water which will be protected for use in public and private water supplies. Conditioning or treatment may be necessary prior to use.

Industrial Water Supply – This beneficial use designates water which will be protected for use as process or cooling water. Quality criteria may vary with the specific type of process involved and the water supply may require prior treatment or conditioning.

Agricultural Water Supply – This beneficial use designates waters which will be protected for irrigation of crops and/or consumption by livestock.

Other Uses – This category of beneficial use is generally used to designate uses not dependent upon water quality such as hydroelectric power generation and navigation.

Figure 4-B: Arkansas's Extraordinary Resource Waters. Key in Table I-B

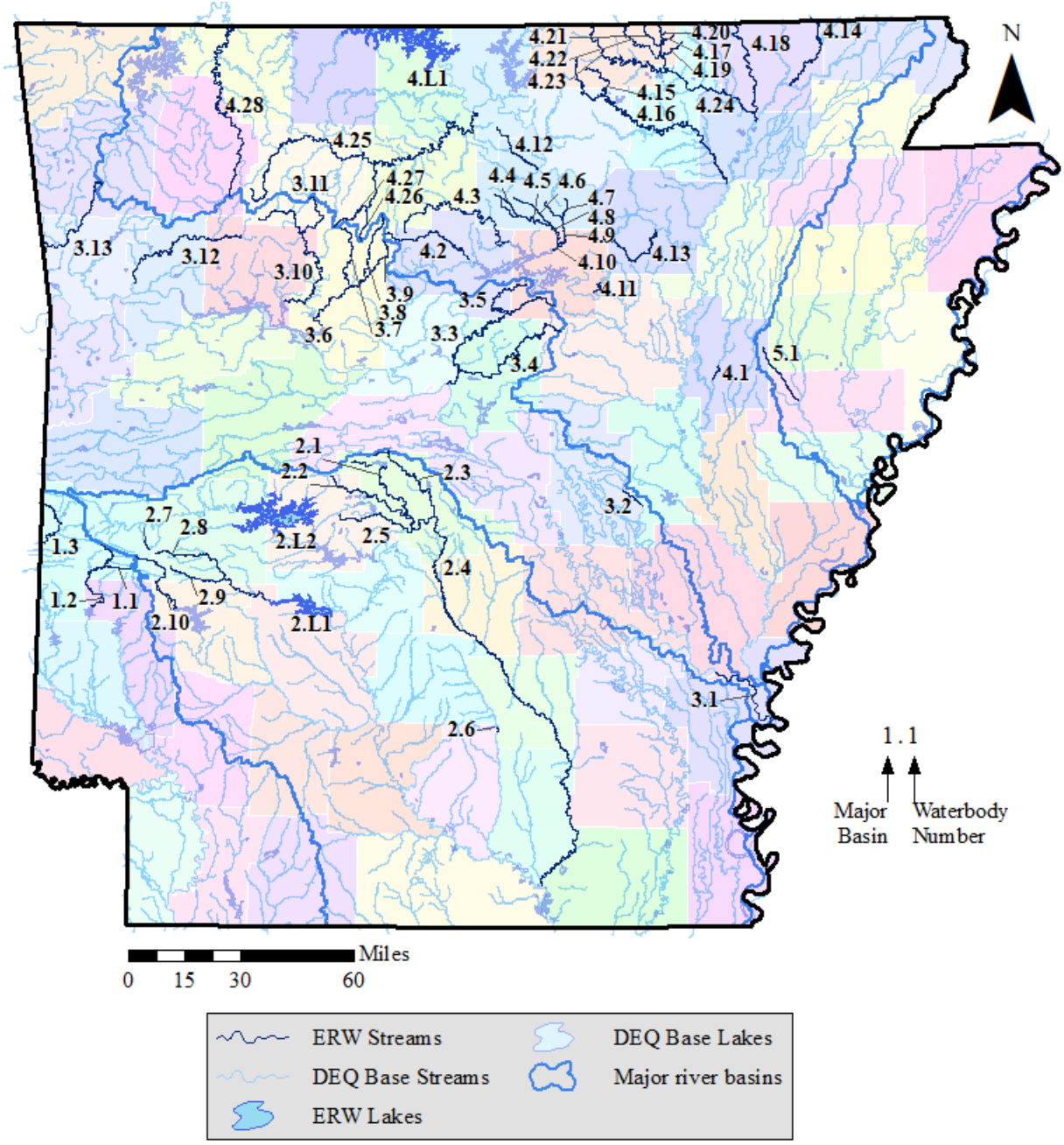


Table I-B. Stream names corresponding to numerical identifier in Figure 4-B.

1. Red River Basin	**3. Arkansas River Basin**	4.4 Lick Creek	4.22 Myatt Creek
1.1 Caney Creek	3.1 Arkansas River	4.5 Turkey Creek	4.23 South Fork Spring River
1.2 Cossatot River	3.2 Bayou Two Prairie	4.6 Tomahawk Creek	4.24 Spring River
1.3 Mountain Fork	3.3 Cadron Creek	4.7 Beech Creek	4.25 Buffalo River
2. Ouachita River Basin	3.4 East Fork Cadron Creek	4.8 Little Raccoon Creek	4.26 Falling Water Creek
2.L.1 De Grey Lake	3.5 North Fork Cadron Creek	4.9 Raccoon Ceek	4.27 Richland Creek
2.L.2 Lake Ouachita	3.6 Illinois Bayou	4.10 Devils Fork Little Red River	4.28 Kings River
2.1 Alum Fork Saline River	3.7 North Fork Illinois Bayou	4.11 Big Creek	**5. St. Francis Basin**
2.2 Mid Fork Saline River	3.8 Mid. Fork Illinois Bayou	4.12 North Sylamore Creek	5.1 Second Creek
2.3 North Fork Saline River	3.9 East Fork Illinois Bayou	4.13 Salado Creek	
2.4 Saline River	3.10 Big Piney Creek	4.14 Current River	
2.5 South Fork Saline River	3.11 Hurricane Creek	4.15 Little Strawberry River	
2.6 Moro Creek	3.12 Mulberry River	4.16 Strawberry River	
2.7 Big Fork	3.13 Lee Creek	4.17 Big Creek	
2.8 Caddo River	**4. White River Basin**	4.18 Eleven Point River	
2.9 Caney Creek	4.1 Cache River	4.19 Gut Creek	
2.10 South Fork Caddo River	4.2 Archey Creek	4.20 Field Creek	
2.11 Little Missouri River	4.3 Mid. Fork Little Red River	4.21 English Creek	

There are ~1,974 stream miles and 83,249 lake acres delineated on the DEQ Base Layer as ERWs.

Figure 5-B: Arkansas's Ecologically Sensitive Waters. Key in Table II-B

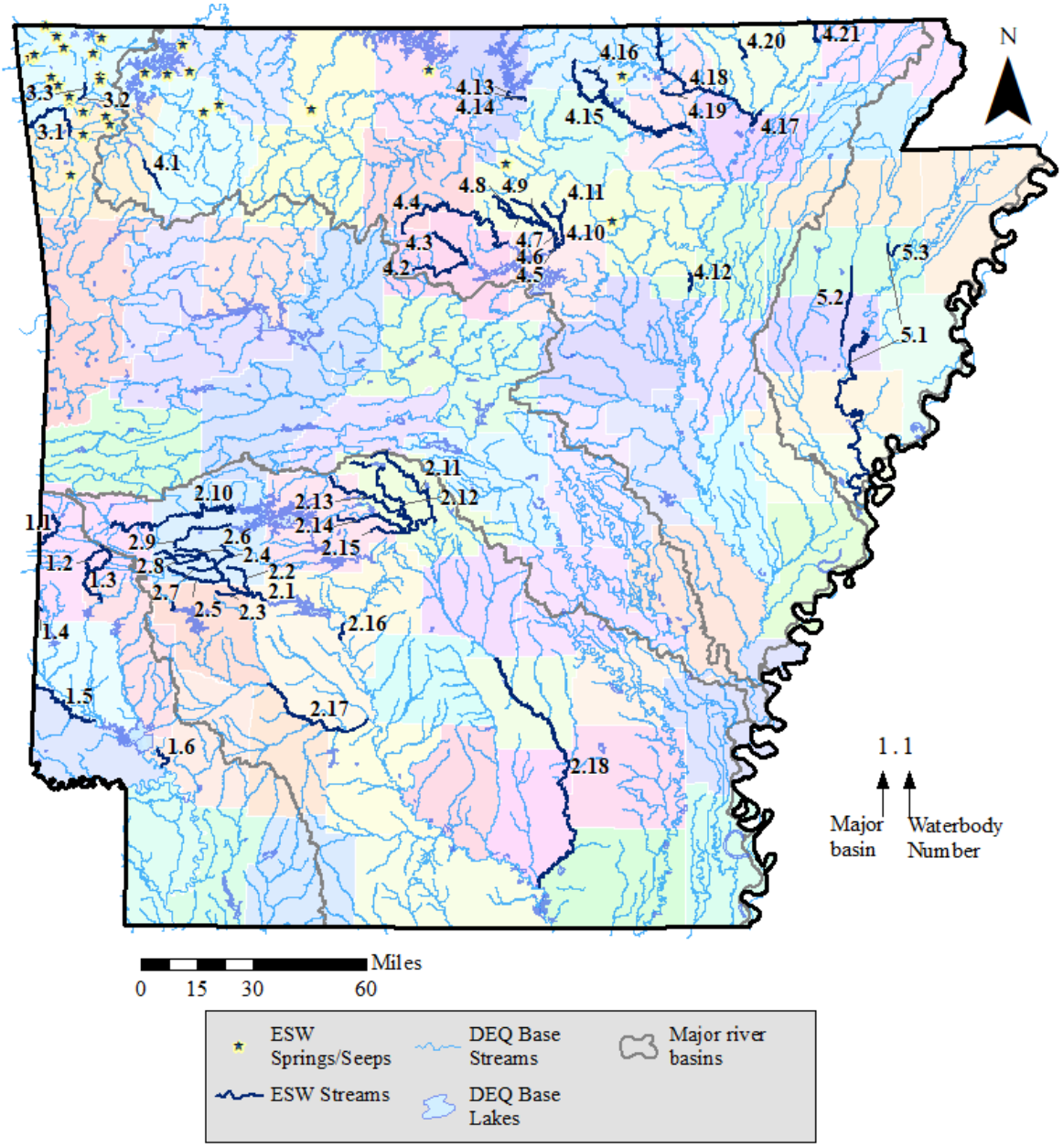


Table II-B. Stream names corresponding to numerical identifier in Figure 5-B.

1. Red River Basin	2.11 North Fork Saline River	4.5 Devils Fork Little Red River	**5. St. Francis Basin**
1.1 Mountain Fork	2.12 Alum Fork Saline River	4.6 Beech Fork	5.1 Saint Francis River
1.2 Brushy Creek	2.13 Middle Fork Saline River	4.7 Turkey Creek	5.2. Straight Slough
1.3 Cossatot River	2.14 South Fork Saline River	4.8 Lick Creek	5.3 Right Hand Chute Little River
1.4 Robinson Creek	2.15 Tenmile Creek	4.9 Tomahawk Creek	
1.5 Little River	2.16 Ouachita River	4.10 Raccoon Creek	
1.6 Yellow Creek	2.17 Little Missouri River	4.11 Little Raccoon Creek	
2. Ouachita River Basin	2.18 Saline River	4.12 Departee Creek	
2.1 Caddo River	**3. Arkansas River Basin**	4.13 North Fork River	
2.2 Caney Creek	3.1 Illinois River	4.14 Otter Creek	
2.3 Rock Creek	3.2 Osage Creek	4.15 Strawberry River	
2.4 Collier Creek	3.3 Little Osage Creek	4.16 Little Strawberry River	
2.5 South Fork Caddo River	**4. White River Basin**	4.17 Black River	
2.6 Lick Creek	4.1 White River	4.18 Spring River	
2.7 Mill Creek	4.2 South Fork Little Red River	4.19 Rock Creek	
2.8 Polk Creek	4.3 Archey Creek	4.20 Eleven Point River	
2.9 South Fork Ouachita River	4.4 Middle Fork Little Red River	4.21 Current River	

There are ~1,295 stream miles delineated on the DEQ Base Layer as ESWs.

Figure 6-B: Arkansas's Natural and Scenic Waters. Key in Table III-B

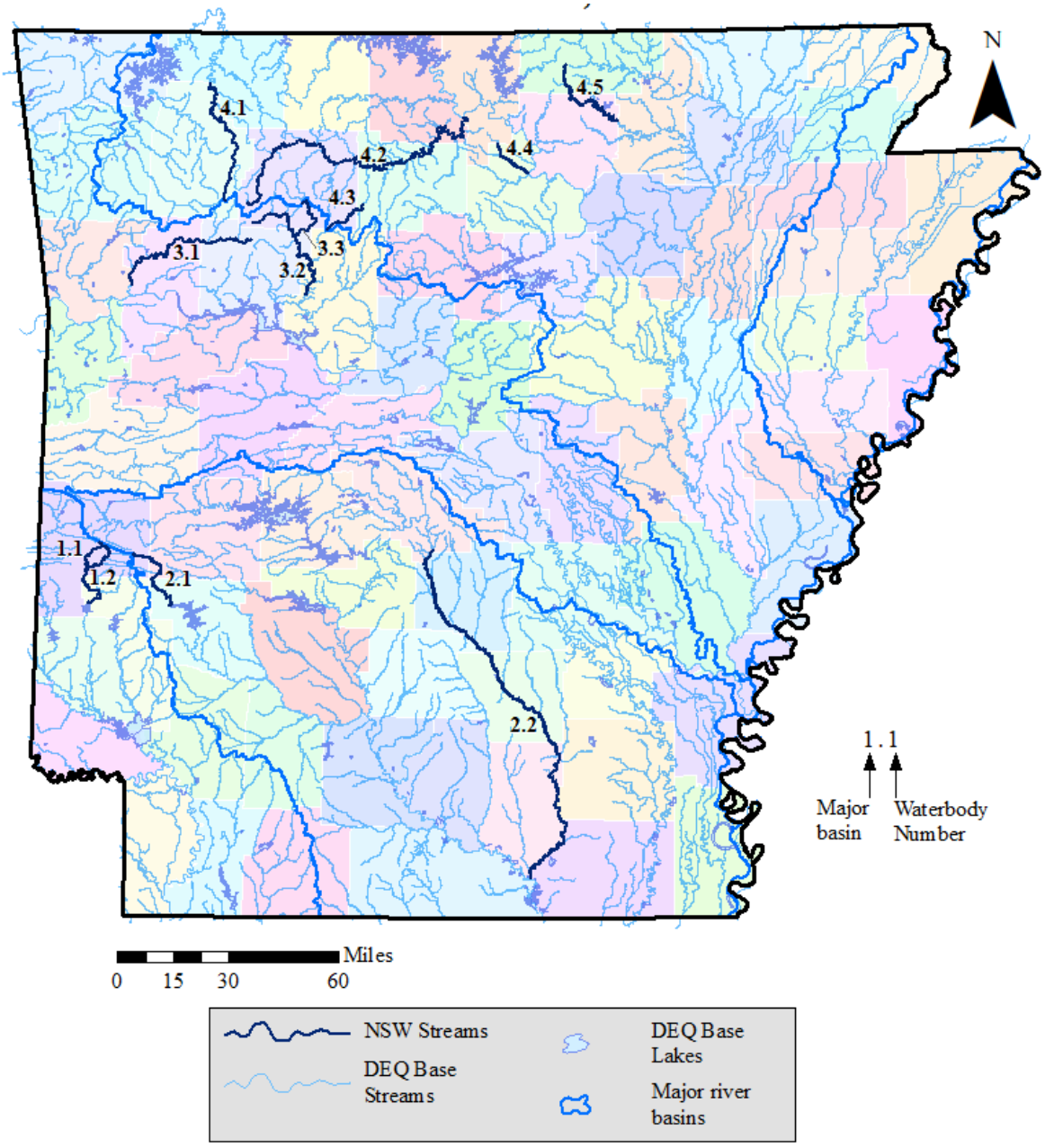


Table III-B. Stream names corresponding to numerical identifier in Figure 6-B.

1. Red River Basin	2. Ouachita River Basin	3. Arkansas River Basin	4. White River Basin
1.1 Brushy Creek	2.1 Little Missouri River	3.1 Mulberry	4.1 Kings River
1.2 Cossatot River	2.2 Saline River	3.2 Big Piney Creek	4.2 Buffalo River
		3.3 Hurricane Creek	4.3 Richland Creek
			4.4 North Sylamore Creek
			4.5 Strawberry River

There are ~685 stream miles delineated on the DEQ Base Layer as NSWs.

B.2 WATER POLLUTION CONTROL PROGRAMS

Water Quality Standards

The Arkansas Water and Air Pollution Control Act (AWAPCA) designates DEQ as the state water pollution control agency for purposes of the CWA pursuant to Arkansas Code Ann. § 8-4-206. Under the AWAPCA, pursuant to Ark. Code Ann. § 8-4-201, DEQ is empowered to administer and enforce all laws and regulations relating to the pollution of waters of the state and APC&EC is authorized to promulgate rules, including WQSs and the classification of the waters of the state. Ark. Code Ann. § 8-4-102 broadly defines "Waters of the state" as:

> *...all streams, lakes, marshes, ponds, watercourses, waterways, wells, springs, irrigation systems, drainage systems, and all other bodies or accumulations of water, surface and underground, natural or artificial, public or private, which are contained within, flows through, or border upon the state or any portion of the state.*

Surface Water

Arkansas's WQSs are based, in part, on the physical, chemical, and biological characteristics of least-disturbed streams within ecoregions that were established by land surface forms, natural vegetation, soil types, and land uses. Waters of the state have been designated to support multiple uses based on the potential attainability of the use.

Specific criteria to protect the designated uses of each waterbody were developed, in part, from the intensive ecoregion studies, an abundance of historical data, numerous additional scientific data, and considerable public and other governmental agency input. Criteria are numeric or narrative and may prohibit physical alterations of certain waters. Aquatic life uses are specifically defined to provide a framework for aquatic life designated use support, which includes community structure and toxicity investigations.

In part, standards were developed with data from least-disturbed streams with characteristics most typical of a particular Level III ecoregion. A single Level III ecoregion can span from one edge of the state to the other and encompass two or three major river basins. The physical, chemical, and biological characteristics of one river basin within a particular Level III ecoregion may or may not be similar to the characteristics of the other river basins in the same ecoregion. In addition, the characteristics of transitions zones between ecoregions, the transition zone of a stream from a highland stream to a lowland stream, and the areas within atypical features of ecoregions may or may not be similar to typical ecoregion characteristics. Therefore, provisions are established in the WQSs to allow modifications of the criteria and the designated uses of specific waterbodies based on: current actual uses, social and economic needs of the area of concern, existing uses, and ERW, ESW, or NSW designation.

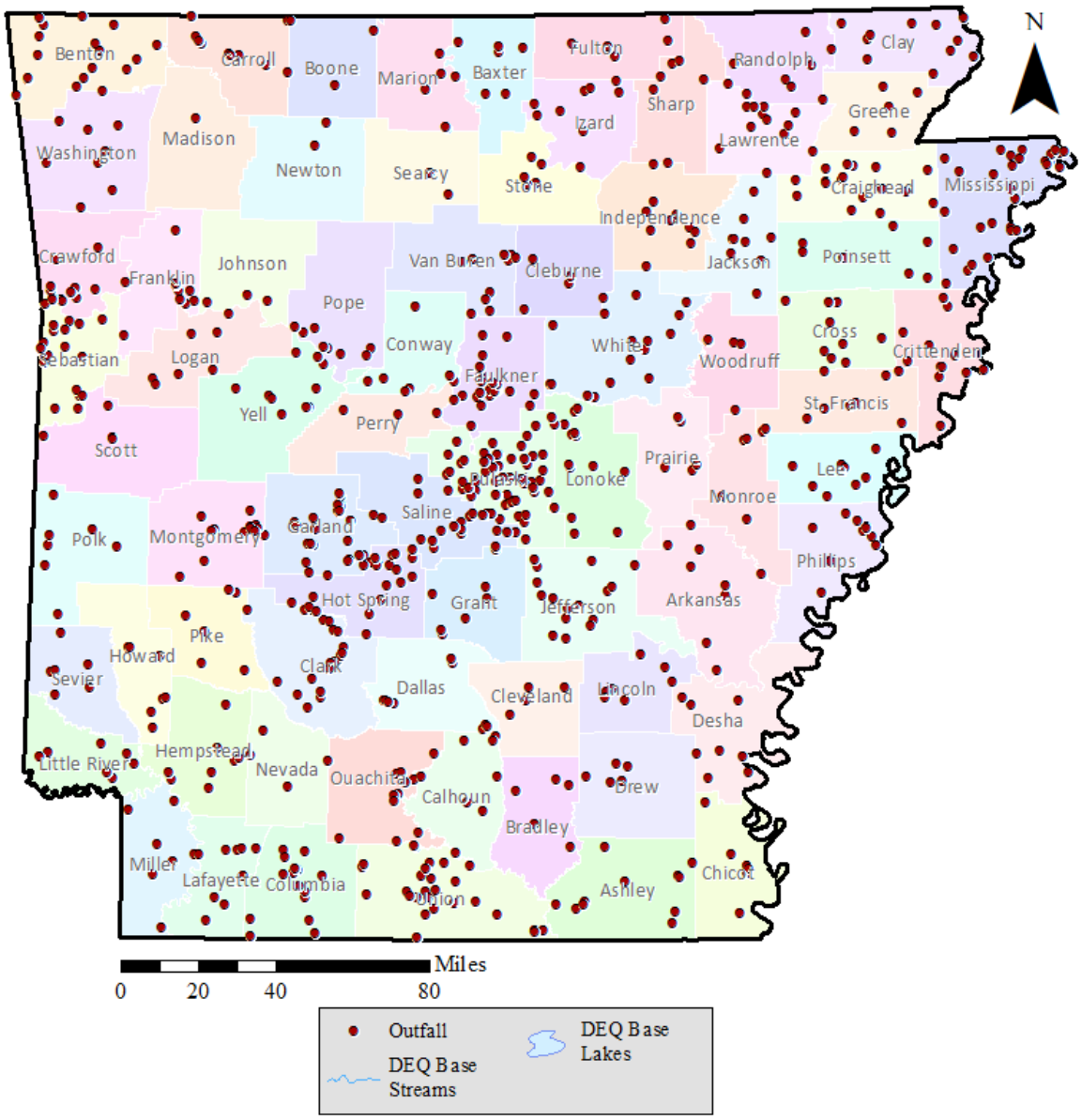
Point Source Control Program

On November 1, 1986, EPA delegated the NPDES Permit Program to DEQ. The Permits Branch of the OWQ administers this program.

In accordance with the CWA, Section 303(e), Arkansas maintains a Continuing Planning Process (CPP) to integrate the NPDES Program, Arkansas's WQSs, and the WQMP. In accordance with Section 208 of the Clean Water Act, the WQMP is an inventory of all permitted municipal and industrial point source dischargers in Arkansas that contain permit limits for water quality-based conventional pollutants such as carbonaceous biochemical oxygen demand (CBOD5), biochemical oxygen demand (BOD5), total suspended solids (TSS), ammonia nitrogen (NH3-N), and dissolved oxygen (DO). The WQMP also contains information associated with each facility such as facility name, permit number, location, design flows, receiving stream name, and critical flows along with wasteload allocations consistent with an approved TMDL. As new information is developed, revisions to the WQMP are made in accordance with the public participation requirements of the CWA.

The Permits Branch administers Arkansas's NPDES program. The Commission has adopted by reference in Rule 6, most of the federal regulations applicable to a NPDES wastewater discharge permitting program. Figure 7-B illustrates the distribution of Arkansas's major and selected minor NPDES permits. Individual NPDES Permits include all point source discharges made to waters of the state. The Permits Branch issues non-stormwater general permits for discharges from sanitary landfills, aggregate facilities, individual sanitary treatment units, water treatment plants, hydrostatic testing, car/truck washes, groundwater cleanup, non-contact cooling water, cooling tower blowdown, and boiler blowdown. A general permit for pesticide discharges has also been issued and provides automatic coverage.

Figure 7-B: Active NPDES Permitted Facilities



Stormwater Requirements

The OWQ's Permits Branch manages three general permits covering various stormwater discharges. The Construction Stormwater General Permit (ARR150000) covers any type of construction activity that is subject to permitting requirements. This general permit requires the development of a Stormwater Pollution Prevention Plan (SWPPP) using best management practices (BMP) to control stormwater contamination from sediment runoff, erosion, and other waste generated at a construction site. The SWPPP must include a detailed description of the construction project; a detailed site map showing drainage, sediment and erosion controls, discharge locations, etc.; a description of the sediment and erosion controls used on the site; inspection and maintenance procedures for the sediment and erosion controls, documentation for TMDL, and water quality standards compliance; and certifications.

The Industrial Stormwater General Permit (IGP) (ARR000000) covers many industry types that are required by federal regulation to obtain permit coverage based on the specific Standard Industrial Code (SIC) or specific industrial activity. All industries covered under the IGP are required to monitor for two basic parameters, TSS and pH, once per year within the first thirty minutes of a storm event. In addition, some industries, based on the specific industrial sector or activity defined in the IGP, are required to monitor for additional parameters. Facilities with permit coverage must conduct quarterly visual inspections. They are also required to conduct a comprehensive site evaluation once a year. They must schedule and conduct corrective action if their monitoring results indicate a parameter benchmark exceedance. The monitoring results, comprehensive site evaluation, four visual inspections, and any corrective action needed must be included and kept at the site with the annual report. This general permit requires the development of a SWPPP using BMPs to address the reduction in pollutants exposed to the stormwater runoff and/or removal of the pollutants from contaminated stormwater. The SWPPP must include a list of personnel that will inspect the facility, a non-stormwater discharge certification, good housekeeping, spill prevention and response, and inventory of exposed material.

Industries that do not have any part of their operation exposed to stormwater may submit a no-exposure certification request. Facilities with a no-exposure certification are not required to develop a SWPPP, monitor, or produce an annual report.

The Small Municipal Separate Storm Sewer System (MS4) General Permit (ARR040000) covers all of the regulated small MS4s (generally serving populations less than 100,000) in the state. This general permit requires the development of a Stormwater Management Plan (SWMP) to address the six minimum control measures: public education, public participation, illicit discharge detection, construction site control, post-construction control, and good housekeeping, as required by federal regulation. Each Small MS4 permittee with coverage under this general permit is required to submit an annual report explaining the different activities carried out under their SWMPs that year and the progress toward the defined goals set out in the SWMP.

The Permits Branch also manages one individual MS4 Permit (ARS000002) covering the storm sewer discharges from the City of Little Rock and the Arkansas Department of Transportation. This permit requires the development of a program to address the same basic measures as the ARR040000 general permit. This permit also requires the co-permittees to sample the stormwater discharges from the permitted outfalls on a quarterly basis.

Point Source Impacts Monitoring

Impacts from major point source discharges of concern are monitored primarily through strategically located water quality monitoring stations within the statewide AWQMN. The water quality data collected at these stations enable DEQ to monitor the discharges from the permitted facilities and identify areas of concern needing enforcement or some other type of abatement activity. Data can also indicate improvement of water quality conditions resulting from pollution control activities. In addition, self-monitoring through monthly discharge monitoring reports is required in the NPDES permits of most dischargers (see "Enforcement" section below).

Toxics Strategy

Since fiscal year 1987, DEQ has utilized toxicity testing as a monitoring tool to measure compliance with its narrative toxicity standard, which states (in part) "Toxic substances shall not be present in receiving waters, after mixing, in such quantities as to be toxic to human, animal, plant or aquatic life, or to interfere with the normal propagation, growth and survival of the indigenous aquatic biota" (Rule 2.508). The implicit intent of the toxics strategy is that there shall be no discharge of any wastewater from any source that:

1. Results in the endangerment of any domestic water supply;
2. Results in aquatic bioaccumulation that endangers human health;
3. Results in any in-stream acute or chronic aquatic toxicity; or
4. Violates any applicable general or numeric state or federal WQS.

The current toxicity testing program consists of self-monitoring conducted by the NPDES permittees. DEQ has been and will continue to implement the post-third round permit policy endorsed by EPA Region 6, with minor revisions. Whole effluent toxicity (WET) testing requirements are included in all major and selected minor permits.

In 1991, the APC&EC adopted numeric aquatic life criteria for twelve pollutants for acute and chronic toxicity: Rule 2.508. On December 22, 1992, EPA promulgated numeric criteria for ten heavy metals and cyanide into Arkansas's WQSs. These criteria were initially expressed as total recoverable metals. Later EPA modified these values by applying a conversion factor to the total recoverable values and expressed them as dissolved values. The promulgated standards for chromium (VI), mercury, and cyanide are expressed as a function of the pollutant's water-effect ratio (WER), while standards for cadmium, chromium (III), copper, lead, nickel, silver, and zinc

are expressed as a function of the pollutant's WER and as a function of hardness. In January 1998, the APC&EC adopted the National Toxics Rule numbers previously promulgated by EPA as a part of Arkansas's WQSs.

When NPDES permit applications are submitted, in-stream waste concentrations (IWC) for all potential pollutants for which there is no adopted state standard are calculated and compared to values listed in the *Quality Criteria For Water* (EPA 1986) also known as the "Gold Book." If toxicity values published in the Gold Book are exceeded by the calculated IWC, whole effluent toxicity testing is required.

Self-Monitoring for Toxicity

The objective of WET testing is to estimate the no observed effect concentration (NOEC) of a facility's effluent. The NOEC is defined as the greatest effluent dilution at and below which toxicity (lethal or sub-lethal) that is statistically different from the control (0% effluent) at the 95% confidence level does not occur. This concentration will allow continued protection of normal propagation of fish and other aquatic life in the receiving waters.

Chronic toxicity tests are conducted for a period of seven days and utilize the fathead minnow (*Pimephales promelas)* and the water flea (*Ceriodaphnia dubia).* The endpoints that are considered to determine adverse effects of toxicants for the fathead minnow are survival and growth. The endpoints that are considered to determine adverse effects of toxicants for the water flea are survival and reproduction.

Acute toxicity tests are conducted for a period of 48 hours and utilize the fathead minnow (*Pimephales promelas)* and the water flea (*Daphnia pulex).* The endpoint that is considered to determine adverse effects of toxicants for the fathead minnow and the water flea is survival.

WET testing is included in the major and significant minor industrial NPDES permits. WET testing is also included in both major and some minor municipal NPDES permits and in one federal permit.

When a facility's effluent experiences a certain number of toxic events, a Toxicity Reduction Evaluation (TRE) is required. A sub-lethal TRE is triggered based on one sub-lethal failure and sub-lethal failures in two out of three consecutive re-tests. A lethal TRE is triggered based on one lethal failure and lethal failure in one out of three consecutive re-tests. A TRE is an investigation intended to determine those actions necessary to achieve compliance with water quality-based effluent limits by reducing an effluent's toxicity to an acceptable level. A TRE is defined as a step-wise process that combines toxicity testing and analyses of the physical and chemical characteristics of a toxic effluent to identify the constituents causing effluent toxicity and/or treatment methods that will reduce the effluent toxicity. The goal of the TRE is to reduce the toxic effects of effluent at the critical dilution. Depending on the results of the TREs, a

facility will have either corrected treatment issues, relocated the effluent discharge, improved treatment capabilities, or assigned WET limits in their NPDES permits.

The NPDES General Permit number ARG790000, Groundwater Clean-Up located within the State of Arkansas, authorizes the discharge of treated groundwater/surface water that may have been contaminated with petroleum fuels. Determinations of coverage under this general permit are issued for short duration discharges, which sometimes only last for several months. The initial general permit was first issued on April 10, 1990. The initial general permit contained monthly acute WET testing requirements for all treated groundwater discharges, which included all permittees covered by the general permit. The monthly acute WET testing for one year requirements were continued with the effective date of the renewal permit on March 1, 1995; February 1, 2001; April 1, 2006; April 1, 2011; April 1, 2016; and April 1, 2021.

Accreditation of Monitoring Data

Ark. Code Ann. § 8-2-201 *et seq*., Environmental Laboratory Accreditation Program Act, establishes mandatory accreditation for certain environmental testing laboratories. Ark. Code Ann. § 8-2-204 clarifies DEQ's authority to refuse to accept analytical results from a laboratory and establishes DEQ's enforcement powers over environmental testing. Rule 9 establishes the fee system for laboratory accreditation.

Enforcement

The Enforcement Branch of the OWQ implements the NPDES enforcement program. The primary basis for enforcement is self-monitoring data submitted by permittees on a discharge monitoring report (DMR). DMR data are entered into the Integrated Compliance Information System (ICIS) national database and reviewed by Enforcement staff. DEQ addresses all permit violations reported by permittees initially through informal enforcement action where feasible. An escalation of enforcement action occurs if the violation(s) are not resolved. Other violations are judged on their severity and actions are taken as necessary. Inspection Reports from the OWQ's Compliance Branch are also an important source of violation data, and enforcement action is initiated in proportion to the severity of the violations noted by DEQ staff in the field.

Wastewater Licensing and Training

Wastewater treatment plant operator licensing and training continues to be a necessary and integral part of the overall scope of the point source pollution control program. The licensing and training verification administered by the Wastewater Licensing Program operates within the authority of Ark. Code Ann. § 8-5-201 *et seq*. These statutes, and the rules promulgated thereunder, set the requirement by law that all operators in responsible charge of a public or private wastewater treatment plant be licensed and certified as competent by DEQ. Ark. Code Ann. § 8-5-207, as established by Act 211 of 1971, has required licensed operators at publicly operated treatment works since 1971. Ark. Code Ann. § 8-5-207 was amended by Act 1103 of

1991 to add the requirement for the licensing of operators at private wastewater treatment plants. There are currently approximately 3100 licensed operators in Arkansas, which includes both municipal and industrial operators. Classification of wastewater treatment plants by the unit processes determine the level of operator staffing and the licensing level of the plant operators.

The Arkansas Environmental Training Academy, a branch of Southern Arkansas University located at Camden, Arkansas, and the Arkansas Rural Water Association, Lonoke, Arkansas perform most wastewater treatment plant operator training. Over 60 training sessions and 700 license exams are administered annually with offerings in all phases of wastewater training at various state locations by the faculty and staff. Private contractors, professional organizations, and other institutions of higher learning provide other sources of training.

Nonpoint Source Control Program

In 1988, DEQ conducted a nonpoint source (NPS) assessment and prepared a management plan pursuant to Section 319 of the CWA. This assessment and portions of the original management program were approved by EPA Region 6.

In 1996, the former Arkansas Soil and Water Conservation Commission, now the Arkansas Department of Agriculture – Natural Resources Division (ADA-NRD), was designated as the NPS program management agency and the lead agency for the agriculture nonpoint source category. The Arkansas Forestry Commission assumed the responsibilities for the silviculture category. DEQ has retained the responsibility of assessing and reporting on nonpoint source pollution and the responsibilities associated with resource extraction (mining). The University of Arkansas Division of Agriculture, Cooperative Extension Service was designated for education outreach.

DEQ and ADA-NRD share the responsibilities of the surface erosion, urban runoff, and road construction / maintenance categories. The NPS Management Program prioritizes watersheds by the use of a matrix approach. The 8-digit HUCs are further broken down into 12-digit HUCs to facilitate focus in implementing projects in critical areas. In addition, both of these entities and numerous other cooperators lend assistance and/or support to each of the priority watersheds.

Assessment

The initial Arkansas nonpoint source pollution assessment was completed in 1988. This assessment was updated in June 1997 using updated assessment criteria. The *Nonpoint Source Pollution Assessment Report* (NSPAR) (ADEQ 1997) assessed 8,700 stream miles and indicated that nonpoint source pollution was impacting (but not necessarily impairing) over 4,100 stream miles. Agricultural activities were identified as the major cause of impacts on 3,197 stream miles. Other impacts were related to silviculture activities, road construction/maintenance activities, and unknown sources.

To reduce the confusion between the NSPAR and this document, DEQ no longer publishes a separate NSPAR. This document, updated every two years, serves as the NSPAR.

Management Program

The Arkansas Nonpoint Source Pollution Management Plan (ANRC, 2018) is developed and implemented by ADA-NRD. It provides for continued monitoring of water quality, demonstrations of the effectiveness of BMPs, and implementation strategies of BMPs to reduce nonpoint source pollutants. In 2006, and in each year since then, ADA-NRD and its subsequent Nonpoint Source Management Program section have and continue to initiate annual meetings of the task force. The task force utilizes new or updated information and data to incorporate into a 12-tiered risk matrix approach to adjust and/or allocate resources and support, when appropriate, to emerging or changing conditions. This approach also facilitates stakeholder participation.

ADA-NRD conducts in-stream water quality monitoring in various priority areas as defined by the NPS Program. Collected data determine project effectiveness, evaluate NPS contribution trends and determine water quality improvement as related to best management practice implementation specifically to known NPS sources. These data are used in DEQ's water quality assessment when appropriate.

No-Discharge State Permits

The No-Discharge Section of the Permits Branch issues individual permits relating to waste disposal systems that do not discharge directly to the waters of the state. These systems are most commonly located at commercial facilities with septic tanks and leach fields and centralized or decentralized wastewater treatment systems for residential developments. Individual permits are also issued for the land application of waste generated by different types of treatment facilities such as wastewater treatment plants, poultry processing plants, food-processing plants, and drilling fluids from oil and gas field exploration activities. This Section issues general permits for carwash septic tanks, one-time land application, saltwater disposal, and land application of water treatment plant residuals. This Section also administers the Underground Injection Control Program for Class I, III, and V wells (excluding bromine-related spent brine disposal wells), and in conjunction with the Arkansas Oil and Gas Commission, issues permits for salt-water disposal systems.

Groundwater

DEQ is empowered to enforce and administer all laws and regulations relating to pollution of the waters of the state, including groundwater, per Ark. Code Ann. § 8-4-201, because "waters of the state" include "…all bodies or accumulations of water, surface *and* underground…."

DEQ's Groundwater Protection Program maintains an ambient monitoring network to record historical and current groundwater-quality conditions. The Office of Land Resources within

DEQ has regulations pertaining to groundwater protections. DEQ's Brownfields Program uses the EPA Region 6 Human Health Media-Specific Screening Levels for purposes of evaluating risk to human health and the environment during site evaluation. Methodologies and standards for risk assessment at contaminated sites have been established. Risk assessments demonstrate the difficulty of simply establishing numerical standards for all contaminated sites, because groundwater quality standards must be established in a manner that will augment existing regulations, provide a uniform set of criteria for defining and addressing groundwater contamination, and fill existing gaps in groundwater protection. Chief among the issues are fundamental policy decisions such as a non-degradation policy versus a risk-based or numeric cleanup standard, the role of stakeholders, coordination among applicable state agencies, and legislative support. In the event that statewide groundwater standard development is undertaken, these policy decisions must be made by a multi-agency team and receive input from multiple levels of agency management.

B.3 COST / BENEFIT ANALYSIS

CWA section 305(b) (and associated sections) requires states to provide an estimate of the environmental, economic, and social costs and benefits needed to achieve CWA objectives and an estimate of the date of such achievement.

A true cost/benefit analysis (CBA) described above to fulfill CWA requirements would be burdensome and expensive. Therefore, EPA guidance (2005) suggests states include a brief narrative that includes as much of the following information as possible.

For costs, states may include "capital investments in municipal and industrial facilities, investments in nonpoint source measures, annual operation and maintenance costs of municipal and industrial facilities, total annual costs of municipal and industrial facilities, and annual costs to states and local governments to administer water pollution control activities."

For benefits, states may include "information on improvements in recreational and commercial fishing; extent of stream miles, lake acres, etc., improved from meeting WQSs; reduced costs of drinking water treatment due to cleaner source water; and increase in use of beaches and recreational boating due to improved water quality."

Cost Information

Costs for implementing CWA regulations are summarized as agency programmatic implementation expenses, pollution abatement capital expenditures, and operating costs. Much of the water quality related budget is self-generated through permit fees; however, a portion is derived through federal grants. These grants include §106 grant money for water pollution control activities, §319 grant money for nonpoint source management issues, and §604(b) grant money for state ambient water quality analysis. Funds from these grants are divided throughout

the appropriate water-quality related state programs as directed by each grant and provide funding for personnel, equipment, survey and research work, and ambient water quality monitoring.

State of Arkansas Budget for Water Quality Control Activities

DEQ has primary responsibility for permitting and enforcement of CWA provisions in Arkansas, but the implementation of water quality control activities is distributed across several state agencies, including DEQ, ADH, Rural Water Association of Arkansas, and ADA-NRD, among others.

Federal CWA Section 604(b) Budget

The §604(b) grant program provides funding to OWQ's laboratory in the amount of approximately $70 thousand per fiscal year. The §604(b) funds are used to help defray expenses for analytical work performed in the OWQ laboratory. Expenses include analysts' salaries and supplies necessary to perform sampling and chemical analyses of ambient river, stream, and lake water quality samples and compliance sampling inspection samples.

Federal CWA Section 106 Budget

The §106 grant program provides funding for DEQ's general water pollution control/water quality management program. Activities funded under the §106 grant include ambient water quality monitoring, assessment of ambient water quality data, development of the Integrated Report, revision of Arkansas's Water Quality Management Plan, development and revision of surface WQSs, development and issuance of waste water discharge permits (NPDES Program), compliance inspections, complaint investigations, and development of enforcement actions. For this period of record (POR), DEQ received approximately $11 million in federal §106 grant funding for these activities.

Federal CWA Section 319 Budget

The Clean Water Act §319 grant for nonpoint source management in Arkansas is implemented by the ADA-NRD. The ADA-NRD works with universities, city and regional officials, private industries, and the federal government to prevent, control, and remediate nonpoint source pollution throughout Arkansas. Part B.2, Nonpoint Source Pollution Control has more information about the Nonpoint Source Program. For the period of record, ADA-NRD received approximately $15.3 million in federal funding for these activities.

Benefits Information

The benefits of implementing the CWA are numerous and obvious. Clean water means higher revenue from aquatic related tourism and recreation, decreased costs to treat drinking and wastewater, and higher revenue from commercial fishing and aquaculture. Because economic

reports are not specific to 305(b) reporting needs, DEQ reports these benefits as conservative estimates of ten percent of expenditures or revenue gains.

Tourism and Recreation

Arkansas has an abundance of streams lakes, reservoirs, and ponds; most of which are used for some sort of aquatic recreation: fishing, swimming, kayaking, scuba diving, canoeing, hunting, motor boating, and waterskiing. All of these activities benefit from clean water, as does Arkansas's tourism revenue (directly or indirectly).

The Arkansas tourism industry was on a steady incline from 2016 – 2019, but declined in 2020[1]. However, many recreational areas experienced increased visitation in 2020. It's likely that, due to the COVID-19 pandemic, outdoor recreation was experienced more on a local level, which may explain the decline in tourism dollars. A conservative estimate for tourism revenue that directly benefited from implementation of the CWA (fishing, boating, canoeing, etc.) would be 10%. Using data from previous 305(b) reports, a conservative estimate of tourism revenue that directly benefited from implementation of the CWA, for the 2022 POR, is over $3.59 billion dollars.

Table IV-B: Estimate of tourism revenue in Arkansas that benefits from implementation of the CWA

Year	Travel expenditures in Arkansas (in billions of dollars)	Estimated tourism revenue that directly benefited from implementation of the CWA (in millions of dollars)
2016	$6.9	$690
2017	$7.2	$720
2018	$7.7	$770
2019	$8.0	$800
2020	$6.0	$600
Total		**$3,589**

According to the United States Fish and Wildlife Service (USFWS) (https://www.census.gov/prod/2012pubs/fhw11-nat.pdf) in 2011 (the most recent data available),

[1] Arkansas Tourism Economic Impact Report, 2020

$496 million was realized in Arkansas for fishing related expenditures. If we assume a conservative 10% benefit from the CWA that would be almost $50 million.

Drinking Water

Arkansas has 80 surface water intake systems that produce (collectively) an average of 386 million gallons per day (ADH personal communication). Cost to treat drinking water due to diminished water quality varies by contaminant and is dependent on multiple variables. Dearmont *et al.* (1998) conducted a case study in Texas and found that costs of treatment increased by $95 per million gallons when contamination is present. If we extrapolate this to Arkansas, this translates to a cost of over $36,000 per day or over $13 million annually. They also found that a 1% increase in turbidity increased chemical treatment costs by 0.25%.

Aquaculture

According to the University of Arkansas at Pine Bluff aquaculture/fisheries center of excellence, Arkansas has a $61 million aquaculture industry (http://www.uapb.edu/academics/school_of_agriculture_fisheries_and_human_sciences/aquaculture_fisheries/aquaculture_fisheries.aspx).

Warm-water (smallmouth bass, striped bass, and walleye) and cold-water (trout) fisheries are another economically important industry for Arkansas. Arkansas has six hatcheries operated by the Arkansas Game and Fish Commission (AGFC) and three National Fish Hatcheries (NFH). According to the USFWS, for each $1 spent of budget expenditures at the Norfork NFH, $95 is invested at the state and local level. For every $1 of hatchery operational budget Greers Ferry hatchery spends, $113 is put back into the economy. [2]

[2] https://www.govinfo.gov/content/pkg/CHRG-113hhrg87010/pdf/CHRG-113hhrg87010.pdf

PART C: SURFACE WATER MONITORING PROGRAM

C.1 MONITORING PROGRAM

Water Quality Monitoring Program

Arkansas monitors more than 150 ambient river and stream surface water monitoring sites on a monthly to bi-monthly basis. The current monitoring program operates under four goals: 1) to better assess the effects of point source discharges upon water quality; 2) to observe nonpoint source contributions over time; 3) to continue monitoring the major rivers due to their basic importance to the State; and 4) to monitor high quality (least impaired) streams to provide long-term chemical data by physiographic region for use in future WQSs revisions. DEQ's monitoring program is thoroughly outlined in State of Arkansas Water Quality Monitoring and Assessment Program, Revision 6 (ADEE, 2020).

In 2019, DEQ initiated a routine lakes sampling program for ~90 significant public lakes (see section C.3 for more), which will be sampled on a 3-year rotation. Every three years, priority lakes are re-evaluated and a new set of lakes are selected to be sampled. Ultimately, all of the publicly owned lakes should have three years' worth of data every 9–12 years. Before the establishment of the rotating program, DEQ had been sampling 16 of the largest lakes in Arkansas, with most being owned and operated by the United States Army Corps of Engineers (USACE), since 2011.

If a waterbody assesses as impaired, needs more information, or needs criteria re-evaluation, a special or intensive survey may be implemented or the waterbody may be added to routine sampling. Table I-C lists DEQ - Water Quality Planning Branch projects within the 2022 POR. These surveys can include biological and/or special needs data collection dependent upon the impairment or type of information needed. All sample sites with data collection during the 2022 POR can be found in Figure 8-C.

Figure 8-C: Sample Sites Collected by DEQ during the 2022 POR

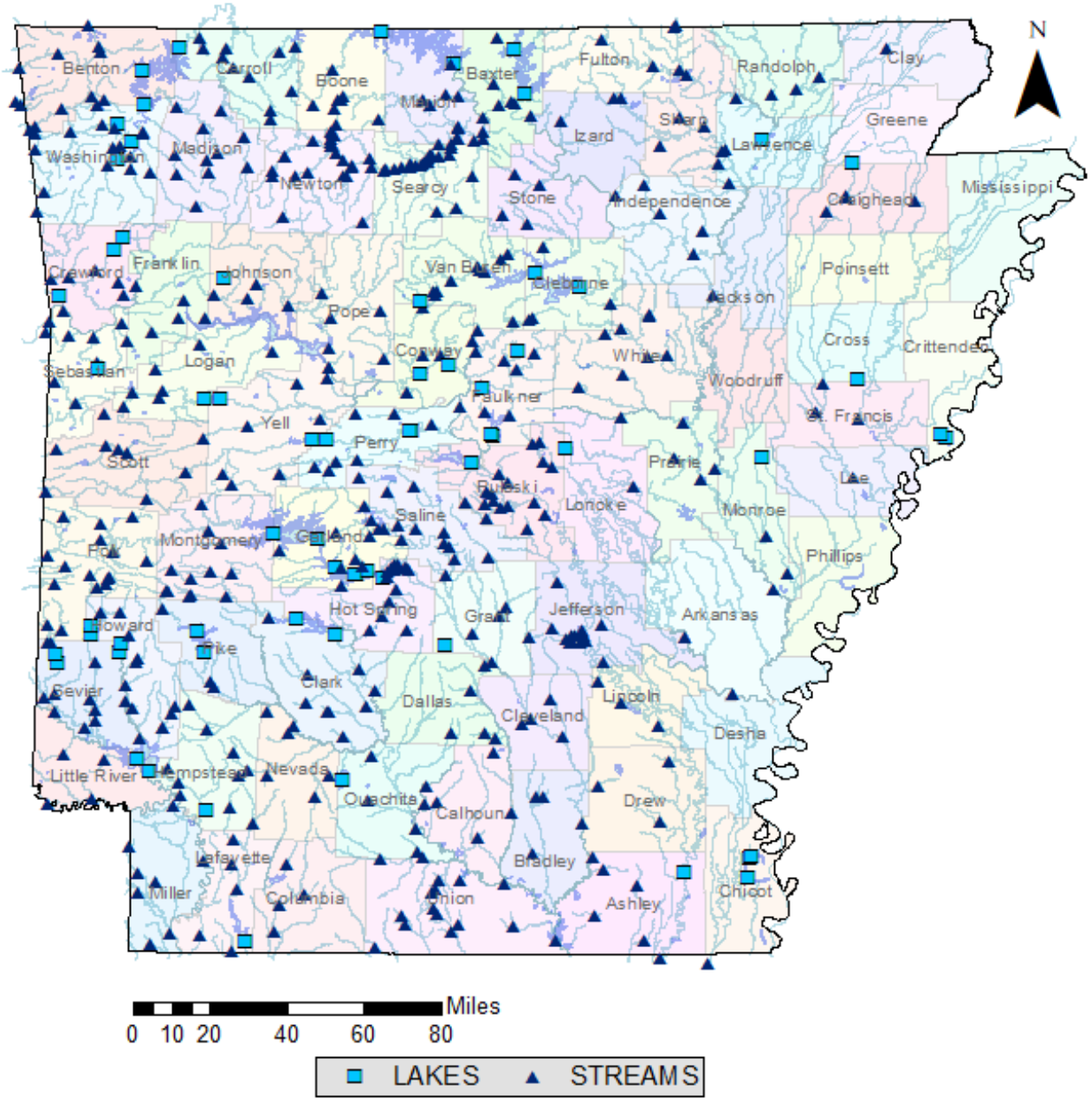


Table I-C: DEQ Water Planning Branch special projects during the 2022 POR

Name	Project Year(s)
Halliburton Mine Reclamation Project	2011 – 2018
Lower Cache River Restoration Project	2012 – 2016
Two Forks Restoration- Biological Monitoring Program	2012 – 2016
Stream Restoration of Tanyard Creek in the Little Sugar Watershed	2013 – 2016
Data Collection for the Development of Nutrient Criteria for Extraordinary Resource Waterbodies in the Ozark Highland Ecoregion of Arkansas	2012 – 2015
Data Collection for the Development of Nutrient Criteria for Extraordinary Resource Waterbodies in the Boston Mountain Ecoregion of Arkansas	2013 – 2016
Data Collection for the Development of Nutrient Criteria for Extraordinary Resource Water Bodies in the Ouachita Mountain Ecoregion	2016 – 2019
Biotic and Abiotic Sampling at Select Wadeable Locations Within the Ouachita Mountain Ecoregion	2016 – 2019
Evaluation of *Escherichia coli* (*E. coli*) Concentrations in Mill Creek, Newton Co., Arkansas	2016 – 2019
Data Collection of Selected Lakes at Risk for Harmful Algal Blooms	2017 – 2019
Data Collection for the Development of Water Quality Criteria for Wadeable Streams in the Western South Central Plains	2018 – 2020
Data Collection for the Development of Water Quality Criteria for Wadeable Streams in the Central South Central Plains Ecoregion	2019 – 2022
Data Collection for the Development and/or Revision of Water Quality Criteria for Wadeable Streams in the Eastern South Central Plains	2020 – 2022
Assessment of the Effects of Holding Time on *E. coli* Densities in Arkansas Surface Water Samples	2021 – 2022
National Aquatic Resource Survey - National Lakes Assessment	2022
Supplemental Data Collection for Development and Refinement of Water Quality Criteria in Ozark Highlands and Boston Mountains Ecoregion Wadeable Streams	2022 – 2024

C.2 DATA USAGE

Arkansas strives to achieve comprehensive assessments by utilizing both DEQ data and data from outside sources. Assessment highlights are described below, but the full 2022 Assessment Methodology used for assessments can be found in Appendix C.

DEQ Data

Arkansas's water quality monitoring network is discussed in section C.1 and data are used as long as they meet the requirements laid out in the Assessment Methodology.

The majority of data that DEQ collects, analyzes and maintains is stored in DEQ's Laboratory Information Management System (LIMS), accessible through https://www.adeq.state.ar.us/techsvs/env_multi_lab/water_quality_station.aspx. Three queries were conducted through DEQ's LIMS database entitled "Water Quality Monitoring Data":

Query 1:

Dates Queried	Parameters Queried
04/01/2016 – 03/31/2021	Chloride (mg/L)
	Dissolved Oxygen (DO) (mg/L)
	Escherichia coli (cfu/100mL)
	Escherichia coli (MPN/100 mL)
	Nitrite+Nitrate as Nitrogen (mg/L)
	pH (none)
	Sulfate (mg/L)
	Temperature, water (C)
	Total dissolved solids (mg/L)
	Total Phosphorus (mg/L)
	Total Nitrogen from Lachat (mg/L)
	Turbidity (NTU)

Query 2:

Dates Queried	Parameters Queried
04/01/2018 – 03/31/2021	Ammonia-nitrogen (mg/L)
	Cadmium (mg/L)
	Cadmium (ug/l)
	Chromium (mg/L)
	Chromium (ug/l)
	Copper (mg/L)
	Copper (ug/l)
	Hardness, Ca, Mg (mg/L)
	Lead (mg/L)
	Lead (ug/l)
	Nickel (mg/L)
	Nickel (ug/l)
	Silver (mg/L)
	Silver (ug/l)
	Total Recoverable Beryllium (mg/L)
	Total Recoverable Beryllium (ug/l)
	Total Recoverable Selenium (mg/L)
	Total Recoverable Selenium (ug/l)
	Zinc (mg/L)
	Zinc (ug/l)

Data were not queried for the Beaver Lake nutrient criteria (Chlorophyll A (ug/l) and Secchi depth (m)) applicable from 1/1/2016 to 12/31/2020 at the Hickory Creek Site since that is not an established DEQ water quality monitoring station. This location is routinely sampled by other entities.

Data not stored in DEQ's LIMS includes:

- macroinvertebrate data which can be accessed through https://www.adeq.state.ar.us/water/planning/surface/macroinvertebrates.aspx
- fish data, which can be accessed through both https://www.adeq.state.ar.us/water/planning/surface/fish.aspx (pre-September 2017) and stored internally (post-September 2017), which is available upon request.
- continuous data, which is stored internally at DEQ, but is available upon request.

Data from Outside DEQ

In accordance with the CWA under Section 303(d) and implementing regulations in 40 C.F.R. § 130.7, DEQ actively solicits existing and readily available water quality data from around Arkansas and neighboring states. DEQ conducted data solicitation via electronic and postal correspondence to various agencies, municipalities, universities, and other entities who may have collected water quality data within the POR. DEQ also uses data uploaded to the Water Quality Portal (WQX) (https://www.waterqualitydata.us/) as well as what's otherwise available (continuous data) on the USGS database (https://waterdata.usgs.gov/ar/nwis/current/?type=flow).

The 2022 Call for Data was the first to implement a standardized submission platform for non-WQX data-submitters using DEQ's ePortal (https://eportal.adeq.state.ar.us/app/#/formversion/bb5bd0c4-7162-48d5-997d-8e61c1368d0b).

For the 2022 cycle, DEQ directly contacted 126 entities. In response, data were received and evaluated from entities listed in Table II-C. Figure 9-C shows where data were collected by each entity.

In order to be considered for assessment and attainment purposes, outside data must first pass all Phase I requirements:

- Be characteristic of the main water mass or distinct hydrologic areas. For example, not taken within a mixing zone, side channel, tributary, or stagnant backwater, etc.
- Be reported in standard units recommended in the relevant approved method and that conform to Rule 2 or can be directly compared or converted to units within Rule 2.
- Have been collected and analyzed under a DEQ accepted QA/QC protocol. Data collection protocols (QAPP and SOP, as apply) should accompany the data.
- All laboratory analyzed parameters (not *in situ*) must be analyzed pursuant to the rules outlined in the Environmental Laboratory Accreditation Program Act, Ark. Code Ann. § 8-2-201 *et seq.* The name and location of the laboratory should accompany the data.
- Be accompanied by precise collection metadata such as time, date, stream name, parameters sampled, and sample site location(s), preferably latitude and longitude in either decimal degrees or degrees, minutes, seconds.

- Be received in either a Microsoft Excel spreadsheet or compatible format not requiring excessive formatting by DEQ, preferably in the template provided by DEQ.
- Have been collected within the period of record for the current assessment cycle.

Once data pass Phase I requirements, they are then evaluated against Phase II requirements. Phase II requirements are specific to each parameter, but generally consist of temporal, quantity, distribution, and spatial requirements. See the Assessment Methodology (Appendix C) for specifics of Phase II requirements for each parameter.

Data that pass Phase I are assigned an assessment unit according to the site location on the DEQ base layer (see discussion in B.1). Phase II requirements are considered for aggregated data on the entire assessment unit and not based on site alone. There are instances where data collected at one site may not pass Phase II requirements alone, but can be used for assessments after aggregation with data from another site on the assessment unit. Phase II requirements may be considered by site alone when investigating possible differences in attainment within an assessment unit, which may result in the decision to split the assessment unit.

Data Not Used

In general, and as described in the Assessment Methodology (Appendix C), some existing and readily available data were evaluated, but not used for assessments during the 2022 assessment cycle if they were:

- unable to meet all Phase I requirements (see above)
- unable to meet Phase II quantity, temporal, distribution, or spatial requirements on their own, or were unable to be aggregated with other data sets to meet Phase II requirements
- duplicates within the same AU on the same day (most protective value was used for assessment purposes)
- taken outside of applicable watershed size requirements. For example, primary contact recreation is not assessed in watersheds less than ten square miles unless primary contact is verified
- taken within springs or other groundwater sources
- taken in non-stream or lake areas such as roadside ditches, puddles, etc.
- preliminary or provisional

Specific existing and readily available data or data sets not used during the 2022 assessment cycle are described below.

The following describes data not used for each entity that submitted data in the 2022 POR:

DEQ – data collected in springs, seeps, mixing zones, or within 0.5 miles of a dam; data flagged for QC; and lake/reservoir data collected outside the epilimnion (for all applicable parameters).

Arkansas State University – Several coordinates were rectified through correspondences. Three sites associated with Project 17-1200 either did not match descriptions (ASUERF-SSC) or were not addressed (ASUERF-CLC, ASUERF-NSC) in the QAPP. Total phosphorous and lead were analyzed in labs without State accreditation. Project 15-020 was not considered representative of ambient conditions.

Arkansas Water Resources Center – Lake sampling data did not meet spatial requirements.

Beaver Water District – All submitted Secchi data was removed except what's applicable in Rule 2.509 (Hickory Creek Site). Non-accredited parameters (copper) or methods not described (total nitrogen) were removed.

Buffalo River Watershed Alliance – data removed from locations other than "standard water collection sites."

GBMc & Associates – data collected from effluent or targeted storm water events.

Missouri Department of Natural Resources – data collected outside of Arkansas (aside from those within a mile of the state line), or water quality parameters analyzed in labs without State accreditation.

National Park Service – removed data reported as summary statistics.

Ozark Water Watch (H2Ozarks) – removed any data collected prior to QAPP (11/9/2020). USGS (Arkansas, Oklahoma, and Louisiana) – any data marked as "preliminary" or "provisional." These data have not been verified by USGS that they meet QA/QC procedures. Other data not used included targeted storm water sampling, lake/reservoir data collected below the epilimnion (for all applicable parameters), and data taken using non-convertible units.

Some USGS long-term continuous data were not used to make long-term continuous assessments as they did not meet quantity and distribution requirements. Data not used from continuous datasets are not reflected in the percentage of data used.

UMETCO Minerals Corporation – data collected during active remediation and construction events.

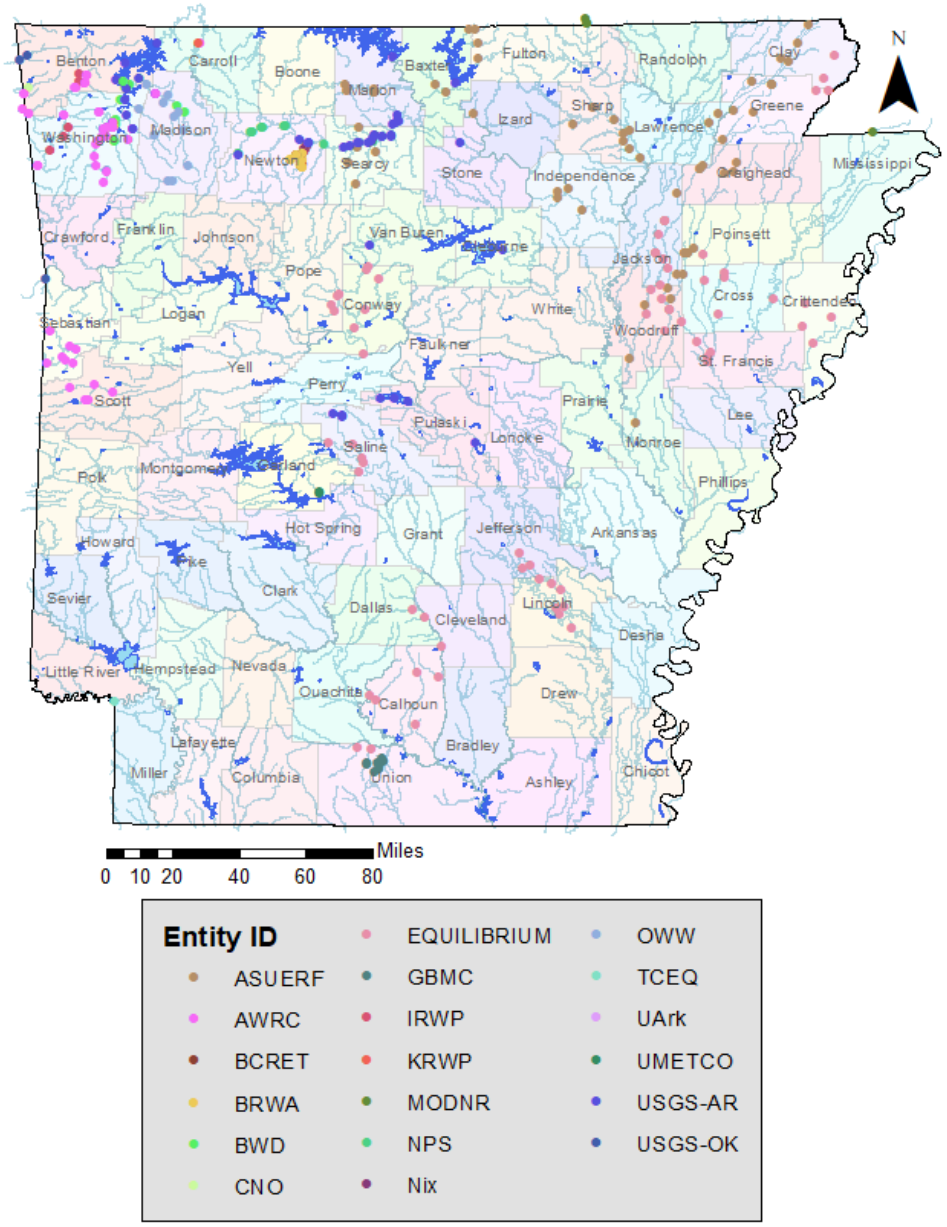
University of Central Arkansas – data not considered representative of ambient waterbodies and QA or collection procedures not described.

Table II-C: Entities with outside data applicable to the 2022 POR

Entity Name
Arkansas Game and Fish Commission (AGFC)
Arkansas State University (ASUERF)
Arkansas Water Resources Center (AWRC)
Beaver Water District (BWD)
Big Creek Research Extension Team (BCRET)
Buffalo River Watershed Alliance (BRWA)
Cherokee Nation (CNO)
Equilibrium
GBMc and Associates (GBMC)
Illinois River Watershed Partnership (IRWP)
Joe Nix – Ouachita Baptist University (Nix)
Kings River Watershed Partnership (KRWP)
Missouri Department of Natural Resources (MODNR)
North American Lake Management Society (NALMS)
National Park Service (NPS)
Ozark Water Watch (OWW)[3]
Texas Commission on Environmental Quality (TCEQ)
UMETCO Minerals Corporation
United States Geological Survey – Arkansas (USGS-AR)
United States Geological Survey – Louisiana (UGSG-LA)
United States Geological Survey – Oklahoma (USGS-OK)
University of Central Arkansas (UCA)

[3] Ozarks Water Watch became H_2Ozarks in 2022

Figure 9-C: Data from Outside Sources



C.3 ASSESSMENT RESULTS

Rivers and Streams Assessment Summary

Attainment Summary

Tables III-C through V-C summarize the designated use support and WQSs attainment status of Arkansas's rivers and streams. Non-support encompasses categories 5, 5-Alt, 4a, and 4b.

Table III-C: Designated use and WQSs support in Arkansas's rivers and streams

Degree of Use Support	Miles
River miles with no known use impairments	2,723
River miles that don't support at least one use	5,730
Total waters with insufficient data (Category 3)	9,850

Table IV-C: Support of assessed rivers and streams by use type

Use Type	Support (miles)	Non-Support (miles)
Agricultural & industrial water supply	5415	153
Aquatic life	3429	3433
Domestic water supply	5323	103
Fish consumption [4]	NA	493
Other	3637	3493
Outstanding resource water	631	933
Primary contact	278	529

[4]Not a designated use.

Table V-C: Total river and stream miles not attaining WQSs by parameter

Parameter	Stream Miles
Aluminum	2
Ammonia	32
Beryllium	2
Biological Integrity	192
Chloride	370
Copper	81
Dissolved Oxygen	2,326
E. coli	523
Lead	632
Mercury	442
Nitrate	55
pH	1491
Phosphorus	17
Priority Organics	51
Selenium	5
Sulfates	222
Temperature	276
Total Dissolved Solids	361
Toxicity	6
Turbidity	2,383
Zinc	120

Lakes Assessment Summary

Background

Although selected lakes have had some historic, long-term assessments, the water quality data from the majority of Arkansas's lakes are sparse. Some lakes have been investigated as a short-term project when a specific or potential problem was identified. Such studies were associated with the Clean Lakes Section of the Water Quality Act, or municipal water supply reservoirs with treatment related concerns. In contrast, the Corps' lakes of the Little Rock District have a relatively large amount of historic, multi-parameter and multi-site water quality data. Additionally, DeGray Reservoir probably has the most extensive historic water quality database of any reservoir in this region of the country.

Arkansas currently has identified ~90 significant publicly owned lakes (Figure 10-C) ranging in size from 40 to over ~40,000 acres;. In 2007, construction was completed on the Lake Fort Smith dam in Crawford County in northwest Arkansas, which combined Lake Shepherd Springs and the original Lake Fort Smith. The new Lake Fort Smith is 1390 surface acres, 422 surface acres larger than the original two lakes combined.

As stated in section C.1, DEQ recently initiated a routine lakes sampling program for ~90 significant public lakes, which utilizes a three-year rotation. Every three years, priority lakes are re-evaluated and a new set of lakes are selected to be sampled. All of Arkansas's publicly owned lakes should have three years' worth of data every 9 years, when possible. Before the establishment of the rotating program, DEQ had been sampling only 16 of the largest lakes in Arkansas, with most being owned and operated by the United States Army Corps of Engineers (USACE), since 2011.

Figure 10-C: Significant Publicly Owned Lakes. Key in Table VI-C

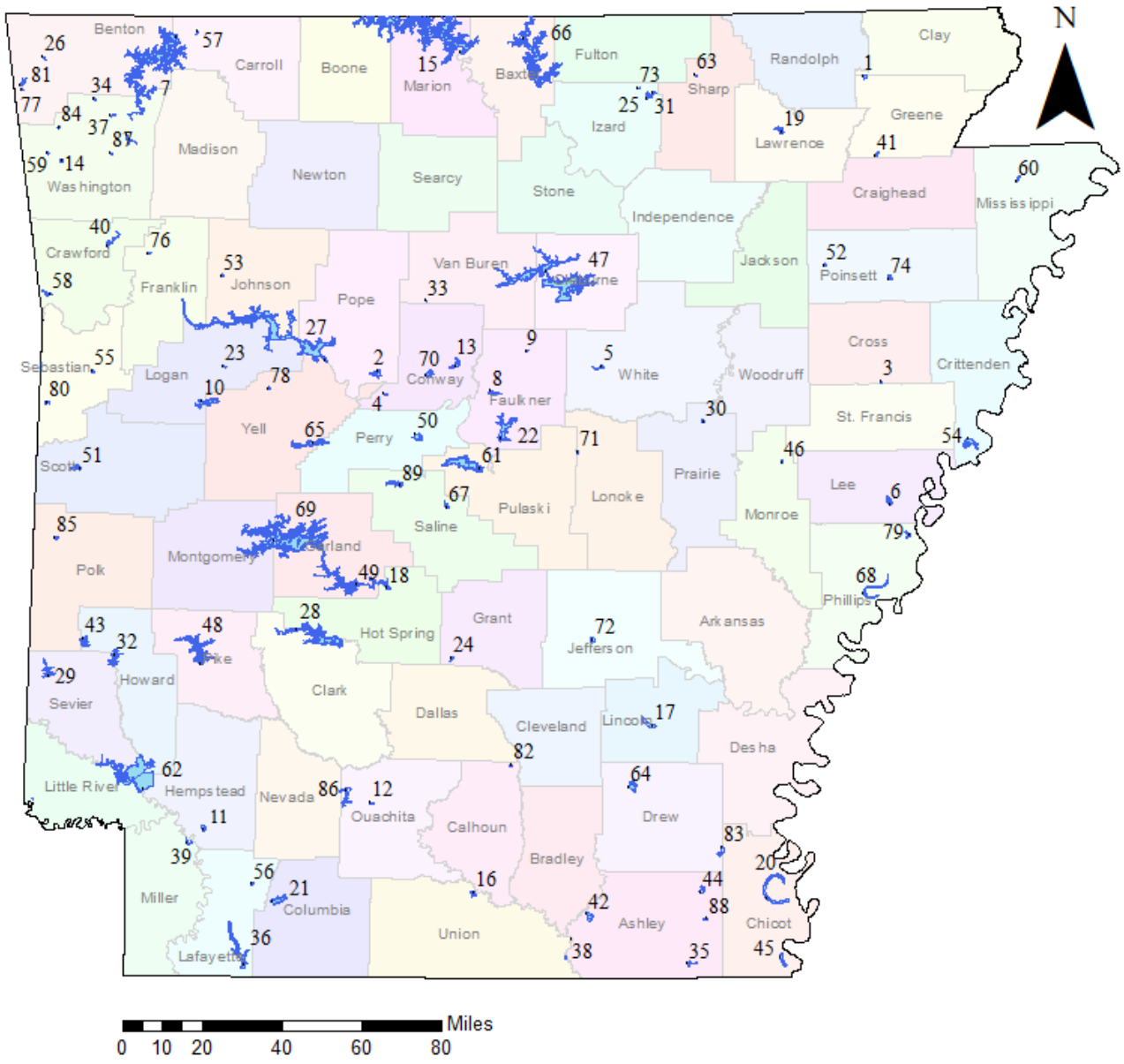


Table VI-C: Lake names and characteristics corresponding to numerical identifier in Figure 10-C

Number	Lake	County	Acres	Average Depth (m)	Watershed (mi^2)	W/A[5]	Ecoregion[6]	Primary Purpose[7]
1	Ashbaugh	Greene	437	5	5.59	8.19	MAP	A
2	Atkins	Pope	129	6	10.8	53.58	AV	A
3	Austell	Cross	60	3	0.78	8.32	MAP	A
4	Bailey	Conway	111	8	9.27	53.45	AV	R
5	Barnett	White	257	27	37.5	93.39	AV	A
6	Bear Creek	Lee	493	10	6.04	7.84	MAP	R
7	Beaver	Benton	28117	58	1190	27.09	OH	H
8	Beaver Fork	Faulkner	722	10	11	9.75	AV	R
9	Bennet	Faulkner	32	N/A	3.33	66.60	AV	F
10	Blue Mountain	Logan	2972	9	488	105.09	AV	F
11	Bois D'Arc	Hempstead	642	4	4	3.99	SCP	A
12	Bragg	Ouachita	172	1.5	8.6	32.00	SCP	A
13	Brewer	Conway	131	20	36.4	177.83	AV	W
14	Budd Kidd	Washington	193	13	3.94	13.07	OH	A
15	Bull Shoals	Marion	33544	67	6036	115.16	OH	H
16	Calion	Union	495	6	18.4	23.79	SCP	A
17	Cane Creek	Lincoln	1734	6	23.8	8.78	SCP	A
18	Catherine	Hot Spring	1528	18	1500	628.27	OM	H

[5] Watershed (acres)/lake acres
[6] AV=Arkansas Valley; BM=Boston Mountains; MAP=Mississippi Alluvial Plains; OH=Ozark Highlands; OM=Ouachita Mountains; SCP=South Central Plains
[7] Corresponds with lake creation needs, not necessarily designated use(s). W=Water Supply; F=Flood Control; H=Hydropower; A=Angling; N=Navigation, R=Recreation

Number	Lake	County	Acres	Average Depth (m)	Watershed (mi^2)	W/A[5]	Ecoregion[6]	Primary Purpose[7]
19	Charles	Lawrence	550	8	19.7	22.92	OH	A
20	Chicot	Chicot	3828	15	17.4	2.91	MAP	R
21	Columbia	Columbia	2380	11	48	12.91	SCP	W
22	Conway	Faulkner	878	5	136	99.13	AV	A
23	Cove	Logan	126	10	9.87	50.13	AV	R
24	Cox Creek	Grant	245	6	9.09	23.75	SCP	A
25	Crown	Izard	610	N/A	13.5	14.16	OH	R
26	Crystal	Benton	38	12	5.3	89.26	OH	A
27	Dardanelle	Pope	34041	14	153666	2889.05	AV	N
28	DeGray	Clark	11521	49	432	24.00	OM	H
29	DeQueen	Sevier	1625	21	171	67.35	OM	F
30	Des Arc	Prairie	295	6	1	2.17	MAP	A
31	Diamond	Izard	113	N/A	1.86	10.53	OH	R
32	Dierks	Howard	1363	22	112	52.59	OM	F
33	Driver Creek	Van Buren	28	N/A	17.1	390.86	AV	A
34	Elmdale	Washington	146	8	7.77	34.06	OH	A
35	Enterprise	Ashley	198	5	2	6.46	MAP	A
36	Erling	Lafayette	5929	7	398	42.96	SCP	W
37	Fayetteville	Washington	171	15	9.38	35.11	OH	R
38	First Old River	Union	220	4	5.07	14.75	SCP	A
39	Felsenthal	Miller/Hempstead	1780	1.33	10800	3883.15	SCP	N
40	Fort. Smith	Crawford	1313	58	75	36.56	BM	W
41	Frierson	Greene	343	8	10.2	19.03	MAP	A
42	Georgia Pacific	Ashley	1559	4	4	1.64	SCP	W
43	Gillham	Howard	1157	21	273	151.01	OM	F

Number	Lake	County	Acres	Average Depth (m)	Watershed (mi^2)	W/A[5]	Ecoregion[6]	Primary Purpose[7]
44	Grampus	Ashley	335	6	2	3.82	MAP	A
45	Grand	Chicot	1192	7	9.81	5.27	MAP	A
46	Greenlee	Monroe	270	6	0.5	1.19	MAP	A
47	Greers Ferry	Cleburne	31034	60	1150	23.72	BM	H
48	Greeson	Pike	7085	39	238	21.50	OM	H
49	Hamilton	Garland	6706	26	1460	139.34	OM	H
50	Harris Brake	Perry	1260	6	11.2	5.69	AV	A
51	Hinkle	Scott	969	15	27.8	18.36	AV	A
52	Hogue	Poinsett	237	4	2	5.40	MAP	A
53	Horsehead	Johnson	109	16	17.3	101.58	BM	R
54	Horseshoe	Crittenden	2388	10	13.5	3.62	MAP	R
55	Jack Nolan	Sebastian	182	9	3.1	10.90	AV	A
56	June	Lafayette	75	5	6.35	54.19	SCP	A
57	Leatherwood	Carroll	85	N/A	13	97.88	OH	F
58	Lee Creek	Crawford	582	11	465	511.34	BM	W
59	Lincoln	Washington	85	N/A	12.5	94.12	OH	W
60	Mallard	Mississippi	318	6	0.5	1.01	MAP	A
61	Maumelle	Pulaski	8960	23	138	9.86	OM	W
62	Millwood	Little River	27920	5	4120	94.44	SCP	F
63	Mirandy	Sharp	26	N/A	1.07	26.34	OH	R
64	Monticello	Drew	1476	12.5	6.8	2.95	SCP	A
65	Nimrod	Yell	2594	8	680	167.77	AV	F
66	Norfork	Baxter	17960	57	1810	64.50	OH	H
67	Norrell	Saline	270	N/A	7.03	16.66	OM	W
68	Old Town	Phillips	2135	4	29.2	8.75	MAP	R

Number	Lake	County	Acres	Average Depth (m)	Watershed (mi^2)	W/A[5]	Ecoregion[6]	Primary Purpose[7]
69	Ouachita	Garland	38184	51	1100	18.44	OM	H
70	Overcup	Conway	805	4	16.6	13.20	AV	A
71	Pickthorne	Lonoke	325	5	13.2	25.99	MAP	A
72	Pine Bluff (Saracen)	Jefferson	467	6	42.2	57.83	MAP	A
73	Pioneer	Izard	30	N/A	0.45	9.60	OH	R
74	Poinsett	Poinsett	338	7	4.4	8.33	MAP	A
75	Sequoyah	Washington	425	8	274	412.61	OH	R
76	Shores	Franklin	72	10	49.9	443.56	BM	R
77	Siloam Springs	Benton	55	N/A	29.3	340.95	OH	R
78	Spring	Yell	81	23	17	134.32	AV	R
79	Storm Creek	Phillips	273	7	9.13	21.40	MAP	R
80	Sugarloaf	Sebastian	291	12	2.33	5.12	AV	A
81	SWEPCO (Flint Creek)	Benton	416	17	14	21.54	OH	W
82	Tricounty	Calhoun	287	7	15.3	34.12	SCP	A
83	Wallace	Drew	321	5	7.05	14.06	MAP	A
84	Wedington	Washington	86	16	3.96	29.47	OH	R
85	White Oak	Ouachita	1652	8	21	8.14	SCP	A
86	Wilhelmina	Polk	197	10	13.4	43.53	OM	A
87	Wilson	Washington	29	N/A	2.55	56.28	OH	W
88	Wilson Break	Ashley	148	5	1	4.32	MAP	A
89	Winona	Saline	1170	30	44.3	24.23	OM	W

Water Quality Standards Development

In 2008, DEQ began working with USGS to develop WQSs for publicly owned lakes. The first phase was to identify reference lakes for each of the lake types and different lake purposes within each of the State's ecoregions. The goals of the first phase were to develop a process for identifying potential reference lakes, identify these lakes, and collect water quality data from these lakes to verify reference conditions. The second phase included intensive, multi-year water quality sampling to support the reference lake determination; establish a database that can be used to help determine water quality trends and criteria; determine the similarities and differences between and among the lakes; and establish a more precise classification of the lakes.

Phase I and Phase II projects have been completed for the smaller impoundments of the Gulf Coastal, Mississippi Alluvial Plains, Boston Mountains, and Ozark Highlands ecoregions. Data produced from these projects have indicated that three to four reference lakes per ecoregion is inadequate because of the vast differences within each ecoregion. The approach outlined in the original projects is being revised to better identify least-disturbed ecoregion lakes.

Attainment Summary

Tables VII-C through IX-C summarize the designated use support and WQSs attainment status of the state's lakes. Non-support encompasses categories 5, 5-Alt, 4a, and 4b. Total surface acres of oxbow lakes in the Ouachita River basin are unknown. Some of these oxbow lakes are impaired for Hg and do not meet the fish consumption use, so there is an underestimate for fish consumption.

Table VII-C: Designated use and WQSs support in Arkansas's lakes

Degree of Use Support	Assessed Total (acres)
Lake acres with no use impairments	158,107
Lake acres that don't support at least one use	28,305
Total lake acres with insufficient data for all uses (Cat. 3)	143,479

Table VIII-C: Support of assessed lakes by use type

Designated Use Type	Support (acres)	Non-Support (acres)
Agricultural and Industrial Water Supply	159,538	0
Aquatic life	168,183	9,346
Domestic water supply	158,622	916
Fish consumption[8]	NA	6,287
Other uses	161,165	9,866
Outstanding Resource Waters	48,309	0
Primary contact recreation	3,417	0

Table IX-C: Total lake acres not attaining WQSs by parameter

Parameter	Lake Acres
Copper	343
Dissolved oxygen	1,932
E. coli	0
Mercury	10,593
Nutrients	7,662
Polychlorinated biphenyl (PCB)	467
pH	8,241
Siltation/Turbidity	1,625
Unknown	325

Section 303(d)

Clean Water Act Section 303(d) requires states to identify waters that do not meet or are not expected to meet applicable WQSs. These waterbodies are compiled into a list known as the 303(d) list or list of impaired waterbodies. The 2022 list of impaired waterbodies (303(d) list) (Tables XII-C through XVIII-C) contained in this report has not yet been approved by the EPA.

As with the 2020 list, the 2022 303(d) list format has been changed from previous 303(d) lists in that it identifies specific conditions on which an assessment unit was listed, if known. Several parameters are subdivided by data type, season, or magnitude. Understanding the condition for the listing helps assessors know how the segment can be delisted in the future. DEQ also hopes that this extra level of detail will help guide future sampling or implementation of best

[8] Not a designated use

management practices. This method may create what is perceived as more listings, but it reflects the listing condition more accurately. For example, an assessment unit may have been listed once for dissolved oxygen in 2018, but may have been impaired for both the critical and primary seasons, which have different criteria. The new format list is set up to reflect both of those conditions. This additional information was integrated into the "Parameter" column for the 2022 303(d) list. The column "Listing Status" was also added to help assessors track the longevity of a pollutant pair's placement on the list, which will aid in prioritizing re-sampling or TMDL development. "Remnant" listings are those that had either no data or not enough data to assess during the current POR. "Carry forward" listings are those that were already on the list and had enough assessable data during the current POR to assess as impaired. "New" listings are those that had not previously been on the list, but were assessed as impaired during the current POR. Beginning in 2020, a column was added to track "Year Listed".

Deviations from Methodology and Corrections

Occasionally assessors will deviate from methodology. These deviations can result in an assessment of support/attainment (not impaired) or non-support/non-attainment (impaired). Such deviations are performed on a case-by-case basis using a weight of evidence approach. For example, if the minimum number of samples is not met, but there are a large percentage of exceedances in the samples provided, the AU may be assessed as impaired.

For the 2022 assessment, deviations from methodology and corrections from previous lists are outlined below:

1) Communication with the AGFC indicated that Lakes Bull Shoals, Greers Ferry, and Ouachita are no longer stocked for trout. Therefore, no lakes were assessed as having a trout aquatic life use.
2) The most protective criteria were applied to waterbody segments that crossed ecoregion borders.
3) Several AUs were placed in category 3 for biological integrity – fish due to marginal scores, available habitat data, gaps in methodology, and watershed size. In 2020, DEQ implemented seining into fish sampling methods to account for smaller bodied genera. These sites will be prioritized for re-sampling when current biological projects are completed. The AUs include: AR_08040101_636, AR_08040203_611, AR_08020402_807, AR_08040103_833, AR_08040103_808, AR_11140109_013, AR_11140109_935, AR_11140201_010, AR_11140304_908, AR_08040102_021, AR_11140108_019, and AR_08040203_821.
4) During the 2020 assessment, AR_11140203_025, which is in 4b for Dissolved Oxygen, was assigned a descriptor of "Short-term Continuous," but a deeper look into historical assessments indicated that this listed was based on discrete critical season data, which is updated in the 2022 list.

5) All historic Hg listings were assigned an aquatic life use. Since the listings are made on fish tissue and consumption advisories, the aquatic life use was removed from Hg listings.
6) In 2020, site "13" was errantly aggregated into the assessment unit AR_11010001_4042, which was improperly delisted for turbidity. However, this assessment unit does delist for turbidity using data for the 2022 POR.
7) Due to multiple UAAs and changing segment names of the stream complex near El Dorado Chemical Corporation, AR_08040201_616 was left off the 2020 list for Ammonia – ELS present and is added to the 2022 list.
8) Total nitrogen data from AR_11110103_813 were excluded from the 75th percentile calculation as that data nearly doubled the threshold.
9) The assessment methodology was changed for macroinvertebrates. Historic records of how macroinvertebrate assessments were completed before the 2020 cycle are missing and a method which DEQ termed "Top 5 EPT" was used to develop a reference condition in the Ouachita Mountains. However, preliminary assessment of macroinvertebrate data in the South Central Plains indicated that the Top 5 EPT method would not sufficiently represent a reference condition in low-gradient ecoregions, which have been found to have low numbers of EPT taxa. The change in methodology and resulting listing decisions can be found in Appendix B.
10) On the 2018 list, AR_08040206_716, AR_08040206_916, AR_08040206_016, and AR_08040206_816, which are in HUC 0804020603 were evaluated based off of AR_08040206_015. However, AR_08040206_015 is in a different HUC 10 (AR_0804020601). These listings were removed because data and/or information is lacking to determine water quality status – the original basis for listing was incorrect.
11) Assessment Unit AR_08040103_023, which was listed in 2020 for short-term continuous critical season DO was mislabeled as being on the North Fork Ouachita River and has been corrected to the Little Missouri River.
12) Prior to the 2020 cycle, AR_11140109_819 was listed for pH but a deeper look into historical records showed that the data were collected on AR_11140109_719.
13) In accordance with the Site Specific Use Variation table in Rule 2, domestic water supply was removed as an impaired use from AR_11140203_023 and AR_08040202_909.
14) Uses were incorrectly assigned to the parameters listed on segment AR_11110207_018 and have been corrected.
15) Beryllium criteria is a human health value, so agricultural and industrial water supply was removed from the impaired uses on AR_08040102_971.
16) On the 2022 draft list, AR_11070208_903 was listed in both categories 1b and 4a. The 4a listing has been removed and the 1b listing use has been corrected to SAL.
17) Previous lists have only included the lower portion of Lake Columbia as impaired for Hg. However, the entire lake has an Hg Advisory issued by ADH, so the upper portion (AR_11140203_4010) was included in category 4a.

18) Due to a mapping error, AR_11140109_024 was added to the 2020 list for Copper on Bear Creek. However, this segment is actually on Rolling Fork and should not have been listed. It was removed based on the original listing being incorrect. Its companion segment, AR_11140109_025 (Bear Creek) was correctly listed and has been delisted during the 2022 cycle based on attaining copper data.
19) The Outstanding Resource Water (ORW) use was left off the Hg listings on the Saline River, but have been corrected.
20) Previous lists have impaired AR_08020402_4010 as "parameter unknown", but the 2006 Integrated Report states that this segment did not attain turbidity criteria. For tracking and delisting purposes, the "unknown parameter" listing has been changed to "Turbidity Base lows" and "Turbidity Storm Flows".
21) Although listed on the 2022 draft in category 4a for Hg, AR_08040201_4080 has no recorded TMDL, ADH advisory, or previous listing. It is presumed to have been listed in error and was therefore removed.
22) In the 2022 draft list, AR_08040201_910 was given a seasonal aquatic life use due to it's watershed size, but a UAA has been conducted on this segment giving it a perennial aquatic life use. The use has been changed from SAL to AL.
23) John Morgan Lake was listed in 4a for Hg along with other Ouachita River Oxbows in 08040202 as defined by the TMDL. However, it was determined that the John Morgan Lake AU was assigned to the incorrect HUC. This AU has been changed in the DEQ base layer to reflect the proper HUC and has been removed from the list.
24) Due to what was likely a sorting error, Planning Segments in the Draft TMDL List were incorrect for many of the 4a listings.
25) During the 2020 cycle, the upstream portion of AR_08020402_007 was split to include segment AR_08020402_607, which better reflected mineral criteria as defined in Rule 2.511. AR_08020402_007 is listed for Priority Organics and this listing should also have been applied to AR_08020402_607, but was unintentionally left off of the 2020 list.

Assessment Categories

DEQ places AUs into categories upon assessment. AUs may be placed into more than one category if different parameters assess differently (Example: pH could attain and be placed in Category 1 while temperature does not attain and is placed in Category 5 for the same AU). Categories are listed below. Categories 4 and 5 contain AUs that do not attain their WQS. Categories 1 and 2 contain AUs that do attain WQSs. Category 1b contains AUs that attain WQSs, but have a TMDL already in place for that parameter. Category 3 AUs need more data or information to make an attainment decision.

Category 1. Attains all water quality criteria and supports all designated uses; categorized by existence of a TMDL or not for one or more constituents.

1a. Attaining all water quality criteria and supporting all designated uses, no use is threatened. No TMDL exists for any constituents.

1b. Attaining all water quality criteria and supporting all designated uses; however, a TMDL remains in place for one or more constituents.

Category 2. Available data and/or information indicate that some, but not all of the designated uses are supported.

Category 3. Insufficient data and/or information are available to make a use support determination.

3a. No data available.

3b. Insufficient data available.

- Data do not meet all quality requirements outlined in this Assessment Methodology;
- Waters in which the data are questionable because of Quality Assurance and/or Quality Control (QA/QC) procedures and/or the AU requires confirmation of impairment before a TMDL is scheduled.
- Where limited available data and/or information indicate potential impacts or downward trends in water quality, the following waterbodies in Category 3 will be prioritized (on a case-by-case basis) for additional investigation: waters designated as ERW, ESW, or NSW; domestic water supplies; and waters located in known karst areas.

Category 4. Water quality standards are not attained for one or more designated uses but the development of a TMDL is not required because:

4a. A TMDL has been completed for the listed parameter(s); or

4b. Other management alternatives are expected to result in the attainment of the water quality standard; or

4c. Non-support of the water quality standard is not caused by a pollutant.

Category 5. The waterbody is impaired, or one or more water quality standards are not attained. Waterbodies in Category 5 will be prioritized as:

High

- Truly impaired; develop a TMDL or other corrective action(s) for the listed parameter(s).

Medium

- Waters currently not attaining standards, but may be delisted with future revisions to APC&EC Rule No. 2, the state water quality standards; or
- Waters which are impaired by point source discharges and future permit restrictions are expected to correct the problem(s).

Low

- Waters currently not attaining one or more water quality standards, but assessed designated uses are determined to be supported; or
- There is insufficient data to make a scientifically defensible decision concerning designated use attainment. Where more data and/or information are needed to verify the need for TMDL development or other corrective action(s) for the listed parameter(s), the following waterbodies in Category 5 will be prioritized (on a case-by-case basis) for additional investigation: waters designated as ERW, ESW, or NSW; domestic water supplies; and waters located in known karst areas; or
- Waters DEQ assessed as unimpaired, but were assessed as impaired by EPA.

Alternative (Alt)

- Waters currently not attaining one or more water quality standards, but alternative restoration approaches may be more immediately beneficial or practicable in achieving water quality standards than pursuing a TMDL approach in the near term.

Waterbodies listed on the 2022 list of impaired waterbodies are depicted on Figure 11-C (Category 4a and 1b listings) and Figure 12-C (Category 5, 5-Alt, and 4b listings).

Waterbodies not currently meeting WQSs but have completed TMDLs for the impaired parameter are divided into two tables:

1) a list of stream segments in Category 4a (Table XII-C)
2) a list of lake segments in Category 4a (Table XIII-C)

Waterbodies not currently meeting WQSs, but other management alternatives are expected to result in the attainment (Category 4b) can be found in Table XIV-C.

The 2022list of impaired waterbody segments (Category 5) is divided into four tables:

1) a list of stream segments in Category 5 (Table XV-C)
2) a list of lake segments in Category 5 (Table XVI-C)
3) a list of stream segments in Category 5-Alt (Table XVII-C)
4) a list of lake segments in Category 5-Alt (Table XVIII-C)

TMDL Prioritization

In 2013, DEQ created the "Long-Term Vision for Assessment, Restoration, and Protection under the Clean Water Act (CWA) 303(d) Program" in accordance with new measures set forth by EPA. This prioritization plan became known as "the Vision." DEQ is finalizing five TMDLs started under this prioritization plan:

- Overflow Creek (AR_08040205_908) – chloride, turbidity base flows, and turbidity storm flows
- Ables Creek (AR_08040205_911) – turbidity base flows and turbidity storm flows

EPA introduced a renewed framework, Vision 2.0, to pick up where the first Vision left off. For Vision 2.0 DEQ prioritizes developing new turbidity TMDLs for listed streams. Revising existing TMDLs, particularly those written as part of the May, 2000 Consent Decree, also continues to be a priority.

Figure 11-C: Arkansas's Waterbodies with non-attaining and attaining TMDLs (Categories 4a and 1b, respectively)

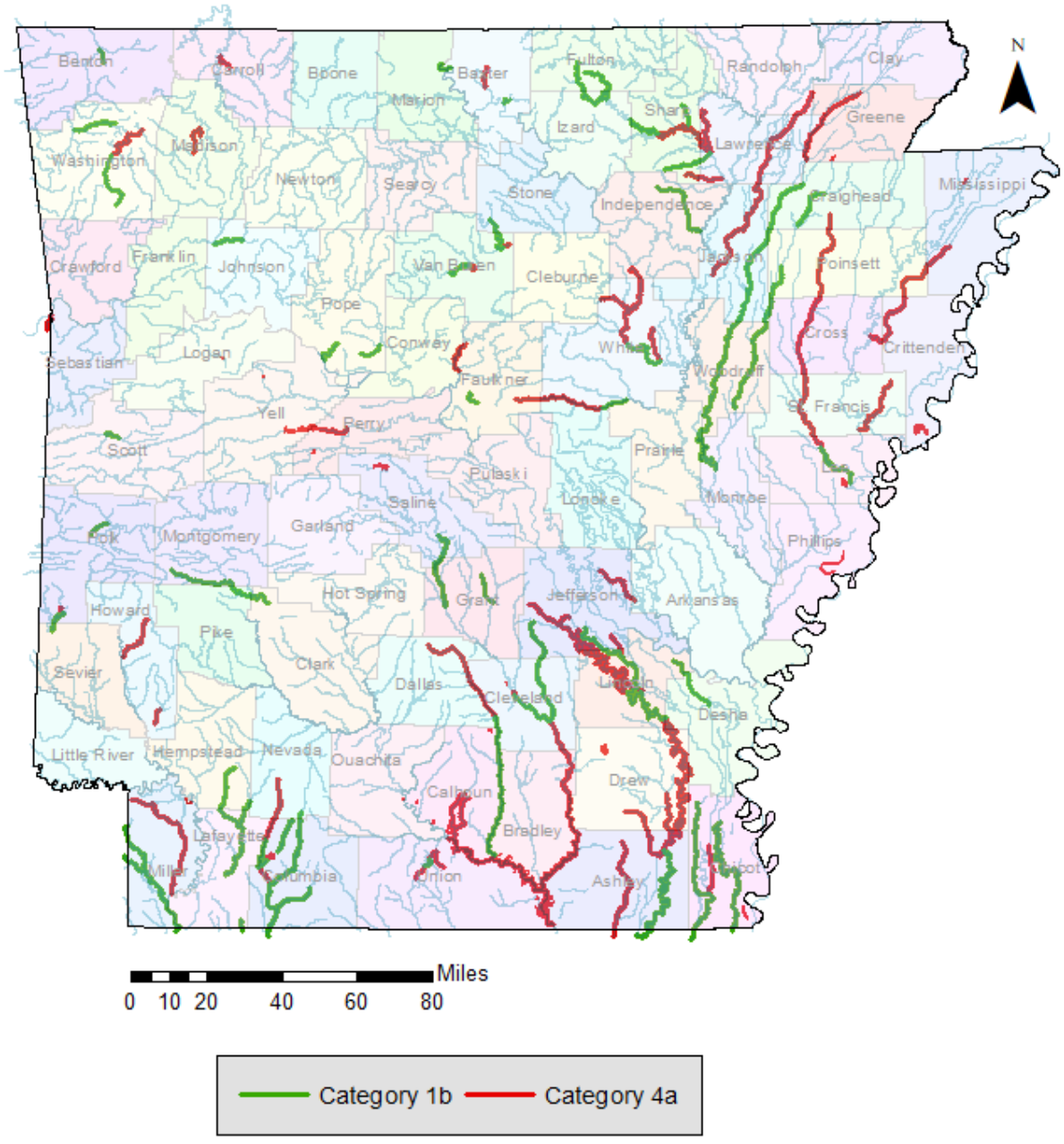
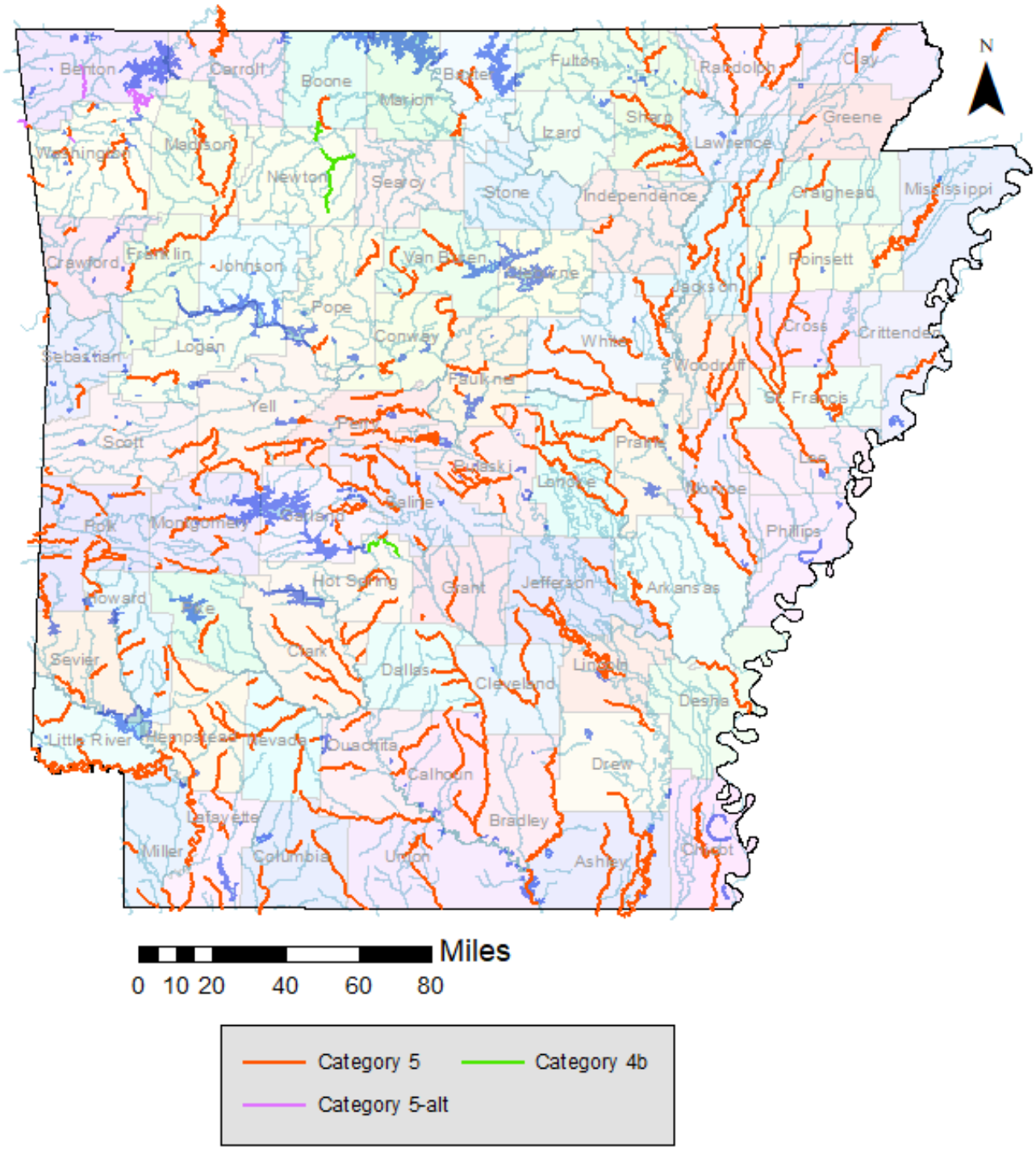


Figure 12-C: Arkansas's Impaired Waterbodies without Completed TMDLs (Category 5, 5-Alt, and 4b)



New and Removed Listings

Most of Arkansas's WQSs were developed after the completion of the ecoregions of Arkansas survey. Least-disturbed waterbodies, approximately six, in each of the ecoregions were studied; the data compiled; average concentrations of water quality constituents were calculated; and standards were set based on those averages. On occasion, WQSs for certain constituents, such as dissolved oxygen, temperature, and pH, will not be attained simply because of weather related conditions. As a result, some waterbodies will be evaluated as impaired during one period of record, only to be evaluated as fully supporting the next.

In addition, some waterbodies have been evaluated as impaired for a constituent simply because the natural background characteristics of the waterbody are significantly different than the ecoregion average. This occurs mostly with the WQSs for pH, dissolved oxygen, and temperature. The table below (Table XI-C) lists the number of pollutant pairs that have been delisted from the 2020 POR. New listings can be identified in Tables XII-C through XVIII-C, which is now formatted to include a column for year listed. For now, only the new listings for the 2020 and 2022 cycle have this information filled out, but it is a goal to have this column completed for future 303(d) lists.

A pollutant pair is one waterbody and one water constituent. One waterbody may have more than one constituent not meeting WQSs, such as pH and temperature. In this case, that would equal two pollutant pairs. There are some constituents that get subdivided further based on criteria found in Rule 2 or by the Assessment Methodology. For example, metals are subdivided into acute and chronic toxicity, which have different criteria depending on the paired hardness. Beginning in the 2020 assessment, these details were included in the list, which creates a perception of more listings. Adding this level of detail is helpful both in knowing how to remediate the impairment, but also in delisting. As stated in the Assessment Methodology for metals, "An AU can only be delisted by the same criterion that was used to list it. For example, if an AU was listed using the Rule 2.512(A) acute criterion, it can only be delisted using the Rule 2.512(A) acute criterion delisting methodology."

To the extent possible, assessors identified the original reason for listing some of the parameters with different methodologies or criteria (i.e. dissolved oxygen, metals, turbidity, minerals, bacteria), which is reflected in the delisting table (Table X-C).

Table XI-C contains a summary listings and delistings for each parameter.

Table X-C: Pollutant pairs delisted from the 2022 303(d) list

Former Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Beneficial Use
5	1A	AR_11140205_010	Primary Season DO	Bodcau Creek	26.46	Miles	AL
5	1B	AR_11140106_003	Turbidity Storm Flows	Red River	17.01	Miles	OU
5	1B	AR_11140106_025	Turbidity Storm Flows	Red River	5.48	Miles	OU
5	1B	AR_11140201_011	Turbidity Base Flows	Red River	14.93	Miles	OU
5	1B	AR_11140302_003	Lead Chronic	Days Creek	19.73	Miles	AL
5	1C	AR_11140109_024	Copper Acute	Bear Creek	11.29	Miles	AL
5	1C	AR_11140109_024	Copper Chronic	Bear Creek	11.29	Miles	AL
5	1C	AR_11140109_025	Copper Acute	Bear Creek	11.29	Miles	AL
5	1C	AR_11140109_025	Copper Chronic	Bear Creek	11.29	Miles	AL
5	1C	AR_11140109_4071	pH	Gillham Lake	1.30	Square Miles	OU
5	2B	AR_08040205_001	Lead Chronic	Bayou Bartholomew	64.48	Miles	AL
5	2B	AR_08040205_006	Temperature - LT Continuous	Bayou Bartholomew	97.00	Miles	AL
5	2B	AR_08040205_013	Lead Chronic	Bayou Bartholomew	34.43	Miles	AL
5	2C	AR_08040203_011	Critical Season DO - ST Continuous	North Fork Saline River	22.64	Miles	AL
5	2C	AR_08040203_020	Biological Integrity - Macroinvertebrates	South Fork Saline River	16.44	Miles	AL
5	2C	AR_08040203_904	pH	Big Creek	15.62	Miles	OU
5	2C	AR_08040203_913	Turbidity Base Flows	Saline River	10.2	Miles	OU
5	2C	AR_08040203_913	Turbidity Storm Flows	Saline River	10.2	Miles	OU
5	2C	AR_08040204_002	Lead Chronic	Saline River	60.20	Miles	AL
5	2D	AR_08040201_006	Primary Season DO	Smackover Creek	4.66	Miles	AL
5	2D	AR_08040201_007	Primary Season DO	Smackover Creek	4.66	Miles	AL
5	2D	AR_08040201_406	Turbidity Storm Flows	Smackover Creek	17.60	Miles	OU

Former Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Beneficial Use
5	2D	AR_08040201_406	Lead Chronic	Smackover Creek	17.60	Miles	AL
5	2D	AR_08040201_910	Lead Chronic	Jug Creek	7.18	Miles	AL
5	2D	AR_08040202_002	Lead Chronic	Ouachita River	7.23	Miles	AL
5	2D	AR_08040202_002	Lead Acute	Ouachita River	7.23	Miles	AL
5	2D	AR_08040202_004	Critical Season DO	Ouachita River	32.53	Miles	AL
5	2E	AR_08040206_015	Lead Chronic	Big Corney Creek	55.09	Miles	AL
5	2E	AR_08040206_016	Lead Chronic	Little Corney Creek	18.51	Miles	AL
5	2E	AR_08040206_716	Lead Chronic	Little Cornie Bayou	4.28	Miles	AL
5	2E	AR_08040206_816	Lead Chronic	Little Cornie Bayou	3.31	Miles	AL
5	2E	AR_08040206_916	Lead Chronic	Walker Branch	4.48	Miles	AL
5	2F	AR_08040101_907	Biological Integrity - Macroinvertebrates	Stokes Creek	1.76	Miles	SAL
4b	2F	AR_08040102_970	Biological Integrity - Macroinvertebrates	Cove Creek	3.67	Miles	AL
5	2G	AR_08040103_4030	pH	Lake Greeson	6.23	Square Miles	OU
5	3A	AR_08020401_001	Primary Season DO	Arkansas River	31.24	Miles	AL
5	3B	AR_08020402_007	Total Dissolved Solids - Site Specific	Bayou Meto	51.29	Miles	AL
5	3B	AR_08020402_007	Turbidity Base Flows	Bayou Meto	51.29	Miles	OU
5	3B	AR_08020402_507	Critical Season DO	Bayou Meto	8.64	Miles	AL
5	3B	AR_08020402_907	Primary Season DO	Bayou Meto	17.14	Miles	AL
5	3C	AR_11110207_024	Critical Season DO	Fouche Creek	22.09	Miles	AL
5	3C	AR_11110207_822	pH	Fourche Creek	3.57	Miles	OU
5	3C	AR_11110207_912	Primary Season DO	White Oak Bayou	19.50	Miles	AL
5	3E	AR_11110206_914	pH - ST Continuous	Dry Fork Creek	12.20	Miles	OU

Former Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Beneficial Use
5	3F	AR_11110203_931	Chronic Ammonia - ELS Present	Whig Creek	10.12	Miles	AL
5	3F	AR_11110203_931	Chronic Ammonia - ELS absent	Whig Creek	10.12	Miles	AL
5	3G	AR_11110204_4061	Lake & Reservoir DO	Blue Mountain Lake	2.89	Square Miles	AL
5	3G	AR_11110204_4061	Turbidity Base Flows	Blue Mountain Lake	2.89	Square Miles	OU
5	3I	AR_11110105_033	Turbidity Base Flows	Poteau River, James Fork	28.19	Miles	OU
5	3I	AR_11110105_034	Turbidity Storm Flows	Sugarloaf Creek	6.87	Miles	OU
5	3I	AR_11110105_035	Turbidity Storm Flows	Prairie Creek	14.00	Miles	OU
5	3I	AR_11110105_036	Turbidity Storm Flows	Cherokee Creek	10.64	Miles	OU
5	3I	AR_11110105_731	Turbidity Base Flows	Poteau River	13.38	Miles	OU
5-alt	3J	AR_11110103_024	Turbidity Base Flows	Illinois River	2.76	Miles	OU
5	3J	AR_11110103_932	Chronic Ammonia - ELS Present	Sager Creek	12.28	Miles	AL
5	4B	AR_08020302_004	Sulfate - Site Specific	Bayou DeView	25.28	Miles	AL
5	4B	AR_08020302_005	Critical Season DO	Bayou De View	8.32	Miles	AL
5	4B	AR_08020302_005	Primary Season DO	Bayou De View	8.32	Miles	AL
5	4B	AR_08020302_005	Sulfate - Site Specific	Bayou De View	8.32	Miles	AL
5	4B	AR_08020302_006	Sulfate - Site Specific	Bayou De View	10.14	Miles	AL
5	4B	AR_08020302_007	Sulfate - Site Specific	Bayou De View	6.17	Miles	AL
5	4B	AR_08020302_011	Primary Season DO	Flag Slough Ditch	16.28	Miles	AL
5	4B	AR_08020302_016	Primary Season DO	Cache River	25.03	Miles	AL
5	4B	AR_08020302_901	Critical Season DO	Unnamed Trib. to Cache River	0.69	Miles	SAL

Former Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Beneficial Use
5	4D	AR_08020301_006	Temperature	Bayou Des Arc	22.72	Miles	AL
5	4D	AR_08020301_007	Lead Chronic	Bayou Des Arc	50.10	Miles	AL
5	4E	AR_11010014_040	Critical Season DO - LT Continuous	South Fork Little Red River	7.7	Miles	AL
5	4F	AR_11010004_017	Primary Season DO	Greenbrier Creek	13.07	Miles	AL
5	4G	AR_11010009_005	Turbidity Base Flows	Black River	15.03	Miles	OU
5	4G	AR_11010009_005	Turbidity Storm Flows	Black River	15.03	Miles	OU
5	4G	AR_11010012_003	Turbidity Base Flows	Coopers Creek	20.24	Miles	OU
5	4G	AR_11010012_806	Primary Season DO	Clayton Creek	6.42	Miles	SAL
5	4H	AR_11010010_012	Critical Season DO	South Fork Spring River	16.06	Miles	AL
5	4J	AR_11010005_004	Temperature	Buffalo River	29.70	Miles	AL
5	4K	AR_11010001_027	Turbidity Base Flows	White River	5.10	Miles	OU
5-alt	4K	AR_11010001_4040	Turbidity Storm Flows	Beaver Lake	5.14	Square Miles	OU
5-alt	4K	AR_11010001_4040	Primary Contact *E. coli*	Beaver Lake	5.14	Square Miles	PC
5-alt	4K	AR_11010001_4041	Turbidity Base Flows	Beaver Lake	2.00	Square Miles	OU
5-alt	4K	AR_11010001_4041	Primary Contact *E. coli*	Beaver Lake	2.00	Square Miles	PC
5	4K	AR_11010001_823	Critical Season DO	White River	5.10	Miles	AL
5	4K	AR_11010001_824	Turbidity Base Flows	Town Branch	4.24	Miles	OU
5	4K	AR_11010001_834	Critical Season DO	War Eagle Creek	9.12	Miles	AL
5	5B	AR_08020205_002	Chloride - Site Specific	L'Anguille River	23.06	Miles	AL
5	5B	AR_08020205_002	Total Dissolved Solids - Site Specific	L'Anguille River	23.06	Miles	AL
5	5B	AR_08020205_003	Chloride - Site Specific	L'Anguille River	2.89	Miles	AL
5	5B	AR_08020205_003	Total Dissolved Solids - Site Specific	L'Anguille River	2.89	Miles	AL

Table XI-C: Waterbody pollutant pairs added and removed for the 2022 period of record

Pollutant	Number of Pollutant Pairs Added	Number of Pollutant Pairs Removed
Ammonia-N	2	3
Biological Integrity	11	3
Dissolved Oxygen	26	19
Metals (Cu, Pb, Zn, Se)	13	18
Minerals (Cl, SO_4, TDS)	4	9
Nutrients	1	0
Pathogens (*E. coli*)	2	2
pH	33	5
Temperature	4	3
Turbidity	23	19
TOTAL	**119**	**81**

Waterbodies in Category 4b

Assessment units placed in Category 4b are assessed as not meeting WQSs; however, required control measures, other than a TMDL, are expected to result in the attainment of WQSs in a reasonable amount of time. EPA IR Guidance (2005) outlines six elements that should be included in the State's rationale to place AUs in Category 4b:

1. Identification of assessment units and a statement of the problem causing the impairment.
2. A description of the proposed implementation strategy and supporting pollution controls necessary to achieve WQSs, including the identification of point and nonpoint source loadings that when implemented assure the attainment of all applicable WQSs.
3. An estimate or projection of the time when WQSs will be met.
4. A reasonable schedule for implementing the necessary pollution measures.
5. A description of, and schedule for, monitoring milestones for tracking and reporting progress to EPA on the implementation of the pollution controls.
6. A commitment to revise as necessary the implementation strategy and corresponding pollution controls if progress towards meeting WQSs in not being shown.

For the 2022 assessment cycle, one additional pollutant pair was placed in category 4b for turbidity. In total, eleven assessment units consisting of twenty-four pollutant pairs are in category 4b for the 2022 assessment cycle (Table XIV-C). Rationale for including the AUs

found in the Buffalo River Watershed (1101005) and Chamberlin Creek, Cove Creek, and Lucinda Creek AUs in Category 4b can be found in Appendix A.

Waterbodies in Category 5-Alt

Assessment units placed in Category 5-Alt are assessed as not meeting WQSs; however, alternate restoration approaches may be more immediately beneficial or practical in achieving WQS than pursuing a TMDL in the near-term. EPA IR Guidance (2015) outlines eight elements that that should be included in the State's rationale to place AUs in Category 5-Alt:

1. Identification of specific impaired water segments or waters addressed by the alternative restoration approach, and identification of all sources contributing to the impairment.
2. Analysis to support why the State believes the implementation of the alternative restoration approach is expected to achieve WQS.
3. An Action Plan of Implementation Plan to document:
    a) The actions to address all sources—both point and nonpoint sources, as appropriate—necessary to achieve WQS (this may include e.g., commitments to adjust permit limits when permits are re-issued or a list of nonpoint source conservation practices of BMPs to be implemented, as part of the alternative restoration approach); and,
    b) A schedule of actions designed to meet WQS with clear milestones and dates, which includes interim milestones and target dates with clear deliverables.
4. Identification of available funding opportunities to implement the alternative restoration plan.
5. Identification of all parties committed, and/or additional parties needed, to take actions that are expected to meet WQS.
6. An estimate of projection of the time when WQS will be met.
7. Plans for effectiveness monitoring to: demonstrate progress made toward achieving WQS following implementation; identify needed improvement for adaptive management as the project progresses; and evaluate the success of actions and outcome.
8. Commitment to periodically evaluate the alternative restoration approach to determine if it is on track to be more immediately beneficial or practicable in achieving WQS than pursuing a TMDL in the near-term, and if the impaired water should be assigned a higher priority for TMDL development.

For the 2022 assessment cycle, one additional AU was placed in category 5-Alt for nutrients. In total eight AUs consisting of nine pollutant pairs are in category 5-Alt. for the 2022 cycle (Tables XVII-C and XVIII-C). Rationale for including these AUs in Category 5-Alt can be found in Appendix A.

Key to Tables XII-C through XVIII-C

Planning Segment – Two-digit alpha-numeric code that identifies the DEQ Planning Segment in which a waterbody is located. Figure 3-B is a map of DEQ's Planning Segments. DEQ's 38 water quality planning segments are based on hydrological characteristics, human activities, geographic characteristics, and other factors.

Assessment Unit – stream segment or lake area assessed. AUs are coded as:

AR_8-digit HUC_ reach number

AR = Arkansas

8-digit HUC = 8-digit hydrologic unit the AU is in

Reach number = a three or four digit code assigned to stream reaches and lake areas by DEQ

Stream Names/Lake Names – the name of the waterbody according to the DEQ base layer.

Miles – the total length (in miles) of the AU measured using the high resolution (1:24,000-scale) NHD.

Acres – total surface acreage for lake.

Parameter – the water quality constituent of which the WQS is not being met.

There are no WQSs in Rule 2 for nitrate listings. This parameter was promulgated by EPA.

Descriptor – further details (e.g. season, data type) of the impaired parameter.

Designated Use Not Supported – uses specified in Rule 2 for each waterbody or stream segment not being supported.

AL = aquatic life
PC = primary contact
DWS = domestic water supply
I = industrial water supply
FC = fish consumption[9]
OU = other use
SC = secondary contact
Ag = agricultural water supply
ORW = outstanding resource water

Sources of Contamination or Source – the probable source of the contaminant causing impairment.

AG = agriculture activities
IP = industrial point source
SE[10] = surface erosion
UR = urban runoff
HP = hydropower
MP = municipal point source
UN = unknown

[9] Not a designated use

[10] Surface Erosion – This category includes erosion from agriculture activities; unpaved road surfaces; in-stream erosion, mainly from unstable stream banks; and any other land surface disturbing activity.

RE = resource extraction (mining; oil and gas extraction)

Priority Rank – A ranking of waters in order of need for corrective action taking into account the severity of the pollution and designated uses of the waters. Applies to waters in Cat. 5 and 5-Alt. See section called “Assessment Categories” for more information regarding priority placements.

Table XII-C: A TMDL has been developed, but segment is attaining (Category 1b)

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Units	Uses
1b	1A	AR_11140203_020	Lead Acute	Bayou Dorcheat	11.40	Miles	AL
1b	1A	AR_11140203_020	Sulfate	Bayou Dorcheat	11.40	Miles	DWS, AG, I
1b	1A	AR_11140203_020	Sulfate - Site Specific	Bayou Dorcheat	11.40	Miles	AL
1b	1A	AR_11140203_021	Lead Acute	Horsehead Creek	31.10	Miles	AL
1b	1A	AR_11140203_022	Lead Acute	Bayou Dorcheat	11.50	Miles	AL
1b	1A	AR_11140203_022	Sulfate	Bayou Dorcheat	11.50	Miles	DWS, AG, I
1b	1A	AR_11140203_022	Sulfate - Site Specific	Bayou Dorcheat	11.50	Miles	AL
1b	1A	AR_11140203_023	Lead Acute	Big Creek	4.40	Miles	AL
1b	1A	AR_11140203_025	Lead Acute	Beech Creek	21.10	Miles	AL
1b	1A	AR_11140203_026	Lead Acute	Bayou Dorcheat	9.60	Miles	AL
1b	1A	AR_11140203_923	Lead Acute	Big Creek	35.10	Miles	AL
1b	1A	AR_11140205_002	Copper Acute	Bodcau Bayou	5.10	Miles	AL
1b	1A	AR_11140205_002	Copper Chronic	Bodcau Bayou	5.10	Miles	AL
1b	1A	AR_11140205_002	Lead Acute	Bodcau Bayou	5.10	Miles	AL
1b	1A	AR_11140205_006	Copper Acute	Bodcau Bayou	23.30	Miles	AL
1b	1A	AR_11140205_006	Copper Chronic	Bodcau Bayou	23.30	Miles	AL
1b	1A	AR_11140205_006	Lead Acute	Bodcau Bayou	23.30	Miles	AL
1b	1A	AR_11140205_006	Turbidity Storm Flows	Bodcau Bayou	23.30	Miles	OU
1b	1A	AR_11140205_007	Lead Acute	Bodcau Bayou	11.70	Miles	AL
1b	1A	AR_11140205_010	Lead Acute	Bodcau Creek	33.10	Miles	AL
1b	1B	AR_11140201_003	Temperature	Red River	8.50	Miles	AL
1b	1B	AR_11140201_003	Turbidity Storm Flows	Red River	8.50	Miles	OU
1b	1B	AR_11140302_001	Sulfate - Site Specific	Sulphur River	7.91	Miles	AL
1b	1B	AR_11140302_001	Temperature	Sulphur River	7.91	Miles	AL
1b	1B	AR_11140302_001	Total Dissolved Solids	Sulphur River	7.91	Miles	DWS, AG, I
1b	1B	AR_11140302_001	Total Dissolved Solids - Site Specific	Sulphur River	7.91	Miles	AL
1b	1B	AR_11140302_002	Sulfate - Site Specific	Sulphur River	10.41	Miles	AL
1b	1B	AR_11140302_002	Temperature	Sulphur River	10.41	Miles	AL

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Units	Uses
1b	1B	AR_11140302_002	Total Dissolved Solids	Sulphur River	10.41	Miles	DWS, AG, I
1b	1B	AR_11140302_002	Total Dissolved Solids - Site Specific	Sulphur River	10.41	Miles	AL
1b	1B	AR_11140302_003	Acute Ammonia	Days Creek	17.60	Miles	AL
1b	1B	AR_11140302_003	Chronic Ammonia - ELS absent	Days Creek	17.60	Miles	AL
1b	1B	AR_11140302_003	Chronic Ammonia - ELS Present	Days Creek	17.60	Miles	AL
1b	1B	AR_11140302_004	Sulfate - Site Specific	Sulphur River	0.23	Miles	AL
1b	1B	AR_11140302_004	Temperature	Sulphur River	0.23	Miles	AL
1b	1B	AR_11140302_004	Total Dissolved Solids	Sulphur River	0.23	Miles	DWS, AG, I
1b	1B	AR_11140302_004	Total Dissolved Solids - Site Specific	Sulphur River	0.23	Miles	AL
1b	1B	AR_11140302_006	Sulfate - Site Specific	Sulphur River	8.20	Miles	AL
1b	1B	AR_11140302_006	Temperature	Sulphur River	8.20	Miles	AL
1b	1B	AR_11140302_006	Total Dissolved Solids	Sulphur River	8.20	Miles	DWS, AG, I
1b	1B	AR_11140302_006	Total Dissolved Solids - Site Specific	Sulphur River	8.20	Miles	AL
1b	1B	AR_11140302_008	Sulfate - Site Specific	Sulphur River	3.02	Miles	AL
1b	1B	AR_11140302_008	Temperature	Sulphur River	3.02	Miles	AL
1b	1B	AR_11140302_008	Total Dissolved Solids	Sulphur River	3.02	Miles	DWS, AG, I
1b	1B	AR_11140302_008	Total Dissolved Solids - Site Specific	Sulphur River	3.02	Miles	AL
1b	1C	AR_11140109_927	Nitrate	Rolling Fork	9.64	Miles	AL
1b	1C	AR_11140109_927	Total Phosphorus	Rolling Fork	9.64	Miles	AL
1b	2A	AR_08050001_018	Chloride	Boeuf River	16.40	Miles	DWS, AG, I
1b	2A	AR_08050001_018	Chloride - Site Specific	Boeuf River	16.40	Miles	AL
1b	2A	AR_08050001_018	Sulfate	Boeuf River	16.40	Miles	DWS, AG, I
1b	2A	AR_08050001_018	Sulfate - Site Specific	Boeuf River	16.40	Miles	AL
1b	2A	AR_08050001_018	Total Dissolved Solids	Boeuf River	16.40	Miles	DWS, AG, I

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Units	Uses
1b	2A	AR_08050001_018	Total Dissolved Solids - Site Specific	Boeuf River	16.40	Miles	AL
1b	2A	AR_08050001_018	Turbidity Base Flows	Boeuf River	16.40	Miles	OU
1b	2A	AR_08050001_022	Chloride	Big Bayou	33.35	Miles	AL
1b	2A	AR_08050001_022	Turbidity Base Flows	Big Bayou	33.35	Miles	OU
1b	2A	AR_08050001_022	Turbidity Storm Flows	Big Bayou	33.35	Miles	OU
1b	2A	AR_08050002_003	Turbidity Base Flows	Bayou Macon	23.33	Miles	OU
1b	2A	AR_08050002_003	Turbidity Storm Flows	Bayou Macon	23.33	Miles	OU
1b	2A	AR_08050002_006	Turbidity Base Flows	Bayou Macon	37.79	Miles	OU
1b	2A	AR_08050002_006	Turbidity Storm Flows	Bayou Macon	37.79	Miles	OU
1b	2A	AR_08050002_910	Chloride	Oak Log Bayou	24.00	Miles	AL
1b	2B	AR_08040205_001	Chloride	Bayou Bartholomew	54.00	Miles	DWS, AG, I
1b	2B	AR_08040205_001	Chloride - Site Specific	Bayou Bartholomew	54.00	Miles	AL
1b	2B	AR_08040205_001	Sulfate	Bayou Bartholomew	54.00	Miles	DWS, AG, I
1b	2B	AR_08040205_001	Sulfate - Site Specific	Bayou Bartholomew	54.00	Miles	AL
1b	2B	AR_08040205_001	Total Dissolved Solids	Bayou Bartholomew	54.00	Miles	DWS, AG, I
1b	2B	AR_08040205_001	Total Dissolved Solids - Site Specific	Bayou Bartholomew	54.00	Miles	AL
1b	2B	AR_08040205_001	Turbidity Storm Flows	Bayou Bartholomew	54.00	Miles	OU
1b	2B	AR_08040205_005	Turbidity Base Flows	Deep Bayou	33.20	Miles	OU
1b	2B	AR_08040205_005	Turbidity Storm Flows	Deep Bayou	33.20	Miles	OU
1b	2B	AR_08040205_013	Chloride	Bayou Bartholomew	34.40	Miles	DWS, AG, I
1b	2B	AR_08040205_013	Chloride - Site Specific	Bayou Bartholomew	34.40	Miles	AL
1b	2B	AR_08040205_013	Sulfate	Bayou Bartholomew	34.40	Miles	DWS, AG, I
1b	2B	AR_08040205_013	Sulfate - Site Specific	Bayou Bartholomew	34.40	Miles	AL
1b	2B	AR_08040205_013	Total Dissolved Solids	Bayou Bartholomew	34.40	Miles	DWS, AG, I
1b	2B	AR_08040205_013	Total Dissolved Solids - Site Specific	Bayou Bartholomew	34.40	Miles	AL
1b	2B	AR_08040205_705	Turbidity Base Flows	Split of Deep Bayou	11.63	Miles	OU
1b	2B	AR_08040205_705	Turbidity Storm Flows	Split of Deep Bayou	11.63	Miles	OU

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Units	Uses
1b	2C	AR_08040203_010	Total Dissolved Solids	Saline River	27.64	Miles	DWS, AG, I, ORW
1b	2C	AR_08040203_010	Total Dissolved Solids - Site Specific	Saline River	27.64	Miles	AL, ORW
1b	2C	AR_08040203_904	Primary Season DO	Big Creek	15.60	Miles	AL
1b	2C	AR_08040203_913	Total Dissolved Solids	Saline River	10.20	Miles	DWS, AG, I, ORW
1b	2C	AR_08040203_913	Total Dissolved Solids - Site Specific	Saline River	10.20	Miles	AL, ORW
1b	2C	AR_08040204_005	Turbidity Storm Flows	Big Creek	48.70	Miles	OU
1b	2C	AR_08040204_006	Total Dissolved Solids	Saline River	17.30	Miles	DWS, AG, I, ORW
1b	2C	AR_08040204_006	Total Dissolved Solids - Site Specific	Saline River	17.30	Miles	AL, ORW
1b	2D	AR_08040201_001	Turbidity Storm Flows	Moro Creek	56.40	Miles	OU, ORW
1b	2D	AR_08040201_616	Acute Ammonia	ECC Creek	4.67	Miles	AL
1b	2D	AR_08040201_616	Chloride	ECC Creek	4.67	Miles	AG, I
1b	2D	AR_08040201_616	Sulfate	ECC Creek	4.67	Miles	AG, I
1b	2D	AR_08040201_616	Total Dissolved Solids	ECC Creek	4.67	Miles	AG, I
1b	2F	AR_08040101_048	Turbidity Storm Flows	Prairie Creek	1.50	Miles	OU
1b	2F	AR_08040101_848	Turbidity Storm Flows	Prairie Creek	1.33	Miles	OU
1b	2F	AR_08040101_948	Turbidity Storm Flows	Prairie Creek	1.56	Miles	OU
1b	2F	AR_08040102_016	Copper Acute	Caddo River	7.00	Miles	AL, ORW
1b	2F	AR_08040102_016	Copper Chronic	Caddo River	7.00	Miles	AL, ORW
1b	2F	AR_08040102_016	Zinc Acute	Caddo River	7.00	Miles	AL, ORW
1b	2F	AR_08040102_016	Zinc Chronic	Caddo River	7.00	Miles	AL, ORW
1b	2F	AR_08040102_018	Copper Acute	Caddo River	4.78	Miles	AL, ORW
1b	2F	AR_08040102_018	Copper Chronic	Caddo River	4.78	Miles	AL, ORW
1b	2F	AR_08040102_018	Zinc Acute	Caddo River	4.78	Miles	AL, ORW
1b	2F	AR_08040102_018	Zinc Chronic	Caddo River	4.78	Miles	AL, ORW
1b	2F	AR_08040102_019	Copper Acute	Caddo River	8.76	Miles	AL, ORW

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Units	Uses
1b	2F	AR_08040102_019	Copper Chronic	Caddo River	8.76	Miles	AL, ORW
1b	2F	AR_08040102_019	Zinc Acute	Caddo River	8.76	Miles	AL, ORW
1b	2F	AR_08040102_019	Zinc Chronic	Caddo River	8.76	Miles	AL, ORW
1b	2F	AR_08040102_023	Copper Acute	Caddo River, S. Fork	18.57	Miles	AL, ORW
1b	2F	AR_08040102_023	Copper Chronic	Caddo River, S. Fork	18.57	Miles	AL, ORW
1b	2F	AR_08040102_023	Zinc Acute	Caddo River, S. Fork	18.57	Miles	AL, ORW
1b	2F	AR_08040102_023	Zinc Chronic	Caddo River, S. Fork	18.57	Miles	AL, ORW
1b	3F	AR_11110203_904	Acute Ammonia	Stone Dam Creek	4.80	Miles	SAL
1b	3F	AR_11110203_904	Chronic Ammonia - ELS absent	Stone Dam Creek	4.80	Miles	SAL
1b	3F	AR_11110203_904	Nitrate	Stone Dam Creek	4.80	Miles	SAL
1b	3F	AR_11110203_927	Turbidity Storm Flows	White Oak Creek	7.60	Miles	OU
1b	3F	AR_11110203_931	Copper Acute	Whig Creek	10.10	Miles	AL
1b	3F	AR_11110203_931	Copper Chronic	Whig Creek	10.10	Miles	AL
1b	3H	AR_11110201_009	pH - ST Continuous	Mulberry River	9.80	Miles	OU, ORW
1b	3I	AR_11110105_031	Copper Acute	Poteau River	6.70	Miles	AL
1b	3I	AR_11110105_031	Copper Chronic	Poteau River	6.70	Miles	AL
1b	3I	AR_11110105_031	Zinc Acute	Poteau River	6.70	Miles	AL
1b	3I	AR_11110105_031	Zinc Chronic	Poteau River	6.70	Miles	AL
1b	3J	AR_11070208_903	Total Phosphorous	Town Branch	5.00	Miles	SAL
1b	3J	AR_11110103_029	Primary Contact *E. coli*	Clear Creek	14.50	Miles	PC
1b	3J	AR_11110103_029	Secondary Contact *E. coli*	Clear Creek	14.50	Miles	SC
1b	4B	AR_08020302_004	Turbidity Storm Flows	Bayou De View	25.30	Miles	OU
1b	4B	AR_08020302_005	Turbidity Base Flows	Bayou De View	8.32	Miles	OU
1b	4B	AR_08020302_005	Turbidity Storm Flows	Bayou De View	8.32	Miles	OU
1b	4B	AR_08020302_006	Turbidity Storm Flows	Bayou De View	10.10	Miles	OU
1b	4B	AR_08020302_007	Turbidity Base Flows	Bayou De View	6.17	Miles	OU
1b	4B	AR_08020302_007	Turbidity Storm Flows	Bayou De View	6.17	Miles	OU
1b	4B	AR_08020302_009	Turbidity Base Flows	Bayou De View	12.95	Miles	OU
1b	4B	AR_08020302_009	Turbidity Storm Flows	Bayou De View	12.95	Miles	OU
1b	4B	AR_08020302_016	Turbidity Base Flows	Cache River	25.03	Miles	OU

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Units	Uses
1b	4B	AR_08020302_016	Turbidity Storm Flows	Cache River	25.03	Miles	OU
1b	4B	AR_08020302_017	Turbidity Storm Flows	Cache River	22.90	Miles	OU
1b	4B	AR_08020302_018	Turbidity Base Flows	Cache River	20.63	Miles	OU
1b	4B	AR_08020302_018	Turbidity Storm Flows	Cache River	20.63	Miles	OU
1b	4B	AR_08020302_019	Turbidity Base Flows	Cache River	18.77	Miles	OU
1b	4B	AR_08020302_019	Turbidity Storm Flows	Cache River	18.77	Miles	OU
1b	4B	AR_08020302_020	Turbidity Base Flows	Cache River	27.62	Miles	OU
1b	4B	AR_08020302_020	Turbidity Storm Flows	Cache River	27.62	Miles	OU
1b	4B	AR_08020302_021	Turbidity Storm Flows	Cache River	17.03	Miles	OU
1b	4B	AR_08020302_818	Turbidity Base Flows	Cache River	5.95	Miles	OU
1b	4B	AR_08020302_818	Turbidity Storm Flows	Cache River	5.95	Miles	OU
1b	4B	AR_08020302_918	Turbidity Base Flows	Cache River	6.89	Miles	OU, ORW
1b	4B	AR_08020302_918	Turbidity Storm Flows	Cache River	6.89	Miles	OU, ORW
1b	4D	AR_08020301_010	Primary Contact *E. coli*	Cypress Bayou	7.79	Miles	PC
1b	4D	AR_08020301_010	Secondary Contact *E. coli*	Cypress Bayou	7.79	Miles	SC
1b	4E	AR_11010014_007	Primary Contact *E. coli*	Little Red River	16.77	Miles	PC
1b	4E	AR_11010014_007	Secondary Contact *E. coli*	Little Red River	16.77	Miles	SC
1b	4E	AR_11010014_028	Primary Contact *E. coli*	Little Red River, Middle Fork	14.17	Miles	PC, ORW
1b	4E	AR_11010014_028	Secondary Contact *E. coli*	Little Red River, Middle Fork	14.17	Miles	SC, ORW
1b	4E	AR_11010014_038	Primary Contact *E. coli*	Little Red River, South Fork	9.70	Miles	PC, ORW
1b	4E	AR_11010014_038	Secondary Contact *E. coli*	Little Red River, South Fork	9.70	Miles	SC, ORW
1b	4F	AR_11010006_001	DO - Trout Waters	White River, North Fork	2.59	Miles	AL
1b	4G	AR_11010009_902	Primary Contact *E. coli*	Data Creek (Dota)	25.38	Miles	PC
1b	4G	AR_11010012_009	Turbidity Base Flows	Strawberry River	16.43	Miles	OU, ORW
1b	4G	AR_11010012_009	Turbidity Storm Flows	Strawberry River	16.43	Miles	OU, ORW
1b	4G	AR_11010012_909	Turbidity Base Flows	Strawberry River	16.43	Miles	OU, ORW

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Units	Uses
1b	4G	AR_11010012_909	Turbidity Base Flows	Strawberry River	16.43	Miles	OU, ORW
1b	4G	AR_11010012_010	Primary Contact *E. coli*	Little Strawberry Creek	19.52	Miles	PC, ORW
1b	4G	AR_11010012_010	Turbidity Base Flows	Little Strawberry Creek	19.52	Miles	OU, ORW
1b	4G	AR_11010012_010	Turbidity Storm Flows	Little Strawberry Creek	19.52	Miles	OU, ORW
1b	4G	AR_11010012_011	Primary Contact *E. coli*	Strawberry River	27.10	Miles	PC, ORW
1b	4G	AR_11010012_011	Secondary Contact *E. coli*	Strawberry River	27.10	Miles	SC, ORW
1b	4G	AR_11010012_014	Primary Contact *E. coli*	Reeds Creek	17.89	Miles	PC
1b	4G	AR_11010012_016	Primary Contact *E. coli*	Mill Creek	7.30	Miles	PC
1b	4G	AR_11010012_016	Secondary Contact *E. coli*	Mill Creek	7.30	Miles	SC
1b	4I	AR_11010003_902	DO - Trout Waters	White River	13.46	Miles	AL
1b	4K	AR_11010001_623	Turbidity Base Flows	White R, W. Fork	13.46	Miles	OU
1b	4K	AR_11010001_623	Turbidity Storm Flows	White R, W. Fork	13.46	Miles	OU
1b	4K	AR_11010001_624	Turbidity Base Flows	White R, W. Fork	5.80	Miles	OU
1b	4K	AR_11010001_624	Turbidity Storm Flows	White R, W. Fork	5.80	Miles	OU
1b	5B	AR_08020205_001	Turbidity Storm Flows	L'Anguille River	17.20	Miles	OU

Table XIII-C: A TMDL has been developed, but segment is impaired (Category 4a)

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Units	Listing Status	Source	Uses
4a	1A	AR_11140203_020	Lead Chronic	Bayou Dorcheat	11.40	Miles	Remnant	UN	AL
4a	1A	AR_11140203_020	Mercury In Tissue	Bayou Dorcheat	11.40	Miles	Remnant	UN	FC
4a	1A	AR_11140203_020	pH	Bayou Dorcheat	11.40	Miles	Remnant	UN	OU
4a	1A	AR_11140203_021	Lead Chronic	Horsehead Creek	31.10	Miles	Remnant	UN	AL
4a	1A	AR_11140203_021	pH	Horsehead Creek	31.10	Miles	Remnant	UN	OU
4a	1A	AR_11140203_022	Lead Chronic	Bayou Dorcheat	11.50	Miles	Carry Forward	UN	AL
4a	1A	AR_11140203_022	Mercury In Tissue	Bayou Dorcheat	11.50	Miles	Remnant	UN	FC
4a	1A	AR_11140203_022	pH	Bayou Dorcheat	11.50	Miles	Carry Forward	UN	OU
4a	1A	AR_11140203_023	Chloride	Big Creek	4.40	Miles	Remnant	UN	AG, I
4a	1A	AR_11140203_023	Lead Chronic	Big Creek	4.40	Miles	Remnant	UN	AL
4a	1A	AR_11140203_023	Sulfate	Big Creek	4.40	Miles	Remnant	UN	AG, I
4a	1A	AR_11140203_023	Total Dissolved Solids	Big Creek	4.40	Miles	Remnant	UN	AG, I
4a	1A	AR_11140203_024	Mercury In Tissue	Bayou Dorcheat	7.60	Miles	Remnant	UN	FC
4a	1A	AR_11140203_024	pH	Bayou Dorcheat	7.60	Miles	Remnant	UN	OU
4a	1A	AR_11140203_025	Turbidity Base Flows	Beech Creek	21.10	Miles	Remnant	SE, UN	OU
4a	1A	AR_11140203_025	Critical Season DO	Beech Creek	21.10	Miles	Remnant	SE, UN	AL
4a	1A	AR_11140203_025	Lead Chronic	Beech Creek	21.10	Miles	Remnant	SE, UN	AL
4a	1A	AR_11140203_025	Turbidity Storm Flows	Beech Creek	21.10	Miles	Remnant	SE, UN	OU
4a	1A	AR_11140203_026	Lead Chronic	Bayou Dorcheat	9.60	Miles	Remnant	UN	AL
4a	1A	AR_11140203_026	Mercury In Tissue	Bayou Dorcheat	9.60	Miles	Remnant	UN	FC
4a	1A	AR_11140203_026	pH	Bayou Dorcheat	9.60	Miles	Remnant	UN	OU
4a	1A	AR_11140203_4010	Mercury In Tissue	Lake Columbia	1.07	Square Miles	Remnant	UN	FC
4a	1A	AR_11140203_4011	Mercury In Tissue	Lake Columbia	6.86	Square Miles	Remnant	UN	FC
4a	1A	AR_11140203_923	Lead Chronic	Big Creek	35.10	Miles	Remnant	UN	AL
4a	1A	AR_11140203_923	pH	Big Creek	35.10	Miles	Remnant	UN	OU
4a	1A	AR_11140203_926	Mercury In Tissue	Bayou Dorcheat	21.84	Miles	Remnant	UN	FC
4a	1A	AR_11140205_002	Turbidity Storm Flows	Bodcau Bayou	5.10	Miles	Remnant	SE, UN	OU
4a	1A	AR_11140205_002	Lead Chronic	Bodcau Bayou	5.10	Miles	Remnant	SE, UN	AL

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Units	Listing Status	Source	Uses
4a	1A	AR_11140205_002	pH	Bodcau Bayou	5.10	Miles	Remnant	SE, UN	OU
4a	1A	AR_11140205_002	Turbidity Base Flows	Bodcau Bayou	5.10	Miles	Remnant	SE, UN	OU
4a	1A	AR_11140205_006	Lead Chronic	Bodcau Bayou	23.30	Miles	Carry Forward	SE, UN	AL
4a	1A	AR_11140205_006	pH	Bodcau Bayou	23.30	Miles	Carry Forward	SE, UN	OU
4a	1A	AR_11140205_006	Turbidity Base Flows	Bodcau Bayou	23.30	Miles	Carry Forward	SE, UN	OU
4a	1A	AR_11140205_007	Lead Chronic	Bodcau Bayou	11.70	Miles	Remnant	UN	AL
4a	1A	AR_11140205_010	Lead Chronic	Bodcau Creek	33.10	Miles	Carry Forward	UN	AL
4a	1B	AR_11140201_003	Turbidity Base Flows	Red River	8.50	Miles	Carry Forward	SE	OU
4a	1B	AR_11140201_012	Total Dissolved Solids - Site Specific	Mckinney Bayou	17.80	Miles	Remnant	UN	AL
4a	1B	AR_11140201_012	Chloride - Site Specific	Mckinney Bayou	17.80	Miles	Remnant	UN	AL
4a	1B	AR_11140201_012	Sulfate - Site Specific	Mckinney Bayou	17.80	Miles	Remnant	UN	AL
4a	1B	AR_11140201_014	Sulfate - Site Specific	Mckinney Bayou	27.00	Miles	Remnant	UN	AL
4a	1B	AR_11140201_014	Total Dissolved Solids - Site Specific	Mckinney Bayou	27.00	Miles	Remnant	UN	AL
4a	1B	AR_11140201_4020	Nutrients	First Old River Lake	1.18	Square Miles	Remnant	UN	AL
4a	1B	AR_11140302_001	Turbidity Base Flows	Sulphur River	7.90	Miles	Remnant	SE	OU
4a	1B	AR_11140302_001	Turbidity Storm Flows	Sulphur River	7.90	Miles	Remnant	SE	OU
4a	1B	AR_11140302_002	Turbidity Base Flows	Sulphur River	10.40	Miles	Remnant	SE	OU
4a	1B	AR_11140302_002	Turbidity Storm Flows	Sulphur River	10.40	Miles	Remnant	SE	OU
4a	1B	AR_11140302_003	Nitrate	Days Creek	17.60	Miles	Carry Forward based on 75%	MP, AG	AL
4a	1B	AR_11140302_004	Turbidity Base Flows	Sulphur River	0.20	Miles	Remnant	SE	OU
4a	1B	AR_11140302_004	Turbidity Storm Flows	Sulphur River	0.20	Miles	Remnant	SE	OU
4a	1B	AR_11140302_006	Turbidity Base Flows	Sulphur River	8.20	Miles	Carry Forward	SE	OU
4a	1B	AR_11140302_006	Turbidity Storm Flows	Sulphur River	8.20	Miles	Carry Forward	SE	OU
4a	1B	AR_11140302_008	Turbidity Base Flows	Sulphur River	3.00	Miles	Remnant	SE	OU
4a	1B	AR_11140302_008	Turbidity Storm Flows	Sulphur River	3.00	Miles	Remnant	SE	OU

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Units	Listing Status	Source	Uses
4a	1C	AR_11140109_013	Primary Contact *E. coli*	Holly Creek	11.20	Miles	Remnant	MP	PC
4a	1C	AR_11140109_013	Secondary Contact *E. coli*	Holly Creek	11.20	Miles	Remnant	MP	SC
4a	1C	AR_11140109_033	Primary Contact *E. coli*	Mine Creek	6.60	Miles	Remnant	MP	PC
4a	1C	AR_11140109_033	Secondary Contact *E. coli*	Mine Creek	6.60	Miles	Remnant	MP	SC
4a	1C	AR_11140109_913	Primary Contact *E. coli*	Holly Creek	11.26	Miles	Remnant	MP	PC
4a	1C	AR_11140109_913	Secondary Contact *E. coli*	Holly Creek	11.26	Miles	Remnant	MP	SC
4a	1C	AR_11140109_919	Nitrate	Rolling Fork	7.30	Miles	Remnant	IP, MP	AL
4a	1C	AR_11140109_919	Total Phosphorus	Rolling Fork	7.30	Miles	Remnant	IP, MP	AL
4a	2A	AR_08050001_018	Turbidity Storm Flows	Boeuf River	16.40	Miles	Carry Forward	SE	OU
4a	2A	AR_08050001_019	Sulfate - Site Specific	Boeuf River	15.60	Miles	Remnant	SE, UN	AL
4a	2A	AR_08050001_019	Turbidity Base Flows	Boeuf River	15.60	Miles	Remnant	SE, UN	OU
4a	2A	AR_08050001_019	Turbidity Storm Flows	Boeuf River	15.60	Miles	Remnant	SE, UN	OU
4a	2A	AR_08050001_019	Chloride - Site Specific	Boeuf River	15.60	Miles	Remnant	SE, UN	AL
4a	2A	AR_08050001_019	Total Dissolved Solids - Site Specific	Boeuf River	15.60	Miles	Remnant	SE, UN	AL
4a	2A	AR_08050002_4020	Nutrients	Grand Lake	4.82	Square Miles	Remnant	UN	AL
4a	2A	AR_08050002_910	Total Dissolved Solids	Oak Log Bayou	24.00	Miles	Remnant	SE, UN	DWS, AG, I
4a	2A	AR_08050002_910	Turbidity Base Flows	Oak Log Bayou	24.00	Miles	Remnant	SE, UN	OU
4a	2A	AR_08050002_910	Turbidity Storm Flows	Oak Log Bayou	24.00	Miles	Remnant	SE, UN	OU
4a	2B	AR_08040205_001	Turbidity Base Flows	Bayou Bartholomew	54.00	Miles	Carry Forward	SE	OU

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Units	Listing Status	Source	Uses
4a	2B	AR_08040205_002	Chloride - Site Specific	Bayou Bartholomew	17.50	Miles	Remnant	SE, UN	AL
4a	2B	AR_08040205_002	Mercury In Tissue	Bayou Bartholomew	17.50	Miles	Remnant	SE, UN	FC
4a	2B	AR_08040205_002	Sulfate - Site Specific	Bayou Bartholomew	17.50	Miles	Remnant	SE, UN	AL
4a	2B	AR_08040205_002	Turbidity Base Flows	Bayou Bartholomew	17.50	Miles	Remnant	SE, UN	OU
4a	2B	AR_08040205_002	Turbidity Storm Flows	Bayou Bartholomew	17.50	Miles	Remnant	SE, UN	OU
4a	2B	AR_08040205_002	Total Dissolved Solids - Site Specific	Bayou Bartholomew	17.50	Miles	Remnant	SE, UN	AL
4a	2B	AR_08040205_005	Primary Contact *E. coli*	Deep Bayou	33.20	Miles	Remnant	SE, UN	PC
4a	2B	AR_08040205_005	Secondary Contact *E. coli*	Deep Bayou	33.20	Miles	Remnant	SE, UN	SC
4a	2B	AR_08040205_006	Turbidity Base Flows	Bayou Bartholomew	97.00	Miles	Carry Forward	SE, UN	OU
4a	2B	AR_08040205_006	Turbidity Storm Flows	Bayou Bartholomew	97.00	Miles	Carry Forward	SE, UN	OU
4a	2B	AR_08040205_007	Mercury In Tissue	Cutoff Creek	19.40	Miles	Remnant	SE, UN	FC
4a	2B	AR_08040205_007	Turbidity Storm Flows	Cutoff Creek	19.40	Miles	Remnant	SE, UN	OU
4a	2B	AR_08040205_007	Turbidity Base Flows	Cutoff Creek	19.40	Miles	Remnant	SE, UN	OU
4a	2B	AR_08040205_012	Mercury In Tissue	Bayou Bartholomew	49.40	Miles	Remnant	SE, UN	FC
4a	2B	AR_08040205_012	Turbidity Base Flows	Bayou Bartholomew	49.40	Miles	Remnant	SE, UN	OU
4a	2B	AR_08040205_012	Turbidity Storm Flows	Bayou Bartholomew	49.40	Miles	Remnant	SE, UN	OU
4a	2B	AR_08040205_013	Turbidity Base Flows	Bayou Bartholomew	34.40	Miles	Carry Forward	SE, UN	OU
4a	2B	AR_08040205_013	Turbidity Storm Flows	Bayou Bartholomew	34.40	Miles	Carry Forward	SE, UN	OU
4a	2B	AR_08040205_013	Primary Contact *E. coli*	Bayou Bartholomew	34.40	Miles	Remnant	SE, UN	PC
4a	2B	AR_08040205_013	Secondary Contact *E. coli*	Bayou Bartholomew	34.40	Miles	Remnant	SE, UN	SC
4a	2B	AR_08040205_901	Primary Contact *E. coli*	Bearhouse Creek	34.50	Miles	Remnant	UN	PC
4a	2B	AR_08040205_901	Secondary Contact *E. coli*	Bearhouse Creek	34.50	Miles	Remnant	UN	SC

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Units	Listing Status	Source	Uses
4a	2B	AR_08040205_902	Secondary Contact *E. coli*	Harding Creek	4.29	Miles	Remnant	UR	SC
4a	2B	AR_08040205_903	Primary Contact *E. coli*	Melton's Creek	5.40	Miles	Remnant	UN	PC
4a	2B	AR_08040205_903	Secondary Contact *E. coli*	Melton's Creek	5.40	Miles	Remnant	UN	SC
4a	2B	AR_08040205_904	Secondary Contact *E. coli*	Jack's Creek	7.40	Miles	Remnant	UN	SC
4a	2B	AR_08040205_904	Primary Contact *E. coli*	Jack's Creek	7.40	Miles	Remnant	UN	PC
4a	2B	AR_08040205_905	Primary Contact *E. coli*	Cross Bayou	2.50	Miles	Remnant	UN	PC
4a	2B	AR_08040205_905	Secondary Contact *E. coli*	Cross Bayou	2.50	Miles	Remnant	UN	SC
4a	2B	AR_08040205_907	Secondary Contact *E. coli*	Chemin-A-Haut Creek	51.20	Miles	Remnant	UN	SC
4a	2B	AR_08040205_907	Primary Contact *E. coli*	Chemin-A-Haut Ck	51.20	Miles	Remnant	UN	PC
4a	2B	AR_08040205_912	Chloride - Site Specific	Bayou Bartholomew	47.10	Miles	Remnant	SE, UN	AL
4a	2B	AR_08040205_912	Sulfate - Site Specific	Bayou Bartholomew	47.10	Miles	Remnant	SE, UN	AL
4a	2B	AR_08040205_912	Total Dissolved Solids - Site Specific	Bayou Bartholomew	47.10	Miles	Remnant	SE, UN	AL
4a	2B	AR_08040205_912	Turbidity Base Flows	Bayou Bartholomew	47.10	Miles	Remnant	SE, UN	OU
4a	2B	AR_08040205_912	Turbidity Storm Flows	Bayou Bartholomew	47.10	Miles	Remnant	SE, UN	OU
4a	2C	AR_08040203_001	Mercury In Tissue	Saline River	1.50	Miles	Remnant	UN	FC

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Units	Listing Status	Source	Uses
4a	2C	AR_08040203_4090	Mercury In Tissue	Grays Lake	0.10	Square Miles	Remnant	UN	FC
4a	2C	AR_08040203_4100	Mercury In Tissue	Lake Winona	0.51	Square Miles	Remnant	UN	FC
4a	2C	AR_08040203_4101	Mercury In Tissue	Lake Winona	1.32	Square Miles	Remnant	UN	FC
4a	2C	AR_08040203_904	Critical Season DO	Big Creek	15.60	Miles	Carry Forward	AG	AL
4a	2C	AR_08040203_904	Turbidity Base Flows	Big Creek	15.60	Miles	Carry Forward	SE	OU
4a	2C	AR_08040203_904	Turbidity Storm Flows	Big Creek	15.60	Miles	Carry Forward	SE	OU
4a	2C	AR_08040204_001	Mercury In Tissue	Saline River	3.80	Miles	Remnant	UN	FC
4a	2C	AR_08040204_002	Mercury In Tissue	Saline River	60.10	Miles	Remnant	UN	FC
4a	2C	AR_08040204_004	Mercury In Tissue	Saline River	20.60	Miles	Remnant	UN	FC
4a	2C	AR_08040204_005	Turbidity Base Flows	Big Creek	48.70	Miles	Carry Forward	SE	OU
4a	2C	AR_08040204_006	Mercury In Tissue	Saline River	17.30	Miles	Remnant	UN	FC
4a	2C	AR_08040204_4020	Mercury In Tissue	Lake Monticello	5.97	Square Miles	Remnant	UN	FC
4a	2D	AR_08040201_001	Mercury In Tissue	Moro Creek	56.40	Miles	Remnant	SE, UN	FC
4a	2D	AR_08040201_001	Turbidity Base Flows	Moro Creek	56.40	Miles	Carry Forward	SE, UN	OU, ORW
4a	2D	AR_08040201_002	Mercury In Tissue	Ouachita River	23.40	Miles	Remnant	UN	FC
4a	2D	AR_08040201_003	Mercury In Tissue	Campagnolle Creek, Lower	19.70	Miles	Remnant	UN	FC
4a	2D	AR_08040201_004	Mercury In Tissue	Ouachita River	2.80	Miles	Remnant	UN	FC
4a	2D	AR_08040201_4010	Mercury In Tissue	Little Bay Lake	0.23	Square Miles	Remnant	UN	FC
4a	2D	AR_08040201_4020	Mercury In Tissue	Pedron Lake	0.07	Square Miles	Remnant	UN	FC
4a	2D	AR_08040201_4030	Mercury In Tissue	Crane Lake	0.02	Square Miles	Remnant	UN	FC
4a	2D	AR_08040201_4040	Mercury In Tissue	Big Johnson Lake	0.16	Square Miles	Remnant	UN	FC
4a	2D	AR_08040201_4050	Mercury In Tissue	Hollingsworth Brake	0.30	Square Miles	Remnant	UN	FC

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Units	Listing Status	Source	Uses
4a	2D	AR_08040201_4060	Mercury In Tissue	Snow Lake	0.12	Square Miles	Remnant	UN	FC
4a	2D	AR_08040201_4070	Mercury In Tissue	Calion Lake	2.00	Square Miles	Remnant	UN	FC
4a	2D	AR_08040201_606	Acute Ammonia	ECC Creek	5.20	Miles	Remnant	IP	SAL
4a	2D	AR_08040201_606	Chloride	ECC Creek	5.20	Miles	Remnant	IP	DWS, AG, I
4a	2D	AR_08040201_606	Chronic Ammonia - ELS absent	ECC Creek	5.20	Miles	Remnant	IP	SAL
4a	2D	AR_08040201_606	Sulfate	ECC Creek	5.20	Miles	Remnant	IP	DWS, AG, I
4a	2D	AR_08040201_606	Total Dissolved Solids	ECC Creek	5.20	Miles	Remnant	IP	DWS, AG, I
4a	2D	AR_08040201_616	Chronic Ammonia - ELS absent	ECC Creek	4.67	Miles	Remnant	IP	AL
4a	2D	AR_08040201_616	Chronic Ammonia - ELS Present	ECC Creek	4.67	Miles	Carry Forward	IP	AL
4a	2D	AR_08040201_626	Chloride	ECC Creek	2.36	Miles	Remnant	IP	AG, I
4a	2D	AR_08040201_626	Sulfate	ECC Creek	2.36	Miles	Remnant	IP	AG, I
4a	2D	AR_08040201_626	Total Dissolved Solids	ECC Creek	2.36	Miles	Remnant	IP	AG, I
4a	2D	AR_08040201_706	Chloride	Flat Creek	2.41	Miles	Remnant	IP	AG, I
4a	2D	AR_08040201_706	Sulfate	Flat Creek	2.41	Miles	Remnant	IP	AG, I
4a	2D	AR_08040201_706	Total Dissolved Solids	Flat Creek	2.41	Miles	Remnant	IP	AG, I
4a	2D	AR_08040201_806	Chloride	Salt Creek	7.20	Miles	Remnant	IP	DWS, AG, I
4a	2D	AR_08040201_806	Total Dissolved Solids	Salt Creek	7.20	Miles	Remnant	IP	DWS, AG, I
4a	2D	AR_08040201_901	Turbidity Base Flows	Moro Creek	57.00	Miles	Remnant	SE	OU
4a	2D	AR_08040201_901	Turbidity Storm Flows	Moro Creek	57.00	Miles	Remnant	SE	OU
4a	2D	AR_08040201_903	Mercury In Tissue	Champagnolle Creek	14.60	Miles	Remnant	UN	FC
4a	2D	AR_08040202_002	Mercury In Tissue	Ouachita River	10.30	Miles	Remnant	UN	FC
4a	2D	AR_08040202_003	Mercury In Tissue	Ouachita River	9.00	Miles	Remnant	UN	FC
4a	2D	AR_08040202_004	Mercury In Tissue	Ouachita River	32.50	Miles	Remnant	UN	FC

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Units	Listing Status	Source	Uses
4a	2D	AR_08040202_4020	Mercury In Tissue	Green Slough	0.30	Square Miles	Remnant	UN	FC
4a	2D	AR_08040202_4030	Mercury In Tissue	Pereogeethe Lake	0.24	Square Miles	Remnant	UN	FC
4a	2D	AR_08040202_4040	Mercury In Tissue	Jones Lake	0.37	Square Miles	Remnant	UN	FC
4a	2D	AR_08040202_4050	Mercury In Tissue	Eagle Lake	0.20	Square Miles	Remnant	UN	FC
4a	2D	AR_08040202_4060	Mercury In Tissue	Benjamin Lake	0.16	Square Miles	Remnant	UN	FC
4a	2D	AR_08040202_4070	Mercury In Tissue	Raymond Lake	0.20	Square Miles	Remnant	UN	FC
4a	2D	AR_08040202_4080	Mercury In Tissue	Hoop Lake	0.13	Square Miles	Remnant	UN	FC
4a	2D	AR_08040202_4100	Mercury In Tissue	Marais Saline Lake	0.26	Square Miles	Remnant	UN	FC
4a	2D	AR_08040202_4110	Mercury In Tissue	Fishtrap Lake	0.20	Square Miles	Remnant	UN	FC
4a	2D	AR_08040202_4120	Mercury In Tissue	Lipsey Brake	0.07	Square Miles	Remnant	UN	FC
4a	2D	AR_08040202_4130	Mercury In Tissue	Panther Brake	0.05	Square Miles	Remnant	UN	FC
4a	2D	AR_08040202_4140	Mercury In Tissue	Crossett Flatwater	0.55	Square Miles	Remnant	UN	FC
4a	2D	AR_08040202_4150	Mercury In Tissue	Mud Lake and Round Brake	0.47	Square Miles	Remnant	UN	FC
4a	2D	AR_08040202_4160	Mercury In Tissue	Redeye Lake, Wildcat Lake, etc.	1.50	Square Miles	Remnant	UN	FC
4a	2D	AR_08040202_4170	Mercury In Tissue	Felsenthal	2.47	Square Miles	Remnant	UN	FC
4a	2D	AR_08040202_4180	Mercury In Tissue	Horseshoe Lake	0.15	Square Miles	Remnant	UN	FC
4a	2D	AR_08040202_4190	Mercury In Tissue	Key Hole Lake	0.01	Square Miles	Remnant	UN	FC
4a	2D	AR_08040202_4200	Mercury In Tissue	Fist Flatwater, Standard Break, etc.	0.43	Square Miles	Remnant	UN	FC

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Units	Listing Status	Source	Uses
4a	2D	AR_08040202_4210	Mercury In Tissue	Buffalo Break	0.02	Square Miles	Remnant	UN	FC
4a	2D	AR_08040202_4220	Mercury In Tissue	Pete Wilson Lake, Otter, Bull, Hornet Brakes	1.24	Square Miles	Remnant	UN	FC
4a	2F	AR_08040101_048	Turbidity Base Flows	Prairie Creek	1.50	Miles	Remnant	UN	OU
4a	2F	AR_08040101_848	Turbidity Base Flows	Prairie Creek	1.33	Miles	Carry Forward	UN	OU
4a	2F	AR_08040101_948	Turbidity Base Flows	Prairie Creek	1.56	Miles	Remnant	UN	OU
4a	3A	AR_08020401_003	Turbidity Base Flows	Wabbaseka Bayou	42.30	Miles	Remnant	SE	OU
4a	3A	AR_08020401_003	Turbidity Storm Flows	Wabbaseka Bayou	42.30	Miles	Remnant	SE	OU
4a	3D	AR_11110205_011	Turbidity Base Flows	Cadron Creek	2.80	Miles	Remnant	SE	OU, ORW
4a	3D	AR_11110205_011	Turbidity Storm Flows	Cadron Creek	2.80	Miles	Remnant	SE	OU, ORW
4a	3D	AR_11110205_012	Turbidity Base Flows	Cadron Creek	13.00	Miles	Remnant	SE	OU, ORW
4a	3D	AR_11110205_012	Turbidity Storm Flows	Cadron Creek	13.00	Miles	Remnant	SE	OU, ORW
4a	3E	AR_11110206_002	Mercury In Tissue	Fourche La Fave River	10.10	Miles	Remnant	UN	FC
4a	3E	AR_11110206_4050	Mercury In Tissue	Lake Nimrod	0.71	Square Miles	Remnant	UN	FC
4a	3E	AR_11110206_4051	Mercury In Tissue	Lake Nimrod	1.21	Square Miles	Remnant	UN	FC
4a	3E	AR_11110206_4052	Mercury In Tissue	Lake Nimrod	5.54	Square Miles	Remnant	UN	FC
4a	3E	AR_11110206_4060	Mercury In Tissue	Dry Fork Lake	0.67	Square Miles	Remnant	UN	FC
4a	3F	AR_11110203_927	Turbidity Base Flows	White Oak Creek	7.60	Miles	Carry Forward	UN	OU
4a	3F	AR_11110203_931	Nitrate	Whig Creek	10.10	Miles	Carry Forward based on 75%	MP, AG	AL
4a	3G	AR_11110204_4070	Mercury In Tissue	Spring Lake	0.33	Square Miles	Remnant	UN	FC

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Units	Listing Status	Source	Uses
4a	3H	AR_11110201_009	pH	Mulberry River	9.80	Miles	Remnant	UN	OU, ORW
4a	3H	AR_11110202_4030	Mercury In Tissue	Cove Lake	0.51	Square Miles	Remnant	UN	FC
4a	3I	AR_11110105_001	Turbidity Base Flows	Poteau River	4.90	Miles	Carry Forward	UR	OU
4a	3I	AR_11110105_001	Turbidity Storm Flows	Poteau River	4.90	Miles	Carry Forward	UR	OU
4a	3I	AR_11110105_031	Total Phosphorus	Poteau River	6.70	Miles	Remnant	IP	AL
4a	4A	AR_08020303_4010	Nutrients	Old Town Lake	8.64	Square Miles	Remnant	UN	AL
4a	4B	AR_08020302_004	Turbidity Base Flows	Bayou De View	25.30	Miles	New	AG, SE	OU
4a	4B	AR_08020302_006	Turbidity Base Flows	Bayou De View	10.14	Miles	New	AG, SE	OU
4a	4B	AR_08020302_017	Turbidity Base Flows	Cache River	22.90	Miles	Remnant	UN	OU
4a	4B	AR_08020302_021	Turbidity Base Flows	Cache River	17.03	Miles	New	AG, SE	OU
4a	4B	AR_08020302_027	Turbidity Base Flows	Cache River	2.20	Miles	Remnant	SE	OU
4a	4B	AR_08020302_027	Turbidity Storm Flows	Cache River	2.20	Miles	Remnant	SE	OU
4a	4B	AR_08020302_028	Turbidity Base Flows	Cache River	6.00	Miles	Remnant	SE	OU
4a	4B	AR_08020302_028	Turbidity Storm Flows	Cache River	6.00	Miles	Remnant	SE	OU
4a	4B	AR_08020302_029	Turbidity Storm Flows	Cache River	5.40	Miles	Remnant	SE	OU
4a	4B	AR_08020302_029	Turbidity Base Flows	Cache River	5.40	Miles	Remnant	SE	OU
4a	4B	AR_08020302_031	Turbidity Base Flows	Cache River	2.90	Miles	Remnant	SE	OU
4a	4B	AR_08020302_031	Turbidity Storm Flows	Cache River	2.90	Miles	Remnant	SE	OU
4a	4B	AR_08020302_032	Turbidity Storm Flows	Cache River Ditch #1	11.00	Miles	Remnant	SE	OU
4a	4B	AR_08020302_032	Turbidity Base Flows	Cache River Ditch #1	11.00	Miles	Remnant	SE	OU
4a	4B	AR_08020302_4020	Turbidity Base Flows	Lake Frierson	1.39	Square Miles	Remnant	UN	OU
4a	4B	AR_08020302_4020	Turbidity Storm Flows	Lake Frierson	1.39	Square Miles	Remnant	UN	OU

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Units	Listing Status	Source	Uses
4a	4C	AR_11010013_006	Turbidity Base Flows	Village Creek	29.10	Miles	Remnant	SE	OU
4a	4C	AR_11010013_006	Turbidity Storm Flows	Village Creek	29.10	Miles	Remnant	SE	OU
4a	4C	AR_11010013_007	Turbidity Base Flows	Village Creek	1.20	Miles	Remnant	SE	OU
4a	4C	AR_11010013_007	Turbidity Storm Flows	Village Creek	1.20	Miles	Remnant	SE	OU
4a	4C	AR_11010013_008	Turbidity Base Flows	Village Creek	12.20	Miles	Remnant	SE	OU
4a	4C	AR_11010013_008	Turbidity Storm Flows	Village Creek	12.20	Miles	Remnant	SE	OU
4a	4C	AR_11010013_012	Turbidity Storm Flows	Village Creek	7.70	Miles	Remnant	SE	OU
4a	4C	AR_11010013_012	Turbidity Base Flows	Village Creek	7.70	Miles	Remnant	SE	OU
4a	4C	AR_11010013_014	Turbidity Storm Flows	Village Creek	25.70	Miles	Remnant	SE	OU
4a	4C	AR_11010013_014	Turbidity Base Flows	Village Creek	25.70	Miles	Remnant	SE	OU
4a	4D	AR_08020301_011	Primary Contact *E. coli*	Cypress Bayou	11.30	Miles	Remnant	UN	PC
4a	4D	AR_08020301_011	Secondary Contact *E. coli*	Cypress Bayou	11.30	Miles	Remnant	UN	SC
4a	4D	AR_08020301_012	Primary Contact *E. coli*	Cypress Bayou	28.20	Miles	Remnant	UN	PC
4a	4D	AR_08020301_012	Secondary Contact *E. coli*	Cypress Bayou	28.20	Miles	Remnant	UN	SC
4a	4E	AR_11010014_004	Secondary Contact *E. coli*	Overflow Creek	0.90	Miles	Remnant	UN	SC
4a	4E	AR_11010014_004	Primary Contact *E. coli*	Overflow Creek	0.90	Miles	Remnant	UN	PC
4a	4E	AR_11010014_006	Primary Contact *E. coli*	Overflow Creek	12.00	Miles	Remnant	UN	PC

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Units	Listing Status	Source	Uses
4a	4E	AR_11010014_006	Secondary Contact *E. coli*	Overflow Creek	12.00	Miles	Remnant	UN	SC
4a	4E	AR_11010014_008	Primary Contact *E. coli*	Little Red River	8.40	Miles	Remnant	UN	PC
4a	4E	AR_11010014_008	Secondary Contact *E. coli*	Little Red River	8.40	Miles	Remnant	UN	SC
4a	4E	AR_11010014_009	Primary Contact *E. coli*	Tenmile Creek	23.50	Miles	Remnant	SE, UN	PC
4a	4E	AR_11010014_009	Secondary Contact *E. coli*	Tenmile Creek	23.50	Miles	Remnant	SE, UN	SC
4a	4E	AR_11010014_009	Turbidity Base Flows	Tenmile Creek	23.50	Miles	Remnant	SE, UN	OU
4a	4E	AR_11010014_009	Turbidity Storm Flows	Tenmile Creek	23.50	Miles	Remnant	SE, UN	OU
4a	4E	AR_11010014_010	Primary Contact *E. coli*	Little Red River	3.70	Miles	Remnant	UN	PC
4a	4E	AR_11010014_010	Secondary Contact *E. coli*	Little Red River	3.70	Miles	Remnant	UN	SC
4a	4E	AR_11010014_012	Secondary Contact *E. coli*	Little Red River	8.40	Miles	Remnant	UN	SC
4a	4E	AR_11010014_012	Primary Contact *E. coli*	Little Red River	8.40	Miles	Remnant	UN	PC
4a	4E	AR_11010014_027	Primary Contact *E. coli*	Little Red River, M. Fork	3.40	Miles	Remnant	UN	PC, ORW
4a	4E	AR_11010014_027	Secondary Contact *E. coli*	Little Red River, M. Fork	3.40	Miles	Remnant	UN	SC, ORW
4a	4E	AR_11010014_036	Mercury In Tissue	Little Red River, S. Fork	4.00	Miles	Remnant	UN	FC
4a	4F	AR_11010004_015	Nitrate	Hicks Creek	13.20	Miles	Carry Forward	MP	AL
4a	4G	AR_11010012_003	Primary Contact *E. coli*	Coopers Creek	20.20	Miles	Remnant	AG	PC
4a	4G	AR_11010012_003	Secondary Contact *E. coli*	Coopers Creek	20.20	Miles	Remnant	AG	SC

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Units	Listing Status	Source	Uses
4a	4G	AR_11010012_004	Turbidity Base Flows	Strawberry River	0.10	Miles	Remnant	SE	OU, ORW
4a	4G	AR_11010012_004	Turbidity Storm Flows	Strawberry River	0.10	Miles	Remnant	SE	OU, ORW
4a	4G	AR_11010012_005	Turbidity Base Flows	Strawberry River	1.80	Miles	Remnant	SE	OU, ORW
4a	4G	AR_11010012_005	Turbidity Storm Flows	Strawberry River	1.80	Miles	Remnant	SE	OU, ORW
4a	4G	AR_11010012_006	Turbidity Base Flows	Strawberry River	20.30	Miles	Carry Forward	SE	OU, ORW
4a	4G	AR_11010012_006	Turbidity Storm Flows	Strawberry River	20.30	Miles	Carry Forward	SE	OU, ORW
4a	4G	AR_11010012_008	Primary Contact *E. coli*	Strawberry River	12.40	Miles	Remnant	SE, UN	PC, ORW
4a	4G	AR_11010012_008	Secondary Contact *E. coli*	Strawberry River	12.40	Miles	Remnant	SE, UN	SC, ORW
4a	4G	AR_11010012_008	Turbidity Base Flows	Strawberry River	12.40	Miles	Remnant	SE	OU, ORW
4a	4G	AR_11010012_008	Turbidity Storm Flows	Strawberry River	12.40	Miles	Remnant	SE	OU, ORW
4a	4G	AR_11010012_011	Turbidity Base Flows	Strawberry River	27.10	Miles	Remnant	SE, AG	OU, ORW
4a	4G	AR_11010012_011	Turbidity Storm Flows	Strawberry River	27.10	Miles	Remnant	SE, AG	OU, ORW
4a	4G	AR_11010012_015	Primary Contact *E. coli*	Caney Cr	12.40	Miles	Remnant	AG	PC
4a	4G	AR_11010012_015	Secondary Contact *E. coli*	Caney Cr	12.40	Miles	Remnant	AG	SC
4a	4K	AR_11010001_023	Turbidity Base Flows	White River	1.90	Miles	Carry Forward	UN	OU
4a	4K	AR_11010001_023	Turbidity Storm Flows	White River	1.90	Miles	Carry Forward	UN	OU
4a	4K	AR_11010001_024	Turbidity Base Flows	White River, West Fork	10.70	Miles	Carry Forward	UN	OU

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Units	Listing Status	Source	Uses
4a	4K	AR_11010001_024	Turbidity Storm Flows	White River, West Fork	10.70	Miles	Carry Forward	UN	OU
4a	4K	AR_11010001_059	Nitrate	Holman Creek	10.60	Miles	Remnant	MP	AL
4a	4K	AR_11010001_823	Turbidity Base Flows	White River	5.10	Miles	Carry Forward	UN	OU
4a	4K	AR_11010001_823	Turbidity Storm Flows	White River	5.10	Miles	Carry Forward	UN	OU
4a	4K	AR_11010001_923	Turbidity Base Flows	White River	0.40	Miles	Remnant	UN	OU
4a	4K	AR_11010001_923	Turbidity Storm Flows	White River	0.40	Miles	Remnant	UN	OU
4a	4K	AR_11010001_945	Total Phosphorus	Osage Creek	7.80	Miles	Remnant	MP	AL
4a	4K	AR_11010001_959	Nitrate	Town Branch	2.60	Miles	Remnant	MP	SAL
4a	5A	AR_08020203_003	Turbidity Base Flows	Blackfish Bayou	2.10	Miles	Remnant	SE	OU
4a	5A	AR_08020203_003	Turbidity Storm Flows	Blackfish Bayou	2.10	Miles	Remnant	SE	OU
4a	5A	AR_08020203_005	Turbidity Storm Flows	Blackfish Bayou	2.60	Miles	Remnant	SE	OU
4a	5A	AR_08020203_005	Turbidity Base Flows	Blackfish Bayou	2.60	Miles	Remnant	SE	OU
4a	5A	AR_08020203_007	Turbidity Base Flows	Blackfish Bayou	16.80	Miles	Remnant	SE	OU
4a	5A	AR_08020203_007	Turbidity Storm Flows	Blackfish Bayou	16.80	Miles	Remnant	SE	OU
4a	5A	AR_08020203_012	Turbidity Base Flows	Tyronza River	35.40	Miles	Remnant	SE	OU
4a	5A	AR_08020203_012	Turbidity Storm Flows	Tyronza River	35.40	Miles	Remnant	SE	OU
4a	5A	AR_08020203_4020	Nutrients	Bear Creek Lake	2.00	Square Miles	Remnant	UN	AL
4a	5A	AR_08020203_4060	Nutrients	Horseshoe Lake	9.66	Square Miles	Remnant	UN	AL
4a	5A	AR_08020203_909	Turbidity Base Flows	Tyronza River	30.30	Miles	Remnant	SE	OU
4a	5A	AR_08020203_909	Turbidity Storm Flows	Tyronza River	30.30	Miles	Remnant	SE	OU
4a	5A	AR_08020203_912	Turbidity Base Flows	Tyronza River	4.70	Miles	Remnant	SE	OU
4a	5A	AR_08020203_912	Turbidity Storm Flows	Tyronza River	4.70	Miles	Remnant	SE	OU
4a	5B	AR_08020205_001	Turbidity Base Flows	L'Anguille River	17.20	Miles	Carry Forward	SE	OU

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Units	Listing Status	Source	Uses
4a	5B	AR_08020205_002	Turbidity Storm Flows	L'Anguille River	23.00	Miles	Remnant	SE	OU
4a	5B	AR_08020205_002	Turbidity Base Flows	L'Anguille River	23.00	Miles	Remnant	SE	OU
4a	5B	AR_08020205_003	Turbidity Base Flows	L'Anguille River	2.90	Miles	Remnant	SE	OU
4a	5B	AR_08020205_003	Turbidity Storm Flows	L'Anguille River	2.90	Miles	Remnant	SE	OU
4a	5B	AR_08020205_004	Primary Contact *E. coli*	L'Anguille River	17.00	Miles	Remnant	SE, UN	PC
4a	5B	AR_08020205_004	Secondary Contact *E. coli*	L'Anguille River	17.00	Miles	Remnant	SE, UN	SC
4a	5B	AR_08020205_004	Turbidity Storm Flows	L'Anguille River	17.00	Miles	Carry Forward	SE, UN	OU
4a	5B	AR_08020205_004	Turbidity Base Flows	L'Anguille River	17.00	Miles	Carry Forward	SE, UN	OU
4a	5B	AR_08020205_005	Turbidity Base Flows	L'Anguille River	53.40	Miles	Remnant	SE, UN	OU
4a	5B	AR_08020205_005	Primary Contact *E. coli*	L'Anguille River	53.40	Miles	Remnant	SE, UN	PC
4a	5B	AR_08020205_005	Secondary Contact *E. coli*	L'Anguille River	53.40	Miles	Remnant	SE, UN	SC
4a	5B	AR_08020205_005	Turbidity Storm Flows	L'Anguille River	53.40	Miles	Remnant	SE, UN	OU
4a	5C	AR_08020204_4010	Nutrients	Mallard Lake	1.28	Square Miles	Remnant	UN	AL

Table XIV-C: Impaired, but other management alternatives are expected to result in attainment (Category 4b). See Appendix A for rationale.

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Source	Uses	Year Listed
4b	2C	AR_08040203_824	pH	Skull Creek	0.45	Miles	Remnant	IP, RE	OU	-
4b	2C	AR_08040203_924	pH	Reyburn Creek	8.13	Miles	Remnant	IP, RE	OU	-
4b	2F	AR_08040102_970	pH	Cove Creek	3.67	Miles	Carry Forward	IP, RE	OU	-
4b	2F	AR_08040102_970	Toxicity	Cove Creek	3.67	Miles	Remnant	IP, RE	AL[11]	-
4b	2F	AR_08040102_971	Aluminum	Chamberlain Creek	2.48	Miles	Remnant	IP, RE	SAL	-
4b	2F	AR_08040102_971	Beryllium	Chamberlain Creek	2.48	Miles	Remnant	IP, RE	DWS	-
4b	2F	AR_08040102_971	Copper Acute	Chamberlain Creek	2.48	Miles	Remnant	IP, RE	SAL	-
4b	2F	AR_08040102_971	Copper Chronic	Chamberlain Creek	2.48	Miles	Remnant	IP, RE	SAL	-
4b	2F	AR_08040102_971	pH	Chamberlain Creek	2.48	Miles	Remnant	IP, RE	OU	-
4b	2F	AR_08040102_971	Primary Season DO	Chamberlain Creek	2.48	Miles	Remnant	IP, RE	SAL	-
4b	2F	AR_08040102_971	Sulfate	Chamberlain Creek	2.48	Miles	Remnant	IP, RE	AG, DWS, I	-
4b	2F	AR_08040102_971	Total Dissolved Solids	Chamberlain Creek	2.48	Miles	Remnant	IP, RE	AG, DWS, I	-
4b	2F	AR_08040102_971	Toxicity	Chamberlain Creek	2.48	Miles	Remnant	IP, RE	SAL	-
4b	2F	AR_08040102_971	Zinc Acute	Chamberlain Creek	2.48	Miles	Remnant	IP, RE	SAL	-
4b	2F	AR_08040102_971	Zinc Chronic	Chamberlain Creek	2.48	Miles	Remnant	IP, RE	SAL	-
4b	2F	AR_08040102_975	pH	Lucinda Creek	0.78	Miles	Remnant	RE	OU	-
4b	4J	AR_11010005_010	Primary Contact *E. coli*	Buffalo River	6.83	Miles	Remnant	UN	ORW, PC	-
4b	4J	AR_11010005_011	Primary Contact *E. coli*	Buffalo River	7.49	Miles	Remnant	UN	ORW, PC	-
4b	4J	AR_11010005_020	Critical Season DO	Big Creek	3.71	Miles	Remnant	UN	AL	-
4b	4J	AR_11010005_020	Critical Season DO - LT Continuous	Big Creek	3.71	Miles	Carry Forward	UN	AL	-

[11] Biological data indicate AL use is being met

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Source	Uses	Year Listed
4b	4J	AR_11010005_020	Critical Season DO - ST Continuous	Big Creek	3.71	Miles	Carry Forward	UN	AL	-
4b	4J	AR_11010005_022	Primary Contact *E. coli*	Big Creek	15.05	Miles	Carry Forward	UN	PC	-
4b	4J	AR_11010005_712	Primary Season DO	UT to Mill Creek	1.59	Miles	Remnant	UN	SAL	-
4b	4J	AR_11010005_912	Turbidity Base Flows	Mill Creek	7.42	Miles	New	SE, UN	OU	2022

Table XV-C: Impaired, but alternative restoration approached are thought to be more immediately beneficial than a TMDL (Category 5-alt.). See Appendix A for rationale.

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Source	Uses	Year Listed
5-alt.	3J	AR_11110103_018	Turbidity Base Flows	Illinois River	4.53	Miles	New	AG, UR, SE	OU, ORW	2022
5-alt.	3J	AR_11110103_018	Turbidity Storm Flows	Illinois River	4.53	Miles	New	AG, UR, SE	OU, ORW	2022
5-alt.	3J	AR_11110103_026	Primary Contact *E. coli*	Moores Creek	4.86	Miles	Remnant	IP, MP, SE, AG	PC	-
5-alt.	3J	AR_11110103_027	Primary Contact *E. coli*	Muddy Fork	7.14	Miles	Remnant	IP, MP, SE, AG	PC	-
5-alt.	3J	AR_11110103_028	Primary Contact *E. coli*	Illinois River	2.85	Miles	Remnant	IP, MP, SE, AG	PC	-
5-alt.	3J	AR_11110103_630	Primary Contact *E. coli*	Little Osage Creek	7.22	Miles	Remnant	IP, MP, SE, AG	PC	-
5-alt.	3J	AR_11110103_933	Primary Contact *E. coli*	Little Osage Creek	4.35	Miles	Remnant	IP, MP, SE, AG	ORW, PC	-
5-alt.	4K	AR_11010001_4041	Turbidity Storm Flows	Beaver Lake	2	Square Miles	Remnant	SE, UN	OU	-
5-alt.	4K	AR_11010001_4042	Chlorophyll a, Total	Beaver Lake	3.5	Square Miles	New	SE, UN	DWS	2022

Table XVI-C: Impaired Waterbodies (Category 5)

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	1A	AR_11140203_020	Turbidity Base Flows	Bayou Dorcheat	9.8	Miles	Remnant	Low	SE	OU	-
5	1A	AR_11140203_022	Turbidity Base Flows	Bayou Dorcheat	11.59	Miles	Carry Forward	Low	SE	OU	-
5	1A	AR_11140203_823	Lead Chronic	Nations Creek	9.89	Miles	New	High	UN	AL	2022
5	1A	AR_11140203_823	pH	Nations Creek	9.89	Miles	New	High	UN	OU	2022
5	1A	AR_11140205_010	pH	Bodcau Creek	26.46	Miles	New	Med.	AG, RE	OU	2022
5	1A	AR_11140205_013	pH	Dooley Creek	19.46	Miles	New	Med.	AG	OU	2022
5	1A	AR_11140205_902	Lead Chronic	Steel Creek	9.37	Miles	New	High	MP, IP	AL	2022
5	1A	AR_11140205_902	pH	Steel Creek	9.37	Miles	New	High	MP, IP	OU	2022
5	1B	AR_11140106_001	Chloride	Red River	36.47	Miles	New	Low	AG, IP	AG, I	2022
5	1B	AR_11140106_001	Turbidity Base Flows	Red River	36.47	Miles	Remnant	Low	SE	OU	-
5	1B	AR_11140106_001	Turbidity Storm Flows	Red River	36.47	Miles	Remnant	Low	SE	OU	-
5	1B	AR_11140106_002	Turbidity Storm Flows	Bull Creek	13.63	Miles	New	High	AG	OU	2022
5	1B	AR_11140106_003	Turbidity Base Flows	Red River	17.01	Miles	Remnant	Low	SE	OU	-
5	1B	AR_11140106_005	Turbidity Base Flows	Red River	20.77	Miles	Carry Forward	Low	SE	OU	-
5	1B	AR_11140106_025	Turbidity Base Flows	Red River	5.48	Miles	Remnant	Low	SE	OU	-
5	1B	AR_11140201_002	Primary Season DO	Poston Bayou	13.05	Miles	New	High	AG	AL	2022
5	1B	AR_11140201_002	Turbidity Storm Flows	Poston Bayou	13.05	Miles	New	High	AG	OU	2022
5	1B	AR_11140201_003	Critical Season DO	Red River	8.48	Miles	New	High	AG	AL	2022
5	1B	AR_11140201_003	Total Dissolved Solids	Red River	8.48	Miles	New	High	AG, SE	AG, I	2022
5	1B	AR_11140201_007	Turbidity Base Flows	Red River	41.01	Miles	Carry Forward	Low	SE	OU	-
5	1B	AR_11140201_008	Critical Season DO	Bois D'Arc Creek	10	Miles	Remnant	Low	UN	AL	-
5	1B	AR_11140201_008	Primary Season DO	Bois D'Arc Creek	10	Miles	Remnant	Low	UN	AL	-
5	1B	AR_11140201_009	Critical Season DO	Bois D'Arc Creek	18.74	Miles	Remnant	Low	UN	AL	-
5	1B	AR_11140201_009	Primary Season DO	Bois D'Arc Creek	18.74	Miles	Remnant	Low	UN	AL	-
5	1B	AR_11140201_010	Critical Season DO - ST Continuous	Bridge Creek	15.66	Miles	New	High	RE, IP	AL	2022
5	1B	AR_11140201_010	pH	Bridge Creek	15.66	Miles	New	High	RE, IP	OU	2022

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	1B	AR_11140201_010	Turbidity Base Flows	Bridge Creek	15.66	Miles	New	High	RE, IP	OU	2022
5	1B	AR_11140201_913	Primary Season DO	Gillespie Ditch	16.74	Miles	New	High	AG	AL	2022
5	1B	AR_11140302_006	Critical Season DO	Sulphur River	8.15	Miles	New	Low	UN	AL	2022
5	1B	AR_11140304_908	pH	West Fork Kelly Bayou	12.39	Miles	New	Med.	RE	OU	2022
5	1C	AR_11140109_001	Temperature	Little River	4.89	Miles	Remnant	Low	UN	AL	-
5	1C	AR_11140109_011	Turbidity Storm Flows	Messer Creek	16.74	Miles	New	Med.	AG	OU	2022
5	1C	AR_11140109_013	Critical Season DO - ST Continuous	Holly Creek	7.94	Miles	New	Low	MP, IP	AL	2022
5	1C	AR_11140109_018	Temperature - LT Continuous	Cossatot River	18.53	Miles	Carry Forward	Low	UN	AL, ORW	2020
5	1C	AR_11140109_019	pH	Cossatot River	17.17	Miles	Carry Forward	Med.	UN	OU, ORW	2020
5	1C	AR_11140109_020	pH - ST Continuous	Bushy Creek	11.63	Miles	Carry Forward	Med.	UN	OU, ORW	2020
5	1C	AR_11140109_021	Copper Chronic	Pond Creek	21.1	Miles	New	Low	MP	AL	2022
5	1C	AR_11140109_021	pH	Pond Creek	21.1	Miles	New	Med.	UN	OU	2022
5	1C	AR_11140109_029	Critical Season DO	Robinson Creek	15.09	Miles	Carry Forward	Med.	UN	AL[11]	2020
5	1C	AR_11140109_029	Critical Season DO - ST Continuous	Robinson Creek	15.09	Miles	Carry Forward	Med.	UN	AL[11]	2020
5	1C	AR_11140109_029	pH	Robinson Creek	15.09	Miles	Carry Forward	Med.	UN	OU	2020
5	1C	AR_11140109_032	pH	Flat Creek	17.06	Miles	New	Med.	IP	OU	2022
5	1C	AR_11140109_533	Primary Season DO	Brushy Creek	3.91	Miles	New	Low	AG	AL	2022
5	1C	AR_11140109_719	pH	Short Creek	7.15	Miles	Carry Forward	Med.	UN	OU	2020
5	1C	AR_11140109_719	pH - ST Continuous	Short Creek	7.15	Miles	Carry Forward	Med.	UN	OU	-
5	1C	AR_11140109_810	pH	Rock Creek	3.19	Miles	New	Med.	AG	OU	2022
5	1C	AR_11140109_820	pH	Big Bellville Creek	8.19	Miles	New	Med.	AG, MP	OU	2022

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	1C	AR_11140109_921	pH	Caney Creek	8.19	Miles	Carry Forward	Low	UN	OU, ORW	-
5	1C	AR_11140109_921	pH - ST Continuous	Caney Creek	8.19	Miles	Carry Forward	Low	UN	OU, ORW	-
5	1C	AR_11140109_929	Critical Season DO	Cross Creek	11.23	Miles	Carry Forward	Med.	UN	AL[11]	2020
5	1C	AR_11140109_929	pH	Cross Creek	11.23	Miles	Carry Forward	Med.	UN	OU	2020
5	1C	AR_11140109_935	pH	Mine Creek	10.72	Miles	New	Med.	MP, IP	OU	2022
5	1D	AR_11140108_012	pH	Sixmile Creek	17.48	Miles	Carry Forward	Med.	AG, UN	OU	2020
5	1D	AR_11140108_012	pH - ST Continuous	Sixmile Creek	17.48	Miles	Carry Forward	Med.	AG, UN	OU	2020
5	1D	AR_11140108_014	Critical Season DO	Mountain Fork River	11.31	Miles	New	High	AG	AL, ORW	2022
5	1D	AR_11140108_014	Temperature - LT Continuous	Mountain Fork River	11.31	Miles	Carry Forward	Low	UN	AL, ORW	2020
5	1D	AR_11140108_019	pH	Mill Creek	12.32	Miles	Carry Forward	Low	UN	OU	-
5	1D	AR_11140108_019	pH - ST Continuous	Mill Creek	12.32	Miles	Carry Forward	Low	UN	OU	-
5	1D	AR_11140108_907	Critical Season DO	Barren Creek	11.65	Miles	New	Med.	AG	AL[11]	2022
5	1D	AR_11140108_907	pH	Barren Creek	11.65	Miles	Carry Forward	Low	UN	OU	-
5	1D	AR_11140108_907	Primary Season DO	Barren Creek	11.65	Miles	Carry Forward	Med.	UN	AL[11]	2020
5	1D	AR_11140108_907	Turbidity Base Flows	Barren Creek	11.65	Miles	Carry Forward	Med.	UN	OU	2020
5	2A	AR_08050002_003	Chloride - Site Specific	Bayou Macon	23.33	Miles	Remnant	Low	UN	AL	-
5	2A	AR_08050002_006	Chloride - Site Specific	Bayou Macon	37.79	Miles	Remnant	Low	UN	AL	-
5	2B	AR_08040205_001	Critical Season DO	Bayou Bartholomew	64.48	Miles	Carry Forward	Low	UN	AL	-

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	2B	AR_08040205_006	Lead Acute	Bayou Bartholomew	97	Miles	Remnant	Low	UN	AL	-
5	2B	AR_08040205_006	Lead Chronic	Bayou Bartholomew	97	Miles	Remnant	Low	UN	AL	-
5	2B	AR_08040205_901	Primary Season DO	Bearhouse Creek	34.59	Miles	Remnant	Low	UN	AL	-
5	2B	AR_08040205_902	Lead Chronic	Harding Creek	4.29	Miles	Remnant	Low	UR	SAL	-
5	2B	AR_08040205_905	Critical Season DO	Cross Bayou	2.46	Miles	Remnant	Low	UN	SAL	-
5	2B	AR_08040205_905	Primary Season DO	Cross Bayou	2.46	Miles	Remnant	Low	UN	SAL	-
5	2B	AR_08040205_907	Critical Season DO	Chemin-A-Haut Creek	48.96	Miles	Remnant	Low	UN	AL	-
5	2B	AR_08040205_908	Chloride - Site Specific	Overflow Creek	29.22	Miles	Remnant	Low	SE	AL	-
5	2B	AR_08040205_908	Turbidity Base Flows	Overflow Creek	29.22	Miles	Remnant	Low	SE	OU	-
5	2B	AR_08040205_908	Turbidity Storm Flows	Overflow Creek	29.22	Miles	Remnant	Low	SE	OU	-
5	2B	AR_08040205_909	Critical Season DO	Main St. Ditch	3.29	Miles	Remnant	Low	UR, UN	SAL	-
5	2B	AR_08040205_909	Lead Chronic	Main St. Ditch	3.29	Miles	Remnant	Low	UR, UN	SAL	-
5	2B	AR_08040205_909	Primary Season DO	Main St. Ditch	3.29	Miles	Remnant	Low	UR, UN	SAL	-
5	2B	AR_08040205_910	Lead Chronic	Bayou Imbeau	5.29	Miles	Remnant	High	UR	SAL	-
5	2B	AR_08040205_910	Primary Contact *E. coli*	Bayou Imbeau	5.29	Miles	Remnant	High	UR	PC	-
5	2B	AR_08040205_910	Primary Season DO	Bayou Imbeau	5.29	Miles	Remnant	High	UR	SAL	-
5	2B	AR_08040205_911	Turbidity Base Flows	Able's Creek	27.97	Miles	Remnant	Low	SE	OU	-
5	2B	AR_08040205_911	Turbidity Storm Flows	Able's Creek	27.97	Miles	Remnant	Low	SE	OU	-
5	2C	AR_08040203_008	pH	Lost Creek Ditch	21.3	Miles	New	High	AG	OU	2022
5	2C	AR_08040203_011	Critical Season DO	Saline River, N. Fork	22.64	Miles	New	Med.	UN	AL[11], ORW	2022
5	2C	AR_08040203_014	Critical Season DO	Saline River, Alum Fork	19.34	Miles	Carry Forward	Med.	UN	AL[11], ORW	-
5	2C	AR_08040203_014	Critical Season DO - ST Continuous	Saline River, Alum Fork	19.34	Miles	Carry Forward	Med.	UN	AL[11], ORW	-
5	2C	AR_08040203_014	pH	Saline River, Alum Fork	19.34	Miles	Carry Forward	Med.	UN	OU, ORW	-

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	2C	AR_08040203_018	pH	Saline River, Alum Fork	7.67	Miles	Remnant	Med.	UN	OU, ORW	-
5	2C	AR_08040203_019	Critical Season DO - ST Continuous	Saline River, Middle Fork	38.05	Miles	Carry Forward	Med.	UN	AL[11], ORW	-
5	2C	AR_08040203_021	Critical Season DO	Cedar Creek	1.16	Miles	Carry Forward	Med.	UN	AL[11]	2020
5	2C	AR_08040203_021	Critical Season DO - ST Continuous	Cedar Creek	1.16	Miles	Carry Forward	Med.	UN	AL[11]	2020
5	2C	AR_08040203_022	Biological Integrity - Fish	Saline River, S Fk	13.62	Miles	Remnant	Med.	UN	AL, ORW	2020
5	2C	AR_08040203_022	Biological Integrity - Macroinvertebrates	Saline River, S Fk	13.62	Miles	Remnant	Med.	UN	AL, ORW	2020
5	2C	AR_08040203_410	Biological Integrity - Fish	Clift Creek	8.28	Miles	New	Med.	UN	AL	2022
5	2C	AR_08040203_410	Critical Season DO - ST Continuous	Clift Creek	8.28	Miles	New	Med.	UN	AL	2022
5	2C	AR_08040203_410	pH	Clift Creek	8.28	Miles	New	Med.	UN	OU	2022
5	2C	AR_08040203_4100	pH	Lake Winona	0.51	Square Miles	Carry Forward	Med.	UN	OU	-
5	2C	AR_08040203_4101	pH	Lake Winona	1.32	Square Miles	Carry Forward	Med.	UN	OU	-
5	2C	AR_08040203_4110	pH	Cox Creek Lake	0.38	Square Miles	Remnant	Low	UN	OU	-
5	2C	AR_08040203_611	Critical Season DO - ST Continuous	North Fork Saline River	14.89	Miles	Remnant	Med.	UN	AL[11], ORW	2020
5	2C	AR_08040203_611	pH	North Fork Saline River	14.89	Miles	Carry Forward	High	UN	OU, ORW	2020
5	2C	AR_08040203_922	Biological Integrity - Fish	Lockett Creek	8.83	Miles	New	Low	UN	AL	2022
5	2C	AR_08040203_922	Critical Season DO	Lockett Creek	8.83	Miles	Carry Forward	Low	UN	AL	2020
5	2C	AR_08040203_922	Critical Season DO - ST Continuous	Lockett Creek	8.83	Miles	Carry Forward	Low	UN	AL	-

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	2C	AR_08040203_922	pH - ST Continuous	Lockett Creek	8.83	Miles	Carry Forward	Med.	UN	OU	2020
5	2C	AR_08040204_002	Temperature	Saline River	60.2	Miles	Carry Forward	Med.	UN	AL, ORW	-
5	2C	AR_08040204_002	Turbidity Base Flows	Saline River	60.2	Miles	Carry Forward	Low	SE, UN	OU, ORW	2020
5	2C	AR_08040204_005	pH	Big Creek	48.74	Miles	Carry Forward	Low	UN	OU	-
5	2C	AR_08040204_006	Turbidity Base Flows	Saline River	17.46	Miles	New	Low	SE	OU, ORW	2022
5	2D	AR_08040201_001	Critical Season DO	Moro Cr, Lower	56.42	Miles	New	High	AG	AL, ORW	2022
5	2D	AR_08040201_001	Lead Chronic	Moro Cr, Lower	56.42	Miles	Carry Forward	Low	UN	AL, ORW	-
5	2D	AR_08040201_006	Lead Chronic	Smackover Creek	4.66	Miles	Remnant	Low	IP, UN	AL	-
5	2D	AR_08040201_006	pH	Smackover Creek	4.66	Miles	Remnant	Low	IP, UN	OU	-
5	2D	AR_08040201_006	Primary Season DO	Smackover Creek	4.66	Miles	Remnant	Low	IP, UN	AL	-
5	2D	AR_08040201_006	Turbidity Base Flows	Smackover Creek	4.66	Miles	Remnant	Low	IP, UN	OU	-
5	2D	AR_08040201_007	Lead Chronic	Smackover Creek	49.84	Miles	Remnant	Low	IP, UN	AL	-
5	2D	AR_08040201_007	pH	Smackover Creek	49.84	Miles	Remnant	Low	IP, UN	OU	-
5	2D	AR_08040201_007	Primary Season DO	Smackover Creek	49.84	Miles	Remnant	Low	IP, UN	AL	-
5	2D	AR_08040201_007	Turbidity Base Flows	Smackover Creek	49.84	Miles	Remnant	Low	IP, UN	OU	-
5	2D	AR_08040201_007	Turbidity Storm Flows	Smackover Creek	49.84	Miles	Remnant	Low	IP, UN	OU	-
5	2D	AR_08040201_406	pH	Smackover Creek	17.6	Miles	Carry Forward	Low	IP	OU	-
5	2D	AR_08040201_406	Turbidity Base Flows	Smackover Creek	17.6	Miles	Carry Forward	Low	IP	OU	-
5	2D	AR_08040201_501	Turbidity Base Flows	Bryant Creek	13.79	Miles	Carry Forward	High	UN	OU	2020
5	2D	AR_08040201_601	Turbidity Base Flows	Guice Creek	11.38	Miles	Carry Forward	High	UN	OU	2020
5	2D	AR_08040201_606	Copper Acute	ECC Creek	5.21	Miles	Remnant	High	IP	SAL	-
5	2D	AR_08040201_606	Copper Chronic	ECC Creek	5.21	Miles	Remnant	High	IP	SAL	-
5	2D	AR_08040201_606	Nitrate	ECC Creek	5.21	Miles	Remnant	High	IP	SAL	-

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	2D	AR_08040201_606	pH	ECC Creek	5.21	Miles	Remnant	High	IP	OU	-
5	2D	AR_08040201_616	Copper Acute	ECC Creek	4.67	Miles	New	High	UR	AL	2022
5	2D	AR_08040201_616	Copper Chronic	ECC Creek	4.67	Miles	New	High	UR	AL	2022
5	2D	AR_08040201_616	Lead Chronic	ECC Creek	4.67	Miles	New	High	UR	AL	2022
5	2D	AR_08040201_616	Turbidity Base Flows	ECC Creek	4.67	Miles	Carry Forward	Med.	IP	OU	2020
5	2D	AR_08040201_626	Copper Acute	ECC Creek	2.36	Miles	New	High	IP, UR	SAL	2022
5	2D	AR_08040201_626	Copper Chronic	ECC Creek	2.36	Miles	New	High	IP,UR	SAL	2022
5	2D	AR_08040201_701	Turbidity Base Flows	Lloyd Creek	19.1	Miles	Carry Forward	High	IP, SE	OU	2020
5	2D	AR_08040201_705	pH	North Bayou	21.88	Miles	New	Med.	AG	OU	2022
5	2D	AR_08040201_726	pH	UT to Haynes Creek (ECC Creek)	4.89	Miles	Remnant	Med.	IP	OU	2020
5	2D	AR_08040201_801	Turbidity Base Flows	Whitewater Creek	21.36	Miles	Carry Forward	High	UN	OU	2020
5	2D	AR_08040201_801	Turbidity Storm Flows	Whitewater Creek	21.36	Miles	Carry Forward	High	UN	OU	2020
5	2D	AR_08040201_803	Turbidity Base Flows	Champagnolle Creek	37.51	Miles	Carry Forward	High	SE	OU	2020
5	2D	AR_08040201_803	Turbidity Storm Flows	Champagnolle Creek	37.51	Miles	Carry Forward	High	SE	OU	2020
5	2D	AR_08040201_806	pH	Salt Creek	7.21	Miles	Remnant	Low	UN	OU	-
5	2D	AR_08040201_901	Critical Season DO	Moro Creek	52.18	Miles	Remnant	Low	UN	AL	-
5	2D	AR_08040201_901	Lead Chronic	Moro Creek	52.18	Miles	Remnant	Low	UN	AL	-
5	2D	AR_08040201_905	Lead Chronic	E. Two Bayou	35.68	Miles	Carry Forward	Med.	IP	AL	2020
5	2D	AR_08040201_905	pH	E. Two Bayou	35.68	Miles	Carry Forward	High	UN	OU	-
5	2D	AR_08040201_905	Primary Contact *E. coli*	E. Two Bayou	35.68	Miles	Remnant	High	UN	PC	-
5	2D	AR_08040201_910	Chronic Ammonia - ELS Present	Jug Creek	7.18	Miles	New	High	IP, MP, UR	AL	2022

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	2D	AR_08040201_910	Critical Season DO	Jug Creek	7.18	Miles	New	High	IP, MP, UR	AL	2022
5	2D	AR_08040202_002	Critical Season DO	Ouachita River	7.23	Miles	New	Low	AG	AL	2022
5	2D	AR_08040202_003	Critical Season DO	Ouachita River	9.04	Miles	Remnant	Low	UN	AL	2020
5	2D	AR_08040202_003	Lead Chronic	Ouachita River	9.04	Miles	Remnant	Low	UN	AL	2020
5	2D	AR_08040202_006	Critical Season DO	Bayou De L'Outre	13.15	Miles	New	High	IP	AL	2022
5	2D	AR_08040202_006	Lead Chronic	Bayou De L'Outre	13.15	Miles	Carry Forward	High	IP	AL	-
5	2D	AR_08040202_006	pH	Bayou De L'Outre	13.15	Miles	Carry Forward	High	IP	OU	-
5	2D	AR_08040202_006	Turbidity Base Flows	Bayou De L'Outre	13.15	Miles	Carry Forward	High	IP	OU	-
5	2D	AR_08040202_007	Lead Chronic	Bayou De L'Outre	1.87	Miles	Remnant	High	IP	AL	-
5	2D	AR_08040202_007	pH	Bayou De L'Outre	1.87	Miles	Remnant	High	IP	OU	-
5	2D	AR_08040202_007	Turbidity Base Flows	Bayou De L'Outre	1.87	Miles	Remnant	High	IP	OU	-
5	2D	AR_08040202_007	Zinc Acute	Bayou De L'Outre	1.87	Miles	Remnant	High	IP	AL	-
5	2D	AR_08040202_007	Zinc Chronic	Bayou De L'Outre	1.87	Miles	Remnant	High	IP	AL	-
5	2D	AR_08040202_008	Lead Chronic	Bayou De L'Outre	4.5	Miles	Remnant	High	IP	AL	-
5	2D	AR_08040202_008	pH	Bayou De L'Outre	4.5	Miles	Remnant	High	IP	OU	-
5	2D	AR_08040202_008	Selenium Acute	Bayou De L'Outre	4.5	Miles	Remnant	High	IP	AL	-
5	2D	AR_08040202_008	Selenium Chronic	Bayou De L'Outre	4.5	Miles	Remnant	High	IP	AL	-
5	2D	AR_08040202_008	Turbidity Base Flows	Bayou De L'Outre	4.5	Miles	Remnant	High	IP	OU	-
5	2D	AR_08040202_008	Zinc Acute	Bayou De L'Outre	4.5	Miles	Remnant	High	IP	AL	-
5	2D	AR_08040202_008	Zinc Chronic	Bayou De L'Outre	4.5	Miles	Remnant	High	IP	AL	-
5	2D	AR_08040202_909	Chloride	Loutre Creek	0.97	Miles	Remnant	High	IP	AG, I	-
5	2D	AR_08040202_909	Selenium Acute	Loutre Creek	0.97	Miles	Remnant	High	IP	SAL	-
5	2D	AR_08040202_909	Selenium Chronic	Loutre Creek	0.97	Miles	Remnant	High	IP	SAL	-
5	2D	AR_08040202_909	Sulfate	Loutre Creek	0.97	Miles	Remnant	High	IP	AG, I	-
5	2D	AR_08040202_909	Total Dissolved Solids	Loutre Creek	0.97	Miles	Remnant	High	IP	AG, I	-
5	2E	AR_08040206_015	Critical Season DO	Big Corney Creek	55.09	Miles	Carry Forward	Low	IP, UN	AL	2020

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	2E	AR_08040206_015	pH	Big Corney Creek	55.09	Miles	Carry Forward	Low	IP, UN	OU	-
5	2E	AR_08040206_015	Turbidity Base Flows	Big Corney Creek	55.09	Miles	Carry Forward	Low	IP, UN	OU	-
5	2F	AR_08040101_032	Biological Integrity - Fish	Fiddlers Creek	12.78	Miles	Remnant	Med.	UN	AL	2020
5	2F	AR_08040101_032	Critical Season DO - ST Continuous	Fiddlers Creek	12.78	Miles	Carry Forward	Low	UN	AL	-
5	2F	AR_08040101_032	pH	Fiddlers Creek	12.78	Miles	Carry Forward	Low	UN	OU	-
5	2F	AR_08040101_032	Turbidity Base Flows	Fiddlers Creek	12.78	Miles	Carry Forward	Low	UN	OU	2020
5	2F	AR_08040101_039	Critical Season DO - ST Continuous	Ouachita River	17.53	Miles	Carry Forward	Med.	UN	AL	2020
5	2F	AR_08040101_039	pH	Ouachita River	17.53	Miles	Carry Forward	Med.	UN	OU	2020
5	2F	AR_08040101_043	Critical Season DO	Ouachita River, S. Fork	25.7	Miles	Carry Forward	Low	UN	AL[11], ORW	2020
5	2F	AR_08040101_043	Critical Season DO - ST Continuous	Ouachita River, S. Fork	25.7	Miles	Carry Forward	Low	UN	AL[11], ORW	-
5	2F	AR_08040101_043	Total Dissolved Solids - Site Specific	Ouachita River, S. Fork	25.7	Miles	New	Low	MP, UR, UN	AL[11], ORW	2022
5	2F	AR_08040101_501	pH	Gulpha Creek	6	Miles	Carry Forward	High	UR	OU	2020
5	2F	AR_08040101_838	Critical Season DO - ST Continuous	Irons Fork	10.39	Miles	Remnant	Low	UN	AL[11]	-
5	2F	AR_08040101_838	pH	Irons Fork	10.39	Miles	Carry Forward	Med.	UN	OU	-
5	2F	AR_08040101_838	pH - ST Continuous	Irons Fork	10.39	Miles	Carry Forward	Med.	UN	OU	-
5	2F	AR_08040101_838	Turbidity Base Flows	Irons Fork	10.39	Miles	Carry Forward	Low	UN	OU	2020
5	2F	AR_08040101_848	Biological Integrity - Fish	Prairie Creek	1.33	Miles	New	High	MP	AL	2022

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	2F	AR_08040101_848	Critical Season DO	Prairie Creek	1.33	Miles	Remnant	High	UN	AL	-
5	2F	AR_08040101_848	Critical Season DO - ST Continuous	Prairie Creek	1.33	Miles	Carry Forward	High	UN	AL	-
5	2F	AR_08040101_848	Primary Contact *E. coli*	Prairie Creek	1.33	Miles	New	High	MP	PC	2022
5	2F	AR_08040101_902	Critical Season DO	Indian Springs Creek	0.71	Miles	Remnant	Med.	UN	SAL	-
5	2F	AR_08040101_902	Primary Season DO	Indian Springs Creek	0.71	Miles	Remnant	Med.	UN	SAL	-
5	2F	AR_08040101_902	Sulfate	Indian Springs Creek	0.71	Miles	Carry Forward	Med.	UN	AG, DWS, I	-
5	2F	AR_08040101_902	Total Dissolved Solids	Indian Springs Creek	0.71	Miles	Carry Forward	Med.	UN	AG, DWS, I	-
5	2F	AR_08040101_907	pH	Stokes Creek	1.76	Miles	New	Med.	UR	OU	2022
5	2F	AR_08040101_920	Total Dissolved Solids - Site Specific	Walnut Creek	5.11	Miles	New	Low	UN	SAL	2022
5	2F	AR_08040101_929	Biological Integrity - Fish	Irons Fork	28.42	Miles	Remnant	Med.	UN	AL	2020
5	2F	AR_08040101_929	Biological Integrity - Macroinvertebrates	Irons Fork	28.42	Miles	New	Med.	UN	AL	2022
5	2F	AR_08040101_929	Critical Season DO	Irons Fork	28.42	Miles	Carry Forward	Med.	UN	AL	2020
5	2F	AR_08040101_929	Critical Season DO - ST Continuous	Irons Fork	28.42	Miles	Carry Forward	Med.	UN	AL	2020
5	2F	AR_08040101_929	pH	Irons Fork	28.42	Miles	Carry Forward	Low	UN	OU	-
5	2F	AR_08040102_003	pH	L'Eau Frais Creek	32.75	Miles	New	Med.	UN	OU	2022
5	2F	AR_08040102_023	Critical Season DO - ST Continuous	Caddo River, S. Fork	18.57	Miles	Carry Forward	Low	UN	AL[11], ORW	-
5	2F	AR_08040102_027	Lead Chronic	Deceiper Creek	8.4	Miles	New	High	IP, MP	AL	2022
5	2F	AR_08040102_027	pH	Deceiper Creek	33.97	Miles	New	High	IP	OU	2022
5	2F	AR_08040102_027	Primary Season DO	Deceiper Creek	33.97	Miles	New	High	IP	AL	2022
5	2F	AR_08040102_027	Turbidity Storm Flows	Deceiper Creek	33.97	Miles	New	High	IP	OU	2022

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	2F	AR_08040102_706	Lead Chronic	Black Branch	9.55	Miles	New	High	IP	AL[11]	2022
5	2F	AR_08040102_706	pH	Black Branch	9.55	Miles	New	High	IP	OU	2022
5	2F	AR_08040102_807	Biological Integrity - Fish	Chatman Creek	13.97	Miles	New	High	UN	AL	2022
5	2F	AR_08040102_807	pH	Chatman Creek	13.97	Miles	New	High	UR, AG, RE, IP	OU	2022
5	2F	AR_08040102_821	Critical Season DO	Collier Creek	12.67	Miles	Carry Forward	Low	UN	AL[11], ORW	2020
5	2F	AR_08040102_902	pH	Casa Massa Creek	5.57	Miles	New	Med.	AG	OU	2022
5	2F	AR_08040102_904	Lead Chronic	Tupelo Creek	8.47	Miles	New	Low	UN	SAL	2022
5	2F	AR_08040102_904	pH	Tupelo Creek	8.47	Miles	New	Low	UN	OU	2022
5	2F	AR_08040102_929	pH	French Creek	12.15	Miles	New	High	UN	OU	2022
5	2F	AR_08040102_976	Critical Season DO	Cove Creek	3.3	Miles	Remnant	Med.	UN	SAL	-
5	2F	AR_08040102_976	pH	Cove Creek	3.3	Miles	Remnant	Med.	UN	OU	-
5	2G	AR_08040103_002	pH	Terre Noire Creek	38.92	Miles	Remnant	Low	UN	OU	-
5	2G	AR_08040103_003	pH	Terre Noire Creek	23.53	Miles	Carry Forward	Low	UN	OU	-
5	2G	AR_08040103_016	Biological Integrity - Fish	Prairie Creek	15.93	Miles	New	High	MP	AL	2022
5	2G	AR_08040103_023	Critical Season DO - ST Continuous	Little Missouri River	3.33	Miles	Carry Forward	Med.	UN	AL[11], ORW	2020
5	2G	AR_08040103_028	pH	Ozan Cr, N. Fork	23.77	Miles	Carry Forward	Med.	UN	OU	-
5	2G	AR_08040103_031	Turbidity Base Flows	Terre Rouge Creek	25.96	Miles	Remnant	Low	SE	OU	-
5	2G	AR_08040103_031	Turbidity Storm Flows	Terre Rouge Creek	25.96	Miles	Remnant	Low	SE	OU	-
5	2G	AR_08040103_033	Turbidity Storm Flows	Terre Rouge Creek	31.9	Miles	New	Low	SE, AG	OU	2022
5	2G	AR_08040103_035	pH	Caney Creek	28.74	Miles	New	Med.	UN	OU	2022
5	2G	AR_08040103_733	pH	Trammel Creek	5.82	Miles	New	Med.	UN	OU	2022
5	2G	AR_08040103_808	pH	Howard Creek	6.13	Miles	New	Med.	UN	OU	2022

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	2G	AR_08040103_833	Critical Season DO - ST Continuous	De Ann Creek	9.63	Miles	New	High	AG	AL	2022
5	2G	AR_08040103_833	pH	De Ann Creek	9.63	Miles	New	High	AG	OU	2022
5	2G	AR_08040103_902	Chronic Ammonia - ELS Present	Caney Creek	15.43	Miles	New	High	MP	AL	2022
5	2G	AR_08040103_902	Turbidity Storm Flows	Caney Creek	15.43	Miles	New	High	SE, AG, UR	OU	2022
5	2G	AR_08040103_905	Biological Integrity - Fish	West Fork Beech Creek	7.52	Miles	New	Low	UN	AL	2022
5	2G	AR_08040103_905	Critical Season DO - ST Continuous	West Fork Beech Creek	7.52	Miles	New	Low	UN	AL	2022
5	2G	AR_08040103_905	pH	West Fork Beech Creek	7.52	Miles	New	Low	UN	OU	2022
5	2G	AR_08040103_908	Biological Integrity - Fish	Garland Creek	11.65	Miles	New	High	AG	AL	2022
5	2G	AR_08040103_908	Critical Season DO - ST Continuous	Garland Creek	11.65	Miles	New	High	AG	AL	2022
5	2G	AR_08040103_908	pH	Garland Creek	11.65	Miles	New	High	AG	OU	2022
5	2G	AR_08040103_933	pH	Pate Creek	8.34	Miles	New	Med.	UR	OU	2022
5	2G	AR_08040103_937	pH	Mill Creek	3.09	Miles	New	Med.	AG	OU	2022
5	3A	AR_08020401_001	Critical Season DO	Arkansas River	31.24	Miles	Carry Forward	Low	UN	AL, ORW	-
5	3A	AR_08020401_003	Primary Season DO	Wabbaseka Bayou	19.52	Miles	Remnant	Low	UN	SAL	-
5	3B	AR_08020402_001	Critical Season DO	Bayou Meto	6.07	Miles	Remnant	Low	UN	AL	-
5	3B	AR_08020402_003	Critical Season DO	Bayou Meto	41.42	Miles	Carry Forward	High	UN	AL	-
5	3B	AR_08020402_003	Primary Season DO	Bayou Meto	41.42	Miles	Carry Forward	High	UN	AL	-
5	3B	AR_08020402_003	Turbidity Base Flows	Bayou Meto	41.42	Miles	New	High	SE	OU	2022
5	3B	AR_08020402_006	Critical Season DO	Bayou Two Prairie	4.49	Miles	Remnant	Low	UN	AL	-
5	3B	AR_08020402_607	Dioxin	Bayou Meto	5.19	Miles	Remnant	Low	IP, UN	FC	-
5	3B	AR_08020402_007	Dioxin	Bayou Meto	51.29	Miles	Remnant	Low	IP, UN	FC	-

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	3B	AR_08020402_106	Critical Season DO	Two Prairie Bayou	1.86	Miles	Remnant	Low	UN	AL, ORW	-
5	3B	AR_08020402_206	Critical Season DO	Two Prairie Bayou	11.1	Miles	Carry Forward	Low	UN	AL	-
5	3B	AR_08020402_206	Lead Chronic	Two Prairie Bayou	11.1	Miles	New	Low	UN	AL	2022
5	3B	AR_08020402_306	Critical Season DO	Two Prairie Bayou	43.3	Miles	Remnant	Low	UN	AL	-
5	3B	AR_08020402_4010	Turbidity – Base Flows	Pickthorne Lake	0.51	Square Miles	Remnant	Low	UN	AL	-
5	3B	AR_08020402_4010	Turbidity – Storm Flows	Pickthorne Lake	0.51	Square Miles	Remnant	Low	UN	AL	-
5	3B	AR_08020402_4020	Lake & Reservoir DO	Rodgers Reservoir	0.88	Square Miles	Remnant	Low	UN	AL	-
5	3B	AR_08020402_607	Critical Season DO	Bayou Meto	5.19	Miles	New	High	MP	AL	2022
5	3B	AR_08020402_806	Critical Season DO	Two Prairie Bayou	6.65	Miles	Remnant	Low	UN	AL, ORW	-
5	3B	AR_08020402_807	pH	Bridge Creek	8.45	Miles	Carry Forward	Med.	UN	OU	2020
5	3B	AR_08020402_807	Primary Season DO	Bridge Creek	8.45	Miles	Carry Forward	Med.	UN	AL	2020
5	3B	AR_08020402_907	pH	Bayou Meto	17.14	Miles	Carry Forward	High	UN	OU	2020
5	3C	AR_11110207_018	Critical Season DO - LT Continuous	Maumelle River	29.79	Miles	Carry Forward	Low	UR, UN	AL	2020
5	3C	AR_11110207_018	pH - LT Continuous	Maumelle River	29.79	Miles	Carry Forward	Low	UR, UN	OU	-
5	3C	AR_11110207_022	Temperature	Fourche Creek	12.83	Miles	New	High	UR	AL	2022
5	3C	AR_11110207_023	Biological Integrity - Fish	Rock Creek	13.42	Miles	New	High	UR	AL	2022
5	3C	AR_11110207_023	pH	Rock Creek	13.42	Miles	New	High	UR	OU	2022
5	3C	AR_11110207_023	Primary Contact *E. coli*	Rock Creek	13.42	Miles	New	High	UR	PC	2022
5	3C	AR_11110207_024	Copper Chronic	Fourche Creek	22.09	Miles	New	High	UR, IP, MP	AL[11]	2022

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	3C	AR_11110207_024	Turbidity Base Flows	Fourche Creek	22.09	Miles	Carry Forward	Med.	SE, UR, UN	OU	-
5	3C	AR_11110207_4010	PCB	Lake Pine Bluff	0.73	Square Miles	Remnant	Low	IP	FC	-
5	3C	AR_11110207_4071	pH	Lake Maumelle	9.28	Square Miles	New	Med.	UN, RE	OU	2022
5	3C	AR_11110207_724	Copper Chronic	McHenry Creek	8.91	Miles	Remnant	Low	UR, UN	SAL	2020
5	3C	AR_11110207_724	pH	McHenry Creek	8.91	Miles	Carry Forward	Low	UR, UN	OU	2020
5	3C	AR_11110207_822	Critical Season DO	Fourche Creek	3.57	Miles	Carry Forward	High	UR, UN	AL	2020
5	3C	AR_11110207_822	Turbidity Base Flows	Fourche Creek	3.57	Miles	Carry Forward	High	UR, UN	OU	2020
5	3C	AR_11110207_822	Turbidity Storm Flows	Fourche Creek	3.57	Miles	New	High	UR, UN	OU	2022
5	3C	AR_11110207_824	Biological Integrity - Macroinvertebrates	Brodie Creek	10.48	Miles	Remnant	Med.	UR, UN	AL	2020
5	3C	AR_11110207_824	pH	Brodie Creek	10.48	Miles	Carry Forward	Med.	UR, UN	OU	2020
5	3C	AR_11110207_826	Critical Season DO - ST Continuous	Fish Creek	9.42	Miles	New	Med.	MP, RE	AL	2022
5	3C	AR_11110207_826	pH	Fish Creek	9.42	Miles	New	Med.	MP, RE	OU	2022
5	3C	AR_11110207_826	Primary Season DO	Fish Creek	9.42	Miles	New	Med.	MP, RE	AL	2022
5	3C	AR_11110207_912	pH	White Oak Bayou	19.5	Miles	Carry Forward	Low	UR, UN	OU	2020
5	3D	AR_11110205_002	Turbidity Base Flows	Cadron Cr, E. Fork	19.56	Miles	Carry Forward	Low	SE, UN	OU, ORW	-
5	3D	AR_11110205_002	Turbidity Storm Flows	Cadron Cr, E. Fork	19.56	Miles	New	Low	AG	OU, ORW	2022
5	3D	AR_11110205_016	pH	Cove Creek	25.17	Miles	Carry Forward	Low	AG, UN	OU	2020
5	3E	AR_11110206_001	Critical Season DO	Fourche La Fave River	53.68	Miles	Remnant	Low	UN	AL	-
5	3E	AR_11110206_007	Critical Season DO	Fourche La Fave River	23.52	Miles	Carry Forward	Low	UN	AL	-

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	3E	AR_11110206_012	pH	Gafford Creek	14.65	Miles	Carry Forward	low	UN	OU	-
5	3E	AR_11110206_012	Turbidity Base Flows	Gafford Creek	14.65	Miles	Carry Forward	low	UN	OU	2020
5	3E	AR_11110206_014	Critical Season DO	S. Fourche River	30.18	Miles	Carry Forward	Low	UN	AL	-
5	3E	AR_11110206_014	Turbidity Base Flows	S. Fourche River	30.18	Miles	New	Low	UN	OU	2022
5	3E	AR_11110206_015	Biological Integrity - Macroinvertebrates	Bear Creek	12.31	Miles	New	Med.	UN	AL	2022
5	3E	AR_11110206_015	pH	Bear Creek	12.31	Miles	Carry Forward	Med.	UN	OU	2020
5	3E	AR_11110206_4052	Lake & Reservoir DO	Lake Nimrod	2.14	Square Miles	New	High	AG	AL	2022
5	3E	AR_11110206_514	Biological Integrity - Macroinvertebrates	Negro Branch	4.98	Miles	New	Low	AG, UN	SAL	2022
5	3E	AR_11110206_514	pH	Negro Branch	4.98	Miles	Carry Forward	Low	UN	OU	-
5	3E	AR_11110206_514	Turbidity Base Flows	Negro Branch	4.98	Miles	Carry Forward	Low	UN	OU	2020
5	3E	AR_11110206_808	pH	Turner Creek	4.76	Miles	Carry Forward	Low	UN	OU	-
5	3E	AR_11110206_808	pH - ST Continuous	Turner Creek	4.76	Miles	Carry Forward	Low	UN	OU	-
5	3E	AR_11110206_808	Turbidity Storm Flows	Turner Creek	4.76	Miles	Remnant	Low	UN	OU	-
5	3E	AR_11110206_914	Critical Season DO	Dry Fork Creek	12.2	Miles	Carry Forward	Low	UN	AL[11]	2020
5	3E	AR_11110206_914	pH	Dry Fork Creek	12.2	Miles	Carry Forward	Low	UN	OU	-
5	3F	AR_11110203_011	Turbidity Base Flows	Point Remove Creek	13.86	Miles	Carry Forward	High	UN	OU	2020
5	3F	AR_11110203_018	Critical Season DO	West Fork Point Remove Creek	11.13	Miles	Carry Forward	Low	UN	AL	2020
5	3F	AR_11110203_018	pH	West Fork Point Remove Creek	11.13	Miles	Carry Forward	Low	UN	OU	-

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	3F	AR_11110203_018	Turbidity Base Flows	West Fork Point Remove Creek	11.13	Miles	New	Low	AG	OU	2022
5	3F	AR_11110203_033	Turbidity Base Flows	Rocky Cypress Creek	19.9	Miles	Carry Forward	Low	SE	OU	-
5	3F	AR_11110203_4020	pH	Driver Creek Lake	0.04	Square Miles	Remnant	Low	UN	OU	-
5	3F	AR_11110203_904	Primary Season DO	Stone Dam Creek	4.8	Miles	Carry Forward	Low	UN	SAL	-
5	3F	AR_11110203_904	Turbidity Base Flows	Stone Dam Creek	4.8	Miles	Carry Forward	Med.	UN	OU	2020
5	3F	AR_11110203_918	pH	Trimble Creek	3.5	Miles	Carry Forward	Low	UN	OU	-
5	3F	AR_11110203_918	Turbidity Base Flows	Trimble Creek	3.5	Miles	New	Low	AG	OU	2022
5	3F	AR_11110203_931	Critical Season DO	Whig Creek	10.12	Miles	Carry Forward	Low	IP, UN	AL	-
5	3F	AR_11110203_931	Primary Season DO	Whig Creek	10.12	Miles	Carry Forward	Low	IP, UN	AL	-
5	3G	AR_11110204_011	Turbidity Base Flows	Petit Jean River	24.06	Miles	Carry Forward	Low	SE	OU	-
5	3H	AR_11110104_006	pH	Lee Creek	5.27	Miles	Remnant	Low	UN	OU, ORW	2020
5	3H	AR_11110104_4020	pH	Lee Creek Lake	0.91	Square Miles	Remnant	Low	UN	OU	-
5	3H	AR_11110201_006	pH	Mulberry River	11.28	Miles	Carry Forward	Med.	UN	OU, ORW	2020
5	3H	AR_11110201_006	Turbidity Base Flows	Mulberry River	11.28	Miles	New	Med.	AG, UN	OU, ORW	2022
5	3H	AR_11110201_008	pH	Mulberry River	29.96	Miles	Remnant	High	UN	OU, ORW	-
5	3H	AR_11110201_012	pH	Little Mulberry Creek	19.29	Miles	Remnant	High	UN	OU	-
5	3H	AR_11110201_912	pH	Friley Creek	7.18	Miles	Remnant	High	UN	OU	-
5	3H	AR_11110202_013	Critical Season DO	Illinois Bayou, E. Fork	16.52	Miles	Remnant	Med.	UN	AL, ORW	-

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	3H	AR_11110202_013	Critical Season DO - ST Continuous	Illinois Bayou, E. Fork	16.52	Miles	Remnant	Med.	UN	AL, ORW	-
5	3H	AR_11110202_013	Primary Season DO	Illinois Bayou, E. Fork	16.52	Miles	Remnant	Med.	UN	AL, ORW	-
5	3H	AR_11110202_4050	pH	Horsehead Lake	0.17	Square Miles	Remnant	Low	UN	OU	-
5	3I	AR_11110105_001	Critical Season DO	Poteau River	4.91	Miles	Carry Forward	Med.	UN	AL	-
5	3I	AR_11110105_036	Turbidity Base Flows	Cherokee Creek	10.64	Miles	New	Low	AG, UN	OU	2022
5	3I	AR_11110105_831	Chloride - Site Specific	UT to Poteau River	0.37	Miles	Remnant	Low	UN	SAL	-
5	3I	AR_11110105_831	Total Dissolved Solids - Site Specific	UT to Poteau River	0.37	Miles	Remnant	Low	UN	SAL	-
5	3I	AR_11110105_925	pH	Briery Creek	3.84	Miles	Carry Forward	Med.	UN	OU	2020
5	3J	AR_11110103_020	Sulfate - Site Specific	Illinois River	2	Miles	Carry Forward	Med.	UN	AL, ORW	-
5	3J	AR_11110103_024	Sulfate - Site Specific	Illinois River	2.76	Miles	Carry Forward	Med.	UN	AL, ORW	-
5	3J	AR_11110103_026	Sulfate	Moores Creek	4.86	Miles	Remnant	Med.	UN	AG, DWS, I	-
5	3J	AR_11110103_027	Sulfate	Muddy Fork	7.14	Miles	Remnant	Med.	UN	AG, DWS, I	-
5	3J	AR_11110103_4080	pH - ST Continuous	Lake Fayetteville	0.27	Square Miles	Remnant	Med.	UN	OU	-
5	3J	AR_11110103_733	Primary Season DO	UT to Brush Creek	3.46	Miles	Carry Forward	Med.	UN	SAL	2020
5	3J	AR_11110103_813	Critical Season DO	Baron Fork	7.3	Miles	Carry Forward	Low	UN	AL	2020
5	4A	AR_08020303_005	Critical Season DO	White River	50.68	Miles	Carry Forward	Low	UN	AL	-
5	4A	AR_08020303_005	Primary Season DO	White River	50.68	Miles	Carry Forward	Low	UN	AL	-
5	4A	AR_08020303_014	Critical Season DO	Boat Gunwale Slash	15.47	Miles	Carry Forward	Low	UN	AL	2020

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	4A	AR_08020303_014	Primary Season DO	Boat Gunwale Slash	15.47	Miles	Carry Forward	Low	UN	AL	2020
5	4A	AR_08020303_914	Critical Season DO	Boat Gunwale Slash	9.96	Miles	Remnant	Low	UN	AL	-
5	4A	AR_08020303_914	Primary Season DO	Boat Gunwale Slash	9.96	Miles	Remnant	Low	UN	AL	-
5	4A	AR_08020304_010	Chloride	Big Creek	40.69	Miles	Remnant	Low	UN	AG, DWS, I	-
5	4A	AR_08020304_010	Total Dissolved Solids	Big Creek	40.69	Miles	Remnant	Low	UN	AG, DWS, I	-
5	4A	AR_08020304_014	Copper Acute	Prairie Cypress Bayou	14.08	Miles	Remnant	Low	UN	AL	-
5	4A	AR_08020304_014	Copper Chronic	Prairie Cypress Bayou	14.08	Miles	Remnant	Low	UN	AL	-
5	4A	AR_08020304_014	Critical Season DO	Prairie Cypress Bayou	14.08	Miles	Carry Forward	Low	UN	AL	-
5	4A	AR_08020304_014	Primary Season DO	Prairie Cypress Bayou	14.08	Miles	Carry Forward	Low	UN	AL	-
5	4B	AR_08020302_002	Critical Season DO	Bayou De View	15.79	Miles	Remnant	Low	UN	AL	-
5	4B	AR_08020302_002	Primary Season DO	Bayou De View	15.79	Miles	Remnant	Low	UN	AL	-
5	4B	AR_08020302_004	Critical Season DO	Bayou De View	25.29	Miles	Carry Forward	Low	AG, UN	AL	-
5	4B	AR_08020302_006	Critical Season DO	Bayou De View	10.14	Miles	Carry Forward	Low	AG, UN	AL	-
5	4B	AR_08020302_007	Critical Season DO	Bayou De View	6.17	Miles	Carry Forward	Low	AG, UN	AL	-
5	4B	AR_08020302_012	Turbidity Base Flows	Cow Lake Ditch	18.23	Miles	Carry Forward	High	AG, UN	OU	2020
5	4B	AR_08020302_012	Turbidity Storm Flows	Cow Lake Ditch	18.23	Miles	New	Low	AG, UN	OU	2022
5	4B	AR_08020302_014	Critical Season DO	Buffalo Creek	10.54	Miles	Remnant	Low	UN	AL	-
5	4B	AR_08020302_014	Primary Season DO	Buffalo Creek	10.54	Miles	Remnant	Low	UN	AL	-
5	4B	AR_08020302_016	Critical Season DO	Cache River	25.03	Miles	Carry Forward	Low	AG, UN	AL	-
5	4B	AR_08020302_018	Critical Season DO	Cache River	20.63	Miles	Remnant	Low	UN	AL	2020
5	4B	AR_08020302_030	Temperature	Swan Pond Ditch	5.7	Miles	Remnant	Low	UN	AL	2020

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	4B	AR_08020302_038	Turbidity Base Flows	Little Cache R Ditch	3.8	Miles	Carry Forward	High	AG, UN	OU	2020
5	4B	AR_08020302_041	Turbidity Base Flows	Cache River Ditch	8.86	Miles	Carry Forward	High	AG, UN	OU	2020
5	4B	AR_08020302_049	Critical Season DO	Willow Ditch	20.81	Miles	New	Low	AG	AL	2022
5	4B	AR_08020302_055	Primary Season DO	Locust Creek	13.24	Miles	Remnant	Low	AG, UN	AL	2020
5	4B	AR_08020302_4020	Copper Acute	Lake Frierson	0.54	Square Miles	Remnant	Low	UN	AL	-
5	4B	AR_08020302_4020	Copper Chronic	Lake Frierson	0.54	Square Miles	Remnant	Low	UN	AL	-
5	4B	AR_08020302_901	Primary Season DO	UT to Cache River	0.69	Miles	Remnant	Low	AG, UN	SAL	2020
5	4B	AR_08020302_903	Critical Season DO	Caney Creek	18.01	Miles	Remnant	Low	UN	AL	-
5	4B	AR_08020302_903	Primary Season DO	Caney Creek	18.01	Miles	Remnant	Low	UN	AL	-
5	4B	AR_08020302_909	Chloride - Site Specific	Lost Creek Ditch	14.08	Miles	Carry Forward	Low	IP, MP	AL	-
5	4B	AR_08020302_921	Turbidity Base Flows	West Cache River Slough	10.2	Miles	Carry Forward	High	AG, UN	OU	2020
5	4B	AR_08020302_937	Turbidity Base Flows	East Slough	7.23	Miles	Carry Forward	High	AG, UN	OU	2020
5	4B	AR_08020302_937	Turbidity Storm Flows	East Slough	7.23	Miles	Carry Forward	High	AG, UN	OU	2020
5	4C	AR_11010013_006	Critical Season DO	Village Creek	29.2	Miles	Remnant	Low	UN	AL	-
5	4C	AR_11010013_006	Primary Season DO	Village Creek	29.2	Miles	Remnant	Low	UN	AL	-
5	4C	AR_11010013_007	Critical Season DO	Village Creek	1.23	Miles	Remnant	Low	UN	AL	-
5	4C	AR_11010013_007	Primary Season DO	Village Creek	1.23	Miles	Remnant	Low	UN	AL	-
5	4C	AR_11010013_008	Critical Season DO	Village Creek	12.24	Miles	Remnant	Low	UN	AL	-
5	4C	AR_11010013_008	Primary Season DO	Village Creek	12.24	Miles	Remnant	Low	UN	AL	-
5	4C	AR_11010013_017	Temperature	White River	12.76	Miles	Remnant	Low	UN	AL	-
5	4C	AR_11010013_020	Critical Season DO	Departee Creek	21.62	Miles	Remnant	Low	AG, UN	AL	-
5	4C	AR_11010013_020	Primary Season DO	Departee Creek	21.62	Miles	Remnant	Low	AG, UN	AL	-
5	4C	AR_11010013_020	Zinc Acute	Departee Creek	21.62	Miles	Remnant	Low	AG, UN	AL	-
5	4C	AR_11010013_020	Zinc Chronic	Departee Creek	21.62	Miles	Remnant	Low	AG, UN	AL	-
5	4C	AR_11010013_021	Critical Season DO	Glaise Creek	43.14	Miles	Remnant	Low	AG, UN	AL	-

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	4C	AR_11010013_021	Primary Season DO	Glaise Creek	43.14	Miles	Remnant	Low	AG, UN	AL	-
5	4C	AR_11010013_021	Zinc Acute	Glaise Creek	43.14	Miles	Remnant	Low	AG, UN	AL	-
5	4C	AR_11010013_021	Zinc Chronic	Glaise Creek	43.14	Miles	Remnant	Low	AG, UN	AL	-
5	4D	AR_08020301_006	Critical Season DO	Bayou Des Arc	22.72	Miles	Carry Forward	Low	SE, UN	AL	-
5	4D	AR_08020301_007	Critical Season DO	Bayou Des Arc	50.1	Miles	New	High	UN	AL	2022
5	4D	AR_08020301_007	Turbidity Base Flows	Bayou Des Arc	50.1	Miles	New	High	SE	OU	2022
5	4D	AR_08020301_009	Critical Season DO	Bull Creek	46.75	Miles	Remnant	Low	UN	AL	-
5	4D	AR_08020301_009	Primary Season DO	Bull Creek	46.75	Miles	Remnant	Low	UN	AL	-
5	4D	AR_08020301_009	Zinc Acute	Bull Creek	46.75	Miles	Remnant	Low	UN	AL	-
5	4D	AR_08020301_009	Zinc Chronic	Bull Creek	46.75	Miles	Remnant	Low	UN	AL	-
5	4D	AR_08020301_010	Critical Season DO	Cypress Bayou	7.79	Miles	Remnant	Low	UN	AL	-
5	4D	AR_08020301_010	Primary Season DO	Cypress Bayou	7.79	Miles	Remnant	Low	UN	AL	-
5	4D	AR_08020301_015	Critical Season DO	Wattensaw Bayou	69.54	Miles	Carry Forward	Low	UN	AL	-
5	4E	AR_11010014_007	pH	Little Red River	16.77	Miles	Carry Forward	Low	UN	OU	2020
5	4E	AR_11010014_036	pH	Little Red River, S. Fork	4.01	Miles	Carry Forward	Low	UN	OU	-
5	4E	AR_11010014_037	pH	Archey Fork	18.06	Miles	Remnant	Low	UN	OU, ORW	2020
5	4E	AR_11010014_038	pH	Little Red River, S. Fork	9.7	Miles	Remnant	Low	UN	OU, ORW	-
5	4E	AR_11010014_940	pH - LT Continuous	Little Red River, S. Fork	13.77	Miles	Carry Forward	Low	UN	OU	-
5	4F	AR_11010004_015	Primary Contact *E. coli*	Hicks Creek	6.83	Miles	Remnant	High	MP, UR, UN	PC	-
5	4F	AR_11010004_017	Critical Season DO	Greenbrier Creek	13.07	Miles	Carry Forward	Low	UN	AL	-
5	4F	AR_11010004_915	pH - ST Continuous	Big Creek	14.63	Miles	Remnant	Low	UN	OU	2020
5	4G	AR_11010008_001	Turbidity Base Flows	Current River	26.65	Miles	Carry Forward	Med.	AG	OU, ORW	2020
5	4G	AR_11010009_008	Turbidity Base Flows	Fourche River	31.41	Miles	Remnant	Low	SE	OU	-

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	4G	AR_11010009_008	Turbidity Storm Flows	Fourche River	31.41	Miles	Remnant	Low	SE	OU	-
5	4G	AR_11010012_002	Temperature - LT Continuous	Strawberry River	10.42	Miles	Carry Forward	Low	AG, UN	AL, ORW	2020
5	4G	AR_11010012_006	Temperature - LT Continuous	Strawberry River	20.3	Miles	Carry Forward	Low	AG, UN	AL, ORW	2020
5	4G	AR_11010012_007	Temperature - LT Continuous	N. Big Creek	24.82	Miles	Carry Forward	Low	UN	AL	2020
5	4G	AR_11010012_013	Temperature - LT Continuous	S. Big Creek	26.74	Miles	Carry Forward	Low	AG, UN	AL	2020
5	4G	AR_11010012_014	Turbidity Base Flows	Reeds Creek	17.89	Miles	Carry Forward	High	AG, UN	OU	2020
5	4G	AR_11010012_902	Temperature	Steep Bank Creek	6.95	Miles	New	High	AG	AL	2022
5	4G	AR_11010012_902	Turbidity Base Flows	Steep Bank Creek	6.95	Miles	New	High	AG	OU	2022
5	4H	AR_11010010_003	Turbidity Base Flows	Spring River	10.61	Miles	Carry Forward	Low	UN	OU, ORW	2020
5	4H	AR_11010010_006	Temperature	Spring River	5.2	Miles	Carry Forward	Low	UN	AL, ORW	-
5	4H	AR_11010010_009	Critical Season DO - ST Continuous	English Creek	9.63	Miles	Remnant	Low	UN	AL, ORW	-
5	4H	AR_11010010_906	Critical Season DO - ST Continuous	Gut Creek	9.37	Miles	Remnant	Low	UN	AL, ORW	-
5	4H	AR_11010011_001	Turbidity Base Flows	Eleven Point River	41.71	Miles	Carry Forward	Low	AG, SE	OU, ORW	2020
5	4I	AR_11010003_949	Turbidity Base Flows	Crooked Creek	14.27	Miles	New	High	UR, AG	OU	2022
5	4J	AR_11010005_001	Temperature	Buffalo River	13.14	Miles	New	Low	SE, UN	AL, ORW	2022
5	4K	AR_11010001_023	Critical Season DO	White River	1.9	Miles	Carry Forward	Low	UR	AL	2020
5	4K	AR_11010001_023	Critical Season DO - LT Continuous	White River	1.9	Miles	New	Low	UR, AG, MP	AL	2022
5	4K	AR_11010001_023	Temperature - LT Continuous	White River	1.9	Miles	New	Low	UR, AG, MP	AL	2022

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	4K	AR_11010001_024	Critical Season DO	White River, W. Fork	10.72	Miles	Carry Forward	Low	UN	AL	2020
5	4K	AR_11010001_024	Sulfate - Site Specific	White River, W. Fork	10.72	Miles	Carry Forward	Low	UN	AL	-
5	4K	AR_11010001_024	Temperature - LT Continuous	White River, W. Fork	10.72	Miles	Carry Forward	Low	UN	AL	2020
5	4K	AR_11010001_024	Total Dissolved Solids - Site Specific	White River, W. Fork	10.72	Miles	Carry Forward	Low	UN	AL	-
5	4K	AR_11010001_026	Critical Season DO	White River, M. Fork	8.14	Miles	Carry Forward	Low	UN	AL	2020
5	4K	AR_11010001_037	Total Dissolved Solids - Site Specific	Kings River	38.18	Miles	Carry Forward	Low	UN	AL[11], ORW	-
5	4K	AR_11010001_060	Critical Season DO	War Eagle Creek	33.72	Miles	Carry Forward	Low	AG, UN	AL	2020
5	4K	AR_11010001_442	pH	Kings River	4.86	Miles	Remnant	Low	UN	OU, ORW	2020
5	4K	AR_11010001_442	pH - ST Continuous	Kings River	4.86	Miles	Remnant	Low	UN	OU, ORW	2020
5	4K	AR_11010001_542	Critical Season DO - ST Continuous	Kings River	18.18	Miles	Remnant	Med.	UN	AL, ORW	-
5	4K	AR_11010001_624	Critical Season DO	White River, W. Fork	5.79	Miles	Remnant	Med.	UN	AL	-
5	4K	AR_11010001_624	Sulfate - Site Specific	White River, W. Fork	5.79	Miles	Carry Forward	Med.	UN	AL	-
5	4K	AR_11010001_916	Critical Season DO - ST Continuous	Leatherwood Creek	5.47	Miles	Remnant	Med.	UN	AL	-
5	4K	AR_11010001_926	Critical Season DO	White River, M. Fork	15.53	Miles	Remnant	Med.	UN	AL	-
5	4K	AR_11010001_926	Primary Season DO	White River, M. Fork	15.53	Miles	Remnant	Med.	UN	AL	-
5	4K	AR_11010001_959	Total Dissolved Solids	Town Branch	2.08	Miles	Remnant	Low	IP, MP	AG, DWS, I	-
5	5A	AR_08020203_008	Critical Season DO	St. Francis River	43.4	Miles	Carry Forward	Low	UN	AL, ORW	-

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	5A	AR_08020203_008	Primary Season DO	St. Francis River	43.4	Miles	Carry Forward	Low	UN	AL, ORW	-
5	5A	AR_08020203_009	Chloride - Site Specific	St. Francis River	13.65	Miles	Remnant	Low	UN	AL, ORW	-
5	5A	AR_08020203_009	Critical Season DO	St. Francis River	13.65	Miles	Remnant	Low	UN	AL, ORW	-
5	5A	AR_08020203_906	Primary Season DO	Ten Mile Bayou	17.84	Miles	Remnant	Low	UN	AL	-
5	5B	AR_08020205_001	Critical Season DO	L'Anguille River	23.44	Miles	Carry Forward	Low	UN	AL	-
5	5B	AR_08020205_001	Primary Season DO	L'Anguille River	23.44	Miles	Carry Forward	Low	UN	AL	-
5	5B	AR_08020205_002	Critical Season DO	L'Anguille River	23.06	Miles	Remnant	Low	UN	AL	-
5	5B	AR_08020205_003	Critical Season DO	L'Anguille River	2.89	Miles	Remnant	Low	UN	AL	-
5	5B	AR_08020205_004	Critical Season DO	L'Anguille River	16.99	Miles	Carry Forward	Low	UN	AL	-
5	5B	AR_08020205_004	Primary Season DO	L'Anguille River	16.99	Miles	Carry Forward	Low	UN	AL	-
5	5B	AR_08020205_005	Chloride - Site Specific	L'Anguille River	53.41	Miles	Remnant	Low	UN	AL	-
5	5B	AR_08020205_005	Critical Season DO	L'Anguille River	53.41	Miles	Remnant	Low	UN	AL	-
5	5B	AR_08020205_005	Primary Season DO	L'Anguille River	53.41	Miles	Remnant	Low	UN	AL	-
5	5B	AR_08020205_005	Sulfate - Site Specific	L'Anguille River	53.41	Miles	Remnant	Low	UN	AL	-
5	5B	AR_08020205_005	Total Dissolved Solids - Site Specific	L'Anguille River	53.41	Miles	Remnant	Low	UN	AL	-
5	5B	AR_08020205_007	Critical Season DO	First Creek	31.2	Miles	Remnant	Low	UN	AL	-
5	5B	AR_08020205_007	Primary Season DO	First Creek	31.2	Miles	Remnant	Low	UN	AL	-
5	5B	AR_08020205_008	Critical Season DO	Second Creek	26.04	Miles	Carry Forward	Low	UN	AL, ORW	-
5	5B	AR_08020205_008	Primary Season DO	Second Creek	26.04	Miles	Carry Forward	Low	UN	AL, ORW	-
5	5B	AR_08020205_901	Critical Season DO	Caney Creek	7.06	Miles	Remnant	Low	UN	AL	-
5	5B	AR_08020205_901	Primary Season DO	Caney Creek	7.06	Miles	Remnant	Low	UN	AL	-
5	5B	AR_08020205_902	Total Dissolved Solids	Prairie Creek	8.4	Miles	Remnant	Low	UN	AG, DWS, I	-

Listing Cat.	Planning Segment	Assessment Unit	Parameter	Waterbody Name	Segment Size	Size Unit	Listing Status	Priority	Source	Uses	Year Listed
5	5C	AR_08020204_001	Primary Season DO	Little River	17.61	Miles	Remnant	Low	UN	AL	-
5	5C	AR_08020204_002	Primary Season DO	Little River	51.04	Miles	Remnant	Low	UN	AL	-

LITERATURE CITED

ANRC. 2018. 2018 – 2023. Nonpoint Source Pollution Management Plan.

ADEQ. 1997. Arkansas' Nonpoint Source Pollution Assessment Report. WQ97-06-04.

ADEE. 2020. State of Arkansas Water Quality Monitoring and Assessment Program.

ADPC&E. 1987. Physical, Chemical, and Biological Characteristics of Least-Disturbed Reference Streams in Arkansas' Ecoregions. Volume 1: Data Compilation.

APC&EC. 2020 (June 2020 Draft). Rule No. 2: Rule Establishing Water Quality Standards for Surface Waters of the State of Arkansas.

Dearmont, D., B. A. McCarl, and D. A. Tolman. 1998. Costs of water treatment due to diminished water quality: A case study in Texas. Water Resources Research. 34(4): 849-853.

Dewitz, J., and U.S. Geological Survey. National Land Cover Database (NLCD) 2019 Products (ver. 2.0, June 2021) [data set]. U.S. Geological Survey data release: https://doi.org/10.5066/P9KZCM54.

EPA. 1986. Quality Criteria for Water. EPA 440/5-86-001. May 1986. U. S. Environmental Protection Agency; Office of Water; Washington, D.C.

EPA. 2005. Guidance for 2006 assessment, listing and reporting requirements pursuant to sections 303(d), 305(b), and 314 of the Clean Water Act. Watershed Branch, Assessment and Watershed Protection Division, Office of Wetlands, Oceans, and Watersheds. Washington, D.C.

EPA. 2006. Information concerning 2008 Clean Water Act sections 303(d), 305(b), and 314 integrated reporting and listing decisions. Memorandum from the Office of Wetlands, Oceans, and Watersheds. October 12, 2006. Washington, D.C.

EPA. 2009. Information concerning 2010 Clean Water Act sections 303(d), 305(b), and 314 integrated reporting and listing decisions. Memorandum from the Office of Wetlands, Oceans, and Watersheds. May 5, 2009. Washington, D.C.

EPA. 2011. Information concerning 2012 Clean Water Act sections 303(d), 305(b), and 314 integrated reporting and listing decisions. Memorandum from the Office of Wetlands, Oceans, and Watersheds. REVIEW DRAFT. Washington, D.C.

EPA. 2013. Information concerning 2014 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions. Memorandum from the Office of Wetlands, Oceans, and Watersheds. REVIEW DRAFT. Washington, D.C.

EPA. 2015. Information concerning 2016 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions. Memorandum from the Office of Wetlands, Oceans, and Watersheds. REVIEW DRAFT. Washington, D.C.

EPA. 2017. Information concerning 2018 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions. Memorandum from the Office of Wetlands, Oceans, and Watersheds. REVIEW DRAFT. Washington, D.C.

EPA. 2021. Information concerning 2022 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions. Memorandum from the Office of Wetlands, Oceans, and Watersheds. REVIEW DRAFT. Washington, D.C.

MAP INFORMATION

Maps depicting the impaired waterbodies are available via an online interactive map.

https://arkansasdeq.maps.arcgis.com/apps/webappviewer/index.html?id=fb5a6aa70fd940cda4c9a3d7bc2fbb15

APPENDIX A – 4B AND 5-ALT RATIONALE

CATEGORY 4B RATIONALE BUFFALO RIVER WATERSHED

Buffalo River Watershed 4b Plan for Pathogens, Dissolved Oxygen and Turbidity

1. Identification of segment(s) and statement of the problem(s) causing the impairment(s).

Three parameters were assessed as not attaining water quality criteria within the Buffalo River watershed that have been placed in Category 4b– pathogens (*Eschericia coli* (*E. coli*)), dissolved oxygen (DO), and turbidity.

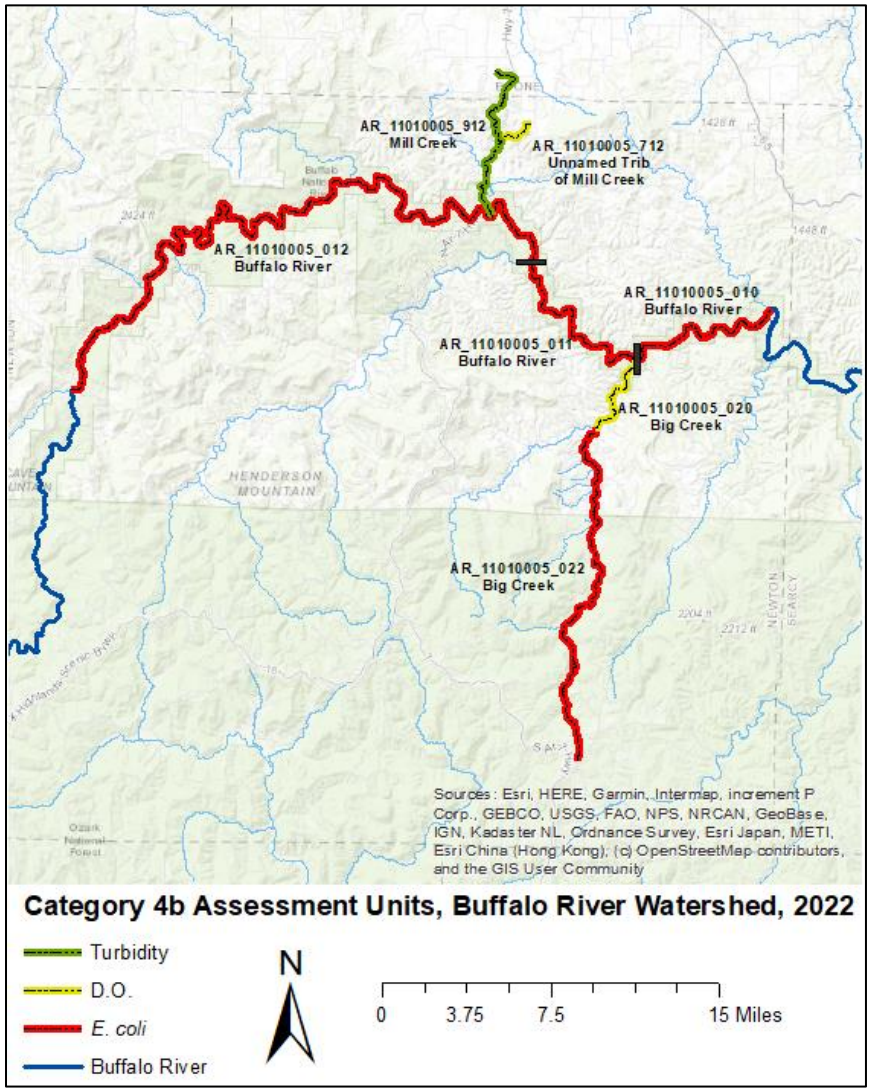


Figure 13. Impaired Segments in 4b, Buffalo River Watershed

1a. Pathogens

Four Assessment Units (AUs) were impaired due to concentrations of *E. coli* that exceeded water quality criteria;

- AR_11010005_010 (Buffalo River)
- AR_11010005_011 (Buffalo River)
- AR_11010005_012 (Buffalo River)
- AR_11010005_022 (Big Creek)

These AUs are shown in Figure 1. The percent exceedance rate and/or geometric means of the data indicated the AUs were not supporting the primary contact recreation designated use.

Sources and causes for elevated pathogen levels in Big Creek and the Buffalo River have not been specifically identified. Land use in the HUC12 subwatersheds associated with these AUs is listed in Table 1. However, because of the karst nature of the surrounding geology, it is possible that pathogens are transported to these AUs via subsurface, as well as surface flow. The results of dye studies in the Buffalo River watershed indicate that pollutants can travel across surface hydrologic divides via subsurface conduits (Soto, 2014). Potential pathogen sources present in the vicinity of the 4b AUs include manure application (swine and chicken) to pastures, livestock, leaking septic tanks, community sewer systems, tourism (primarily on the Buffalo River), and wildlife (including feral swine).

Extensive monitoring was conducted in Big Creek upstream and downstream of a swine concentrated animal feeding operation (CAFO) that was previously operating in the Big Creek subwatershed. The monitoring data at the downstream station showed no consistent increase or decrease in pathogen concentrations between the period prior to manure slurry application (September – December 2013) and the same four months in subsequent years after manure application began (Sharpley et al., 2019).

In partnership with USGS and Buffalo National River (BUFF), the Division (DEQ) is finalizing the report for a microbial source tracking study in the Mill Creek subwatershed of the Buffalo River (https://www.fondriest.com/news/investigating-pollution-tainted-groundwater-in-buffalo-river-watershed.htm). The Mill Creek Study suggests that cattle, and to a lesser extent, poultry are major contributors of *E. coli*, especially during high storm-flow events. Genetic markers also suggest that sources in the Crooked Creek watershed, which is connected through a series of springs, also contribute to *E. coli* concentrations (Justus *et al*., in prog.). The land use in the most upstream AU in Crooked Creek (~13 miles), which is closest in proximity to Mill Creek and contains the sampling site used in the report, is heavily pasture (41%), and similarly developed (8%) to Mill Creek. Just downstream of the Crooked Creek AU is the City of Harrison WWTP, which has reported no violations during the period of record.

The Marble Falls Sewage Improvement District (SID) wastewater treatment plant discharges to AR_11010005_712, which drains to AR_11010005_912, and eventually a segment impaired for *E. coli*, (AR_11010005_012 (Buffalo)) for a total distance of ~2.3 river miles. The Mill Creek report found human contributions to *E. coli*, but records indicate that most residences in the watershed use septic systems for wastewater treatment (Justus *et al*., in prog.). Land use in the HUC12 associated with AR_11010005_712 is shown in Table 2.

During the 2022 assessment, AR_11010005_012 (from Beech Creek to Little Buffalo River) was placed in 4b for *E. coli* based on the geometric mean of data collected during the 2020 primary contact recreation season. Data collected on this segment in 2016, 2017, and 2020 indicated no impairments through the independent sample assessment, but there was an increase in impairments for the 2020 season. The Buffalo River experienced 1.5 million visitors in 2020. This peak in primary contact recreation may be a contributor to the *E. coli* impairment.

Table 1. AUs listed for E. coli in the Buffalo River Watershed

AU	Name	Monitoring Station(s)	HUC12(s) in which the AU is located	Selected land uses in Watershed (NLCD 2016)*
AR_11010005_010	Buffalo River	BUFR0415	110100050304	Pasture = 11% Developed = 4% Forest = 83% Other = 2%
AR_11010005_011	Buffalo River	BUFR04, BUFR0414	110100050303	Pasture = 14% Developed = 6% Forest = 76% Other = 4%
AR_11010005_012	Buffalo River	BUFR02, BUFR0218, BUFR0220, BUFR0258, BUFR0259, BUFR0280, BUFR0281, BUFR03, BUFR0304, BUFT55	110100050207 110100050205	Pasture = 14% Developed = 4% Forest = 79% Other = 2%
AR_11010005_022	Big Creek upstream of the Left Fork	BC6, BC7	110100050302	Pasture = 6% Developed = 3% Forest = 88% Other = 1%

* Note that percentages may not sum to 100 because the area of open water is not included or because values were rounded to the closest whole number. NLCD = National Land Cover Database.

1b. Dissolved Oxygen

Two AUs were impaired due to concentrations of dissolved oxygen (DO) that exceeded water quality criteria;

- AR_11010005_020 (Big Creek)
- AR_11010005_712 (Unnamed Trib. of Mill Creek)

DO concentrations in AU AR_11010005_020 (Big Creek downstream of the Left Fork; shown in Figure 1) do not meet water quality criteria at times. Monitoring stations that are located on this AU include BUFT06 (DEQ) and 07055814 (USGS). Continuous DO data were collected at the 07055814 station from June 2014 through May 2017. During the summer months of 2014-2016, mean daily DO values for the critical season (when the water temperature exceeded 22.0°C) were below the 6.0 mg/L criterion only about 5% of the time, but diurnal fluctuations of 3 to 4 mg/L were common and caused numerous instantaneous values to fall below the criterion.

Available data do not point to an obvious cause of the low DO in this Big Creek AU. Land use in the HUC12 associated with AR_11010005_020 is shown in Table 2 (HUC12 110100050303). Nutrient concentrations in the Big Creek watershed have been classified as low, i.e., below biological response levels reported in literature (Sharpley et al. 2019). The USGS has been conducting a study to evaluate the occurrence and possible causes of filamentous algae blooms in the Buffalo River during recent years (https://www.fondriest.com/news/investigating-pollution-tainted-groundwater-in-buffalo-river-watershed.htm). No information was found regarding quantities of algae in Big Creek. Excessive algae may not be the primary cause of the low DO conditions in Big Creek.

DO concentrations in AR_11010005_712 (Unnamed Trib. of Mill Creek) do not meet water quality criteria at times. The monitoring station that is located on AU AR_11010005_712 includes WHI0212 (DEQ). Data were collected from June 2016 through May of 2018. Data collected in August and September of 2017 exceeded the primary season (when the water temperature is below 22°C) standard of 6 mg/L.

The Marble Falls Sewage Improvement District (SID) wastewater treatment plant discharges to AR_11010005_712 but discharge monitoring data from the time of the excursions show that the plant was not discharging. Available data do not point to an obvious cause of the low DO in this AU. Land use in the HUC12 associated with AR_11010005_712 is shown in the table above (HUC12 110100050206).

Fluctuations in DO concentrations can be caused by chemical, physical, and/or natural environmental processes. One such cause is the natural diurnal fluctuations in response to respiration and photosynthesis (Wetzel, 2001). Other causes could be the physical habitat

composition of the stream, bedrock or any other smooth streambed surface, and the chemical oxygen demand of water quality constituents found in the water.

Table 2. AUs listed for D.O. in the Buffalo River Watershed

AU	Name	Monitoring Station(s)	HUC12(s) in which the AU is located	Selected land uses in Watershed (NLCD 2016)*
AR_11010005_020	Big Creek	BUFT06, BC1, BC2, BC3, 07055814	110100050303	Pasture = 9% Developed = 4% Forest = 85% Other = 2%
AR_11010005_712	Unnamed Trib. of Mill Creek	WHI0212	110100050206	Pasture = 15% Developed = 7% Forest = 76% Other = 2%

* Note that percentages may not sum to 100 because the area of open water is not included or because values were rounded to the closest whole number. NLCD = National Land Cover Database.

1c. Turbidity

One AU was impaired due to concentrations of turbidity (base flows) that exceeded water quality criteria;

- AR_11010005_912 (Mill Creek)

Turbidity – base flows concentrations in AU AR_11010005_912 (Mill Creek; shown in Figure 1) do not meet water quality criteria at times. Monitoring stations that are located on this AU include BUFT04, BUFT0401, WHI0213, WHI0215. Data were collected at these stations during the summer from 2016 – 2020. Data in from 2018 – 2020 exceeded the turbidity base flows standard of 10.

Table 3. AUs listed for turbidity in the Buffalo River Watershed

AU	Name	Monitoring Station(s)	HUC12(s) in which the AU is located	Selected land uses in Watershed (NLCD 2016)*
AR_11010005_912	Mill Creek	BUFT04, BUFT0401, BUFT0402, WHI0211, WHI0213, WHI0215	110100050206	Pasture = 28% Developed = 5% Forest = 66% Other = 3%

* Note that percentages may not sum to 100 because the area of open water is not included or because values were rounded to the closest whole number. NLCD = National Land Cover Database.

The Marble Falls Sewage Improvement District (SID) wastewater treatment plant discharges to AR_11010005_712. Discharge monitoring data for turbidity is not required in the permit, but total suspended solid data were not in violation during the time of exceedances. Land use in the watershed associated with AR_11010005_712 is shown in Table 3.

Given the findings of the Mill Creek report, it is probable that, in addition to *E. coli* contributions, cattle could be a major contributor to turbidity, especially if access to creeks is unrestricted. However, *E. coli* data were not collected alongside turbidity samples for this segment in the distribution or amount necessary to conduct an assessment. The Mill Creek report also indicated that the Crooked Creek and Mill Creek watersheds are connected through a series of springs (Justus *et al*., in prog.). The City of Harrison operates a major (>1.0 MGD) treatment facility, which is approximately 11 miles downstream of the springs connecting the two watersheds, but discharge data has indicated no violations during the period of record. With just

under half of the land use in pasture (41%) or developed (8%) in the upper segment of the Crooked Creek watershed, land use is potentially a large contributor to sedimentation.

2. Description of pollution controls and how they will achieve water quality standards.

The water quality target for *E. coli* in the 4b AUs is the state water quality criteria for primary contact recreation. Since there is no definitive indication that the low DO conditions in the 4b AU are the result of nutrient inputs, the water quality target for DO is the state water quality criteria.

The proposed strategy for achieving water quality standards in these 4b AUs is implementation of the Buffalo River Watershed Management Plan (WMP; FTN 2018) by the Buffalo River Conservation Committee (BRCC; the successor of the Beautiful Buffalo River Action Committee) and its partners.

In August 2016, Arkansas Governor Asa Hutchinson formed the Beautiful Buffalo River Action Committee (BBRAC) to establish an Arkansas-led approach to identify and address potential issues of concern in the Buffalo River watershed. BBRAC was comprised of the Arkansas Department of Energy and Environment, Division of Environmental Quality (DEQ); Arkansas Department of Agriculture-Natural Resource Division (NRD); Arkansas Game and Fish Commission; Arkansas Department of Transformation and Shared Services-Arkansas Geographic Information Systems; Arkansas Department of Health; and Arkansas Department of Parks, Heritage, and Tourism. One of the most significant charges of BBRAC to date was to develop a non-regulatory management plan for the watershed. On January 15, 2018 the NRD finalized the Buffalo River WMP. It was accepted by EPA in June 2018. The WMP outlines voluntary measures that may help to reduce nonpoint source runoff and makes recommendations for water quality monitoring and studies within the watershed. Stakeholders and BBRAC partners are necessary for successful strategy milestone development. DEQ and BRCC (the successor of BBRAC) are committed to revising the strategy as necessary to work towards achieving attainment of water-quality standards for the Buffalo River.

The WMP recommends implementing best management practices (BMPs) only after sources and transport pathways of pathogens, particularly *E. coli*, have been identified. This would allow for more effective use of BMPs and a more efficient use of resources. A number of nonpoint source pollution control practices, and studies, are proposed and discussed in the WMP.

In September 2019, Arkansas Governor Asa Hutchinson formed BRCC. BRCC is the next step in the process that began in 2016 with the BBRAC. Members of the committee will utilize the Buffalo River WMP to prioritize and fund projects in the most critical areas of the watershed. BRCC comprises the following Cabinet Secretaries or their designates: Wes Ward, Secretary of Agriculture – Chair; Shane Khoury, Secretary of Energy and Environment; Shea Lewis, Secretary of Parks, Heritage, and Tourism; and Renee Mallory, Secretary of Health. $1 million in

state general revenue funds and $1 million matched private funds were allocated for conservation and water quality grants within the Buffalo River Watershed. Funding has been used for unpaved roads, feral hog eradication, filamentous algae research, and wastewater treatment facility upgrades. Remaining funding as of 2022 is $103,903.

Two suspected permitted sources of pathogens to the listed AUs have recently been addressed. The first is a swine CAFO located in the Big Creek watershed. As of January 2020, the CAFO has been converted to a conservation easement and manure holding ponds on the property have been remediated (Walkenhorst 2020); (Buffalo River Watershed Alliance 2021a).

The second is the Marble Falls SID wastewater treatment plant. This facility has a history of discharges of untreated sewage and pathogen permit limit exceedances. It discharges to Mill Creek, which joins the Buffalo River approximately 3.6 miles above the upper end of AR_11010005_011. However, this facility met pathogen permit limits in 2019 and 2020 (https://echo.epa.gov/effluent-charts#AR0034088). This utility is exploring options for replacing the existing treatment system and has been granted funding assistance for this project from BRCC (BRCC, 2020). The utility is also seeking funding from USDA Rural Development, and other sources (Newton County Times, 2020).

A septic tank remediation program for the Buffalo River watershed has also been funded by the BRCC (BRCC, 2020). This program has the potential to reduce *E. coli* and nutrient loads to the impaired AUs.

3. An estimate or projection of the time when water quality standards will be attained.

Pathogen criteria attainment in Big Creek and the Buffalo River is contingent upon source and cause identification and subsequent implementation of BMPs designed to address those sources and causes at the appropriate spatial and temporal scales. Attaining water quality standards in these 4b AUs within 10-15 years is considered to be a reasonable goal based on experience in a stream in eastern Oklahoma that was previously impaired for pathogens; practices were installed in that watershed beginning in 2002 and streams were delisted in 2006 and 2016 (US EPA 2019).

Dissolved oxygen criteria attainment in Big Creek and Unnamed Trib. Of Mill Creek is contingent upon source and cause identification and subsequent implementation of BMPs designed to address those sources and causes at the appropriate spatial and temporal scales. Because Big Creek and Unnamed Trib. Of Mill Creek have smaller watersheds than the main stem of the Buffalo River, implementation of practices on a relatively small scale can yield noticeable improvements in water quality.

Turbidity attainment in Mill Creek, dissolved oxygen criteria attainment in Big Creek, and dissolved oxygen attainment on Unnamed Trib. Of Mill Creek is contingent upon source and

cause identification and subsequent implementation of BMPs designed to address those sources and causes at the appropriate spatial and temporal scales.

4. Reasonable schedule for implementing the necessary pollution controls.

Table ES.3 of the WMP provides a proposed schedule for implementation of the plan. The table includes clear milestones, dates, and responsible parties. Activities include monitoring, investigative studies, education and outreach, planning, additional management strategies, evaluation of milestones, and a schedule to update the WMP as needed. The information in Table ES.3 is discussed in Section 7.8 of the WMP, including the evaluation schedule for meeting the milestones toward the implementation of pollution controls. This discussion also includes a well-defined structure identifying the parties responsible for monitoring, the type of activities that will occur, and the indicators that will be used to determine success of the program.

On June 1, 2022, $278,400 was approved from the Water Development Fund to administer the Septic Tank Remediation Pilot Program in the Buffalo River Watershed. Additionally, Newton County was granted $1,000,000 through the Water Sewer Solid Waste Fund to improve wastewater and treatment plants.

Information regarding a schedule for work on the Marble Falls SID wastewater treatment system is not currently available. The septic tank remediation pilot program for the Buffalo River watershed will last three years (Buffalo River Watershed Alliance 2021b)(https://www.agriculture.arkansas.gov/wp-content/uploads/2020/07/00-AR-CWSRF-IUP-SFY-2021-DRAFT-07-27-2020-0722-hrs.pdf).

5. Description of, and schedule for, monitoring milestones for tracking and reporting effectiveness of the pollution controls.

Routine water quality monitoring programs described in the Buffalo River WMP will continue. On-going special water quality studies by USGS and its partners are identified in Item 1. Water quality data relevant to tracking effectiveness of pollution controls is evaluated as part of the Arkansas Integrated Report. The results of the integrated assessment are reported to EPA and the public every two years.

6. Commitment to revise, as necessary, the implementation strategy and corresponding pollution controls if progress toward meeting water quality standards is not attained.

Duties of the BRCC include annual review of the Buffalo River WMP with recommendations for updates, and a report of progress to the Governor of Arkansas on successes during the year (https://www.agriculture.arkansas.gov/wp-content/uploads/2020/05/BRCC_Background_and_FAQs.pdf). Table ES.3 of the WMP specifies that the plan would be updated as needed starting 2023 (or sooner). Section 7.9 of the WMP outlines the information that will be addressed or considered during the review of the plan. If an

update of the WMP specifies any changes in recommended implementation of conservation practices, the agencies and organizations involved with implementation will carry out the recommended changes.

Evaluation components of alternative restoration approaches would be very similar to those provided in table ES.3 of the Buffalo River WMP. A key element that will be included is implementation tracking of BMPs in the Buffalo River watershed from 2018-2028. Indicators of this element would be measured through the linear feet/acres of BMPs implemented. The WMP also includes a proposed revision date of 2024-2025 utilizing data collected from the previous seven years. The WMP is intended to be a living document that reflects stakeholder interest and concerns related to protection of the Buffalo River watershed.

Literature Cited

BRCC. 2022. *Buffalo River Conservation Committee 2020 Annual Report.* Prepared by Arkansas Department of Agriculture with support from BRCC members. Retrieved from https://www.agriculture.arkansas.gov/wp-content/uploads/2022-Buffalo-RIver-Conservation-Committee-Annual-Report-1.pdf.

BRCC. 2020. *Buffalo River Conservation Committee 2020 Annual Report.* Prepared by Arkansas Department of Agriculture with support from BRCC members. Retrieved from https://buffaloriveralliance.org/resources/Documents/Buffalo%20River%20Conservation%20Committee%20Annual%20Report%202020.pdf

Buffalo River Watershed Alliance. 2021a. C&H Closure Update. Article in *March 2021 Newsletter*. Retrieved from https://buffaloriveralliance.org/Latest-Newsletters

Buffalo River Watershed Alliance. 2021b. Buffalo River Conservation Committee (BRCC) Update. Article in *March 2021 Newsletter*. Retrieved from https://buffaloriveralliance.org/Latest-Newsletters

FTN Associates, Ltd. 2018. Buffalo River Watershed-Based Management Plan. Prepared by FTN Associates, Ltd., Little Rock, AR. May 22, 2018. FTN No. R03015-005-031. Retrieved from https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/2018-05-22-final-buffalo-river-wmp.pdf

Justus, B.G, Wentz, N., Barnett, M., Banks, S., Driver L., & Brady, A.M. In prog. *Differentiating bacteria and nutrient sources and pathways in Mill Creek, a karst tributary to the Buffalo River, Arkansas.*

Newton County Times. 2020. *Newton County projects selected by BRCC*. Staff report posted 9/14/2020. Retrieved from https://newtoncountytimes.com/stories/newton-county-projects-selected-by-brcc,1488

Sharpley, A., Brye, K., Daniels, M., Gbur, E., Haggard, B., Hays, P., Savin, M., VanDevender, K., Zhu, J., and Willis, A. 2019. *Monitoring the Sustainable Management of Nutrients on C&H Farm in Big Creek Watershed.* Fayetteville, AR: University of Arkansas Division of Agriculture. Retrieved from http://www.bigcreekresearch.org/

Soto, L. 2014. *Summary of Previous Dye Tracing Reports in the Area of the Buffalo National River, Arkansas.* US National Park Service.

US EPA. 2019. *Restoration Efforts Reduce Bacteria in the Illinois River Watershed*. US Environmental Protection Agency, Office of Water. Washington DC: US EPA. https://www.epa.gov/sites/production/files/2020-07/documents/ok_illinios_river_watershed_1826_508.pdf

Walkenhorst, E. 2020. Payment made, state gains hog farm land; Buffalo River's protection still seen as priority. *Arkansas Democrat Gazette*. Retrieved from https://www.arkansasonline.com/news/2020/jan/07/payment-made-state-gains-hog-farm-land-/

Wetzel, Robert G. 2001. Limnology, Lake and River Ecosystems. Third Edition. Academic Press. 525 B Street, Suite 1900, San Diego, California, 92101-4495.

CATEGORY 4B RATIONALE COVE CREEK WATERSHED

In a letter dated November 6, 2018, Halliburton Energy Services, Inc. Project Manager, James McGinty presented DEQ with the following Category 4b rationale:

In response to DEQ's October 18, 2018 email request for additional site Category 4b qualification details, Halliburton Energy Services, Inc. (HESI) is providing the following references to further support the Dresser Industries-Magcobar former mine site ("DIM Site") request to change the related stream segments in the draft 2018 303(d) from Category 5 to Category 4b.

The following stream segments associated with the former DIM Site are listed in DEQ draft 2018 303(d) listing:

- Cove Creek (AR_08040102_970) for pH, toxicity, and macroinvertebrates
- Chamberlain Creek (AR_08040102_971) for dissolved oxygen, pH, sulfate, TDS, copper, zinc, aluminum, beryllium, and toxicity.
- Lucinda Creek (AR_08040102_975) for pH.

HESI and DEQ have developed and initiated detailed corrective action plans for improving these 303(d) listed streams. As requested by DEQ, HESl has further detailed below the appropriate references to site improvement project documents that satisfy the six conditions for qualifying for the Category 4b designation.

1. Identification of segment and statement of problem causing the impairment.

Stream segment information for each reach is provided above. The cause for impairment is the same for all reaches listed. Halliburton, in cooperation with EPA and DEQ, performed an extensive site investigation for the site and receiving streams. The April 19, 2007 DIM Site, Site Investigation Report (SIR) identifies the stream segments and problems leading to the 303(d) listing of these stream segments. A complete version of the DIM Site SIR can be found on the Arkansas Pollution Control and Ecology Commission (APC&EC) website in Docket 16-003-R at the following link: https://www.adeq.state.ar.us/regs/drafts/3rdParty/reg02/16-003-R/.

HESl is providing the following DIM Former Mine Site Environmental Improvement Project (EIP) Notice of Intent (NOI), Appendix A, SI Report references that identify the stream segments and statement of problems causing the impairment:

All Creeks

• SIR, Executive Summary (pages ES-1 through ESC-10) gives an overview of the site conditions that are causing the stream segment water quality impairment. In general, the production of acid rock drainage (ARD) and its subsequent migration to the streams resulting in

elevated dissolved minerals, low pH, and increased metals' mobility describes the stream reach impairment.

- SIR, Sections 6.2 and 6.3 explains the persistence and migration of potential contaminants at the DIM Site and how these contaminants are derived from naturally occurring geologic materials present prior to mining or other human activities in the area. The current environmental conditions have occurred because disturbance to the site from former mining activities accelerated weathering and ARD generation. Dissolved minerals and metals are leached from the site to surface waters related to the Site at concentrations above background levels.

- SIR, Section 5.4.2.1 Cove Creek identifies the water quality impairments (metals, sulfates, and TDS). Chamberlain Creek water flowing into Cove Creek is causing this impairment in Cove Creek.

Chamberlain Creek

- SIR, Section 5.4.2.2 Chamberlain Creek identifies the water quality impairments. Chamberlain Creek flows directly from the DIM Site Southwest Spoil Area. The DIM Site stormwater run-off and shallow groundwater, which contain ARD, negatively affects Chamberlain Creek.

- SIR, Section 2.1.1 Land Use In The Site Vicinity describes other mining operations and exploratory prospects that may also contribute contaminants to the listed streams (specifically the Christy Mine on Chamberlain Creek).

Lucinda Creek

- SIR, Section 5.4.2.4 Lucinda and Rusher Creeks describes the impacts from ARD in these creeks. Rusher Creek flows into Lucinda Creek below Lucinda Lake.

2. Description of pollution controls and how they will achieve water quality standards.

The DEQ required pollution controls and site improvements to be implemented at the DIM Site per Consent Administrative Order (CAO) LIS 16-043 (2016) are specifically described in the Remedial Action Decision Document (RADD) (ADEQ. 2016. RADD, DIM Former Mine Site). These pollution controls will, in combination, achieve applicable water quality standards for the reaches of Cove Creek, Chamberlain Creek, and Lucinda Creek noted above. A complete version of the RADD report can be found on the APC&EC website in Docket 16-003-R at the following link: https://www.adeq.state.ar.us/regs/drafts/3rdParty/reg02/16-003-R/.

Appendix C of the DIM Site EIP NOI includes the RADD, which identifies pollution controls and how HESI will achieve water quality standards as follows:

• RADD, Section 9.0 Justification for Selections of Remedial Alternatives explains that the following pollution control combination would meet the Remedial Action Levels (RADD, Section 8.1) in off-site streams, would reduce identified risks to acceptable levels and is implementable at a reasonable cost. Thus, this Selected Remedial Alternative Combination (SRAC) provides overall protection of human health and the environment and high levels of short-term and long-term effectiveness. This SRAC will also promote the reduction of toxicity by reducing mobility of Site contaminants. The SRAC for the DIM Site includes:

- Pit Lake -PL2 modified -Operate Existing WTS, Maintain Pit Lake Water Level with temporary water quality standards for minerals as part of the EIP process;
- Spoil Pile -SP2- Selective Regrading, Augment Vegetation, and ARD Capture;
- Shallow Groundwater System -SGW3 -Expanded ARD Capture/Treatment System;
- Bedrock Groundwater -BOW2 -Verify Connection to Municipal Water System;
- Sludge Ponds -SLU2- Soil Cover, Revegetate;
- Chamberlain Creek -CHM2 -Source Control;
- Tailings Impoundments -TI2 -Regrade, Stabilize Dams, Revegetate;
- Affected Streams -AS2 -Source Control; and
- Clearwater Lake -CWL2 -Source Control.

• RADD, Section 10 -Selected Remedy/Site Plan and Implementation Schedule are set forth in this section of the RADD. Pollution controls primarily consist of actions to prevent contact of precipitation with former spoils and/or collection and treatment of low pH water that remains affected by contact with disturbed areas of the site.

3. An estimate or projection of the time when WQS will be met.

A detailed schedule of the remedial actions detailed herein is included in Table 10 of the RADD (2016) and Section 7 of the DEQ approved EIP NOI. The project schedules reflect a long-term approach for compliance with remedial goals including Arkansas water quality standards at the site. Current versions of the DEQ DIM Site RADD and EIP NOI reports can be found on the APC&EC website in Docket 16-003-R at the following link: https://www.adeq.state.ar.us/regs/drafts/3rdParty/reg02/16-003-R/.

Table 10 EIP NOI/RADD Implementation Schedule[12]

Schedule	Activity
Within 3 months of CAO effective date	Verification report for connection status of residents submitted to DEQ.

[12] This schedule is tentative and dependent on the effective date of the CAO or EIP (as noted). The schedule is contingent on construction occurring during the summer months. The schedule also assumes that DEQ comments will be received within 2 months of each submittal.

Within 9 months of CAO effective date	Draft remedial design for sludge ponds submitted to DEQ for review and approval.
Within 12 months of CAO effective date	Identified, unconnected residents connected to public water system if authorization is given.
Within 13 months of CAO effective date	Final remedial design for sludge ponds submitted to DEQ.
Within 18 months of CAO effective date	Remediation of sludge ponds completed.
Within 2 months of EIP approval	Draft EMP submitted to DEQ for review and approval.
Within 4 months of receipt of DEQ comments on draft EMP	Final EMP submitted to DEQ.
Within 6 months of DEQ approval of final EMP	Draft RDP submitted to DEQ for review and approval.
Within 4 months of receipt of DEQ comments on draft RDP	Final RDP submitted to DEQ.
Within 6 months of DEQ approval of final RDP	Draft RAIWP submitted to DEQ for review and approval.
Within 6 months of receipt of DEQ comments on draft RAIWP	Final RAIWP submitted to DEQ.
Within 48 months of DEQ approval of final RAIWP	Remediation construction activities completed.
Within 160 months of EIP approval[13]	Post-project water quality standards become effective.

4. Schedule for implementing pollution controls. See item 3 above.

5. Monitoring plan to track effectiveness of pollution controls.

The Effectiveness Monitoring Plan (EMP) (FTN Associates, Ltd. 2017. DIM Former Mine Site, EMP) addresses tracking of effectiveness of pollution controls at the DIM site. HESI and DEQ are is the process of finalizing the EMP and working through some of the DEQ comments relating to groundwater assessment (i.e. not surface water or waters related to 303(d) listing segments found above). The EMP is expected to be finalized in 2018 and implemented according to the project schedule and will satisfy the requirement that a monitoring plan track the effectiveness of pollution controls in the three waterbodies noted above.

6. Commitment to revise pollution controls, as necessary.

The DEQ RADD addresses monitoring and progress towards achieving site goals as well as evaluations of remedial alternatives as necessary during the RADD implementation. The DEQ DIM site RADD report Section 11 states:

[13] Basis for the total time frame is included in the EIP NOI.

> *If compliance or progress toward compliance, to include obtaining the necessary access agreements and/or institutional controls, is not demonstrated, the RADD may be modified so that additional remedial alternatives can be considered, evaluated, and implemented in a reasonable timeframe.*

Additionally, the DIM Site CAO LIS 16-043 (2016) Section 20, page 10 explains that DEQ has the right to revise the RADD during the implementation of the RADD. Consequently, a mechanism exists to revise the pollution controls for the three waterbodies noted above if necessary.

CATEGORY 5-ALT RATIONALE BEAVER LAKE PATHOGENS, TURBIDITY, AND PH

Beaver Lake 5-Alt Plan for Turbidity, Pathogens, pH

1. Assessment Units (AUs) in 5-alt associated water quality criteria not in attainment, and identification of possible sources contributing to non-attainment.

- Beaver Lake – War Eagle Arm (AR_11010001_4041), Turbidity storm flows (previously part of area known as Beaver Lake upper)
- Beaver Lake – Hickory Creek site (AR_11010001_4042), Nutrients - chlorophyll *a*

The table below shows land use in the immediate watershed (12-digit Hydrologic Unit Code, HUC12) for each AU, and the location of the 5-alt AUs is shown on a map on the following page.

Assessment Unit	Name	Monitoring Station	HUC12(s) in which the AU is located	Selected land uses in HUC12 (NLCD 2016)*
AR_11010001_4041	Beaver Lake - War Eagle Arm	07049160 (USGS)	110100010611	11% pasture 32% developed 29% forest 27% other
AR_1101001_4042	Beaver Lake – Hickory Creek	07049187 (USGS) HC (AWRC)	110100010703	10% pasture 31% developed 26% forest 28% other

* Note that percentages will not sum to 100 because the area of open water is not included. NLCD = National Land Cover Database.

1a. Assessment Unit Modifications

The AU containing the Hickory Creek sites (AR_11010001_4042) was extended ~0.35 miles downstream to better capture sites sampled for the Hickory Creek assessments. The previous AU boundary was placed right at the site location. When conducting spatial joins, any entities that sampled just downstream of that boundary with the purposes of sampling the Hickory Creek site would get placed in the downstream AU. This change was made to better automate processes and prevent error in future assessments. The new boundary placement added ~54 acres to AR_11010001_4042, which was detracted from AR_11010001_4043.

1b. Turbidity

The May 2012 Revision of the Beaver Lake Watershed Protection Strategy (WPS) lists the following water quality threats and possible sources of sediment (turbidity): hydrologic modification resulting from land use change due to urbanization, runoff from new development, construction site runoff, streambank erosion, loss of stream buffers, inadequate pasture best management practices (BMPs), and unpaved roads.

The WPS identifies channel erosion as contributing 60% of the sediment load to Beaver Lake, and pasture as contributing approximately 16%. SWAT modeling indicates that the Beaver Lake and War Eagle Creek HUC10 subbasins contribute the largest portions of sediment load to the reservoir (TetraTech, 2009). The Beaver Lake and War Eagle Creek HUC10s cover 20.1% and 28.0%, respectively, of the entire Beaver Lake HUC8 watershed.

The Beaver Lake HUC10, which includes the impaired AUs, is also identified as a high priority area for sediment control in the WPS. This subbasin is estimated to generate 45% of the sediment load that enters Beaver Lake. Sediment sources identified for this HUC10 are "residential low density land uses, construction sites, and channel erosion." Unpaved roads are also identified as a sediment source to be addressed in this subbasin. Local word of mouth suggests that reservoir shoreline erosion has become more of a concern recently. There is a perception that there has been an increase in the frequency and duration of pool levels at or near flood stage, and this is exposing new areas to wave erosion, potentially increasing sediment input to the reservoir, and reservoir turbidity (personal communication, K. Farmer, FTN, 4/21/21).

Expansion of development associated with future community growth is anticipated in the watersheds of both 5-alt AUs. Significant expansion of development associated with growth of Springdale is anticipated in the 110100010703 HUC12 and may also occur in the 110100010611 HUC12. Growth of Goshen is expected to significantly increase developed area in the 110100010701 and 110100010702 HUC12s (TetraTech, 2009; 2012).

Two AUs (AR_11010001_4040 and AR_11010001_4041), which has previously been placed in 5-alt., attained the turbidity base flows standard on Beaver Lake during the 2022 Assessment cycle. The assessment unit that remains in 5-alt. for turbidity storm flows (AR_11010001_4041) did not have enough data to assess (24 monthly samples), but the 16 samples that were available did not exceed the lake and reservoir turbidity standard in any instance.

1c. Pathogens

AUs in the upper portion of Beaver Lake have been listed as impaired for pathogens in previous years. The USGS began monitoring bacteria in these AUs in 2008 (07049187) and 2009 (07049160). Simple linear regression analyses of these data indicate slightly declining trends, but the statistical significance of the regression is poor due to the inherent temporal variability of bacteria data. For the last four years (January 2017 – March 2021), the highest bacteria measurements at these two stations were 48 cfu/100 mL of fecal coliforms and 50 cfu/100 mL of *E. coli* (based on 26 sampling dates at 07049160 and 21 sampling dates at 07049187). These values are considerably less than the applicable water quality criteria for single samples.

No permitted point sources of pathogens discharge to the 5-alt AUs. Community wastewater treatment plants discharge to the White River (Fayetteville-Noland, NPDES permit number AR0020010) and War Eagle Creek (Huntsville, NPDES permit number AR0022004). There have been occasional exceedances of the fecal coliform limit in the Fayetteville and Huntsville discharges, but these discharges are located more than 16 miles upstream of the 5-alt AUs, and are farther from the associated monitoring stations.

A recent study attempted to identify sources of *E. coli* present in Beaver Lake by identifying species-specific genetic markers within water samples (Gibson et al., 2017). Sixty water samples were collected from each site between February 2014 and September 2015. Samples were analyzed for *E. coli* and genetic markers from fecal bacteria specific to humans, poultry, and cows. Sampling locations for this study included single sites in AUs AR_11010001_4040 (White River) and AR_11010001_4041 (War Eagle Creek). Findings from this study for the sampling locations within the 5-alt AUs are summarized below.

- Mean *E. coli* concentrations at the White River monitoring location (AR_11010001_4040) were statistically significantly higher than at any of the other monitoring locations in the study.
- Mean *E. coli* concentrations at the War Eagle Creek, Pine Creek, and Hickory Creek sites were similar to each other.
- At the War Eagle Creek station (AR_11010001_4041), 33% of markers were from poultry waste, while 25% were from human waste, and 8% were from cow waste.
- At the White River station (AR_11010001_4040), 30% of markers were from poultry waste, while 20-22% of markers were from human waste, and 17% were from cow waste.

- At stations in the 5-alt AUs, the percentage of human and poultry markers present are similar for base flows and rain event samples, while the percentage of cow markers present are higher in rain event samples than in base flows samples.

Overall, the results from this study indicate that human and poultry waste are the largest contributors of pathogens to the 5-alt AUs. Potential sources of these pathogens include runoff from poultry facilities and pastures where poultry litter is applied, and septic systems. In addition, boaters may illegally discharge untreated wastewater to the reservoir in the impaired AUs.

Two AUs (AR_11010001_4040 and AR_11010001_4041), which had previously been placed in 5-alt., attained the *E. coli* – primary contact season standard during the 2022 assessment cycle. No AUs remain on the list for *E. coli.* All but one E. coli sample fell below 67 cfu/100mL, and the highest sample (180 cfu/100mL) fell below the primary season criteria for lakes.

1d. Nutrients

Nutrient criteria are a relatively new EPA policy, which many states including Arkansas, are still working toward. The Upper White River watershed was declared a nutrient surplus area in 2005 by the Arkansas General Assembly– a designation that requires a nutrient management plan and permitting requirements for phosphorus removal. There are two facilities in the watershed above Hickory Creek defined as major municipal (>1 mgd). Both facilities have phosphorus limits and neither have had phosphorus exceedances from April 2016 – March 2021. One former minor facility in the watershed had a history of permit violations, but did not have phosphorus limits. This facility was regionalized with one of the major facilities in December 2020 and no longer discharges.

In 2016, site specific criteria for nutrient targets was adopted on Beaver Lake, which established a growing season geometric mean of 8 ug/L for chlorophyll *a* and an annual average Secchi transparency of 1.1 m. These values were based on a 2008 study and are implemented using data from the Hickory Creek Site (approximate location:36.25439, -94.02657) due to the proximity of the estimated plunge point, a drinking water intake, and the confluence of two major tributaries.

Compared to nonpoint nutrient sources, point sources have a relatively small contribution, especially in watersheds where permit limits include nutrients. As explained in previous sections, sediment load, population growth, and agriculture have been identified as sources of listings for other parameters, and it is likely that nutrients are introduced by the same processes.

2. Analysis to support why the State believes the implementation of the alternative restoration approach is expected to achieve water quality standards (WQS).

The WPS has been in place since before 2012 and is currently implemented with the support of the Beaver Watershed Alliance (BWA). Because BMP implementation is voluntary, it is important to have an active, well organized, and sustainable watershed advocacy group. BWA is an active stewardship group that "... works to proactively protect, enhance, and sustain the high water quality of Beaver Lake and its tributaries through voluntary BMP implementation, outreach and education, and scientific evaluation." This group has been active in the watershed for 10 years and has good relationships with state and federal agencies, local governments, local businesses, and other non-governmental organizations (NGOs). The work of the BWA and its partners has resulted in implementation of BMPs in both urban and rural areas of the watershed. According to BWA's website (www.beaverwatershedalliance.org), they had nine outreach activities from January 2021 thru April 2021, including trash pickup events, tree planting, rain garden installations, stewardship, Arkansas Native Seed Program, and a Forest and Wildfire Management Workshop. They also have other programs available, newsletters, a podcast, a quarterly speaker series, and 17 educational brochures available for download.

While much of the focus of the WPS is practices to reduce erosion and turbidity, BMPs that reduce erosion and turbidity also reduce nutrients and pathogens (Irvine et al., 2002). A summary of published sediment, nutrient, and pathogen reduction efficiencies of selected BMPs can be found in the Middle White River Watershed-Based Management Plan (FTN, 2019).

There has been significant work in the Beaver Lake watershed, particularly in the watershed of the West Fork of the White River and in Fayetteville and Springdale, to reduce or control erosion and sediment loads. Trend analysis of water quality data collected tributaries upstream of Beaver Lake a slight decreasing trend in turbidity concentrations, despite continued expansion of development and construction in this area of the watershed (Scott et al., 2016; Scott and Haggard, 2019). This suggests that programs and practices implemented are preventing water quality decline, and are beginning to improve water quality.

3. **Action Plan**
    a. **Actions to address all sources**
    b. **Schedule of actions designed to meet WQS with**
        i. **Milestones**
        ii. **Dates**
        iii. **Interim milestones**
        iv. **Deliverables**

The WPS outlines an action plan for protection and improvement of Beaver Lake water quality, including the 5-alt AUs. The WPS includes water quality targets, milestones, and a proposed implementation schedule. Since the 2012 revision of the WPS, many of the milestones and deliverables have been achieved. However, additional work is still needed to bring the AUs in the Beaver Lake watershed into attainment with water quality standards. The table below shows a schedule of actions associated with a number of applicable new programs that are not included in the 2012 WPS. These programs would promote implementation of BMPs that can reduce turbidity and pathogens in the 5-alt AUs.

Program (lead entity)	Dates	Milestones	Interim milestones	Deliverables
Arkansas Unpaved Roads Program (NRD)	2015 – ongoing	Environmentally Sensitive Maintenance (ESM) of county unpaved roads	County road personnel trained in ESM	Reduced sediment and nutrient loads
Controlled Access & Livestock Fencing Initiative (Arkansas Assoc. of Conservation Districts, USFWS[1])	2015 – ongoing	Reduce livestock use of riparian corridor	Landowner outreach, install BMPs within critical subbasins	Reduced sediment and pathogen loads
Working Lands for Northern Bobwhite Quail/North Arkansas Quail Focal Landscape RCPP[2] (NRCS)	2018 – ongoing	Increase quail habitat	Landowner outreach, install BMPs	Increase in quail populations[3]
Septic Tank Remediation Program (H_2Ozark)	2021 – ongoing	Reduce number of failing septic systems in Beaver Lake watershed	Tank owner outreach	Reduced pathogen loads
Brush Creek – Roberts Creek National Water Quality Initiative (NRCS)	2021-2024	15% of critical source areas with conservation 15% reduction in sediment load Pasture condition improved on 50% of contracted area	Landowner outreach, contract and install BMPs	Reduced sediment and pathogen loads
Low Impact Development chapter added to Fayetteville municipal code	2014	Reduce runoff volume	Implement and maintain LID elements	Reduce sediment and pathogen loads from Fayetteville

Program (lead entity)	Dates	Milestones	Interim milestones	Deliverables
West Fork White River Initiative RCPP[2] (NRCS)	2016 – ongoing	Large-scale river restoration, reduce streambank erosion	Landowner outreach, contract and install BMPs, design and implement river restoration projects	Reduced sediment and pathogen loads
Experimental demonstration of ponds for source water protection and watershed management (BWA)	2017-2020	Demonstration of water quality benefits of ponds	Design and implement pond, water quality monitoring, field day(s)	Reduced sediment and pathogen loads
Riparian, Forest and Source Water Protection Landowner Outreach (BWA)	2014 – ongoing	Increase use of BMPs by landowners	Landowner outreach, assist with design of BMPs, install/implement BMPs	Reduce sediment and pathogen loads
Low Impact Development / Green Infrastructure construction, LID Mini Grant Program & LID Management (BWA)	2017 – ongoing	Increase use of LID elements, particularly rain gardens	Landowner outreach; design, install, and maintain rain gardens	Reduce runoff, and sediment and pathogen loads
Lakeside Watershed Opportunity Assessment (BWA)	2015	Identify locations for implementation of BMPs	Landowner outreach	Reduce runoff, sediment, and pathogen loads

Notes:
1. USFWS = US Fish and Wildlife Service
2. RCPP = Regional Conservation Partnership Program
3. Conservation practices recommended in this program can reduce sediment, nutrient, and bacteria loads, e.g., prescribed grazing, forage and biomass planting, and access control. Therefore, while improved water quality is not a stated deliverable of this program, its implementation could reduce sediment, nutrient, and bacteria loads.

Stormwater management plans currently in use in the City of Springdale and City of Fayetteville can also protect and improve water quality in the 5-alt AUs.

4. Identify funding sources to implement the Plan

From 2011 to 2020, the total for all monetary grant awards to the BWA since the Beaver Lake WPS has been put in place is $3,496,758. BWA has received funding for three (3) Section 319 non-point source projects in the Beaver Lake Watershed, totaling $922,194 with $695,396 of associated match. BWA has a contract to deliver watershed protection services to the Beaver Water District that has a total value of $2,372,218 through 2020. This contract is funded through a Source Water Protection Fund supported by BWD water sales since 2016. Additionally, BWA receives contributions from local business, cities, counties, and other water providers that have added more than $290,000 to the investment in watershed protection services.

Though BWD does not directly administer funds, the watershed benefits tremendously from the USDA NRCS Regional Conservation Partnership Program, which has brought $8.4 million ($4 million hard dollars) for stream restoration and watershed protection in the West Fork White River Watershed.

In the WPS, Table 5-1 under Adaptive Management identifies potential funding sources, including but not limited to: tax credits, Conservation Reserve Program, Conservation Reserve Enhancement Program, Environmental Quality Incentives Program, Arkansas Stream Team, 319 Grants, land trusts, fees, and legislative appropriations. Programs mentioned in the table in Item 3 provide financial assistance to landowners for implementing BMPs.

5. Identify potential partners to implement the Plan

In the WPS, Table 5-1 under Adaptive Management identifies the following responsible groups needed to implement the WPS: County Farm Service agencies, NRCS, local governments, local water suppliers, AGFC, Arkansas Forestry Commission, Land Trusts, MS4s, DEQ, UA-Fayetteville Extension Service, US Army COE, Beaver Lake Watershed Council, Northwest Arkansas Council, UA- Fayetteville, Homebuilders Association, Illinois River Watershed Partnership, H_2Ozarks (formerly Ozarks Water Watch), Kings River Watershed Partnership, conservation groups, landowners, and USGS. The BWA currently works with these partners.

6. Estimate of time when WQS will be met

Table 4-1 of the WPS lists estimated total reductions in sediment and phosphorus loads from implementing core BMPs through 2055. Water quality modeling was used to evaluate the impact of implementing these core BMPs on reservoir water quality.

For pathogens, data from the last four years at USGS stations 07049160 and 07049187 show reduced values compared to previous years, although continued monitoring is needed to confirm this trend. In northeast Oklahoma, streams were delisted for pathogens around 10 years after a program of BMP implementation was initiated (US EPA, 2019). Based on recent data at the USGS stations and this example from northeast Oklahoma, it seems reasonable to expect pathogen criteria to be consistently maintained in the Beaver Lake AUs within a decade.

7. Plans for monitoring that:

a. Demonstrate progress made toward achieving WQS following implementation

b. Identify needed improvement for adaptive management as the project progresses

c. Evaluate the success of actions and outcome

Current water quality sampling within and upstream of the 5-alt AUs includes:

- DEQ collected quarterly epilimnion samples from a station in AR_11010001_4042 during 1999-2019. Samples were tested for sixty-seven (67) water quality parameters. These samples were not analyzed for pathogens due to the difficulty of meeting holding time requirements with the driving time to the DEQ laboratory in North Little Rock.
- BWD currently collects monthly samples on nine (9) Beaver Lake tributary sites and tests for twenty-four (24) water quality parameters. All monitoring stations are sampled within the epilimnion. BWD collects daily measurements of turbidity and bacteria at the BWD water intake, which is located downstream of the 5-alt AUs.
- The annual Beaver Lake Secchi Day held in August is organized by the BWD. This event provides lake water transparency data as well as chlorophyll-a, total phosphorus, and total nitrogen. It is both a monitoring tool and community engagement event.
- In 2012, StreamSmart, a voluntary citizen science based monitoring program, was launched to increase the extent and frequency of water quality monitoring in the Beaver Lake Watershed. No monitored stations are within the 5-alt AUs that are the focus of this justification. However, they are located upstream of the 5-alt AUs. Water quality improvement at these stations could translate to improvement in the listed AUs. Samples are collected in February, May, August, and November. Analyses conducted through this program that are relevant to the impairments of concern are measurement of TSS concentration, habitat assessment, and macroinvertebrate assessment. The StreamSmart program was developed by the Beaver Water District, Audubon Arkansas, and the Arkansas Water Resources Center (AWRC) (Ozarks Water Watch, 2019a; Danovi, 2020).

- Beaver Lake Volunteer Program, a volunteer citizen science monitoring program, began in 2014. It is a partnership between H_2Ozarks and Beaver Water District. Data are collected one to two times a month during April – September. All monitoring stations are located downstream of the 5-alt AUs (Ozarks Water Watch, 2019b; Thorpe and Danovi, 2020).
- Streambank erosion monitoring was conducted during 2016-2017 at sites located upstream of 5-alt AUs (Watershed Conservation Resource Center, 2018).
- USGS is collecting samples every two months from a station in AU AR_11010001_4041.

8. Commitment to periodically evaluate the alternative restoration approach to determine if it is on track to be more immediately beneficial or practicable in achieving WQS than pursuing a TMDL in the near-term, and if the impaired water should be assigned a higher priority for TMDL development.

Every two years DEQ compiles and evaluates available water quality data from Beaver Lake for water quality criteria attainment. This assessment will be used to determine if the alternative restoration approach is making progress toward addressing the water quality impairments.

BWA states, "The Beaver Watershed Alliance has adopted the [WPS] document for revision and periodic updates with input from the original Policy and Technical Advisory Group organizations. The Protection Strategy will remain "evergreen" in that new and important issues, water quality data, and emerging pollutants will be addressed on a repeating cycle and in a timely manner." (Beaver Watershed Alliance, 2019). BWA has been working to develop watershed success metrics which will serve other watershed organizations in defining their goals. Multiple ongoing projects including monitoring, stream restoration, low impact development, and nutrient transport studies are being carried out by the Alliance and their partners.

The May 2012 WPS is an update for the 2009 version and is currently undergoing a revision. Additionally, H_2Ozarks held the first public meeting for developing the WMP for the Upper White River Watershed in January 2022. H_2Ozarks produces annual water quality summaries for the upper White River watershed, including Beaver Lake and its tributaries. These reports summarize the water quality data collected by citizens, including data from the StreamSmart and Beaver Lake Volunteer Programs.

Literature Cited

Avery, Ray. March 29, 2014. Beaver Lake and its Tributaries: 2013 Source Water Quality Report. Beaver Water District.

Beaver Watershed Alliance. 2012. Beaver Lake Watershed Protection Strategy, May 2012 Revision. Beaver Watershed Alliance, PO Box 319, Goshen AR, 72735. Accessed September 24, 2019. https://www.beaverwatershedalliance.org/strategy/watershed-protection-strategy.aspx.

Danovi, A. 2020. *StreamSmart Volunteer Monitoring Quarterly Data Report.* Rogers, AR: Ozarks Water Watch. Retrieved from https://owwbeaverlake.org/wp-content/uploads/2020/04/Winter2020DataReport.pdf.

EPA. 2020. *ICIS*. Retrieved from EPA May 25, 2021: https://enviro.epa.gov/enviro/ICIS_DETAIL_REPORTS_NPDESID.icis_tst?npdesid=AR0022004&npvalue=1&npvalue=13&npvalue=14&npvalue=3&npvalue=4&npvalue=5&npvalue=6&rvalue=13&npvalue=2&npvalue=7&npvalue=8&npvalue=11&npvalue=12.

FTN. 2019. *Middle White River Watershed-based Management Plan.* Little Rock: Arkansas Natural Resources Commission.

Gibson, K. E., Lee, J. A., Jackson, J. M., Smith, L. N., and Almeida, G. 2017. Identification of factors affecting fecal pollution in Beaver Lake Reservoir. *Journal of Environmental Quality, 46*(5), pp. 1048-1056.

Irvine, K. N., E.L. Somogye, and G.W. Pettibone. 2002. Turbidity, Suspended Solids, and Bacteria Relationships, in the Buffalo River Watershed. Department of Geography/Planning, Department of Biology, State University College at Buffalo, 1300 Elmwood Ave., Buffalo, NY 14222. https://msaag.aag.org/wp-content/uploads/2013/05/5_Irvine_et_al.pdf.

Ozarks Water Watch. 2019a. *StreamSmart Volunteer Program*. Retrieved November 10, 2020, from Ozarks Water Watch at Beaver Lake: https://owwbeaverlake.org/water-quality/streamsmart-volunteer-program/.

Ozarks Water Watch. 2019b. *Beaver Lake Volunteer Program*. Retrieved November 10, 2020, from Ozarks Water Watch at Beaver Lake: https://owwbeaverlake.org/water-quality/beaver-lake-volunteer-program/.

Scott, E. E., and Haggard, B. E. 2019. *Constituent Loads and Trends in the Upper Illinois River Watershed and Upper White River Basin: 2015 October through 2018 September.* Fayetteville, AR: Arkansas Water Resources Center.

Scott, E. E., Simpson, Z. P., and Haggard, B. E. 2016. *Constituent Loads and Trends in the Upper Illinois River Watershed and Upper White River Basin.* Fayetteville, AR: Arkansas Water Resource Center.

Simpson, Z. 2016. *Trend Analysis of Water Quality in Northwest Arkansas Streams Reflects Changes in the Watershed.* Fayetteville, AR: University of Arkansas.

TetraTech. 2009. *Technical Memorandum, Beaver Lake SWAT Modeling Baseline Analysis.* Research Triangle Park, NC: TetraTech. Retrieved April 2021, from https://www.yumpu.com/en/document/read/44172959/swat-model-recalibration-tetratech-ffxcom.

Thorpe, T., and Danovi, A. 2020. *Beaver Lake Watershed Volunteer Lake Monitoring Report 2014-2019.* Rogers, AR: Ozarks Water Watch. Retrieved from https://owwbeaverlake.org/wp-content/uploads/2020/04/Lake-Monitoring-2020-Report.pdf.

US EPA. 2019. *Restoration Efforts Reduce Bacteria in the Illinois River Watershed.* US Environmental Protection Agency, Office of Water. Washington DC.

Watershed Conservation Resource Center. 2018. *2017 Summary of Streambank Erosion Monitoring.* Springdale, AR: Beaver Watershed Alliance. Retrieved from https://www.beaverwatershedalliance.org/pdf/BWA-Bank-Erosion-Monitoring-2017.pdf.

CATEGORY 5-ALT RATIONALE ILLINOIS RIVER WATERSHED PATHOGENS

Illinois River Watershed 5-Alt Plan for Pathogens

1. Assessment Units (AUs) in 5-alt and identification of sources contributing to impairments

Two parameters were assessed as not attaining water quality criteria within the Illinois River watershed that have been placed in Category 5-alt.

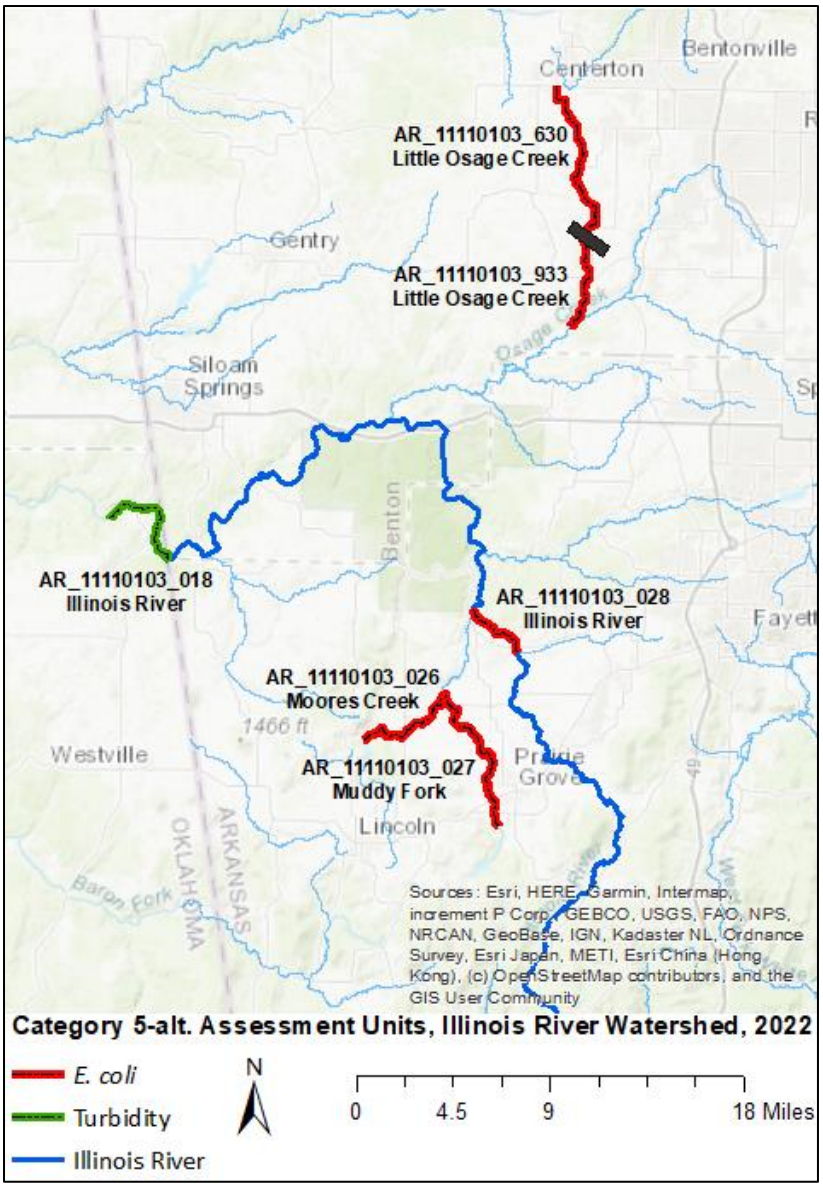


Figure 14. Impaired Segments in 5-alt., Illinois River Watershed

1a. Pathogens

Five Assessment Units (AUs) were impaired due to concentrations of *E. coli* that exceeded water quality criteria;

- AR_11110103_026 (Moores Creek)
- AR_11110103_027 (Muddy Fork)
- AR_11110103_028 (Illinois River)
- AR_11110103_630 (Little Osage Creek)
- AR_11110103_933 (Little Osage Creek

The 2012 EPA-accepted Upper Illinois River Watershed Based Plan (WBP) lists possible sources of pathogens from urban contributions as failing septic systems, wildlife, illicit discharges, agriculture, urban runoff, and others. The possible agricultural pathogen sources identified were manure/litter application runoff, livestock access to streams, poultry litter storage, and animal feeding operations (FTN, 2012).

Table 4. AUs listed for E. coli in the Illinois River Watershed

Assessment Unit	Stream name	Reach length (miles)	HUC12(s) in which the AU is located	Selected land uses in HUC12 (NLCD 2016)
AR_11110103_026	Moores Creek	4.8	111101030102	61% pasture 7% developed 30% forest 1% herbaceous & shrub
AR_11110103_027	Muddy Fork	7.1	111101030101	45% pasture 9% developed

Assessment Unit	Stream name	Reach length (miles)	HUC12(s) in which the AU is located	Selected land uses in HUC12 (NLCD 2016)
				43% forest 1% herbaceous & shrub
AR_11110103_028	Illinois River	2.9	111101030403	30% pasture 4% developed 62% forest 2% herbaceous & shrub
AR_11110103_933	Little Osage Creek	4.3	111101030302	66% pasture 21% developed 12% forest 1% herbaceous & shrub
AR_11110103_630	Little Osage Creek	7.2		

* Note that percentages may not sum to 100 because the area of open water is not included or because values were rounded to the closest whole number. NLCD = National Land Cover Database.

Point source discharges may contribute to the pathogen impairments in AU AR_11110103_027. The only discharge of treated sanitary wastewater directly into one of the listed AUs is the City of Prairie Grove wastewater treatment plant (NPDES permit number AR0022098), which discharges into the Muddy Fork of the Illinois River (AU AR_11110103_027). During the period 2016 – March 2021, discharge from this wastewater treatment plant violated permit fecal coliform limits seven times, four times in 2019 and twice in 2020, and once in 2021 (US EPA, 2022).

The only other discharge associated with the listed AUs is from the City of Fayetteville West Side wastewater treatment plant (NPDES permit number AR0050288). Discharge from this wastewater treatment plant eventually drains into the Illinois River (AU AR_11110103_028), but only after

traveling more than 5 miles through Goose Creek. During the period 2016-2021, discharge from this wastewater treatment plant met all bacteria permit limits (US EPA, 2022).

A recent bacteria monitoring study included sampling of AUs AR_11110103_028 and AR_11110103_933, as well as other previously listed AUs, including AU AR_11110103_025 on the Muddy Fork. This study identified pasture in riparian zones, and deposition of manure in streams by livestock, and possibly wildlife, as the most likely sources of high bacterial levels at sampling sites. The study also noted that high bacteria levels in most sampled streams is a localized issue, and bacteria levels can vary significantly over time (Scott et al., 2015). The results of this study suggest that bacteria sources causing listing of these AUs are most likely located near the water quality stations (within 2 km). Possible pathogen sources associated with riparian pastures include manure/litter application runoff, and livestock access to streams (FTN, 2012).

Another recent study attempted to identify *E. coli* sources by identifying associated viruses. Samples were analyzed for the presence of viruses specific to humans, cows, and swine (Gibson, 2016). Samples were collected in the following streams/AUs:

- AR_11110103_013 Baron Fork,
- AR_11110103_023 Illinois River,
- AR_11110103_029 Clear Creek,
- AR_11110103_028 Illinois River,
- AR_11110103_025 Muddy Fork,
- AR_11110103_030 Osage Creek,
- AR_11110103_931 Spring Creek, and
- AR_11110103_933 Little Osage Creek (Gibson, 2013).

The results of one of the tests in this study indicate that, in samples with high virus levels, associated with rain storms, a higher proportion (71%) of fecal pollution in Clear Creek, Muddy Fork, and Little Osage Creek is from animal sources (cow) than from human sources. Other test results indicate that, at other times and in other streams, human wastewater may account for the majority of fecal pollution in the sampled streams. Unfortunately, there was not a statistically significant correlation between *E. coli* and virus levels ($r^2 = 0.379$), i.e., high *E. coli* levels did not necessarily occur in the same samples as high virus levels (Water Currents, 2016) (Gibson, 2015) (Gibson, 2016). The results of this study suggest that both human and animal waste contribute *E. coli* to the five AUs in Category 5-alt, but did not show that either human waste or animal waste contributes the majority of *E. coli* in the streams that were sampled.

1b. Turbidity

One AU was impaired due to concentrations of turbidity (base and storm flows) that exceeded water quality criteria;

- AR_11110103_018 (Illinois River)

One AU on the Illinois River (AR_11110103_024), which was in the Lake Wedington HUC 12, was impaired for turbidity base flows in 2020, but was delisted in 2022. One AU on the Illinois River (AR_11110103_018) was impaired for turbidity base and storm flows in 2022. The newly listed portion is downstream of the delisted segment and is just across the Oklahoma border.

Table 5.AUs listed for turbidity in the Illinois River Watershed

Assessment Unit	Stream name	Reach length (miles)	HUC12(s) in which the AU is located	Selected land uses in Watershed (NLCD 2016)
AR_11110103_018	Illinois River	4.5	111101030606	41% pasture 16% developed 41% forest 2% herbaceous & shrub

* Note that percentages may not sum to 100 because the area of open water is not included or because values were rounded to the closest whole number. NLCD = National Land Cover Database.

The WBP lists possible sources of turbidity as impervious roads, unpaved roads, construction, stream bank erosion, cattle in stream, and overgrazed pasture (FTN, 2012). With almost half of the land use in this watershed in pasture, this has the potential to be a large contributor to sedimentation. The next largest land use in the watershed is forest. Use of unpaved roads for forestry activities can contribute to increased sedimentation in surface waters. Stream bank erosion is listed in the WBP as a possible source of turbidity in the watershed. Changes in flow regime due to watershed disturbance can cause stream bank erosion to occur. Sixteen percent of the watershed is urbanized and hydrologic modification due to any land use change has the potential for bank erosion or bed scour.

2. Analysis to support why the State believes the implementation of the alternative restoration approach is expected to achieve water quality standards (WQS).

An alternative restoration strategy is well-suited for the Illinois River Watershed because impairment sources are primarily from nonpoint source contributions. Rural land use in the HUC12s associated with the impaired stream reaches ranges from 62% forested with 30% pasture to 12% forested and 66% pasture. Discharges from point sources are regulated through the National Pollution Discharge Elimination System. Any corrective actions that may be needed for point sources will occur under the direction of this program.

The Memorandum of Agreement (MOA) signed in November 2018 between the states of Arkansas and Oklahoma also supports the development and use of alternative restoration measures. The MOA outlines the formation of a Watershed Improvement Plan (WIP), which will include and update 319 projects, and a WIP Advisory Group. The WIP will identify possible water-quality improvement strategies for point and nonpoint sources outlined in each state's watershed-based management plans.

Implementation of urban and pasture-related conservation practices implemented in Oklahoma and Arkansas was part of a successful effort to reduce bacteria in Oklahoma stream reaches in the Illinois River watershed (US EPA, 2019). A February 16, 2016 USDA Blog post credited BMPs implemented through the Natural Resources Conservation Service (NRCS) Illinois River Sub-Basin and Eucha-Spavinaw Lake Watershed Initiative as contributing to delisting of two segments of the Illinois River. These reports suggest that implementation of BMPs in the Illinois River watershed is already improving water quality.

Bacteria reduction efficiencies have been reported by the Texas A&M Extension Service and Virginia Tech for some BMPs that restore riparian buffer, improve pasture, and reduce livestock access to streams. A summary of these efficiencies can be found in the Strawberry River Watershed-Based Management Plan (FTN, 2016). These bacteria reduction efficiencies include 37% - 46% reduction for fencing cattle out of streams, 46% reduction for stream crossings, 85% reduction for water facilities, and 66% - 72% reduction for prescribed grazing.

Similar strategies for livestock and forestry have been published by the University of Arkansas Cooperative Extension Service. BMPs for improving riparian zones for livestock grazing and limiting sediment runoff through forestry activities are available through the extension service as well as the Arkansas Forestry Commission.

Because BMP implementation is voluntary, it is important to have an active, well-organized, and sustainable watershed advocacy group such as the Illinois River Watershed Partnership (IRWP). This group has been active in the watershed for 15 years and has good relationships with state and federal agencies, local governments, local businesses, and other non-governmental organizations (NGOs). The work of the IRWP and its partners has resulted in implementation of BMPs in both urban and rural areas of the watershed. Examples of IRWP's early work in the Illinois River watershed are listed in the WBP. Examples of more recent activities, during 2019, include educating 991 stakeholders, providing one-on-one technical guidance to 83 stakeholders and watershed landowners, and producing customized conservation plans for 19 watershed landowners (IRWP, 2020). IRWP's Riparian Restoration Program supports implementation of BMPs in priority watersheds, including Moores Creek and Muddy Fork Illinois River. IRWP has committed over $1 million to this program over the last two years and will be investing $1.5 million over the next three years. They plan to achieve their goal of restoring 20 miles of riparian area with projects such as 42,000 linear feet of fence for rotational grazing and installing alternative water sources for over 1300 acres of land (IRWP, personal communication, 2021).

3. Action Plan
    a. Actions to address all sources
    b. Schedule of actions designed to meet WQS with
        i. Milestones
        ii. Dates
        iii. Interim milestones
        iv. Deliverables

Based on the information in Item 1, outreach activities and BMPs that will be targeted are those that improve vegetation in riparian areas and reduce or control livestock access to impacted streams. The WBP includes a description of measurable milestones for education and outreach, best management practice implementation, and water quality monitoring. Since the completion and implementation of the WBP, many of the milestones and deliverables have been achieved. However, additional work is still needed to bring all the AUs in the Illinois River watershed into attainment for pathogens and turbidity. Table 3 shows a schedule of actions associated with applicable new programs that are not included in the 2012 WBP. These programs would promote implementation of BMPs that can reduce agricultural bacteria and turbidity sources associated with targeted stream reaches.

Program (lead entity)	Dates	Milestones	Interim milestones	Deliverables
Riparian Restoration Program (IRWP)	2019 - 2024	Restore 20 miles of riparian corridor; add 2 sq. miles of rotational grazing	Landowner outreach	BMPs on 20 miles of riparian corridor; reduced sediment, nutrient, and bacteria loads
Controlled Access & Livestock Fencing Initiative (Arkansas Assoc. of Conservation Districts, USFWS[1])	2015 – ongoing	Reduce livestock use of riparian corridor	Landowner outreach; install BMPs within 2 km of critical areas	Reduced sediment, nutrient, and bacteria loads
Working Lands for Northern Bobwhite Quail/North Arkansas Quail Focal Landscape RCPP[2] (NRCS)	2018 – ongoing	Increase quail habitat	Landowner outreach; install BMPs	Increase in quail populations[3]
Septic Tank Remediation Program (IRWP)	2021 - 2023	Reduce number of failing septic systems in Arkansas Illinois River watershed	Tank owner outreach	Reduced nutrient and bacterial loads
Unpaved Roads Program (IRWP/NRD)	2021 - 2023	Reduce non-point source sediment loads in Illinois River Watershed	Landowner outreach; install BMPs	Reduced sedimentation
Wastewater Treatment Plant Upgrades (NRD)	2022 - ongoing	Increase capacity and reduce point source contributions	Funding allocations	Reduced nutrient and bacterial loads
Illinois River Watershed RCPP[2] (NRCS)	2015 - 2019	Increase implementation of BMPs	Landowner outreach	Reduce sediment, nutrient, and bacteria

				loads; improve wildlife habitat
Blue Cities/Blue Neighborhoods Program (IRWP)	2021 - 2022	Improve infrastructure to reduce stormwater runoff	Community outreach	Reduce stormwater runoff, reduce stream bank erosion

Table 6. Schedule of Restoration Activities

Notes: 1. USFWS = US Fish and Wildlife Service
4. RCPP = Regional Conservation Partnership Program
5. Conservation practices recommended in this program can reduce bacteria and sediment loads, e.g., prescribed grazing, forage and biomass planting, and access control. Therefore, while improved water quality is not a stated deliverable of this program, its implementation could reduce sediment and bacteria loads.

4. Identify funding sources to implement the Plan

To date, almost forty million dollars ($40,000,000) have been invested in nonpoint source controls in the Illinois River watershed through USDA and EPA programs. Over an eleven (11) year period (2000-2011), a total of fifty-eight (58) Section 319 nonpoint source projects were funded in the Illinois River watershed.

An informal survey of the mayors of Fayetteville, Springdale, Rogers, Bentonville, and Siloam Springs was conducted to get an idea of the amount of capital investment that has occurred since 2000 to reduce the phosphorus loadings from the discharges of the wastewater treatment facilities. As a conservative amount, more than $225 million ($225,000,000) has been invested in the last two decades. This figure does not include any of the investments made for infrastructure improvements. Most recently (July 2022) Prairie Grove City Council approved a bid to expand the wastewater treatment facility to keep up with projected population growth. Part of the funding is through the Water, Sewer and Solid Waste Fund.

On September 10, 2018, the Arkansas Natural Resource Commission (ANRC) and the Illinois River Watershed Partnership (IRWP) announced a new agreement to improve water quality in the Illinois River (this is the Riparian Restoration Program listed in the first row of the table in Item 3). IRWP received a $1.4 million grant to assist landowners with implementing best management practices in the watershed. The Walton Foundation provided the necessary matching funds for the project. The goal is to protect or restore twenty (20) miles of riparian area.

Additional potential funding sources include, but are not limited to: tax credits, Conservation Reserve Program, Conservation Reserve Enhancement Program, Environmental Quality

Incentives Program, Arkansas Stream Team, 319 Grants, land trusts, fees, private entities, corporations, legislative appropriations, County Conservation District Controlled Access & Livestock Fencing Initiative (Illinois River watershed is a focus area), NRCS Conservation Stewardship Program, and NRCS Agricultural Conservation Easement Program. Programs mentioned in the table in Item 3 provide financial assistance to landowners for implementing BMPs.

5. Identify potential partners to implement the Plan

Table 7.6 of the 2012 WBP identifies twenty-five (25) potential partners that may share common goals within the watershed. Potential partners include NGOs; governmental entities at the city, state, and federal level; academia; and businesses/industries. The IRWP currently works with many of these partners (irwp.org), and is developing partnerships in Oklahoma (IRWP, 2020).

6. Estimate of time when WQS will be met

Implementation of effective nonpoint source BMPs to address this issue is strictly on a voluntary basis. However, implementation of the BMPs could lead to timely attainment of the turbidity and primary contact recreation designated use in the Illinois River watershed. In Oklahoma, practices were installed beginning in 2002, and streams were delisted in 2006 and 2016. Based on this, achievement of WQS could be possible in ten (10) years.

7. Plans for monitoring that:
    a. Demonstrate progress made toward achieving WQS following implementation
    b. Identify needed improvement for adaptive management as the project progresses
    c. Evaluate the success of actions and outcome

In preparation of the 2022 303(d) list, data from 36 water quality monitoring stations was used to assess 20 stream Assessment Units and three lake Assessment Units, approximately (227 river miles and 450 lake acres within the Illinois River watershed. A portion of those stations are operated by DEQ as part of the Ambient Water Quality Monitoring Network. Additional information was from stations operated by the Oklahoma Conservation Commission, Cherokee Nation, and the Arkansas Water Resource Center. Water quality samples collected are analyzed for numerous water quality constituents including turbidity. It is widely accepted in scientific literature that storm water runoff mobilizes both pathogens and sediment, and there is a strong relationship between turbidity levels and pathogen concentrations (Irvine, et al., 2002). Therefore, decreasing the turbidity in the streams should result in the reduction of pathogens as well.

8. Commitment to periodically evaluate the alternative restoration approach to determine if it is on track to be more immediately beneficial or practicable in achieving WQS than pursuing a TMDL in the near-term, and if the impaired water should be assigned a higher priority for TMDL development.

Water quality in the Illinois River basin is routinely monitored as part of the DEQ Ambient Water Quality Monitoring Network. Every two years the data is compiled and evaluated for water quality criteria attainment. This assessment, and other readily available information, will aid in determining if the alternative restoration approach is making progress toward addressing the water quality issues.

The states of Arkansas and Oklahoma, through a Memorandum of Agreement (MOA) signed in November 2018, agreed to establish a Monitoring and Assessment Workgroup (MAW) and to develop a Watershed Improvement Plan (WIP) (Arkansas and Oklahoma, 2018).

A Technical Advisory Committee, a subcommittee of the MAW, was established and began meeting in early 2019. Their focus is to develop a monitoring and assessment program to ascertain progress toward meeting the Oklahoma total phosphorus criterion. Delegates from Arkansas and Oklahoma have convened on several occasions since January 2019. The determination of base flows, sampling methodologies, data quality objective, and other factors are being developed.

The MOA outlines the formation of a Watershed Improvement Plan (WIP), which will include and update 319 projects, and a WIP Advisory Group. The WIP will identify possible water-quality improvement strategies for point and nonpoint sources outlined in each state’s watershed-based management plans.

Literature Cited

Arkansas and Oklahoma. 2018. Memorandum of Agreement By and Between the Oklahoma Secretary of Energy and Environment, the Oklahoma Secretary of Agriculture, The Arkansas Department of Environmental Quality, and the Arkansas Natural Resources Commission, or Successor Agencies.

FTN. 2012. Watershed-Based Management Plan for the Upper Illinois River Watershed, Northwest Arkansas. Prepared by FTN Associates, Ltd., July 17, 2012. https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2018/uirw-watershed-based-plan-2012-11-30-final.pdf

FTN. 2016. Strawberry River Watershed-Based Management Plan. Prepared by FTN Associates, Ltd., November 18, 2016. https://www.arkansaswater.org/21-newsflashes/366-strawberry-river-watershed-based-management-plan

Gibson, K.E. 2013. *Fecal Source Characterization in Select 303(d) listed Streams in the Illinois River Watershed with Elevated Levels of Escherichia coli*. Fayetteville, AR: Arkansas Water Resource Center.

Gibson, K. 2015. Use of Coliphage and Enteric Viruses for FST in Impaired Streams in the Illinois River Watershed. Presentation at 6th Annual Symposium on Waterborne Pathogens, Savannah, Georgia, USA, April 13-14, 2015.

Gibson, K. 2016. Continuation of Analysis for Host-specific Viruses in Water Samples Collected from Selected 303(d) Listed Streams in the Illinois River Watershed. Fayetteville, Arkansas, USA.

Irvine, K. N., E.L. Somogye, and G.W. Pettibone. 2002. Turbidity, Suspended Solids, and Bacteria Relationships, in the Buffalo River Watershed. Department of Geography/Planning, Department of Biology, State University College at Buffalo, 1300 Elmwood Ave., Buffalo, NY 14222. https://msaag.aag.org/wp-content/uploads/2013/05/5_Irvine_et_al.pdf

IRWP. 2020. Annual Report 2019 - *Boots on the Ground*. Cave Springs, AR: Illinois River Watershed Partnership. http://irwp.org/assets/Annual-Report-web.pdf

Scott, E.E., Smith, B.A., Leh, M., Arnold, B., and Haggard, B.E. 2015. *Bacteria Monitoring in the Upper Illinois River Watershed*. Fayetteville, AR: Arkansas Water Resource Center. https://scholarworks.uark.edu/awrctr/9/

US EPA. 2019. *Restoration Efforts Reduce Bacteria in the Illinois River Watershed*. US Environmental Protection Agency, Office of Water. Washington DC: US EPA. https://www.epa.gov/sites/production/files/2020-07/documents/ok_illinios_river_watershed_1826_508.pdf

US EPA. 2021. Enforcement Compliance History Online, Effluent Limit Exceedences Report. Retrieved December 15, 2022.

Water Currents. 2016. UA Researcher Tracks the Source of Pathogen Pollution in the Illinois River. Water Currents, November 20, 2016. Retrieved March 2021 from https://watercurrents.uark.edu/ua-researcher-tracks-the-source-of-pathogen-pollution-in-the-illinois-river-watershed/.

APPENDIX B - MACROINVERTEBRATE ASSESSMENT REVISIONS

1.0 BACKGROUND

For DEQ to assess macroinvertebrate data, reference conditions must be generated to compare site-specific data. Historically, reference condition selection process hasn't been well documented, so DEQ staff within the 2022 cycle worked to create a repeatable framework to select reference sites from the full data set being used in that respective cycle.

2.0 ASSESSMENT OVERVIEW

The general steps for assessment are as follows:

1. Compile all sites sampled in a given ecoregion.
2. Select a subset of sites to act as references of high quality.
3. Calculate 6 metrics for each reference site.
4. Take the average of each metric to get the reference condition.
5. Compare each site's metrics to the reference condition as **Percent Comparisons**.
6. Score the **Percent Comparisons** for each metric with either a 0, 2, 4, or 6 based on Table 4 in the **Assessment Methodology**.
7. Sum the scores for each site and divide by 30 plus the percent dominance score[14] to create a **Scored Percentage**.
8. Determine if the **Scored Percentage** indicates support or non-support (< 50% is *Non-Support* and >54% is *Support*. This range is reserved for staff to use a weigh-of-evidence approach to make a final decision).

General descriptions of the metrics DEQ uses in assessment are as follows:

Parameter	Description	Predicted Response To Pollution
Taxa Richness	The total number of unique taxa identified per site.	Decrease
EPT Richness	The total number of unique Ephemeroptera, Plecoptera, and or Trichoptera (EPT) taxa identified per site.	Decrease

[14] Percent contribution of dominant taxa is not a comparison to reference value, but rather actual percent contribution for the given site.

Parameter	Description	Predicted Response To Pollution
HBI	A measure of how pollutant tolerant a given sample is. This is scaled from 0-10 (0 Excellent water quality; 10 Very bad water quality).	Increase
Percent Dominance	The maximum relative abundance of an individual taxa divided by total abundance of all taxa in a given sample.	Increase
EPT-Chironomidae Ratio	The proportion of EPT individuals to Chironomid (midge) individuals.	Decrease
Scraper to Filter-Collector Ratio	The proportion of scraper functional feeding group individuals to filter-collector individuals.	Variable

3.0 STATEMENT OF PURPOSE

Although the Assessment Methodology is descriptive in the metrics to use for conducting an assessment, it is lacking in instruction of how to select sites for a reference condition. Therefore, we have attempted to establish a robust and reproducible guidance for reference selection for future assessments, which we will herein refer to as the "Top 15%" method. The planning branch is currently in the process of very extensive ecoregion-specific surveys that will generate sufficient data to update water quality standards as well as generate Indices of Biological Integrity (IBIs) for fish and macroinvertebrates. Until these IBIs are completed, DEQ proposes to use the methods laid out in this document. The following narrative describes how past reference condition selection methods compare to the final "Top 15%" method proposals to listing changes based on these comparisons.

The framework for reference selection utilized in 2020 was a "Top-5 EPT" approach in that it used thresholds for a subset of metrics (HBI <4.25; Taxa Richness < 20; Percent Dominance < 20%; etc.) to generate the suite of reference sites within an ecoregion. This process performed well for our high gradient ecoregions, which typify the higher diversity and lower tolerance values defined by a "very good" HBI of 4.25 (Hilsenhoff 1987). However, we feel that the characteristics of our low gradient ecoregions "*do not provide the diversity of habitat or fauna afforded by steeper gradient streams*" (Plaflkin, 1989) and utilizing the thresholds in the "Top-5 EPT" method are inappropriate.

Overall, the current method is limiting in that the amount of sites collected within an ecoregion limits the assessment. For example, if a single macroinvertebrate sample was collected within one site in the Arkansas Valley ecoregion, there would be no reference sites with which to compare. With the current method, we are limited to large studies conducted within an ecoregion across a land use gradient. DEQ is seeking to transition to a more standardized reference site selection process that can be used regardless of ecoregion for the current and any applicable future cycle.

4.0 DATA CORRECTION

Before proceeding with the method change narrative, there are data inconsistencies within the 2020 assessment that DEQ staff have discovered and wish to address. These inconsistencies lie primarily in calculating the metrics, but some result from how data was represented in the database.

DEQ currently uses an Access® database to store macroinvertebrate data and queries for assessment. This database is based on the **TetraTech** product *Ecological Data Application System (EDAS)*.

There were two metrics in particular in which staff noticed inconsistencies when running the 2022 assessment, which resulted in noticeable changes to percent comparisons.

Metric	Explanation
HBI	Occasionally, riffle kicks were kept separate during fieldwork and when analyzed in the lab, while others were aggregated. This resulted in 3 samples from the same site having their own HBI values calculated and then averaged to create a single value for the site. A full taxa list for the site should have been aggregated before generating a single HBI metric. This correction resulted in a maximum difference of 1.32 HBI units between sites. There were 28 total sites with discrepancies in the correction. The discrepancy was > 1 HBI unit at 4 sites. The rest of the sites had difference of < 0.25 HBI units. Additionally, new tolerance value information became available for some taxa and was added to the database in 2021 leading to slight differences in the final metric calculation.
Scraper-FilterCollector Ratio	The original calculation incorporated an extra variable into the denominator of the equation that greatly shifted the ratio. The variables needed are *Scraper* and *FilterCollector.* However, an additional *Collector* variable was erroneously added to the denominator. Each site was affected by this change. The average of the differences was 3.52 with the maximum difference being 27.96.

5.0 PREVIOUS REFERENCE SELECTION – "TOP 5 EPT"

As mentioned previously, DEQ staff originally used a "Top 5 EPT" approach to the filtering criteria for selecting reference sites. Staff sought to pick criteria that would select sites scoring well in key metrics based on indicators of high quality macroinvertebrate assemblages according to Plafkin, 1989. The final selection criteria used in 2020 was as follows (done in sequential order):

1. Only use sites sampled for the Ouachita Mountains ERW (Extraordinary Resource Water) and Mineral & Nutrient study.
2. Sites with HBI values < 4.25
3. Sites with Percent Dominance < 0.2
4. Sites within the top 5 EPT Index scores* of sites stemming from filter 3

*The top 5 EPT Index scores may result in more than 5 selected reference sites, especially if there were multiple sites with the same EPT index scores.

8.0 REFERENCES

ADEQ (Arkansas Division of Environmental Quality). 2022. Assessment Methodology for the Preparation of the 2022 Integrated Water Quality Monitoring and Assessment Report."https://www.adeq.state.ar.us/water/planning/integrated/303d/pdfs/2022/am_2022_draft_5_final.pdf

Hilsenhoff, William L. 1987. "An Improved Biotic Index of Organic Stream Pollution." *The Great Lakes Entomologist*.

Lenat, David R. 1993. "A Biotic Index for the Southeastern United States: Derivation and List of Tolerance Values, with Criteria for Assigning Water-Quality Ratings." *Journal of the North American Benthological Society*.

MDEQ (Mississippi Department of Environmental Quality). 2003. "Development and application of the Mississippi benthic index of stream quality (M-BISQ)." *MDEQ, Office of Pollution Control*, Jackson.
Available: www.deq.state.ms.us/mdeq.nsf/pdf/WMB_fullM_BISQReport/$File/303dlBl_Final_Report_070903_Report_and_Append.PDF?OpenElement. (March 2013) [Google Scholar]

Plafkin, James L. 1989. Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish. *United States Environmental Protection Agency, Office of Water.*

5.1 Concerns with the "Top 5 EPT"

The set of criteria laid out previously performed well for the Ouachita Mountains Ecoregion, but was overly-selective for Arkansas's low-gradient systems. When testing the method on South Central Plains data (not included in the 2022 period of record), the initial filter for the "Top-5 EPT" method was limited to 2 possible reference sites. Streams in low gradient systems, and especially in the lower Mississippi, have been found to have low numbers of EPT taxa (MDEQ, 2003), which have historically been used in developing tolerance values (Lenat, 1993). Thus, metrics developed for the Plafkin study have worked well determining our high-gradient, EPT-rich ecoregions, but not as well for low-gradient ecoregions. Instead of selecting different filter thresholds (e.g. HBI > 6.25, considered "fair" water quality, but likely more in-line with our low-gradient reference sites) for each ecoregion DEQ wishes to propose an update to the reference site selection framework into a simplified and less subjective percent based methodology. Again, DEQ recognizes that the following methods will not be a "fix-all", but are what we feel are most comparable among ecoregions until IBIs are developed.

6.0 UPDATED REFERENCE SELECTION – "TOP 15%"

The 2022 data set being used as an example contains 43 total sampling events (40 sites total; 3 sites sampled twice). No new data was collected or removed between the 2020 and 2022 period of record (POR), and all sites needing to be assessed were contained within the Ouachita Mountain ecoregion. The information provided below is based on the 2022 data set.

The proposed filter for reference selection is summarized as follows:

1. Determine the number of sites that make up 15% of the total data set. Use conventional rounding to deal with decimals (ie. 15% of 43 = 6.45, which becomes 6).
2. Using that resulting number, find the 15% of scores that represent best ecological condition for both HBI (lowest 15%) and EPT-Chironomidae Ratio (highest 15%). There may be sites that overlap. In this example, the maximum amount of possible reference sites is 12. For the 2022 assessment, there are 10 sites in the result; 2 sites being in the top 15% for both metrics.

6.1 Metric Selection Rationale

We opted to remove the first filter "Only use sites sampled for the Ouachita Mountains ERW (Extraordinary Resource Water) and Mineral & Nutrient study" since each ecoregion was not likely to have enough ERW designated waters to create a robust reference condition. Additionally, automatically assuming that these waters are of the highest quality at the time of assessment may lead to missing important water quality issues occurring therein.

Fifteen percent was selected with future ecoregion studies in mind. Current projects (including the Boston and Ozark Mountain ecoregions), which will be captured in future

cycles range contain approximately 30 sites. Selecting a cutoff of 10% would limit our reference conditions to 3 sites per metric. Conversely, 20% seemed to be too inclusive (9 sites per metric for the Ouachita Mountains, which could potentially put 18 sites in our reference condition). The primary reasons for choosing HBI and EPT-Chironomidae Ratio are because they take into account abundance and relative sensitivity of the macroinvertebrate community. HBI is a metric that is based around using tolerance values to create its scale. With that in mind, HBI is the most direct metric DEQ uses incorporating tolerance value with abundance. When this metric is selected in the reference condition generation process, there isn't speculation about how tolerant the organisms are. The scale will trend lower with higher abundance of sensitive species and vice-versa. Thus, this metric will select for sites with the most sensitive taxa assemblages. Between the two methods, average HBI decreased from 3.64 to 3.39, moving toward a more sensitive community.

In addition to HBI, we wanted to select a filter that accounted for the ratio of intolerant to tolerant species. The EPT-Chironomidae Ratio incorporates abundance, but the respective abundances (EPT vs Chironomidae) are associated with taxa of varying tolerance values. Within this context, the EPT groupings will have lower average tolerance values than the Chironomidae taxa. Using the EPT-Chironomidae ratio as one of the two filters to select reference sites will still account for sensitive EPT species relative to less sensitive chironomids despite their lower abundance expected in the low-gradient ecoregions. Accounting for the proportion of the EPT community was considered more robust than looking at the EPT index alone, especially in low-gradient systems. Between the two methods, the EPT-Chironomidae Ratio increased from 3.62 to 23.37, indicating a higher number of sensitive EPT taxa to chironomids.

Given DEQ's set of metrics in the 2022 Assessment Methodology, these (HBI and EPT-Chironomid Ratio) are the current subset of metrics that are the most robust (Plafkin., 1989). We did not want to consider the top 15% of all 6 metrics due to the increased chance of overlap between metrics, selecting the majority of sites for the reference condition (i.e. the 2022 data would have 36 of the 43 data points selected).

The metrics not used as screens are not necessarily robust indicators of perturbations when observed in isolation. Dominance is generally considered to be better when the values are lower. However, there is no certainty that low dominance values will be represented by taxa with low tolerance values and vice-versa. Although the average percent contribution nearly doubled from the "Top-5 EPT" method to the "Top 15%" method (0.16 to 0.29%, respectively), the difference in average tolerance values increased only slightly (4.36 to 4.45, respectively). As this pertains to reference conditions, higher dominance factored into the final aggregate may ensure that the average used to judge individual sites will not disproportionately judge higher dominance values as "poor" given that those sites may likely have highly sensitive taxa. A similar idea was behind not selecting taxa richness, and EPT richness for the proposed filtering criteria due to the weak correlation between tolerance values and taxa richness in particular (R^2 =0.042). As stated above, EPT Index was considered as a filter metric, but the EPT:Chironimid filter had a more protective average HBI (3.58 vs 3.84).

6.2 Metric Selection Discussion

The primary goal was to demonstrate that the subset of metrics being used in the "Top 15%" Method framework are the most robust in terms of abundance and sensitivity using current biological integrity assessment methodology. This framework is intended to result in a reasonable enough subset of sites to calculate sufficient reference conditions for assessment. The IBI's that will be developed will be specifically calibrated to respective Ecoregions and will be able to relate a larger suite of metrics in a more robust, statistical framework.

6.3 Effect of Updated Selection On Original 2020 Listings

2020 Macro listings

Site ID	Stream Name	Assessment Unit	Top 5 EPT Score	Top 15 Score	Delist?
SFS0002	South Fork Saline River	AR_08040203_020	50	72.2	Yes†
OUA0195	South Fork Saline River	AR_08040203_022	44.4	50	No
OUA0223	Stokes Creek	AR_08040101_907	50	61.1	Yes
ARK0209	Brodie Creek	AR_11110207_824	50	44.4	No
OUA0100	Cove Creek	AR_08040102_970	50	61.1	Yes

†This would have also been delisted due to the data corrections described in section 4.0.

Proposed 2022 Listings

Site ID	Stream Name	Assessment Unit	Top 5 EPT Score	Top 15 EPT Score	Listing Status
ARK0187	Negro Branch	AR_11110206_514	50	44.4	New*
ARK0209	Brodie Creek	AR_11110207_824	50	44.4	Remnant

OUA0194	Irons Fork	AR_08040101_929	61.1	33	New
BRC0002	Bear Creek	AR_11110206_015	50	50	New*
OUA0195	South Fork Saline River	AR_08040203_022	44.4	50	Remnant

*These segments should have been listed in 2020, but were left off in error.

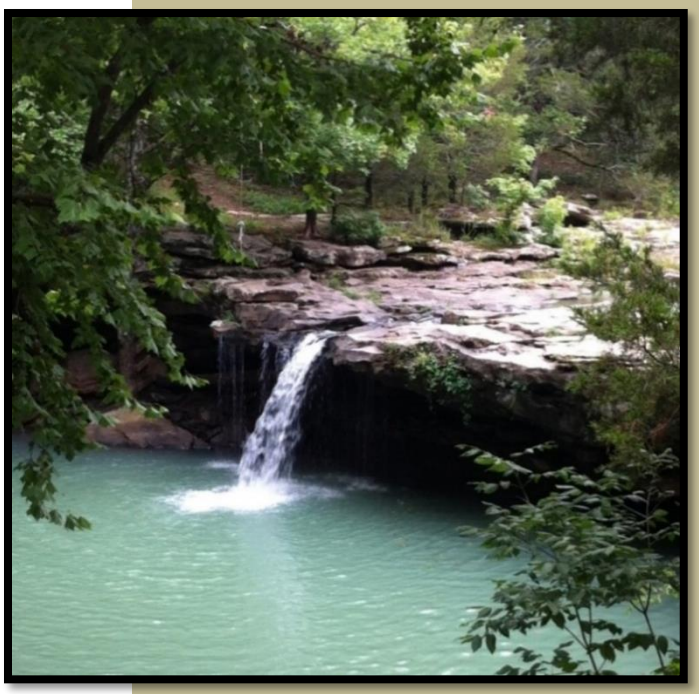
7.0 CONCLUSION

The updated reference selection resulted changes to 2020 listings, but it does so by way of a process that is more reproducible to any data set ADEQ acquires for future assessments. One of the delistings (AR_08040203_020) occurred as a result of the data error corrections described in section 4.0. The other two delistings resulted from a change in methodology, but previously had the highest comparable estimates (50%) in the non-attainment decision matrix (see Table 5 in Arkansas's 2022 Assessment Methodology). There was one new listing as a result of method changes (AR_08040101_929). The percent comparison changed primarily due to the weight of the Chironomid-EPT ratio reference condition, which was 3.25 in 2020 and 23.36 in 2022. Justification for using this metric for reference condition along with HBI can be found in section 6.1. Given the lack of documentation for establishing reference condition, DEQ attempted to develop a standardized method which would be objective and robust enough for varying ecoregional conditions and the expected amount of samples therein. The method described above is intended to serve as a temporary solution until the IBI's are developed and deployed.

APPENDIX C – THE 2022 ASSESSMENT METHODOLOGY

ASSESSMENT METHODOLOGY

2022



For the Preparation of:

The 2022 Integrated Water Quality Monitoring and Assessment Report

Pursuant to Clean Water Act Sections 303(d) and 305(b)

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

1.0 ASSESSMENT BACKGROUND

Section 305(b) of the Federal Water Pollution Control Act (hereinafter "Clean Water Act") requires states to perform a comprehensive assessment of the State's water quality to be reported to the U.S. Environmental Protection Agency (EPA) every two years. The report provides information on the quality of the state's waters; the extent to which state waters provide for the protection and propagation of a balanced population of fish, shellfish, and wildlife, and allow recreational activities in and on the water; and how pollution control measures are leading to water quality standards attainment.

In addition, Section 303(d) of the Clean Water Act requires each state to identify waters where existing pollution controls are not stringent enough to achieve state water quality standards and establish a priority ranking of these waters. States must develop Total Maximum Daily Loads (TMDLs) or other corrective actions for the identified waters. TMDLs describe the amount of each pollutant a waterbody can receive and not violate water quality standards. States submit the list of impaired waters (303(d) list) to EPA. EPA has the option to approve, disapprove, or take no action on the list within 30 days of submission.

Arkansas Department of Energy and Environment, Division of Environmental Quality (DEQ) follows the specific requirements of 40 C.F.R. § 130.7-130.8 and EPA's most current 305(b) reporting and 303(d) listing requirements and guidance when developing this assessment methodology. Current EPA guidance recommends producing one report combining requirements of the Clean Water Act for Sections 305(b) reporting and 303(d) submissions. This is, in general, referred to as the Integrated Report (IR).

Arkansas's combined report is the *Integrated Water Quality Monitoring and Assessment Report* (305(b) Report). The 305(b) Report describes the quality of all of the surface waters of the state that were evaluated for a specified assessment period (period of record). This report is prepared using the *Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b), and 314 of the Clean Water Act (EPA 2005)* which is supplemented by memoranda regarding development of the 2008, 2010, 2012, 2014, 2016, 2018, and 2022 305(b) Reports (EPA 2006, 2009, 2011, 2013, 2015, 2017, and 2021 respectively). Arkansas's waters are evaluated in terms of whether their assigned water quality criteria and designated uses, as delineated in the Arkansas Pollution Control and Ecology Commission's (APC&EC) Rule[1] 2 *Water Quality Standards for Surface Waters of the State of Arkansas* (APC&EC 2020), herein referred to as Rule 2, are being attained.

Rule 2 provides the foundation for the 305(b) Report, establishing water quality standards for surface waters of the State of Arkansas; designated uses associated with those water quality standards; and criteria and policies established to protect, maintain, and restore designated uses. Water quality data are assessed for compliance with Rule 2 to determine impairment and designated use support, based upon the frequency, duration, and/or magnitude of water quality criteria exceedances as delineated in DEQ's assessment methodology.

[1]Act 315 of 2019 was enacted by the Arkansas General Assembly requiring revisions of the use of Rule in lieu of Regulation.

2.0 INTEGRATED REPORTING CATEGORIES

Arkansas's waters are assessed based on water quality criteria and designated use support, according to Rule 2 and this assessment methodology. Water quality standard attainment is determined based on support of designated uses and/or criteria in place to protect those designated uses. An assessment unit (AU), previously referred to as a monitoring segment, is the basic unit of record for conducting and reporting water quality assessments. AUs are individual stream reaches, lakes, lake areas, or other defined waterbodies and are grouped by planning segments and 8-digit hydrologic unit codes (HUC). AUs are delineated using GIS layers and several real world considerations such as tributaries, land use boundaries, point source dischargers, monitoring stations, physical breaks, and other factors.

Arkansas's assessments are formatted to reflect EPA's 305(b)/303(d) Integrated Report (IR) guidance (EPA 2005, 2006, 2009, 2011, 2013, 2015, 2017, and 2021) which suggests placing AUs into the following five integrated reporting categories upon assessment. AUs may be assessed as Category 1, 'support' if all water quality criteria and designated uses, for which data are available, are attained. AUs may be assessed as 'non-support' if any water quality criteria or designated use is not attained, and may be placed in Category 4 or 5, as appropriate. AUs may be placed in Category 3 if there is not enough information to make a scientifically defensible attainment decision. Historically, Category 2 is rarely used in Arkansas.

Some impaired AUs will be distinguished between pollutant causes currently without a TMDL (Category 5) and pollutant causes for which TMDLs have already been approved (Category 4a). In some instances, a regulatory response outside of a TMDL is permissible and the AU/pollutant pair is assigned to Category 4b (alternative pollution control) or Category 5 alt. In instances where non-attainment is not caused by a pollutant, AUs will be placed in Category 4c. Examples of this would be naturally occurring deviations from current criteria where site specific criteria would be more appropriate but are yet to be developed. Note that Category 4 waters are not part of the 303(d) list of impaired waterbodies; however, a list of Category 4 waters are public noticed along with the 303(d) list (Category 5).

The 303(d) list of impaired waterbodies (Category 5) consists of AUs not supporting one or more designated use and/or not meeting water quality criteria. Category 5 is prioritized by DEQ for planning and management purposes in accordance with 40 § C.F.R. 130.7 (b)(4) which states: "The list required under §§ 130.7(b)(1) and 130.7(b)(2) of this section shall include a priority ranking for all listed water quality-limited segments still requiring TMDLs, taking into account the severity of the pollution and the uses to be made of such waters and shall identify the pollutants causing or expected to cause violations of the applicable water quality standards. The priority ranking shall specifically include the identification of waters targeted for TMDL development in the next two years." Therefore, any waterbody ranked as "high" within Category 5 may be targeted for TMDL development.

Category 1. Attains all water quality criteria and supports all designated uses; categorized by existence of a TMDL or not for one or more constituents.

1a. Attaining all water quality criteria and supporting all designated uses, no use is threatened. No TMDL exists for any constituents.

1b. Attaining all water quality criteria and supporting all designated uses; however, a TMDL remains in place for one or more constituents.

Category 2. Available data and/or information indicate that some, but not all of the designated uses are supported.

Category 3. Insufficient data and/or information are available to make a use support determination.

3a. No data available.

3b. Insufficient data available.

- Data do not meet all quality requirements outlined in this assessment methodology;
- Waters in which the data are questionable because of Quality Assurance and/or Quality Control (QA/QC) procedures and/or the AU requires confirmation of impairment before a TMDL is scheduled.
- Where limited available data and/or information indicate potential impacts or downward trends in water quality, the following waterbodies in Category 3 may be prioritized (on a case-by-case basis) for additional investigation: waters designated as Extraordinary Resource Waters (ERW), Ecologically Sensitive Waterbody (ESW) or Natural and Scenic Waterways (NSW); domestic water supplies; and waters located in known karst areas.

Category 4. Water quality standards are not attained for one or more designated uses but the development of a TMDL is not required because:

4a. A TMDL has been completed for the listed parameter(s); or

4b. Other management alternatives are expected to result in the attainment of the water quality standard; or

4c. Non-support of the water quality standard is not caused by a pollutant.

Category 5. The waterbody is impaired, or one or more water quality standards are not attained. Waterbodies in Category 5 will be prioritized as:

High

- Truly impaired; develop a TMDL or other corrective action(s) for the listed parameter(s).

Medium

- Waters currently not attaining standards, but may be de-listed with future revisions to APC&EC Rule 2, the state water quality standards; or

- Waters which are impaired by point source discharges and future permit restrictions are expected to correct the problem(s).

Low

- Waters currently not attaining one or more water quality criteria, but assessed designated uses are determined to be supported; or
- There is insufficient data to make a scientifically defensible decision concerning designated use attainment. Where more data and/or information are needed to verify the need for TMDL development or other corrective action(s) for the listed parameter(s), the following waterbodies in Category 5 may be prioritized (on a case-by-case basis) for additional investigation: waters designated as ERW, ESW, or NSW; domestic water supplies; and waters located in known karst areas; or
- Waters DEQ assessed as unimpaired, but were assessed as impaired by EPA.

Alt

- Waters where alternative restoration approaches may be more immediately beneficial or practicable in achieving WQS than pursuing the TMDL approach in the near-term.

Data assessment forms the basis of water quality standard attainment decisions. In order to conduct accurate assessments, evaluated data must reflect current ambient surface water quality conditions, adhere to robust quality and quantity considerations, and represent accurate temporal and spatial requirements. Data are assessed based on the current EPA-approved water quality standards for the State of Arkansas (APC&EC, 2020) and this assessment methodology. In some cases, a weight of evidence approach may be used to supersede a preliminary assessment. When this occurs, justification will be provided within the 305(b) report as well as submitted with the 303(d) list for public notice and any supporting documentation will be provided. A more robust discussion of how final attainment decisions are determined can be found in Section 3.10 Final Attainment Determination Process.

3.1 WATER QUALITY DATA TYPES AND CONDITIONS

3.1.1 Data Types

Water quality data are collected in a variety of ways in Arkansas and are utilized differently for assessment purposes. Data sets are generally classified as discrete or continuous. Unless otherwise specified, assessment methodologies are designed for use with discrete data sets. When continuous data are used for assessment purposes, assessment methodologies will be identified as such. Different data types will not be combined for assessment purposes. If multiple data types exist for one AU the most appropriate set will be used for assessments based on robustness, scientific soundness, and representativeness. A weight of evidence approach may be applied when making decisions about which data set to use.

3.1.1.1 Discrete Data

Discrete data are generally characterized as data generated from samples taken at the same location with a significant amount of time passing, or a significant event (such as a storm event) occurring between each sample such that potential changes in water chemistry can be noted. These samples can be *in situ* measurements (pH, temperature, etc.) or grab samples to be taken to a lab for analysis (metals, toxics, etc.). An example of a discrete data set would be DEQ's ambient monitoring network where samples are collected from the same locations on a monthly basis. Discrete sampling works well when resources are limited, allowing entities to sample a larger area over time.

3.1.1.2 Continuous Data

Continuous data are generally characterized as data generated from a series of discrete *in situ* samples taken at frequent, regular intervals at the same location over time. Typically, these data are collected using a continuous logging meter taking measurements in regular time increments such as from once a second to once an hour. Water quality parameters typical of this collection are pH, dissolved oxygen, and temperature.

For assessment purposes, DEQ considers two types of continuous data: long-term and short-term. Long-term continuous data spans long time periods, from weeks to years. Long-term continuous data are typically collected at minute to hourly intervals. Short-term continuous data spans a shorter time frame, typically a 48 – 96 hour period. These time periods target diurnal shifts in

certain water quality parameters and measurements are typically collected every few seconds or minutes.

When managing data for assessment purposes, both long-term and short-term continuous data taken in less than hourly readings (example: data recorded every fifteen minutes) will be calculated into hourly averages. All long-term and short-term assessments require at least hourly readings. Short-term continuous data must span 90% of each 24 hour period. Data acceptance will be determined by representativeness.

3.1.2 Data Conditions

At times, data results are "censored," meaning they are reported as less than some value or greater than some value. This is a common and typical occurrence. DEQ will handle these data in the following ways.3.1.2.1 Data below detection limits

Data that are lower than detection limits of laboratory methods or equipment are typically represented as less than the numerical detection limit (example: <0.05 mg/L). In these cases, DEQ will use one-half the detection limit and assign that value as the numeric result for that data point (Clarke 1998, Scott et al. 2016, Croghan and Egeghy 2003, and Dixon 2005). In the example, the data point would be 0.025 mg/L. This is done so that the result can be used, as an actual number, in assessment calculations and data management. Numbers with symbols cannot be easily sorted or managed, thus the need to be converted into a usable number.

3.1.2.2 Data above detection limits

Data that are greater than detection limits of laboratory methods will be represented as the numerical detection limit (example: >1500 cfu/100 mL) as long as the detection limit is greater than applicable criteria. In the example, the data point would be 1500 cfu/100 mL, which could be utilized for assessing a ERW, ESW, NSW, Reservoir or Lake in the secondary contact season (criteria = 1490 cfu/100 mL), but could not be used for all other waters in the secondary contact season (criteria = 2050 cfu/100 mL). Maximum detection limits that are below applicable criteria will not be used for assessment purposes.

3.1.2.3 Other data conditions

Some data are represented as approximate. This is common for bacteria data as it is common to extrapolate to a larger sample size than what is analyzed (EPA 2014). Approximate data (Example: ~125 cfu) will be used in assessments by dropping the approximate sign and using the whole number value. In the example, the data point would be 125 cfu. This is done so that the result can be used, as an actual number, in assessment calculations and data management. Numbers with symbols cannot be easily sorted or managed, thus the need to be converted into a usable number.

3.2 DATA ASSEMBLY

Pursuant to 40 C.F.R. § 130.7(b)(5), DEQ assembles and evaluates all existing and readily available water quality data and information, from DEQ and outside entities, to make water quality standard attainment decisions. Data are evaluated for use by determining adherence (or not) to data quality considerations outlined in this document (Sections 3.3 and 6.0 and subsections thereof).

The primary data used in the assessment of Arkansas's water quality are generated as part of DEQ's water quality monitoring activities, described in the *State of Arkansas's Water Quality Monitoring and Assessment Program, Revision 6* (DEQ 2021). Additionally, local, state, and

federal agencies, and other entities are solicited by DEQ to provide water quality data that meets or exceeds DEQ accepted QA/QC protocols.

Any entity may submit water quality data to DEQ without solicitation. All data received will be evaluated for use. The 305(b) report will include a list of all outside entities who provided data as well as a map of where data were collected that were used in assessments.

PERIOD OF RECORD FOR THE 2022 305(B) REPORT:

Toxics and ammonia toxicity analysis: *April 1, 2018 through March 31, 2021*

Beaver Lake site specific nutrient criteria: *January 1, 2016 through December 31, 2020*

All other analyses: *April 1, 2016 through March 31, 2021*

3.2.1 No New Data

If no new qualifying water quality data have been generated for an AU during the current period of record, water quality standard and designated use attainment decisions from the preceding assessment period will be carried forward unless a substantial change in water quality standards or assessment methodology has occurred. If substantial changes in water quality standards or assessment methodology has occurred since the preceding assessment period, and those changes would affect previous assessment decisions, the data from the preceding period of record may be re-assessed using newly-adopted water quality standards and newly defined methodology to determine current water quality standard attainment.

3.2.2 Absence of Data

AUs may be "monitored" or "non-monitored." A monitored AU contains a water quality monitoring station within its delineated boundaries. A non-monitored AU does not contain a water quality monitoring station within its delineated boundaries. Water quality standard attainment assessments can be made for AUs in the absence of data if it can be reasonably established that non-monitored AUs are similar in watershed characteristic and condition to contiguous monitored AUs. When this occurs, the AU will be identified as "evaluated."

DEQ will consider land use practices, tributary location, impoundments, point sources, and other hydrological features that could impact the water quality between the station site and the contiguous non-monitored AU. If similarity in watershed characteristic and/or condition cannot be established, contiguous non-monitored AUs will remain unassessed.

Water quality standard non-attainment assessments, in the absence of data, can be made for non-monitored stream segments if it can be reasonably established that the segment is similar with respect to the cause and magnitude of impairment to contiguous monitored waters. However, an evaluation of non-attainment will not be made for non-monitored AUs when the source or the origin of the impairment in contiguous monitored waters is unknown, and/or when the magnitude or frequency of the impairment is such that contiguous segments may not be impacted.

Non-monitored AUs that are evaluated using data from monitored AUs will be noted as such in the Impaired Waterbodies 303(d) list.

3.3 DATA QUALITY CONSIDERATIONS

DEQ maintains a strong commitment to the collection and use of high quality data to support environmental decisions and regulatory programs. DEQ uses data submitted by various entities in different ways, depending on the quality and quantity of the data; however, all data submitted to DEQ will be evaluated for use. Although all existing and readily available water quality data are "evaluated," not all data can be used to make assessments or attainment decisions. Data sets must first be evaluated for adherence to data quality requirements as defined below.

Data quality requirements are categorized into Phase I and Phase II. Phase I requirements are general to all parameters; whereas Phase II requirements are specific to the parameter being assessed. Phase II requirements are explained in more detail in Section 6.0 and subsections thereof.

Certain Phase I data quality requirements are considered "essential." These requirements are essential for data to be considered scientifically valid for any purpose. Essential data requirements are listed below along with other Phase I requirements.

Data sets that meet all Phase I and Phase II data quality requirements can be used for attainment decisions. Data sets that fail to meet all quality requirements may be used for screening purposes. However, failure to meet essential quality requirements will exempt those data from use in screening or assessment purposes altogether.

Each individual data set presented for consideration will be evaluated against Phase I data quality requirements. If the data set meets essential Phase I data quality requirements, it will then be evaluated against the remaining Phase I and Phase II data quality requirements. If the data set does not meet essential Phase I data quality requirements it will not be evaluated further.

Phase I Data Quality Requirements

Essential data requirements:

- Be characteristic of the main water mass or distinct hydrologic areas. For example, not taken within a mixing zone, side channel, tributary, or stagnant backwater, etc.
- Be reported in standard units recommended in the relevant approved method and that conform to Rule 2 or can be directly compared or converted to units within Rule 2.
- Have been collected and analyzed under a DEQ accepted QA/QC protocol. Data collection protocols (QAPP and SOP, as apply) should accompany the data.
- All laboratory analyzed parameters (not *in situ*) must be analyzed pursuant to the rules outlined in the Environmental Laboratory Accreditation Program Act, Ark. Code Ann. § 8-2-201 *et seq.* The name and location of the laboratory should accompany the data.
- Be accompanied by precise collection metadata such as time, date, stream name, parameters sampled, and sample site location(s), preferably latitude and longitude in either decimal degrees or degrees, minutes, seconds.
- Be received in either a Microsoft Excel spreadsheet or compatible format not requiring excessive formatting by DEQ, preferably in the template provided by DEQ.
- Have been collected within the period of record for the current assessment cycle.

Phase II Data Quality Requirements

Phase II data quality requirements will be specific for each parameter and will be detailed in the appropriate subsection of Section 6.0 Specific Standards.

If multiple data sets pass Phase I data quality requirements for the same AU, they may be combined and considered as an aggregate data set for Phase II data quality requirements (see Section 3.3.2 Aggregate Data Sets for more information). If only one data set for a given AU passes Phase I data quality requirements it will be considered as a standalone data set for Phase II data quality requirements.

These requirements apply to the entire data set for a given AU, whether individual or aggregate, that will be considered for assessment.

- Meet sampling temporal conditions described for each parameter or designated use being assessed. These conditions include season (time of year) such as "critical season," "secondary contact season," or "primary season," each defined within the applicable parameter.
- Meet data quantity requirements for each parameter or designated use being assessed. If quantity requirements are not met, but all other data quality considerations are met, AUs may be assessed as Category 3b. Insufficient data available.
- Meet data distribution throughout the appropriate season(s) or overall time frame appropriate for each parameter or designated use being assessed. Samples should always be "evenly distributed" for the temporal conditions outlined for each parameter. "Evenly distributed" is defined in Section 6.0. AUs that do not meet specific distribution requirements may be assessed as Category 3b. Insufficient data available.
- Meet sample spatial requirements described for each parameter or designated use being assessed. These can include lake sampling depth, specific sampling locations, or other spatial requirements.

3.3.1 Individual Data Sets

Individual data sets must first meet the Phase I data quality requirements outlined in Section 3.2 above to be considered for assessment purposes. If an individual data set is the only data set for a given AU, then that data set must also meet the Phase II data quality requirements outlined above to be used for attainment purposes.

When more than one individual data set exists for a given AU, each data set will be independently evaluated for use. If water quality data indicate that an AU is not homogenous, resulting in conflicting attainment conclusions, the AU will warrant further examination. The assessor will evaluate data from each station individually to confirm impairments and determine whether or not it would be more appropriate to split an AU. If data indicate that it is more appropriate to split an AU, the resulting AUs will be re-assessed based on data within the newly-defined boundaries for the applicable period of record.

3.3.2 Aggregate Data Sets

AUs are delineated to represent homogenous waters with regard to water quality. Therefore, it follows that any independent sample taken from an AU is representative of conditions within that

AU. Occasionally more than one monitoring station with available data exists within an AU or several entities may provide data for the same monitoring location. Since each independent sample is considered to be representative of the AU at the time of collection, aggregation of independent samples into one data set within an AU may be appropriate. Aggregation can occur for data from the same entity or from different entities. Aggregation of data sets will be evaluated on a case by case basis.

Data sets of different types (e.g. discrete vs. continuous) will not be combined into an aggregate data set. Different data types will always be assessed independently, if available.

Aggregation of data sets may be full or partial. Fully aggregated data sets will use all data points from all available data sets (that meet data requirements) from an AU. Partially aggregated data sets will use a subset of available data points for the AU. These scenarios are described below.

3.3.2.1 Fully aggregating data sets

Individual data sets of the same type (e.g. discrete data) that pass Phase I quality requirements may be combined into a single aggregate data set for that AU. Individual data sets that do not pass Phase II quality requirements on their own may still be used for assessments if, when combined with another data set of the same type, pass Phase II quality requirements as an aggregate set.

3.3.2.2 Partially aggregating data sets

For certain conditions, explained below for both streams and lakes, data sets may be partially aggregated. Partial aggregation of data sets may be appropriate in order to not weight data toward temporal or spatial conditions.

For streams, data sets taken within the same AU on the same day will be partially aggregated. Data sets will be aggregated and duplicate data points per day will be omitted, retaining only the most protective data point per day. This will prevent weighting limited data sets temporally.

For lakes, samples taken at multiple site locations within the same AU, and on the same day may be aggregated if they are taken at different depths. If multiple data sets exist for a single lake AU on the same day, the most protective data point for each depth will be used (provided Phase II depth requirements are met). This will prevent weighting data spatially.

3.4 DATA QUANTITY CONSIDERATIONS

DEQ strives to follow EPA guidance, which encourages collection of adequate data to make well-grounded attainment determinations (EPA 2005). Use of limited data is acceptable to EPA as limited financial, field, and laboratory resources often dictate the number of samples that can be collected and analyzed (EPA 2002). EPA has not established, required, nor encouraged the establishment of rigid minimum sample set size requirements in the water quality standards attainment status determination process (EPA 2005). As such, EPA discourages the use of target sample sizes applied in an assessment methodology as absolute exclusionary rules (EPA 2005).

However, EPA recognizes that assessments based on larger sample sets are more likely to yield accurate conclusions than assessments based on smaller sample sets, and that it may be appropriate to identify an initial sample size screen, but also provide for a further assessment of sample sets that do not meet the target sample size (EPA 2005).

DEQ strives for a minimum of ten (10) water quality samples to make water quality criteria and designated use attainment decisions for most physical and chemical parameters. The primary goal of obtaining ten (10) or more data points is to protect against the occurrence of Type I and Type II errors. A Type I error would result in assessing an assessment unit as non-support when it is actually fully supporting its criteria and uses. A Type II error occurs when an assessment unit is assessed as support despite it actually not meeting its criteria and/or uses.

For water quality and designated use attainment decisions, data sets containing fewer than ten (10) ($n<10$) data points will be used as a screening sample, unless fewer than ten (10) samples is appropriate for the parameter, such as primary contact season bacteria, or if non-attainment is reached in only one (1) or two (2) samples such as radioactivity, toxics, and ammonia. Surface water AUs with fewer than 10 ($n<10$) data points and two or more ($n\geq2$) exceedances will warrant additional monitoring and may be placed into Category 3 for further investigation. Impairments based on this limited data set may be assessed on a case-by-case basis. Once the sample size reaches ten (10) data points or greater ($n\geq10$) the appropriate rate of exceedance applies.

Specific data quantity requirements are described for each parameter within Section 6.0 and subsections thereof. AUs that fail to meet the Phase II data quantity requirement may be categorized as Category 3, insufficient data to determine attainment.

3.5 DATA REPRESENTATIVENESS CONSIDERATIONS

Spatial and temporal representativeness of data and information must be considered when characterizing annual ambient conditions for a given AU. Specifics of spatial and temporal distribution will be discussed within each parameter in Section 6.0 and subsections thereof of this document.

Spatial and temporal representativeness of a grab sample is a qualitative assessment addressed primarily in sample design through selection of sampling sites and use of procedures that reflect project goals and environment being sampled (i.e., monitoring the presence and magnitude of toxicity at specific sites for potential impacts on aquatic life may require specialized parameter sampling). For assessment purposes, grab samples from a given monitoring site are considered representative of the waterbody for that distance upstream and downstream in which there are no significant influences to the waterbody that might cause a change in water quality (e.g., point source discharges, confluence with another stream, etc.) or when there is an absence of contextual information indicating unstable hydrologic conditions, such as: 1) precipitation, 2) stream flow, 3) differing land use patterns, or 4) historic patterns of pollutant concentrations in the monitoring segment.

Continuous data are considered representative when the data set accurately represents seasonality in the waterbody. Data sets with significant blocks of missing time that do not reflect ambient conditions will not be used for assessment purposes.

3.6 STATISTICAL CONFIDENCE

Past EPA guidelines (EPA 1996 and 2002) have recommended listing waterbody segments as impaired (for conventional pollutants) when "10% of measurements exceed the water quality criterion." Making attainment decisions by simply applying a literal percent exceedance rate (10 exceedances out of 100 equals 10%) is referred to as a "raw score" assessment method. While this

"raw score" assessment method can be applied, it errs significantly toward making false positive listings (Washington State Department of Ecology 2002).

In an effort to limit or reduce false positive (Type 1 error) listings, DEQ utilizes binomial distribution methodology for certain parameters, as appropriate. It will not be used on parameters where only one or two excursions of the criteria will result in an assessment of non-attainment such as toxics, radioactivity, and ammonia. Additionally, binomial distribution method will not be applied to bacteria data due to assessment language established in Rule 2.507. The binomial distribution method will be applied to the following parameters: temperature, turbidity, pH, dissolved oxygen, and minerals.

When the binomial distribution method is not applied, the specific method used for each parameter is described within applicable Sections 6.1- 6.12.

The binomial distribution method is a non-parametric, robust, and well known method for characterizing the probability of proportions; in this case, the percent a data set exceeds a predetermined constant. Statistical analysis methods, such as the binomial distribution method, are used to increase the confidence level of the final decision of attainment of water quality criteria.

Use of the binomial distribution method also allows DEQ to statistically consider the waterbody as a whole rather than just the available sample set. The "raw score" method only determines exceedances in the available sample set, which are only a representation of the whole waterbody. The binomial distribution method allows for a margin of safety to statistically declare, with a set degree of confidence, that the sample set accurately represent the waterbody as a whole. This is more effective, from an environmental standpoint, than simply determining whether or not the sample set exceed standards.

The EPA suggests that states determine the level of error they are willing to accept during the decision making process. Statistical methods should be employed to help achieve the state's acceptable level of error. DEQ strives to attain a greater than ninety percent (>90%) confidence level when determining the water quality attainment status of an AU. Table 2 specifies the minimum number of exceedances required per sample size to list an AU on the 303(d) list of impaired waterbodies. Conversely, Table 3 specifies the maximum number of exceedances allowed per sample size to de-list a listed AU. Each table assumes >90% confidence level for a decision with exceedance rates of ten (10), twenty (20), and twenty-five (25) percent using the binomial distribution method.

Utilizing the mathematical functions in Microsoft Excel, the exceedance rates were calculated using the following formula:

BINOM.INV(X,Y,Z)

Where:

X = number of samples in the data set (Trials)

Y = percent exceedance rate expressed as a decimal, (Probability_s); 10%=0.10, 20%=0.20, 25%=0.25

Z = confidence level to be attained, expressed as a decimal, (Alpha) 90%=0.9

Text above in parentheses is language input for Microsoft Excel arguments.

Thus, for a data set that contains 10 samples, to be assessed on a 10% exceedance rate and attain a 90% confidence level in the final decision, the formula would be:

BINOM.INV(10,0.1,0.9)

Table 1: Minimum number of sample exceedances required to assess as non-attaining (**list**) water quality standards, using binomial distribution, with 90% confidence that the true exceedance percentage in the waterbody is greater than or equal to 10%, 20%, or 25%.

10% Exceedance Rate	
Sample Size	Minimum Number of Exceedances Needed to Assess as Non-Attains
10-11	2
12-18	3
19-25	4
26-32	5
33-40	6
41-47	7
48-55	8
56-63	9
64-71	10
72-79	11
80-88	12
89-96	13
97-100	14

20% Exceedance Rate	
Sample Size	Minimum Number of Exceedances Needed to Assess as Non-Attains
10-13	4
14-16	5
17-20	6
21-24	7
25-28	8
29-32	9
33-36	10
37-40	11
41-45	12
46-49	13
50-53	14
54-57	15
58-62	16
63-66	17
67-70	18
71-75	19
76-79	20
80-83	21
84-88	22
89-92	23
93-96	24
97-100	25

25% Exceedance Rate	
Sample Size	Minimum Number of Exceedances Needed to Assess as Non-Attains
10	4
11-13	5
14-16	6
17-19	7
20-23	8
24-26	9
27-29	10
30-33	11
34-36	12
37-39	13
40-43	14
44-46	15
47-50	16
51-53	17
54-57	18
58-60	19
61-64	20
65-67	21
68-71	22
72-74	23
75-78	24
79-81	25
82-85	26
86-88	27
89-92	28
93-96	29
97-99	30
100	31

Table 2: Maximum number of sample exceedances allowed in order to assess as attaining (**de-list**) water quality standards, using binomial distribution, with 90% confidence that the true exceedance percentage in the waterbody is greater than or equal to 10%, 20%, 25%.

10% Exceedance Rate	
Sample Size	Maximum Number of Allowable Exceedances to Assess as Attains
10-11	1
12-18	2
19-25	3
26-32	4
33-40	5
41-47	6
48-55	7
56-63	8
64-71	9
72-79	10
80-88	11
89-96	12
97-100	13

20% Exceedance Rate	
Sample Size	Maximum Number of Allowable Exceedances to Assess as Attains
10-13	3
14-16	4
17-20	5
21-24	6
25-28	7
29-32	8
33-36	9
37-40	10
41-45	11
46-49	12
50-53	13
54-57	14
58-62	15
63-66	16
67-70	17
71-75	18
76-79	19
80-83	20
84-88	21
89-92	22
93-96	23
97-100	24

25% Exceedance Rate	
Sample Size	Maximum Number of Allowable Exceedances to Assess as Attains
10	3
11-13	4
14-16	5
17-19	6
20-23	7
24-26	8
27-29	9
30-33	10
34-36	11
37-39	12
40-43	13
44-46	14
47-50	15
51-53	16
54-57	17
58-60	18
61-64	19
65-67	20
68-71	21
72-74	22
75-78	23
79-81	24
82-85	25
86-88	26
89-92	27
93-96	28
97-99	29
100	30

3.7 INTERNAL DATA ASSESSMENT METHOD

Data generated by DEQ will be analyzed using the Water Quality Analysis Reporter (WQAR), Microsoft Excel, R, or other data management software. Attainment results are calculated using the water quality standards in Rule 2 and the processes outlined in DEQ's Assessment Methodology.

Station IDs are assigned to AUs where applicable. AUs with assigned stations are identified as "monitored." AUs without stations, where data from another contiguous segment are used for evaluating attainment, are identified as "evaluated" and the AU containing the station data are linked to the unit without the data for tracking purposes. AUs are identified as "unassessed" when there are no water quality data available with which to evaluate attainment.

Water quality standards and methodology processes have been entered into the WQAR system as standard sets. Standard sets contain specific water quality criteria for parameters that apply to waters. For instance, the "Boston Mountains Less than 10 sqmi" standard set contains specific criteria that apply to Boston Mountain streams with watershed areas of less than 10 square miles for temperature, primary and critical season dissolved oxygen, and turbidity all flows and base flows. The "Boston Mountains Less than 10 sqmi" standard set can then be applied to all AUs in the Boston Mountains ecoregion that have watershed areas of less than 10 square miles. Other standard sets that apply more broadly include parameters such as pH, metals, bacteria, and minerals.

WQAR automatically calculates attainment of each standard using station data pulled directly from DEQs internal Laboratory Information Management System (LIMS). Attainment is calculated for each standard applied to the monitoring segment for the period of record. The integrated reporting category (Section 2.0) for each parameter is examined and an integrated reporting category is recommended for the monitoring segment.

Any internal data incapable of being assessed by WQAR for any reason will be assessed following the same protocols described below for external data.

3.8 EXTERNAL DATA ASSESSMENT METHOD

Readily available data not generated by DEQ is considered "external data." Because WQAR was created for use with DEQ internal data formatting only, extracted directly from LIMS, external data must be assessed through other means. Typically, external data are presented in Microsoft Excel or Microsoft Excel compatible format and are evaluated using tools available through the Microsoft Excel program.

3.9 IMPAIRMENT SOURCE DETERMINATION

For any monitored AU where a water quality standard has been assessed as non-support, the source(s) of impairment will be identified using available information (field observation, land use maps, point source location, nonpoint source assessment reports, special studies, and knowledge of field personnel familiar with the waterbody).

3.10 FINAL ATTAINMENT DECISION PROCESS

For parameters that allow for both discrete and continuous data (pH, temperature, and dissolved oxygen), data types will not be combined. Discrete data and continuous data will be evaluated separately. Attainment decisions will be based on the most appropriate and protective decision for the AU. Factors that could determine which data set will be used for attainment decisions could include quantity of data, quality of data sets, and time of year data were collected. A weight of evidence approach will be used to make the final attainment decision. When multiple data types meet all quality requirements for a given AU, final attainment decisions will be justified within the 305(b) report and any supporting documentation will be provided.

Occasionally DEQ will make final attainment decisions that differ from the initial attainment result produced from strict adherence to the methods contained within this assessment methodology. These differences in attainment results are made using a weight of evidence approach. Factors that may influence the decision to provide a differing final attainment decision could include, but are not limited to, magnitude, frequency, and duration of data; reports or peer reviewed literature; and DEQ personnel's unique understanding of a particular AU (such as ecoregion transitional zones and anthropogenic modifications within the AU).

Final attainment decisions that differ from initial attainment decisions reached using WQAR (for internal data) or Microsoft Excel (or similar software for external data, biological data, WET data, etc.) will be noted within the 305(b) report as well as submitted with the 303(d) list for public notice and any supporting documentation will be provided.

4.0 WATER QUALITY STANDARDS

Water quality standards are comprised of: 1) an antidegradation policy; 2) designated uses; and 3) narrative and numeric criteria, which work in concert to protect water quality.

4.1 ANTIDEGRADATION

An antidegradation policy is a requirement of the federal Clean Water Act, which is designed to prevent or limit future degradation of the nation's waters. Rule 2 contains an antidegradation policy that applies to all surface waters of the state. Per Rule 2.201 existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected. Arkansas's High Quality Waters as described in Rule 2.202 and Outstanding Resource Waters, as described in Rule 2.203 are to be protected and maintained for those beneficial uses and water quality for which the outstanding resource designation was granted. These waterbodies may be listed as non-support if the chemical, physical, and/or biological characteristics for which the waterbody was designated have been determined to be impaired or absent, as defined by the following assessment criteria. Per Rule 2.204, in those cases where potential water quality impairment associated with a thermal discharge is involved, the antidegradation policy and implementing method shall be consistent with Section 316 of the Clean Water Act, 33 U.S.C. § 1326.

4.2 DESIGNATED USES

The primary purpose of the 303(d) list of impaired waterbodies is to identify those waters that are not currently supporting one or more designated uses or not attaining one or more water quality criteria. The support/non-support status of designated uses is most often determined utilizing water quality criteria or other water quality indicators. EPA guidance (2005) makes suggestions as to which water quality constituents are protective of which designated uses to determine the support status of those designated uses.

DEQ has developed Table 3 to illustrate which water quality criteria may be used either independently or together to assist in determining the support status of each designated use. The designated use "Other Uses" Rule 2.302(J) is typically not dependent upon current water quality criteria so it is not included in Table 3. Fish Consumption is not a designated use in Rule 2; however it can be used to list a waterbody on the 303(d) list. Fish advisories are issued by the Epidemiology Branch of the Arkansas Department of Health (ADH). Parameters for which no assessment methodology exists in this document were not included within this table.

Table 3: Designated Uses for Arkansas's surface waters and rules used for assessment.

	Extraordinary Resource Waters, Ecologically Sensitive Waterbody, and Natural and Scenic Waterways Rule 2.302 (A), (B), and (C)	Primary and Secondary Contact Rule 2.302 (D) & (E)	Aquatic Life Rule 2.302 (F)	Domestic Water Supply Rule 2.302 (G)	Industrial & Agriculture Water Supply Rule 2.302 (H) & (I)
Biological Integrity Rule 2.405	•		•		
Temperature Rule 2.502	•		•		
Turbidity Rule 2.503	•				
pH Rule 2.504	•				
Dissolved Oxygen Rule 2.505	•		•		
Radioactivity Rule 2.506	•	•	•	•	•
Bacteria Rule 2.507	•	•			
Toxic Substances Rule 2.508	•		•	•	
Nutrients Rule 2.509	•		•		
Site Specific Minerals Rule 2.511(A)	•		•		
Minerals Rule 2.511(C)	•			•	•
Ammonia Rule 2.512	•		•		

4.3 WATER QUALITY CRITERIA

4.3.1 Narrative Criteria

Rule 2 contains narrative criteria (written descriptions) that apply to all waters of the state and are used to evaluate support of applicable designated uses. Narrative criteria include general descriptions, such as the existence of nuisance species, biological integrity, taste and odor producing substances, visible globules on surface waters, nutrients, and toxins.

When listing and delisting methodologies are not specified for a particular narrative criterion within the assessment methodology, the following general methods may be used. Narrative criteria are evaluated by using screening levels established by EPA or other scientific literature, if they are available, as well as other information, including water quality studies, documentation of fish kills or contaminant spills, and photographic evidence. A weight of evidence approach may be used and final attainment decisions will be justified within the 305(b) report as well as submitted with the 303(d) list for public notice and any supporting documentation will be provided.

4.3.2 Numeric Criteria

Numeric criteria are values established in Rule 2 that provide a quantitative basis for assessing designated use support, developing permit limitations, and for managing point and nonpoint loadings in Arkansas's surface waters. Listing and delisting methodologies for instream water quality against numerical criteria are outlined in Section 6.0 and subsections thereof.

5.0 BIOLOGICAL INTEGRITY

This section establishes the protocol for assessment of biological integrity for Arkansas's surface waters, per APC&EC Rule 2.405:

> *For all waters with specific aquatic life use designated in Appendix A, aquatic biota should not be impacted. Aquatic biota should be representative of streams that have the ability to support the designated fishery, taking into consideration the seasonal and natural variability of the aquatic biota community under naturally varying habitat and hydrological conditions; the technical and economic feasibility of the options available to address the relevant conditions; and other factors.*
>
> *An aquatic biota assessment should compare biota communities that are similar in habitat and hydrologic condition, based upon either an in-stream study including an upstream and downstream comparison, a comparison to a reference water body within the same ecoregion, or a comparison to community characteristics from a composite of reference waters. Such a comparison should consider the seasonal and natural variability of the aquatic biota community. It is the responsibility of the Department to evaluate the data for an aquatic biota assessment to protect aquatic life uses designated in Appendix A. Such data may be used to develop permit effluent limitations or conditions.*

ASSESSMENT METHODOLOGY FOR BIOLOGICAL INTEGRITY

Biological integrity is evaluated using macroinvertebrate and/or fish communities collected within the waterbody. At a minimum, biological data must be collected using methods outlined in a Quality Assurance Project Plan with requirements equal to or more stringent than that of DEQ. Results from acute and chronic toxicity tests of vertebrates and invertebrates will also be evaluated, when available, but are not required to make a use determination.

To assess an AU for biological integrity, determine the support status of either macroinvertebrates and/or fish using the methods outlined in Sections 5.1 and/or 5.2. Results from fish and/or macroinvertebrate community analysis, and toxicity test data if available, will be used to determine support or non-support of the aquatic life designated use. Refer to Figures 1 and 2 for a step-wise process regarding use attainment using biological integrity.

There is always the possibility that a biological community may be assessed as non-support due to unrepresentative data such as the collection of a large number of young-of-year specimens and at transition zones between ecoregions. This information and a short explanation will be included in the 305(b) report.

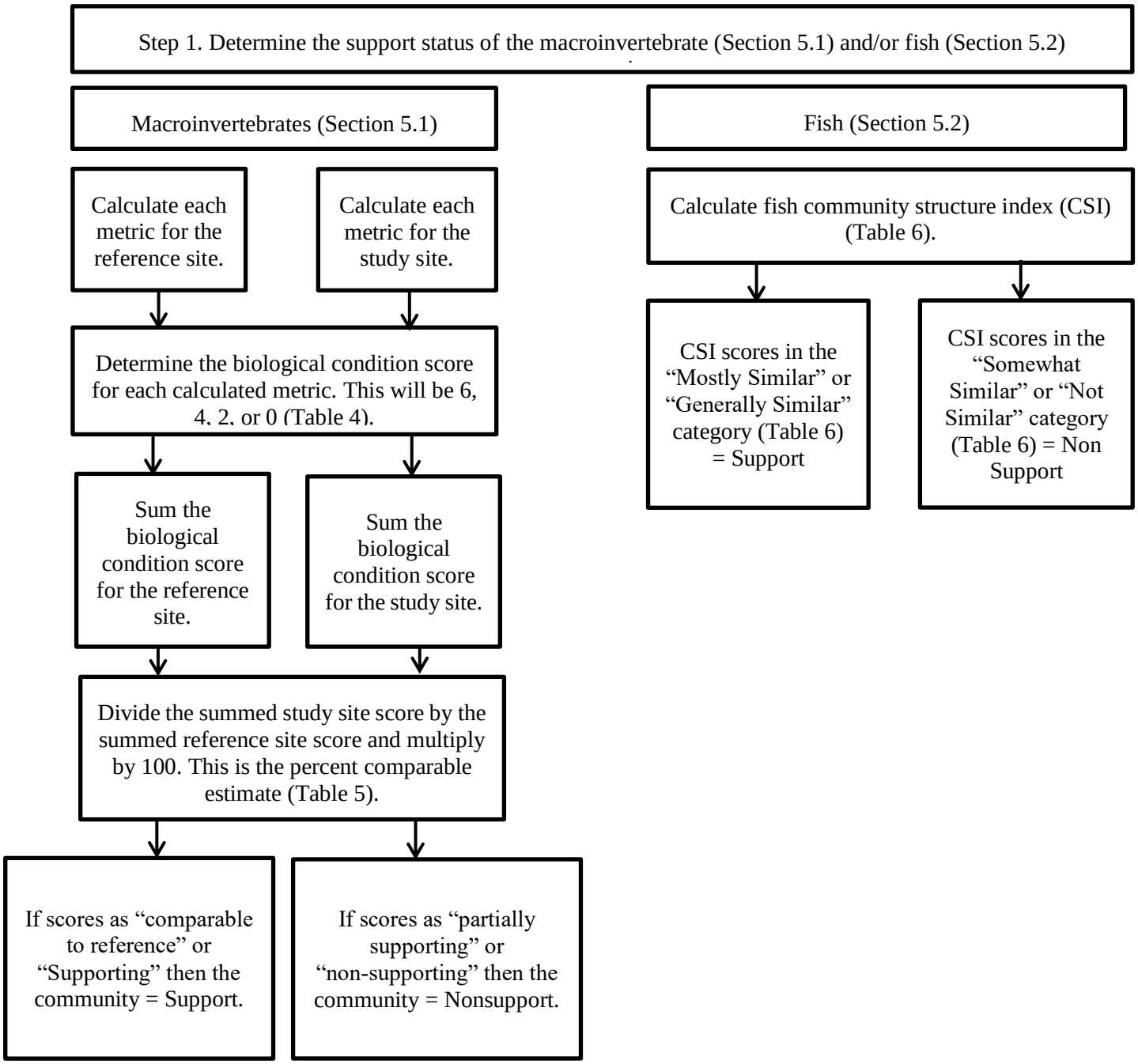


Figure 1: Determining Aquatic Life Use designated use attainment Step 1.

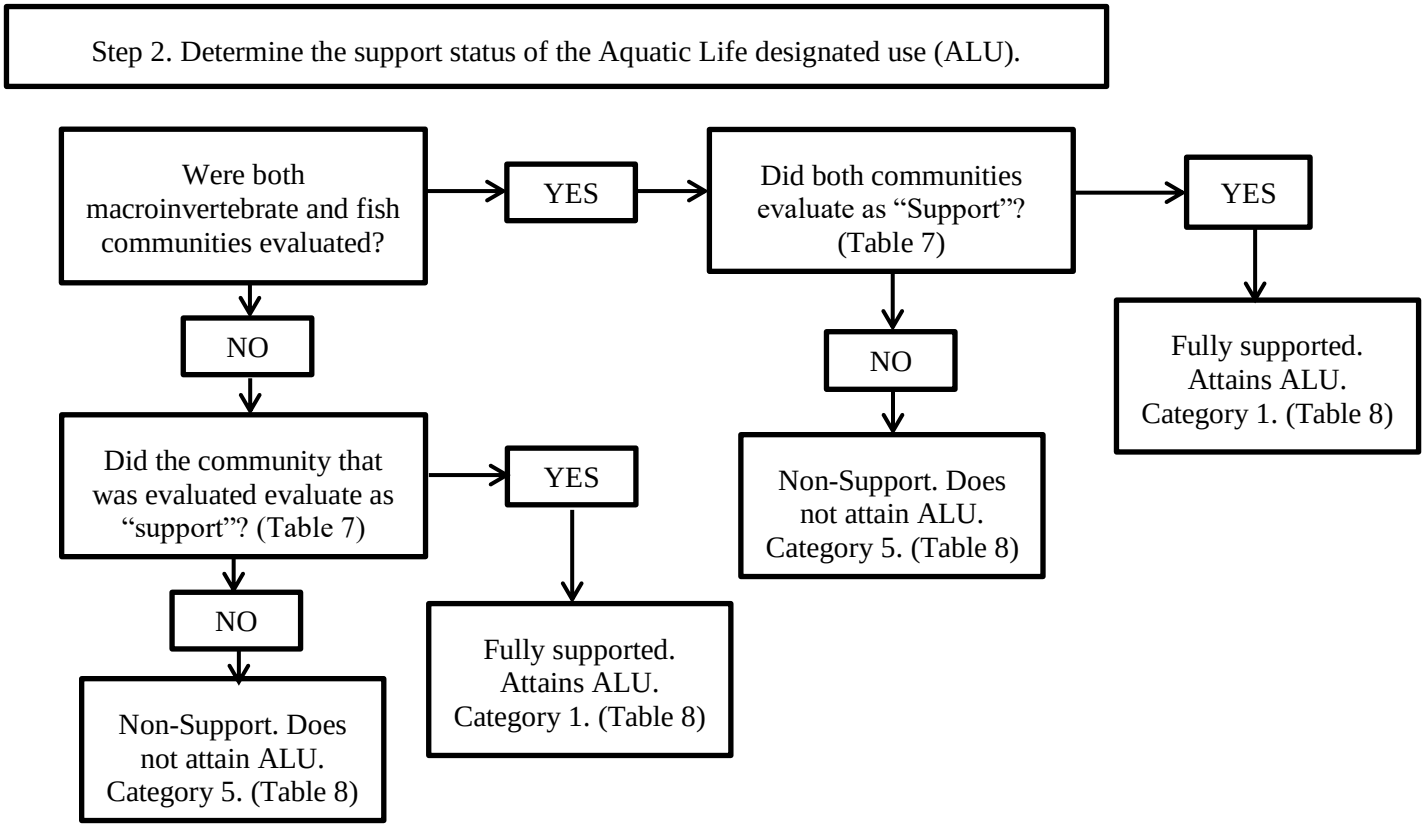


Figure 2: Determining Aquatic Life Use designated use attainment Step 2.

5.1 MACROINVERTEBRATE COMMUNITY ANALYSIS

Modified metrics set forth in *Rapid Bioassessment Protocols for Use in Stream and Rivers* (Plafkin et al. 1989) are used in analysis of macroinvertebrate community samples. Each site will have a Rapid Bioassessment score derived from a multi-metric analysis, which includes: 1) taxa richness, 2) Ephemeroptera-Plecoptera-Trichoptera Index (EPT Index), 3) Hilsenhoff Biotic Index (HBI), 4) percent contribution of dominant taxa, 5) ratio of EPT to Chironomid taxa, and 6) ratio of scrapers to filter-collectors. See *Arkansas's Water Quality and Compliance Monitoring Quality Assurance Project Plan* (ADEQ 2020) at the DEQ website: http://adeq.state.ar.us for more information. DEQ's metric modification or deviation from Plafkin et al. (1989) includes removal of the ratio of shedders to total taxa metrics. DEQ field sampling methodologies do not include the collection of coarse particulate organic matter (CPOM) (i.e. leaf packs) to evaluate macroinvertebrate communities. Collection of CPOM is required to calculate the ratio of shredders to total taxa.

Macroinvertebrate community analysis is as follows: using raw data, calculate all six metric values (Table 4) for each study site and reference site. Instructions for these calculations are found in Plafkin et al. (1989). Metric values from each study site are compared to metric values from a reference site for five of the six metrics to calculate a percent comparison to reference value. Percent contribution of dominant taxa is not a comparison to reference value, but rather actual percent contribution for the given site. Using the percent comparison to reference values for all six metrics, a bioassessment score (6, 4, 2, or 0) is assigned for each metric (Table 4). Bioassessment scores for each metric per site (study and reference) are summed to create a single biological condition score for that site. The ratio of scores between the sample site to reference site provides the percent comparable estimate for each study site (Table 5). The percent comparable estimate score is then used to determine attainment status of "support" or "non-support" (Table 5).

Table 4: Macroinvertebrate bioassessment metrics and scoring criteria[1].

Metric	Biological Condition Scoring Criteria			
	6	4	2	0
Taxa Richness[2]	≥80%	<80-60%	<60-40%	<40%
Hilsenhoff Biotic Index[3]	≥85%	<85-70%	<70-50%	<50%
Ratio of EPT to Chironomid Abundances[2]	≥75%	<75-50%	<50-25%	<25%
% Contribution of Dominant Taxa[4]	<20%	20-<30%	30-<40%	≥40%
EPT Index[2]	≥90%	<90-80%	<80%-70	<70%
Ratio of Scrapers to Filter-Collectors[2]	≥50%	<50-35%	<35-20%	<20%

[1] Modified from Plafkin, J.L. M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers: Benthic macroinvertebrates and fish. U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Washington D.C. EPA 440-4-89-001.

[2] Score is a ratio of study site to reference site X 100.

[3] Score is a ratio of reference site to study site X 100.

[4] Scoring criteria evaluate actual percent contribution, not percent comparability to reference site.

[5] Range of values obtained. A comparison to the reference site is incorporated in these indices.

Table 5: Scoring criteria for macroinvertebrate community attainment decisions (modified from Plafkin et al. 1989).

	Biological Condition Category	% Comparable Estimate	Attribute
Support	Comparable to reference	≥83%	Comparable to the best situation in an ecoregion.
	Supporting	54-79%	Community structure less than reference site. Taxa richness lower and tolerant forms are more prevalent.
Non-Support	Partially Supporting	21-50%	Obvious decline in community structure with loss of intolerant forms. EPT index reduced.
	Non-supporting	<20%	Community dominated by 1 or 2 taxa, few taxa present.

If the percent comparable estimates fall between the 50-54% cutoff for support vs non-support, a weight of evidence approach may be utilized to make a final support or non-support decision using available physical, chemical, and biological data and information.

5.2 FISH COMMUNTIY ANALYSIS

DEQ's Community Structure Index (CSI) (Table 6) will be used in the analysis of fish communities. The CSI was established utilizing information from the 1987 ecoregion survey (APC&EC 1987) and supplemented with data from additional least-disturbed streams identified by DEQ personnel. A group of Arkansas ichthyologists reviewed the data. The current metric scores and similarity ranking categories were established utilizing the prevailing deviations in the ecoregion survey data set and employed best professional judgment. Ecoregion specific metric scores for watersheds (>10 mi^2) outlined in *Arkansas's Water Quality and Compliance Monitoring Quality Assurance Project Plan* (ADEQ 2020), available at the DEQ website: http://adeq.state.ar.us, will be calculated for each site and total scores will be evaluated and assessed as follows:

Table 6: Fish Community Structure Index (CSI) ecoregion values.

Ecoregion	Total Score	Category	Attribute
Ozark Highlands	**37-45**	Mostly Similar	Comparable to the best situation to be expected. Balanced trophic structure and optimum community structure present.
	25-36	Generally Similar	Community structure less than expected. Taxa richness lower than expected. Some intolerant taxa loss. Percent contribution of tolerant forms may increase.
	13-24	Somewhat Similar	Obvious decline in taxa richness due to the loss of tolerant forms. Loss of Key and Indicator taxa.
	0-12	Not Similar	Few taxa present and normally dominated by one (1) or two (2) taxa.
Boston Mountains **Ouachita Mountains** **AR River Valley** **Typical Gulf Coastal** **Spring-Influenced Gulf Coastal**	**25-32**	Mostly Similar	Comparable to the best situation to be expected. Balanced trophic structure and optimum community structure present.
	24-17	Generally Similar	Community structure less than expected. Taxa richness lower than expected. Some intolerant taxa loss. Percent contribution of tolerant forms may increase.
	16-9	Somewhat Similar	Obvious decline in taxa richness due to the loss of tolerant forms. Loss of Key and Indicator taxa.
	0-8	Not Similar	Few taxa present and normally dominated by one (1) or two (2) taxa.
Channel Altered Delta **Least-Disturbed Delta**	**22-28**	Mostly Similar	Comparable to the best situation to be expected. Balanced trophic structure and optimum community structure present.
	21-15	Generally Similar	Community structure less than expected. Taxa richness lower than expected. Some intolerant taxa loss. Percent contribution of tolerant forms may increase.
	14-8	Somewhat Similar	Obvious decline in taxa richness due to the loss of tolerant forms. Loss of Key and Indicator taxa.
	0-8	Not Similar	Few taxa present and normally dominated by one (1) or two (2) taxa.

AQUATIC LIFE USE ATTAINMENT DETERMINATION

LISTING METHODOLOGY:

AUs may be listed as non-support when one or both of the evaluated biological communities (macroinvertebrates and/or fish) indicate perturbation/degradation (Tables 7* 8), or when one or both of the toxicity test organisms (vertebrate and/or invertebrate) fail greater than one acute or chronic toxicity test in a three-year period (Table 9).

Aquatic life designated use attainment can be assessed using both biological integrity data and water chemistry data. When only water chemistry data are available for an AU and assessment results indicate water quality impairment for temperature, dissolved oxygen, ammonia, radioactivity, site specific minerals, or toxic substances it will be assumed that the aquatic life designated use is not attained. However, if physical and biological data are collected which indicate the aquatic life designated use is attained, the water quality impairment will remain, but it will be noted that the aquatic life designated use is being attained.

DELISTING METHODOLOGY:

AUs may be listed as support when evaluated biological communities (macroinvertebrates and/or fish, which ever community led to the impaired attainment decision) do not indicate perturbation/degradation (Table 8) and when there have been no ambient toxicity test failures, acute or chronic, in a three-year period (Table 9).

Table 7: Biological community assessment determination.

Data Type	Support	Non-Support
Macroinvertebrate Community Data Available	Macroinvertebrate community structure analysis (Table 5) indicates comparable to reference or supporting	Macroinvertebrate community structure analysis (Table 5) indicates partially supporting or non-supporting*
Fish Community Data Available	Community Structure Index score (Table 6) is either mostly or generally similar; general presence of sensitive and indicator species	Community Structure Index score (Table 6) is either somewhat or not similar; absence of sensitive and indicator species*

* The aquatic life designated use may be assessed as support, despite an initial evaluation of non-support, if it is demonstrated that the non-support assessment is due to unrepresentative biological community data and not toxicity; based on acceptable variances in ecoregion community structures. Under certain conditions, biological community data can be skewed due to an unrepresentative sample, which includes but is not limited to:

- Collection of irruptive species (e.g., large percentage of young-of-year in an isolated area that is not representative of the entire AU), which could trigger an inaccurate ‘non-support’ determination.
- Transitional areas between ecoregions.
- AUs that are intermittent in nature.

A weight of evidence approach is used in these circumstances to prevent the inappropriate listing of waters. If a support determination is made due to an unrepresentative sample, it will be explained in detail in the 305(b) Report and supporting documentation will be provided.

Table 8: Aquatic life designated use listing protocol.

Type of Data Present	Evaluation Result		Final Assessment	Listing Category
	Fish Community	Macroinvertebrate Community		
Fish Community and/or Macroinvertebrate Community	S	S	FS	1
	S	NS	NS	5
	NS	S	NS	5
	NS	NS	NS	5
At Least One Biological Community	S	NA	FS	1
	NA	S	FS	1
	S	S	FS	1
	NA	NA	UA	3
	NS	NA	NS	5
	NA	NS	NS	5

S = Support NS = Non-Support FS = Fully Supporting NA = No Available Data UA = Unassessed

Table 9: Ambient toxicity listing protocol.

Type of Test	Evaluation Result		Final Assessment	Listing Category
	Vertebrate	Invertebrate		
Acute Toxicity	S	S	FS	1
	S	NS	NS	5
	NS	S	NS	5
	NS	NS	NS	5
Chronic Toxicity	S	S	FS	1
	S	NS	NS	5
	NS	S	NS	5
	NS	NS	NS	5

S = Support NS = Non-Support FS = Fully Supporting

6.0 SPECIFIC STANDARDS

Per Rule 2.501 (Applicability), unless otherwise indicated, the following specific criteria shall apply to all surface waters of the state at all times except during periods when flows are less than the applicable critical flow. Streams with regulated flow will be addressed on a case-by-case basis to maintain designated instream uses. These criteria apply outside the applicable mixing zone.

6.0.1 General Description of Phase II Data Quality Requirements

In general, Phase II requirements are categorized into temporal, distribution and quantity, and spatial categories. Phase II data quality requirements are discussed in detail for each parameter within their respective Section (6.1 - 6.12). Each general category is described below.

Temporal requirements

Temporal requirements relate to time of year, season, or other time dependent sample collection considerations. If a parameter does not have a particular season, such as pH, temporal requirements many not be listed for this parameter; or the temporal requirement may read "year-round." These parameters should be collected throughout the year without preference to any particular season or time of year. Conversely, a parameter with specific seasonal considerations, such as bacteria, will have temporal requirements listed for the particular sampling season(s)—for this example, primary and secondary contact season. "Season" will be defined within the parameter.

As per Phase I data quality requirements, data should be collected within the stated assessment cycle period of record for each parameter.

Distribution and quantity requirements

Distribution requirements are intended to be a guideline unless otherwise explicitly stated. If a parameter says "ten (10) samples evenly distributed over twelve (12) months," that is intended to be a guideline for minimum sample size and how those samples should be distributed. If more samples are taken over a longer time period, then DEQ would assess the data set for appropriate distribution.

"Evenly distributed" is meant to be a general guideline for sample distribution. It does not mean that monthly samples must be taken exactly thirty (30) days apart without exception or that an exact number of days must exist between each sample in a data set. There is no way to describe or predict every scenario for sample distribution, so "evenly distributed" is intended to be a general guide. "Evenly distributed" is also intended to guard against samples being clumped or concentrated toward one time of the year when the parameter should be collected year-round. DEQ welcomes entities to ask about sample distribution prior to finalizing sampling plans for data intended to be submitted for assessment purposes.

Quantity requirements are intended to be minimum number of samples necessary to assess waters. This applies to both listing and delisting methodologies. Three exceptions exist to this minimum requirement: radioactivity (Section 6.5), toxic substances (Section 6.7), and ammonia (Section 6.12). For these three parameters, an assessment of non-attainment can be achieved before reaching ten (10) samples because these parameters are not assessed based on a percentage for non-attainment purposes; they are assessed as "not attained" whenever an absolute threshold is reached. A minimum of ten (10) samples are still required to delist or to assess as "attains" for these three parameters.

Spatial requirements

Spatial requirements relate to where samples should be taken within the waterbody, if any particular requirements exist beyond Phase I requirements or QAPP requirements. As per Phase I data requirements, all data must be characteristic of the main water mass or hydrologic area. Spatial requirements may also be noted in the QAPP accompanying the data. If no spatial requirements are listed in Phase II data requirements, then collection should adhere to Phase I and QAPP requirements.

Spatial requirements for lakes and reservoirs are intended to ensure assessment consistent with standards development. Primary contact recreation, secondary contact recreation, and the majority of lake aquatic life productivity occur in the epilimnion (uppermost stratified layer). For these reasons, Arkansas's water quality standards for lakes and reservoirs were developed using data collected within the epilimnion. If no epilimnion exists—due to natural depth limitations or seasonal mixing—samples should be taken between 0.33 and 2.0 meters of the surface unless otherwise noted within the Phase II quality requirements for a parameter.

6.0.2 Continuous data

For assessment purposes, both short-term and long-term continuous data taken in less than hourly readings (example: data recorded every fifteen minutes) will be calculated into hourly averages. Both long-term and short-term continuous data will be evaluated for representativeness. Short-term continuous data must span 90% of the 24 hour period.

6.1 TEMPERATURE

This section establishes the protocol for assessment of temperature criteria within Arkansas's surface waters, per APC&EC Rule 2.502:

The following standards are applicable:

Waterbodies	***Limit °C (°F)***
Streams	
Ozark Highlands	*29 (84.2)*
Boston Mountains	*31 (87.8)*
Arkansas River Valley	*31 (87.8)*
Ouachita Mountains	*30 (86.0)*
Springwater-influenced Gulf Coastal	*30 (86.0)*
Typical Gulf Coastal	*30 (86.0)*
Least-Altered Delta	*30 (86.0)*
Channel-Altered Delta	*32 (89.6)*
White River (Dam #1 to mouth)	*32 (89.6)*
St. Francis River	*32 (89.6)*
Mississippi River	*32 (89.6)*
Arkansas River	*32 (89.6)*
Ouachita River (L. Missouri to Louisiana state line)	*32 (89.6)*
Red River	*32 (89.6)*
Lakes and Reservoirs	*32 (89.6)*
Trout Waters	*20 (68.0)*

PHASE II DATA QUALITY REQUIREMENTS FOR TEMPERATURE

Both discrete and long-term continuous data can be considered for temperature assessment of all waters. Short-term continuous data sets, such as 48-96 hour diel studies will be used for screening purposes only.

Streams and Rivers

1. Temporal requirements

- Discrete Data
    - Discrete data should be collected year-round.

- Long-Term Continuous Data
  - For non-trout waters, long-term continuous data should be collected during the critical season.
    - Critical season is defined, in Rule 2, as that time of year when water temperatures naturally exceed 22 degrees Celsius for the given AU.
    - Only data above 22 degrees Celsius will be utilized for assessments made using long-term continuous data.
  - For trout waters long-term continuous data should be collected year-round.

2. Minimum distribution and quantity requirements
- Discrete Data
  - Ten (10) discrete samples are required to make temperature attainment decisions.
  - Data must be evenly distributed over at least two (2) years and three (3) quarters per year.
- Long-Term Continuous Data
  - For non-Trout Waters, data must be evenly distributed throughout the critical season.
  - For Trout Waters Long-term continuous data must cover ten (10) months of a twelve (12) month period
  - Data must be collected at least hourly.

3. Spatial requirements
- None that are not already covered in Phase I requirements.

Lakes and Reservoirs

1. Temporal requirements

- Discrete Data
  - Discrete temperature data should be collected year-round.
- Long-term Continuous Data
  - Collect long-term continuous data during the critical season.
    - Critical season is defined, in Rule 2, as that time of year when water temperatures naturally exceed 22 degrees Celsius for the given AU.
    - Only data above 22 degrees Celsius will be utilized for assessments made using long-term continuous data.

2. Minimum distribution and quantity requirements

- Discrete data
  - A minimum of ten (10) quarterly samples.
- Long-term Continuous Data
  - Data must be collected throughout the critical season.
  - Data must be collected at least hourly

3. Spatial requirements

- Take samples within the epilimnion (if present). Sample depth shall be between 0.33 and 2.0 meters.

ASSESSMENT METHODOLOGY FOR TEMPERATURE

Like data sets (e.g. discrete and discrete) from various sources may be combined into an aggregate data set as per Section 3.3.2; however, differing data types (discrete and long-term continuous) will not be combined. Refer to Section 3.11 for information regarding final attainment decisions should both types of data exist for an AU. Temperature assessments can be made using long-term continuous data measured for only one critical season; however, if multiple critical season data sets exist from different years, within the period of record, data sets will be combined. Continuous data will be calculated to hourly average for assessment purposes. This average will then be used as a discrete measurement and the total number of hourly averages will be used to determine the size of the sample set for comparison to Table 1. Binomial distribution method will be applied for temperature data assessments, per Section 3.7.

LISTING METHODOLOGY:

Stream, river, reservoir, and lake AUs may be assessed as non-attainment when, using the **ten (10) percent** exceedance rate within Table 1, greater than or equal to the minimum number of samples allowed for the entire qualifying data set exceed the applicable temperature criteria listed in Rule 2.502 (or site specific in Appendix A) . This methodology applies to both discrete and long-term continuous data sets.

DELISTING METHODOLOGY:

Stream, river, reservoir, and lake AUs may be assessed as support when, using the **ten (10) percent** exceedance rate within Table 2, no more than the maximum number of samples allowed for the entire qualifying data set exceed the applicable temperature criteria listed in Rule 2.502 (or site specific in Appendix A) . This methodology applies to both discrete and long-term continuous data sets.

In some instances, DEQ may use discrete data to delist AUs that were listed using continuous data, and vice versa. However, this will not be the rule, it will be the exception. When this occurs, justification of use of a different type of data for delisting will be provided within the 305(b) report as well as submitted with the 303(d) list for public notice and any supporting documentation will be provided. Justification for this methodology could include limited data availability, inability to acquire the same type of data that was used to list, or other special circumstances.

6.2 TURBIDITY

This section establishes the protocol for assessment of turbidity criteria within Arkansas's surface waters, per APC&EC Rule 2.503:

> *There shall be no distinctly visible increase in turbidity of receiving waters attributable to discharges or instream activities. The values below should not be exceeded during base flow (June to October) in more than 20% of samples. The values below should not be exceeded during storm flows in more than 25% of samples taken in not less than 24 monthly samples.*

Waterbodies	***Base Flows Values (NTU)***	***Storm Flow Values (NTU)***
Streams		
Ozark Highlands	*10*	*17*
Boston Mountains	*10*	*19*
Arkansas River Valley	*21*	*40*
Ouachita Mountains	*10*	*18*
Springwater-influenced Gulf Coastal	*21*	*32*
Typical Gulf Coastal	*21*	*32*
Least-Altered Delta	*45*	*84*
Channel-Altered Delta	*75*	*250*
Arkansas River	*50*	*52*
Mississippi River	*50*	*75*
Red River	*50*	*150*
St. Francis River	*75*	*100*
Trout	*10*	*15*
Lakes and Reservoirs	*25*	*45*

PHASE II DATA QUALITY REQUIREMENTS FOR TURBIDITY

Turbidity assessments can be made with discrete data collected in Nephelometric Turbidity Units (NTU) only. Data collected in Formazin Nephelometric Units (FNU) will be used for screening purposes only.

Short-term and long-term continuous data will be used for screening purposes, if available.

Base Flow

Streams and Rivers

1. Temporal requirements
   - Discrete data should be collected during base flow season.
   - Base flows season is defined, in Rule 2, as June to October.
2. Minimum distribution and quantity requirements
   - Ten (10) discrete samples are required to make turbidity attainment decisions for base flows.
   - Samples must be evenly distributed throughout the base flows season.
   - Samples must be taken over at least two (2) years.
3. Spatial requirements
   - None that are not already covered in Phase I requirements.

Lakes and Reservoirs

1. Temporal requirements
   - Discrete data should be collected during base flows season.
   - Base flow season is defined, in Rule 2, as June to October.
2. Minimum distribution and quantity requirements
   - Five (5) discrete samples are required to make turbidity attainment decisions for base flow.
   - Samples must be taken over at least three (3) years.
3. Spatial requirements
   - Take samples within the epilimnion (if present). Sample depth shall be between 0.33 and 2.0 meters.

Storm Flow

All Waters

1. Data temporal requirements
   - Discrete data should be taken year-round. This includes June to October (base flows season).
2. Minimum data distribution and quantity requirements
   - Discrete Data
     - Discrete samples must be taken in no less than twenty-four (24) monthly samples.
     - Samples must be evenly distributed throughout the time period sampled.
3. Spatial requirements
   - For lakes and reservoirs, take samples within the epilimnion (if present). Sample depth shall be between 0.33 and 2.0 meters.
   - For streams and rivers, none that are not already covered in Phase I requirements.

ASSESSMENT METHODOLOGY FOR TURBIDITY

Like data sets (e.g. discrete and discrete) from various sources may be combined into an aggregate data set as per Section 3.3.2. Discrete samples from multiple base flows seasons within the period of record (if exist) will be combined for assessments. If an AU is assessed as not meeting either the base flow or storm flow values, or both, it may be listed as non-attainment for turbidity. Binomial distribution method will be applied to turbidity data, per Section 3.6.

BASE FLOWS LISTING METHODOLOGY:

Stream, river, reservoir, and lake AUs may be assessed as non-attainment when, using the **twenty (20) percent** exceedance rate within Table 1 greater than or equal to the minimum number of samples for the entire qualifying data set from June to October exceed the applicable base flows values listed in APC&EC Rule 2.503.

BASE FLOWS DELISTING METHODOLOGY:

Stream, river, reservoir, and lake AUs may be assessed as in attainment when, using the **twenty (20) percent** exceedance rate in Table 2, no more than the maximum number of samples allowed for the entire qualifying data set from June to October exceed the applicable base flows values listed in APC&EC Rule 2.503.

STORM FLOWS LISTING METHODOLOGY:

Stream, river, reservoir, and lake AUs may be assessed as non-attainment when, using the **twenty-five (25) percent** exceedance rate within Table 1, greater than or equal to the minimum number of samples for the entire qualifying data set (sample set not to be fewer than 24 data points) exceed the applicable storm flows values listed in APC&EC Rule 2.503.

STORM FLOWS DELISTING METHODOLOGY:

Stream, river, reservoir, and lake AUs may be assessed as in attainment when, using the **twenty-five (25) percent** exceedance rate in Table 2, no more than the maximum number of samples allowed for the entire qualifying data set (sample set not to be fewer than 24 data points) exceed the applicable storm flows values listed in APC&EC Rule 2.503.

6.3 PH

This section establishes the protocol for assessment of pH criteria within Arkansas's surface waters, per APC&EC Rule 2.504:

> *pH between 6.0 and 9.0 standard units are the applicable standards for streams.*

PHASE II DATA QUALITY REQUIREMENTS FOR PH

pH assessments can be made using discrete data, short-term continuous data, or long-term continuous data in streams and rivers; and discrete data and long-term continuous data in lakes and reservoirs.

Streams and Rivers

1. Temporal requirements
   - pH data should be collected year-round.
2. Minimum distribution and quantity requirements
   - Discrete Data
     - Ten (10) discrete samples are required to make pH attainment decisions.
     - Discrete data must be evenly distributed over at least two (2) years and three (3) quarters per year.
   - Short-term Continuous data
     - Two (2) diel deployments of at least forty-eight (48) hours each.
     - Diel deployments must be spaced at least two weeks (14 days) apart.
     - The two diel deployments must be within the same year. You may have multiple years within the period of record (POR), but each year must have two deployments. Multiple years need not be consecutive.
     - Data must be collected at least hourly.
   - Long-term Continuous Data
     - Long-term continuous data must cover ten (10) month of a twelve (12) month period.
     - Data must be collected at least hourly.
3. Spatial requirements
   - None that are not already covered in Phase I requirements.

Lakes and Reservoirs

1. Temporal requirements
   - pH data should be collected year-round.
2. Minimum distribution and quantity requirements
   - Discrete Data
     - A minimum of ten (10) quarterly samples.
   - Long-term Continuous Data
     - Long-term continuous data must cover ten (10) of the twelve (12) month period

- Data must be collected at least hourly.

3. Spatial requirements

- Take samples within the epilimnion (if present). Sample depth shall be between 0.33 and 2.0 meters.

ASSESSMENT METHODOLOGY FOR pH

Like data sets (e.g. discrete and discrete) from various sources may be combined into an aggregate data set as per Section 3.3.2; however, differing data types (discrete, short-term continuous, and long-term continuous) will not be combined. Refer to Section 3.10 for information regarding final attainment decisions should more than one type of data set exist for an AU. Binomial distribution method will be applied to pH data, per Section 3.8.

LISTING METHODOLOGY:

Stream, river, reservoir, and lake AUs may be assessed as non-attainment when, using the **ten (10) percent** exceedance rate in Table 1, greater than or equal to the minimum number of samples for the entire qualifying data set exceed the applicable pH criteria listed in APC&EC Rule 2.504. This methodology applies to discrete, short-term continuous, and long-term continuous data.

AUs may not be listed as "non-attain" if the assessment decision is a result of data representing natural conditions (i.e., anthropogenic activities cannot be identified by DEQ as the source). If this occurs, the basis for determination of natural conditions will be noted in the 305(b) Report as well as submitted with the 303(d) list for public notice and any supporting documentation will be provided.

DELISTING METHODOLOGY:

Stream, river, reservoir, and lake AUs may be assessed as attainment when, using the **ten (10) percent** exceedance rate within Table 2, no more than the maximum number of samples allowed for the entire qualifying data set exceed the applicable pH criteria listed in APC&EC Rule 2.504. This methodology applies to discrete, short-term continuous, and long-term continuous data.

In some instances, DEQ may use discrete data to delist AUs that were listed using continuous data, and vice versa. However, this will not be the rule, it will be the exception. When this occurs, justification of use of a different type of data for delisting will be provided within the 305(b) Report as well as submitted with the 303(d) list for public notice and any supporting documentation will be provided. Justification for this methodology could include limited data availability, inability to acquire the same type of data that was used to list, or other special circumstances.

6.4 DISSOLVED OXYGEN

This section establishes the protocol for assessment of dissolved oxygen criteria within Arkansas's surface waters, per APC&EC Rule 2.505 and any site specific dissolved oxygen criteria within Appendix A of Rule 2:

Rivers and Streams

The following dissolved oxygen standards must be met:

Waterbodies	***Limit (mg/L)***	
Streams	*Primary*	*Critical*
Ozark Highlands		
<10 mi^2 watershed	*6*	*2*
10 to 100 mi^2	*6*	*5*
>100 mi^2 watershed	*6*	*6*
Boston Mountains		
<10 mi^2 watershed	*6*	*2*
>10 mi^2 watershed	*6*	*6*
Arkansas River Valley		
<10 mi^2 watershed	*5*	*2*
10 mi^2 to 150 mi^2	*5*	*3*
151 mi^2 to 400 mi^2	*5*	*4*
>400 mi^2 watershed	*5*	*5*
Ouachita Mountains		
<10 mi^2 watershed	*6*	*2*
>10 mi^2 watershed	*6*	*6*
Typical Gulf Coastal		
<10 mi^2 watershed	*5*	*2*
10 mi^2 to 500 mi^2	*5*	*3*
>500 mi^2 watershed	*5*	*5*
Springwater-influenced Gulf Coastal		
All size watersheds	*6*	*5*
Delta (least-altered and channel altered)		
<10 mi^2 watershed	*5*	*2*
10 mi^2 to 100 mi^2	*5*	*3*
>100 mi^2 watershed	*5*	*5*
Trout Waters		
All size watersheds	*6*	*6*

In streams with watersheds of less than 10 mi^2, it is assumed that insufficient water exists to support a fishery during the critical season. During this time, a dissolved oxygen standard of 2 mg/l will apply to prevent nuisance conditions. However, field verification is required in areas suspected of having significant groundwater flows or enduring pools which may support unique

aquatic biota. In such waters the critical season standard for the next size category of stream shall apply.

All streams with watersheds of less than 10 mi^2 are expected to support aquatic life during the primary season when stream flows, including discharges, equal or exceed 1 cubic foot per second (cfs). However, when site verification indicates that aquatic life exists at flows below 1 cfs, such aquatic biota will be protected by the primary standard (refer to the State of Arkansas Continuing Planning Process for field verification requirements).

Also, in these streams with watersheds of less than 10 mi^2, where waste discharges are 1 cfs or more, they are assumed to provide sufficient water to support aquatic life and, therefore, must meet the dissolved oxygen standards of the next size category of streams.

Lakes and Reservoirs

Specific dissolved oxygen standards for lakes and reservoirs shall be 5 mg/L.

PHASE II DATA QUALITY REQUIREMENTS FOR DISSOLVED OXYGEN

Assessments for dissolved oxygen can be made using discrete data, short-term continuous data, or long-term continuous data depending on season. Concurrent temperature data must accompany dissolved oxygen data to be used for assessments.

Trout Waters

1. Temporal requirements

- Discrete data and long-term continuous data
  - Year-round.
- Short-term continuous data
  - Mid-May to mid-September.

2. Minimum data distribution and quantity requirements

- Discrete data
  - Ten (10) discrete samples are needed to make dissolved oxygen attainment decisions.
  - Discrete data must be evenly distributed throughout the year.
  - Discrete data must be evenly distributed over at least two (2) years and three (3) quarters per year.
- Short-term continuous data
  - Two (2) diel deployments of no less than forty-eight (48) hours.
  - Diel deployments must be taken at least two weeks (14 days) apart.
  - The two diel deployments must be within the same year. You may have multiple years within the period of record (POR), but each year must have two deployments. Multiple years need not be consecutive.
  - Data must be collected at least hourly.
- Long-term continuous data
  - Data must cover ten (10) months of a twelve (12) month period.
  - Data must be collected at least hourly.

3. Spatial requirements

- For streams and rivers, none that are not already covered in Phase I requirements.
- For lakes and reservoirs, samples are to be taken within the epilimnion (if present). Sample depth shall be between 0.33 and 2.0 meters.

Non-Trout Waters

Primary Season – Streams and Rivers

1. Temporal requirements

- Discrete, Short-term, and Long-term continuous data
  - Data must be collected during the primary season.
    - "Primary season" is defined as the time of year when water temperatures are less than or equal to 22 degrees Celsius.

2. Minimum data distribution and quantity requirements

- Discrete data
  - Ten (10) discrete samples are needed to make dissolved oxygen attainment decisions.
  - Discrete data must be evenly distributed throughout the primary season.
  - Discrete data must be distributed over at least two (2) primary seasons.
- Short-term continuous
  - Two (2) diel deployments of no less than forty-eight (48) hours
  - Diel deployments must be taken at least two weeks (14 days) apart
  - The two diel deployments must be within the same year. You may have multiple years within the period of record (POR), but each year must have two deployments. Multiple years need not be consecutive.
  - Data must be collected at least hourly.
- Long-term continuous data
  - Data must be evenly distributed throughout the primary season.
  - Data must be collected at least hourly.

3. Spatial requirements

- None that are not already covered in Phase I requirements.

Critical Season – Streams and Rivers

1. Temporal requirements

- Discrete, Short-term, and Long-term continuous data
  - Data must be collected during the critical season.
    - "Critical season" is defined as the time of year when water temperatures are greater than 22 degrees Celsius.

2. Minimum data distribution and quantity requirements

- Discrete data
  - Ten (10) discrete samples are needed to make dissolved oxygen attainment decisions.
  - Discrete data must be evenly distributed throughout the critical season.
  - Discrete data must be distributed over at least two critical seasons.

- Short-term continuous data
  - Two (2) diel deployments of no less than forty-eight (48) hours each
  - Diel deployments must be taken at least two weeks (14 days) apart beginning post-retrieval.
  - The two diel deployments must be within the same year. You may have multiple years within the POR, but each year must have two deployments. Multiple years need not be consecutive.
  - Data must be collected at least hourly.
- Long-term continuous data
  - Data must be evenly distributed throughout the critical season.
  - Data must be collected at least hourly.

3. Spatial requirements
   - None that are not already covered in Phase I requirements.

Lakes and Reservoirs

1. Temporal requirements
   - Discrete, Short-term, and Long-term continuous data
     - Year-round.

2. Minimum data distribution and quantity requirements
   - Discrete data
     - A minimum of ten (10) quarterly samples.
   - Short-term continuous data
     - Two (2) diel deployments of no less than forty-eight (48) hours each with at least hourly readings are required for attainment decisions.
     - Diel deployments must be taken at least two weeks (14 days) apart when water temperatures are greater than 22 degrees Celsius.
     - The two diel deployments must be within the same year. You may have multiple years within the POR, but each year must have two deployments. Years need not be consecutive.
     - Data must be collected at least hourly.
   - Long-term continuous data
     - Data must be evenly distributed throughout the critical season.
     - Data must be collected at least hourly.

3. Spatial requirements
   - Taken within the epilimnion (if present). Sample depth shall be between 0.33 and 2.0 meters.

ASSESSMENT METHODOLOGY FOR DISSOLVED OXYGEN

Like data sets (e.g. discrete and discrete) from various sources may be combined into an aggregate data set as per Section 3.3.2; however, differing data types (discrete, short-term continuous, and long-term continuous) will not be combined. Refer to Section 3.10 for information regarding final attainment decisions should more than one type of data set exist for an AU. Concurrent

temperature data must accompany dissolved oxygen data for attainment decisions. Binomial distribution method will be applied to all data types of dissolved oxygen data, per Section 3.6. If long-term continuous data sets do not meet requirements for long-term assessments, they may be used to assess critical season if they meet short-term data requirements. Continuous data sets will be calculated into hourly averages.

LISTING METHODOLOGY:

Stream, river, reservoir, and lake AUs may be assessed as non-attainment when, using the **ten (10) percent** exceedance rate within Table 1, greater than or equal to the minimum number of samples for the entire qualifying data set fail to meet the minimum applicable dissolved oxygen criteria listed in APC&EC Rule 2.505 (or site specific in Appendix A) for either the primary or critical season, or year-round, as appropriate. This methodology applies to discrete, short-term continuous, and long-term continuous data.

DELISTING METHODOLOGY:

Stream, river, reservoir, and lake AUs may be assessed as attainment when, using the **ten (10) percent** exceedance rate within Table 2, no more than the maximum number of samples allowed for the entire qualifying data set fail to meet the applicable dissolved oxygen criteria listed in APC&EC Rule 2.505 (or site specific in Appendix A). Delisting methodology will be used for the same condition that it was listed on (primary or critical season, or year-round). This methodology applies to discrete, short-term continuous, and long-term continuous data.

In some instances, DEQ may use discrete data to delist AUs that were listed using continuous data, and vice versa. However, this will not be the rule, it will be the exception. When this occurs, justification of use of a different type of data for delisting will be provided within the 305(b) report as well as submitted with the 303(d) list for public notice and any supporting documentation will be provided. Justification for this methodology could include limited data availability, inability to acquire the same type of data that was used to list, or other special circumstances.

6.5 RADIOACTIVITY

This section establishes the protocol for assessment of radioactivity criteria within Arkansas's surface waters, per APC&EC Rule 2.506:

> *The Rules for the Control of Sources of Ionizing Radiation of the Division of Radiological Health, Arkansas Department of Health, limits the maximum permissible levels of radiation that may be present in effluents to surface waters in uncontrollable areas. These limits shall apply for the purposes of these standards, except that in no case shall the levels of dissolved radium-226 and strontium-90 exceed 3 and 10 picocuries/liter, respectively, in the receiving water after mixing, nor shall the gross beta concentration exceed 1000 picocuries/liter.*

PHASE II DATA QUALITY REQUIREMENTS FOR RADIOACTIVITY

Assessments for radioactivity will be made using discrete data only.

1. Data temporal requirements:
   - Discrete data should be collected year-round.
2. Minimum Data distribution and quantity requirements:
   - Ten (10) samples are required to make attainment decisions for radioactivity; unless an assessment of non-attainment can be reached in fewer than ten (10) samples.
   - For streams and rivers samples must be evenly distributed over at least two (2) years and three (3) quarters per year; unless an assessment of non-attainment can be reached in fewer than ten (10) samples.
   - For lakes and reservoirs a minimum of ten (10) quarterly samples; unless an assessment of non-attainment can be reached in fewer than ten (10) samples.
3. Spatial requirements
   - None that are not already covered in Phase I requirements.

ASSESSMENT METHODOLOGY FOR RADIOACTIVITY

Like data sets (e.g. discrete and discrete) from various sources may be combined into an aggregate data set as per Section 3.3.2.

LISTING METHODOLOGY:

Stream, river, reservoir, and lake AUs may be assessed as non-attainment when a **single sample within the period of record exceeds** the concentration of 3 picocuries/Liter for radium-226, or the concentration of 10 picocuries/Liter for strontium-90, or if the gross beta concentration exceeds 1000 picocuries/liter per APC&EC Rule 2.506, even if the minimum of ten (10) samples has not been reached.

DELISTING METHODOLOGY:

Stream, river, reservoir, and lake AUs may be assessed as attainment when **no samples in the period of record exceed** the concentration of 3 picocuries/Liter for radium-226, or the concentration of 10 picocuries/Liter for strontium-90, or if the gross beta concentration does not exceeds 1000 picocuries/liter per APC&EC Rule 2.506. A minimum of ten (10) samples must be reached to make an assessment of attainment.

6.6 BACTERIA

This section establishes the protocol for assessment of bacteria criteria within Arkansas's surface waters, per APC&EC Rule 2.507:

For the purposes of this rule, all streams with watersheds less than 10 mi^2 shall not be designated for primary contact unless and until site verification indicates that such use is attainable. No mixing zones are allowed for discharges of bacteria.

For assessment of ambient waters as impaired by bacteria, the below listed applicable values for E. coli shall not be exceeded in more than 25% of samples in no less than eight (8) samples taken during the primary contact season or during the secondary contact season.

The following standards are applicable:

Contact Recreation Seasons	***Limit (col/100mL)***			
Primary Contact[1]	*E. coli*		*Fecal Coliform*	
	IS[3]	*GM[4]*	*IS[3]*	*GM[4]*
ERW, ESW, NSW, Reservoirs, Lakes	*298*	*126*	*400*	*200*
All Other Waters	*410*	*-*	*400*	*200*
Secondary Contact[5]				
ERW, ESW, NSW, Reservoirs, Lakes[2]	*1490*	*630*	*2000*	*1000*
All Other Waters	*2050*	*-*	*2000*	*1000*

[1] May 1 to September 30
[3] For assessment of Individual Sample Criteria– at least eight (8) data points
[4] For calculation and assessment of Geometric Mean – calculated on a minimum of five (5) samples spaced evenly and within a thirty (30)-day period.
[5] October 1 to April 30

The Arkansas Department of Health has the responsibility of approving or disapproving surface waters for public water supply and of approving or disapproving the suitability of specifically delineated outdoor bathing places for body contact recreation, and it has issued rules and regulations pertaining to such uses.

PHASE II DATA QUALITY REQUIREMENTS FOR BACTERIA

Bacterial assessments are made with discrete *Escherichia coli* (*E. coli*) data. In the absence of *E. coli* data, discrete fecal coliform data may be utilized.

Primary Contact Season

1. Data temporal requirements
- Discrete data must be collected during primary contact season.
  - Primary contact season is defined, in Rule 2, as May 1 to September 30.

2. Minimum data distribution and quantity requirements
- Individual Samples
  - A minimum of one (1) primary contact season is required.
  - Eight (8) discrete samples are required per primary contact season used for assessment.
  - Discrete data must be evenly spaced within the primary contact season (within the same calendar year).
- Geometric Mean
  - Five (5) discrete samples spaced evenly and within a thirty-day period are required to calculate geometric mean.

3. Spatial Requirements
- Individual Samples
  - Applicable for assessments in all waters.
- Geometric Mean
  - *E. coli* - Applicable for assessments only in ERW, ESW, NSW waters; lakes; and reservoirs. In all other waters, geometric mean is not applicable and individual samples must be used for assessment.
  - Fecal Coliform – Applicable for assessments in all waters.
- For lakes and reservoirs, samples are to be taken within the epilimnion (if present). Sample depth shall be between 0.33 and 2.0 meters.

Secondary Contact Season

1. Data temporal requirements
- Discrete data must be collected during secondary contact season.
  - Secondary contact season is defined, in Rule 2, as October 1 to April 30.

2. Minimum Data distribution and quantity requirements
- Individual Samples
  - A minimum of one (1) secondary contact season is required.
  - Eight (8) discrete samples are required per secondary contact season used for assessment.
  - Discrete data must be evenly spaced within the secondary contact season.
- Geometric Mean
  - Five (5) discrete samples spaced evenly and within a thirty-day period are required to calculate geometric mean.

3. Spatial Requirements
- Individual Samples
  - Applicable for assessments in all waters.
- Geometric Mean
  - *E. coli* - Applicable for assessments only in ERW, ESW, NSW waters; lakes; and reservoirs. In all other waters, geometric mean is not applicable and individual samples must be used for assessment.
  - Fecal Coliform – Applicable for assessments in all waters.
- For lakes and reservoirs, samples are to be taken within the epilimnion (if present). Sample depth shall be between 0.33 and 2.0 meters.

ASSESSMENT METHODOLOGY FOR BACTERIA

Bacterial assessments are made with discrete *Escherichia coli* (*E. coli)* data. In the absence of *E. coli* bacteria data, fecal coliform bacteria data may be utilized for assessments. Bacterial assessments are made with discrete data only. Like data sets (e.g. discrete and discrete) from various sources may be combined into an aggregate data set as per Section 3.3.2. Data in most probable number (MPN) units will be evaluated for use in assessments of *E. coli*.

Assessments can be made using individual samples or geometric mean (as appropriate per spatial requirements described above). If adequate data sets exist for both single sample and geometric mean assessment (within the same year), both methods will be assessed separately and the most protective result will be used as the final assessment decision.

Binomial distribution method will not be applied. A straight mathematical 25% exceedance rate will be used to assess attainment (Example: 2 exceedances in 8 samples equal 25%).

For assessment of ambient waters using bacteria:

- Primary Contact
  - Individual Samples - Assessments can be made using data from only one primary contact season within the period of record; however, if complete data sets exist for more than one primary contact season within the period of record, data sets will be combined for assessment. Each primary season must contain eight (8) evenly distributed samples (per Phase II requirements above). Primary contact seasons with fewer than eight (8) samples will not be combined with data from other primary contact seasons and will not be used for assessment purposes.
  - Geometric Mean - All geometric means calculated for any primary contact season within the period of record will be considered for assessment purposes. All samples within a thirty day period that meet the "evenly spaced" requirement must be used for geometric mean calculation. Example: If daily measurements exist for a thirty day period, all thirty readings must be used, not just any five or more of those readings.

- Secondary Contact
  - Individual Samples - Assessments can be made using data from only one secondary contact season within the period of record; however, if complete data sets exist for more than one secondary contact season within the period of record, data sets will be combined for assessment. Each secondary season must contain eight (8) evenly distributed samples (per Phase II requirements above). Secondary contact seasons with fewer than eight (8) samples will not be combined with data from other secondary contact seasons and will not be used for assessment purposes.
  - Geometric Mean - All geometric means calculated for any secondary contact season within the period of record will be considered for assessment purposes. All samples within a thirty day period that meet the "evenly spaced" requirement must be used for geometric mean calculation. Example: If daily readings exist for a thirty day period, all thirty readings must be used, not just any five or more of those readings.

LISTING METHODOLOGY:

Individual Samples

Stream, river, reservoir, and lake AUs may be assessed as non-support when the applicable criteria is exceeded in **greater than 25 percent** of samples collected during months within the applicable contact season (as described above).

If the assessment of non-support is based on only one (1) season of data (eight (8) discrete samples within one primary contact season, or within one secondary contact season), the AU may be placed in Category 3 and more data may be collected for re-assessment in a future assessment cycle.

If the assessment of non-support is based on more than one season of data, the AU will be placed in Category 5, truly impaired.

Geometric Mean

Stream, river, reservoir, and lake AUs may be assessed as non-support **when the geometric mean for the applicable contact season is exceeded**. If one or more geometric mean calculations within the season exceed the criteria the AU may be assessed as non-support.

DELISTING METHODOLOGY:

Individual Samples

Stream, river, reservoir, and lake AUs may be assessed as support when the applicable criteria is **exceeded in 25 percent or less** of samples collected during months within the applicable contact season (as described above). This assessment result will apply for single season and multi-season assessments.

Geometric Mean

Stream, river, reservoir, and lake AUs will be assessed as support **when the geometric mean for the applicable contact season is not exceeded**. If more than one geometric mean calculation exists, all must not exceed the criteria.

Table 10: Statewide bacteria assessment criteria.

	Escherichia coli	CRITERIA	SUPPORT	NON-SUPPORT
PRIMIMARY CONTACT	ERW, ESW, and NSW Waters	GM 126 col/100 mL*	≤ criteria	> criteria
	Lakes, Reservoirs	298 col/100 mL (May-Sept)	≤ 25% exceedance	>25% exceedance
	All other waters	410 col/100 mL (May-Sept)	≤ 25% exceedance	>25% exceedance
SECONDARY CONTACT	ERW, ESW, and NSW Waters	GM 630 col/100 mL*	≤ criteria	> criteria
	Lakes, Reservoirs	1490 col/100 mL (Oct. - April)	≤ 25% exceedance	>25% exceedance
	All other waters	2050 col/100 mL (Oct. - April)	≤ 25% exceedance	>25% exceedance
FECAL COLIFORM		**CRITERIA**	**SUPPORT**	**NON-SUPPORT**
PRIMARY CONTACT All Waters including ERW, ESW, NSW, Lakes, and Reservoirs		GM 200 col/100 mL*	≤ criteria	> criteria
		400 col/100 mL (May-Sept)	≤ 25% exceedance	>25% exceedance
SECONDARY CONTACT All Waters including ERW, ESW, NSW, Lakes, and Reservoirs		GM 1000 col/100 mL*	≤ criteria	> criteria
		2000 col/100 mL (Oct. - April)	≤ 25% exceedance	>25% exceedance

ERW: Extraordinary Resource Water, **NSW**: Natural and Scenic Waterway, **ESW**: Ecologically Sensitive Water

*Geometric mean can be calculated for any 30-day period within a season (primary season May 1 through September 30; secondary season October 1 through April 30).

6.7 TOXIC SUBSTANCES

This section establishes the protocol for assessment of toxic substances criteria within Arkansas's surface waters, per APC&EC Rule 2.508:

> *Toxic substances shall not be present in receiving waters, after mixing, in such quantities as to be toxic to human, animal, plant or aquatic life or to interfere with the normal propagation, growth and survival of the indigenous aquatic biota. For non-permit issues and as a guideline for evaluating toxic substances not listed in the following tables, the Division may consider No Observed Effect Concentrations or other literature values as appropriate. For the substances listed below, the following standards shall apply:*

ALL WATERBODIES - AQUATIC LIFE CRITERIA

Substance	***Acute Values (µg/L)***	***Chronic Values (µg/L)***
		(24-hr Average)
PCBs		*0.0140*
Aldrin	*3.0*	
Dieldrin	*2.5*	*0.0019*
DDT (& metabolites)	*1.1*	*0.0010*
*Endrin**	*0.18*	*0.0023*
Toxaphene	*0.73*	*0.0002*
Chlordane	*2.4*	*0.0043*
*Endosulfan**	*0.22*	*0.056*
Heptachlor	*0.52*	*0.0038*
*Hexachlorocyclohexane**	*2.0*	*0.080*
Pentachlorophenol	$e^{[1.005(pH)-4.869]}$	$e^{[1.005(pH)-5.134]}$
Chlorpyrifos	*0.083*	*0.041*

** Total of all isomers*

*DISSOLVED METALS**

	Acute Criteria (CMC) - µg/L(ppb)		***Chronic Criteria (CCC) - µg/L(ppb)***	
Substance	***Formula X Conversion***		***Formula X Conversion***	
Cadmium	$e^{[1.128(\ln hardness)]-3.828}$	*(a)*	$e^{[0.7852(\ln hardness)]-3.490}$	*(c)*
Chromium(III)	$e^{[0.819(\ln hardness)]+3.688}$	*0.316*	$e^{[0.8190(\ln hardness)]+1.561}$	*0.860*
Chromium (VI)	*16*	*0.982*	*11*	*0.962*
Copper	$e^{[0..9422(\ln hardness)]-1.464}$	*0.960*	$e^{[0.8545(\ln hardness)]-1.465}$	*0.960*
Lead	$e^{[1.273(\ln hardness)]-1.460}$	*(b)*	$e^{[1.273(\ln hardness)]-4.705}$	*(b)*
Mercury	*2.4*	*0.85*	*0.012***	*NONE*
Nickel	$e^{[0.8460(\ln hardness)]+3.3612}$	*0.998*	$e^{[0.8460(\ln hardness)]+1.1645}$	*0.997*
*Selenium***	*20*	*NONE*	*5*	*NONE*
Silver	$e^{[1.72(\ln hardness)]-6.52}$	*0.85*	----------	*NONE*
Zinc	$e^{[0.8473(\ln hardness)]+0.8604}$	*0.978*	$e^{[0.8473(\ln hardness)]+0.7614}$	*0.986*
*Cyanide***	*22.36*	*NONE*	*5.2*	*NONE*

**These values may be adjusted by a site specific Water Effects Ratio (WER) as defined in 40 CFR Part 131.36 (c).*

(a) Calculated as: 1.136672 - [(ln hardness)(0.041838)]

(b) Calculated as: 1.46203 - [(ln hardness)(0.145712)]

(c) Calculated as: 1.101672 - [(ln hardness)(0.041838)]

***Expressed as total recoverable. Mercury based on bioaccumulation of residues in aquatic organisms, rather than toxicity.*

ALL WATERBODIES - HUMAN HEALTH CRITERIA

Substance	***Criteria (ng/L)****
Dioxin (2,3,7,8 TCDD)	*0.001*
Chlordane	*5.0*
PCBs (polychlorinated biphenyls)	*0.4*
alpha Hexachlorocyclohexane	*37.3*
Beryllium	*4000***
Dieldrin	*1.2*
Toxaphene	*6.3*

** Criteria based on a lifetime risk factor of 10^{-5}.*

***4000 ng/l is also represented as 4.0 ug/l, which is the Maximum contaminant level (MCL) under the EPA Safe Drinking Water Act [40 U.S.C. s/s 300f et seq. (1974)]*

PHASE II DATA QUALITY REQUIREMENTS FOR TOXICS

Only discrete data will be used to make attainment decisions regarding toxicity. Concurrent instream hardness data must accompany metals data for metals toxicity attainment decisions unless toxic data falls below minimum criteria calculated at 25 mg/L hardness.

Streams and Rivers

1. Data temporal requirements:
   - Assessments can be made with discrete samples taken throughout the calendar year or period of record. There is no designated "season" for toxics.
2. Data distribution and quantity requirements:
   - Ten (10) samples are required to make toxic criteria attainment decisions; unless an assessment of non-attainment can be reached in fewer than ten (10) samples.
   - Data must be evenly distributed over at least two (2) years and three (3) quarters per year; unless an assessment of non-attainment can be reached in fewer than ten (10) samples.
3. Spatial requirements
   - None that are not already covered in Phase I requirements.

Lakes and Reservoirs

1. Temporal requirements
   - Collect toxics data quarterly, at a minimum.
2. Minimum distribution and quantity requirements
   - A minimum of ten (10) quarterly samples; unless an assessment of non-attainment can be reached in fewer than ten (10) samples.
3. Spatial requirements
   - Take samples within the epilimnion (if present). Sample depth shall be between 0.33 and 2.0 meters.

ASSESSMENT METHODOLOGY FOR TOXIC SUBSTANCES

Like data sets (e.g. discrete and discrete) from various sources may be combined into an aggregate data set as per Section 3.3.2. Metals toxicity will be evaluated based on instream hardness values at the time of sample collection. If the ambient hardness value is less than 25 mg/L, then a hardness value of 25 mg/L will be used to calculate metals toxicity.

LISTING METHODOLOGY:

Stream, river, reservoir, and lake AUs may be assessed as non-support when **more than one (>1)** exceedance of the criterion, per APC&EC Rule 2.508, occurs during the period of record, even if the minimum of ten (10) samples has not been reached.

DELISTING METHODOLOGY:

Stream, river, reservoir, and lake AUs may be assessed as support when there are **one or fewer (≤ 1)** exceedances of the criterion, per APC&EC Rule 2.508, during the period of record. A minimum of ten (10) samples must be reached to make an assessment of attainment.

6.8 FISH CONSUMPTION

This section establishes the protocol for determining attainment of fish consumption within Arkansas's surface waters.

ASSESSMENT METHODOLOGY FOR FISH CONSUMPTION

Fish consumption listings are based on fish consumption advisories issued by the Epidemiology Branch at Arkansas Department of Health.

LISTING METHODOLOGY:

Stream, river, reservoir, and lake AUs will be listed as non-support for fish consumption if a primary segment of the fish community (e.g., all predators or all largemouth bass) has restrictions for any group of people (e.g., general population or high risk groups).

DELISTING METHODOLOGY:

Stream, river, reservoir, and lake AUs will be listed as support if there are no fish consumption restrictions or only a *limited consumption* of fish is recommended (e.g., no more than 2 meals per month or no consumption of fish over 15 inches).

6.9 NUTRIENTS

This section establishes the protocol for assessment of nutrients within Arkansas's surface water, per APC&EC Rule 2.509:

> *(A) Materials stimulating algal growth shall not be present in concentrations sufficient to cause objectionable algal densities or other nuisance aquatic vegetation or otherwise impair any designated use of the waterbody. Impairment of a waterbody from excess nutrients is dependent on the natural waterbody characteristics such as stream flow, residence time, stream slope, substrate type, canopy, riparian vegetation, primary use of waterbody, season of the year and ecoregion water chemistry. Because nutrient water column concentrations do not always correlate directly with stream impairments, impairments will be assessed by a combination of factors such as water clarity, periphyton or phytoplankton production, dissolved oxygen values, dissolved oxygen saturation, diurnal dissolved oxygen fluctuations, pH values, aquatic-life community structure and possibly others. However, when excess nutrients result in an impairment, based upon Department assessment methodology, by any Arkansas established numeric water quality standard, the waterbody will be determined to be impaired by nutrients.*
>
> (*B)Site Specific Nutrient Standards*

Lake	*Chlorophyll a (ug/L)***	*Secchi Transparency (m)****
*Beaver Lake**	*8*	*1.1*

> **These standards are for measurement at the Hickory Creek site over the old thalweg, below the confluence of War Eagle Creek and the White River in Beaver Lake.*
> ***Growing season geometric mean (May - October)*
> ****Annual Average*

SCREENING REQUIREMENTS FOR NUTRIENTS IN WADEABLE STREAMS

Total Nitrogen (TN) and Total Phosphorus (TP) data will be screened per respective ecoregion using the 75th percentile of all available TN and TP for the appropriate period of record that have passed Phase 1 requirements.

Arithmetic mean TN and TP concentrations for each assessment unit will then be compared to the 75th percentile screening values for the appropriate ecoregion and evaluated according to Figure 3. Data in each assessment unit for comparison against ecoregion values must meet the following requirements:

- Discrete Data
    - Ten (10) discrete samples are needed to make TN or TP attainment decisions.
    - Data must be evenly distributed over at least two (2) years and three (3) quarters per year.

PHASE II DATA QUALITY REQUIREMENTS FOR NUTRIENTS

Continuous and biological data requirements must be met for full nutrient assessment. Either short-term or long-term continuous data are required, not both. The 75th percentile screening values are calculated from only discrete samples collected during the period of record. Nutrient

screenings will be made by calculating the average concentration of each site for the period of record which will be compared to the 75th percentile for that ecoregion. For purposes of nutrient assessment, a "year" is defined as a 12 month period.

Streams and Rivers

1. Temporal requirements:

- Short-term and Long-term Continuous Data
  - Diel dissolved oxygen and pH deployments must be collected within the same critical season (same year) as discrete total nitrogen and total phosphorus samples.
    - Critical season is defined, in Rule 2, as that time of year when water temperatures naturally exceed 22 degrees Celsius for the given AU.
- Biological Communities
  - Fish communities must be collected during the same critical season as the diel dissolved oxygen and pH deployments.
  - Macroinvertebrate communities must be collected during the same year as fish collections, during fall base flow conditions.

2. Minimum distribution and quantity requirements

- Short-term Continuous Data
  - Two (2) diel deployments of at least 48 hours each with at least hourly readings are required.
  - Diel deployments must be spaced at least two weeks (14 days) apart within the same critical season.

Long-term Continuous Data

  - Data must be evenly distributed throughout the critical season
  - Data must be collected at least hourly.
- Biological Communities
  - One (1) fish community or one (1) macroinvertebrate community data set is required per year.

3. Spatial and other requirements

- Short-term and Long-term Continuous
  - None that are not already covered in Phase I requirements.

- Biological Communities
  - Must be collected in representative habitats of the stream segments.
  - Must satisfy biological community sampling protocols.

Beaver Lake

1. Temporal requirements

- Secchi Disk Transparency

- Secchi disk transparency depths should be collected year-round. Beaver Lake Secchi disk readings will be assessed on a calendar year.

- Growing Season Chlorophyll *a* Geometric Mean
  - Chlorophyll *a* should be collected during the growing season.
  - Growing season is defined as May – October per Rule 2.509(B).

2. Minimum distribution and quantity requirements

- Secchi Disk Transparency
  - Ten (10) discrete samples evenly distributed over twelve (12) calendar months are required per year to calculate an annual average.
- Growing Season Chlorophyll *a* Geometric Mean
  - Five (5) evenly distributed discrete samples are required per growing season to calculate a geometric mean.

3. Spatial requirements

- Secchi Disk Transparency and Growing Season Chlorophyll *a* Geometric Mean
  - All data shall be collected at the Hickory Creek site over the old thalweg, below the confluence of War Eagle Creek and the White River in Beaver Lake.
- All parameter (Chlorophyll a, DO, pH, temperature, etc.; excluding Secchi disk) samples are to be taken (between 0.33 and 2.0 meters.

ASSESSMENT METHODOLOGY FOR NUTRIENTS

To date, assessment methodologies for nutrients have only been developed for, and only apply to, wadeable streams (Figure 3) and Beaver Lake. Methodologies for wadeable streams were developed defining "wadeable" as fourth order streams and smaller using Strahler stream order (Strahler 1952). Site verification and best professional judgement was used to classify an AU as wadeable.

Nutrient assessment relies on "paired data." This means that physical, chemical, and biological data must be collected within the same year or season. Like data sets (e.g. discrete and discrete) from various sources may be combined into an aggregate data set as per Section 3.3.2; however, differing data types (discrete, short-term continuous, and long-term continuous) will not be combined.

Beaver Lake Secchi disk readings and growing season chlorophyll *a* concentrations will be assessed per calendar year. If multiple chlorophyll *a* samples exist on the same day, but at the different depths, the most protective sample at each depth will be used for assessments.

LISTING METHODOLOGY FOR WADEABLE STREAMS:

Wadeable stream and river AUs will be listed as non-support for nutrients when the following conditions occur:

- The mean total phosphorus or total nitrogen concentration of the monitoring segment is greater than the 75th percentile of the total phosphorus or total nitrogen data from wadeable stream and river AUs within an ecoregion, **and**

- When either the short-term or long-term data sets indicate at least one of the two water quality translators, as listed in the flow chart, are exceeded (as per methodologies in Sections 6.3 and 6.4), **and**
- One or both biological communities, as listed in the flow chart, are evaluated as impaired.

Water quality translators are dissolved oxygen and pH. Two separate, 48 hour data sets within the same critical season (when water temperatures are greater than 22°C) are required for evaluation.

The dissolved oxygen translator is a 10% exceedance of the water quality criteria as described in Section 6.4. The pH translator is considered to be exceeded when pH varies from the criteria of between 6.0 and 9.0 standard units and assessment is described in Section 6.3.

Any wadeable stream or river segment that exceeds screening level criteria, but lacks adequate data to assess may be placed into Category 3b, Insufficient Data. Category 3 streams may be prioritized based on the magnitude of nutrient concentration, available data, and staff resources.

SUPPORT AND DELISTING METHODOLOGY FOR WADEABLE STREAMS:

Support Methodology
Wadeable streams and river AUs may be assessed as support when:

- The mean total phosphorus or total nitrogen concentration of the monitoring segment is less than the 75th percentile of the total phosphorus or total nitrogen data from wadeable stream and river AUs within an ecoregion.

Delisting Methodology

- The mean total phosphorus or total nitrogen concentration of the monitoring segment is less than the 75th percentile of the total phosphorus or total nitrogen data from wadeable stream and river AUs within an ecoregion, **and**
- When neither the short-term or long-term data sets indicate water quality translators, as listed in the flow chart, are not exceeded (as per methodologies in 6.3 and 6.4), **and**
- Biological communities used to make the listing are evaluated as unimpaired.

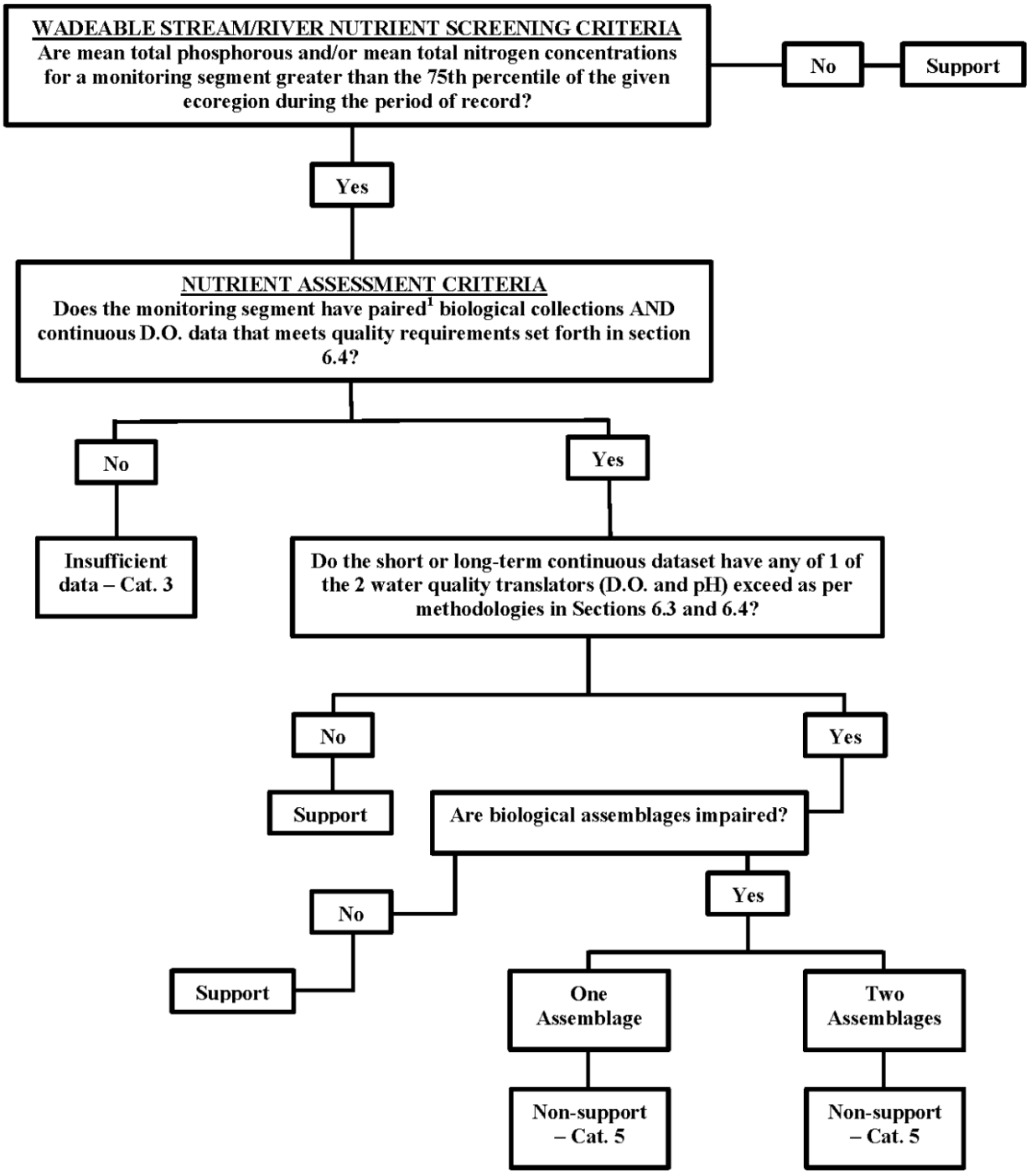
LISTING METHODOLOGY FOR BEAVER LAKE:

The Hickory Creek AU of Beaver Lake may be listed as non-support of its domestic water supply designated use when there are **three or more (≥3) geometric mean** exceedances of the chlorophyll *a* criteria within the five-year period of record.

The Hickory Creek AU of Beaver Lake may be listed as non-support of its domestic water supply designated use when there are **three or more (≥3) annual average** exceedances of the secchi transparency criteria within the five-year period of record.

DELISTING METHODOLOGY FOR BEAVER LAKE:

The Hickory Creek AU of Beaver Lake may be listed as supporting its domestic water supply designated use when there are **no more than two (2) geometric mean** exceedances of the chlorophyll *a* criteria ***and*** **no more than two (2) annual averages** exceedances of the secchi transparency criteria within the five-year period of record.



[1] Paired data/collections are defined as combined physical, chemical, and biological collections within the same calendar year and/or season.

[2] D. O. data must be continuous, either long-term or short-term.

[3] Section 5.0 discusses the determining factors for biological impairment.

Figure 3: Nutrient assessment flowchart for wadeable streams and rivers.

6.10 MINERAL QUALITY

6.10.1 Site specific minerals for aquatic life use

This section establishes the protocol for assessment of site specific mineral criteria within Arkansas's waters, per APC&EC Rule 2.511 (A):

> *(A) Site Specific Mineral Quality Criteria*
>
> *Mineral quality shall not be altered by municipal, industrial, other waste discharges or instream activities so as to interfere with designated uses. The following criteria apply to the streams indicated.*

PHASE II DATA QUALITY REQUIREMENTS FOR MINERALS FOR AQUATIC LIFE USE

Only discrete data will be used to make assessments for minerals. All Phase II considerations apply to waters with site specific minerals criteria Rule 2.511(A)).

1. Data temporal requirements
   - Discrete data should be collected year-round.
2. Minimum data distribution and quantity requirements
   - Ten (10) discrete samples are required to make minerals attainment decisions.
   - For streams and rivers, discrete samples must be evenly distributed over at least two (2) years and three (3) quarters per year.
   - For lakes and reservoirs a minimum of ten (10) quarterly samples.
3. Spatial requirements
   - For streams and rivers, none that are not already covered in Phase I requirements.
   - For lakes and reservoirs, samples are to be taken within the epilimnion (if present). Sample depth shall be between 0.33 and 2.0 meters.

ASSESSMENT METHODOLOGY FOR SITE SPECIFIC MINERAL QUALITY FOR AQUATIC LIFE USE

Waters with site specific mineral criteria are assessed according to site specific values for chlorides, sulfates, and/or TDS listed in APC&EC Rule 2.511(A). Like data sets (e.g. discrete and discrete) from various sources may be combined into an aggregate data set as per Section 3.3.2. Binomial distribution method will be applied to site specific mineral data, per Section 3.6.

LISTING METHODOLOGY:

Stream, river, reservoir, and lake AUs with site specific mineral criteria may be assessed as non-support when, using the **twenty-five (25) percent** exceedance rate within Table 1, greater than or equal to the minimum number of samples for the entire qualifying data set exceed the applicable site specific mineral criteria listed in APC&EC Rule 2.511(A).

DELISTING METHODOLOGY:

Stream, river, reservoir, and lake AUs with site specific mineral criteria may be assessed as support when, using the **twenty-five (25) percent** exceedance rate within Table 2, no more than

the maximum number of samples allowed for the entire qualifying data set exceed the applicable site specific mineral criteria listed in APC&EC Rule 2.511(A).6.10.2Mineral Quality for Domestic, Agricultural, and Industrial Water Supply Uses

This section establishes the protocol for assessment of mineral quality fordomestic, agriculture, and industrial water supply designated uses within Arkansas's surface waters, per APC&EC Rule 2.511(C):

> *(C) Domestic Water Supply Criteria*
>
> *In no case shall discharges cause concentrations in any waterbody to exceed 250, 250 and 500 mg/L of chlorides, sulfates and total dissolved solids, respectively, or cause concentrations to exceed the applicable criteria, except in accordance with Rules 2.306 and 2.308.*

This section is written in accordance with the Federal Safe Drinking Water Act (40 § C.F.R 143.3) and also establishes the protocol for assessing impairment due to exceedance of limits for agricultural and industrial water supplies.

PHASE II DATA QUALITY REQUIREMENTS FOR MINERAL QUALITY FOR DOMESTIC, AGRICULTURAL, AND INDUSTRIAL WATER SUPPLY USES

Minerals data (chloride, sulfates, TDS) will be used to assess well as Domestic, Agricultural, and Industrial Water Supply Uses. Only discrete data will be used.

Streams and Rivers

1. Data temporal requirements
   - Discrete data should be collected year-round.
2. Minimum data distribution and quantity requirements
   - Ten (10) discrete samples are required to make minerals attainment decisions.
   - Discrete samples must be evenly distributed over at least two (2) years and three (3) quarters per year.
3. Spatial requirements
   - None that are not already covered in Phase I requirements.

Lakes and Reservoirs

1. Temporal requirements
   - Collect minerals data quarterly, at a minimum.
2. Minimum distribution and quantity requirements
   - A minimum of ten (10) quarterly samples.
3. Spatial requirements
   - Take samples within the epilimnion (if present). Sample depth shall be between 0.33 and 2.0 meters.

ASSESSMENT METHODOLOGY FOR DOMESTIC, AGRICULTURAL, AND INDUSTRIAL WATER SUPPLY USE

Like data sets (e.g. discrete and discrete) from various sources may be combined into an aggregate data set as per Section 3.3.2. Binomial distribution method will be applied to non-site specific mineral data, as per Section 3.6.

LISTING METHODOLOGY:

Stream, river, reservoir, and lake AUs may be assessed as non-support when, using the **ten (10) percent** exceedance rate within Table 1, greater than or equal to the minimum number of samples for the entire qualifying data set exceed the applicable mineral criteria listed in APC&EC Rule 2.511(C).

DELISTING METHODOLOGY:

Stream, river, reservoir, and lake AUs may be assessed as support when, using the **ten (10) percent** exceedance rate within Table 2, no more than the maximum number of samples allowed for the entire qualifying data set exceed the applicable mineral criteria listed in APC&EC Rule 2.511(C).

6.12 AMMONIA

This section establishes the protocol for assessment of ammonia criteria in Arkansas's surface waters, per APC&EC Rule 2.512:

The total ammonia nitrogen (N) criteria and the frequency of occurrence are as follows:

(A)The one-hour average concentration of total ammonia nitrogen shall not exceed, more than once every three years on the average, the acute criterion as shown in the following table:

pH-Dependent Values of the CMC (Acute Criterion)- mg/L

pH	*Salmonids* Present*	*Salmonids Absent*
6.5	*32.6*	*48.8*
6.6	*31.3*	*46.8*
6.7	*29.8*	*44.6*
6.8	*28.1*	*42.0*
6.9	*26.2*	*39.1*
7.0	*24.1*	*36.1*
7.1	*22.0*	*32.8*
7.2	*19.7*	*29.5*
7.3	*17.5*	*26.2*
7.4	*15.4*	*23.0*
7.5	*13.3*	*19.9*
7.6	*11.4*	*17.0*
7.7	*9.65*	*14.4*
7.8	*8.11*	*12.1*
7.9	*6.77*	*10.1*
8.0	*5.62*	*8.40*
8.1	*4.64*	*6.95*
8.2	*3.83*	*5.72*
8.3	*3.15*	*4.71*
8.4	*2.59*	*3.88*
8.5	*2.14*	*3.20*
8.6	*1.77*	*2.65*
8.7	*1.47*	*2.20*
8.8	*1.23*	*1.84*
8.9	*1.04*	*1.56*
9.0	*0.885*	*1.32*

** Family of fishes, which includes trout.*

(B) The monthly average concentration of total ammonia nitrogen shall not exceed those values shown as the chronic criterion in the following tables:

Temperature and pH-Dependent Values of the CCC (Chronic Criterion)

for Fish Early Life Stages Present – mg/L

	Temperature °C									
pH	***0***	***14***	***16***	***18***	***20***	***22***	***24***	***26***	***28***	***30***
6.5	*6.67*	*6.67*	*6.06*	*5.33*	*4.68*	*4.12*	*3.62*	*3.18*	*2.80*	*2.46*
6.6	*6.57*	*6.57*	*5.97*	*5.25*	*4.61*	*4.05*	*3.56*	*3.13*	*2.75*	*2.42*
6.7	*6.44*	*6.44*	*5.86*	*5.15*	*4.52*	*3.98*	*3.50*	*3.07*	*2.70*	*2.37*
6.8	*6.29*	*6.29*	*5.72*	*5.03*	*4.42*	*3.89*	*3.42*	*3.00*	*2.64*	*2.32*
6.9	*6.12*	*6.12*	*5.56*	*4.89*	*4.30*	*3.78*	*3.32*	*2.92*	*2.57*	*2.25*
7.0	*5.91*	*5.91*	*5.37*	*4.72*	*4.15*	*3.65*	*3.21*	*2.82*	*2.48*	*2.18*
7.1	*5.67*	*5.67*	*5.15*	*4.53*	*3.98*	*3.50*	*3.08*	*2.70*	*2.38*	*2.09*
7.2	*5.39*	*5.39*	*4.90*	*4.31*	*3.78*	*3.33*	*2.92*	*2.57*	*2.26*	*1.99*
7.3	*5.08*	*5.08*	*4.61*	*4.06*	*3.57*	*3.13*	*2.76*	*2.42*	*2.13*	*1.87*
7.4	*4.73*	*4.73*	*4.30*	*3.78*	*3.32*	*2.92*	*2.57*	*2.26*	*1.98*	*1.74*
7.5	*4.36*	*4.36*	*3.97*	*3.49*	*3.06*	*2.69*	*2.37*	*2.08*	*1.83*	*1.61*
7.6	*3.98*	*3.98*	*3.61*	*3.18*	*2.79*	*2.45*	*2.16*	*1.90*	*1.67*	*1.47*
7.7	*3.58*	*3.58*	*3.25*	*2.86*	*2.51*	*2.21*	*1.94*	*1.71*	*1.50*	*1.32*
7.8	*3.18*	*3.18*	*2.89*	*2.54*	*2.23*	*1.96*	*1.73*	*1.52*	*1.33*	*1.17*
7.9	*2.80*	*2.80*	*2.54*	*2.24*	*1.96*	*1.73*	*1.52*	*1.33*	*1.17*	*1.03*
8.0	*2.43*	*2.43*	*2.21*	*1.94*	*1.71*	*1.50*	*1.32*	*1.16*	*1.02*	*0.897*
8.1	*2.10*	*2.10*	*1.91*	*1.68*	*1.47*	*1.29*	*1.14*	*1.00*	*0.879*	*0.773*
8.2	*1.79*	*1.79*	*1.63*	*1.43*	*1.26*	*1.11*	*0.973*	*0.855*	*0.752*	*0.661*
8.3	*1.52*	*1.52*	*1.39*	*1.22*	*1.07*	*0.941*	*0.827*	*0.727*	*0.639*	*0.562*
8.4	*1.29*	*1.29*	*1.17*	*1.03*	*0.906*	*0.796*	*0.700*	*0.615*	*0.541*	*0.475*
8.5	*1.09*	*1.09*	*0.990*	*0.870*	*0.765*	*0.672*	*0.591*	*0.520*	*0.457*	*0.401*
8.6	*0.920*	*0.920*	*0.836*	*0.735*	*0.646*	*0.568*	*0.499*	*0.439*	*0.386*	*0.339*
8.7	*0.778*	*0.778*	*0.707*	*0.622*	*0.547*	*0.480*	*0.422*	*0.371*	*0.326*	*0.287*
8.8	*0.661*	*0.661*	*0.601*	*0.528*	*0.464*	*0.408*	*0.359*	*0.315*	*0.277*	*0.244*
8.9	*0.565*	*0.565*	*0.513*	*0.451*	*0.397*	*0.349*	*0.306*	*0.269*	*0.237*	*0.208*
9.0	*0.486*	*0.486*	*0.442*	*0.389*	*0.342*	*0.300*	*0.264*	*0.232*	*0.204*	*0.179*

Temperature and pH-Dependent Values of the CCC (Chronic Criterion)

for Fish Early Life Stages Absent – mg/L

Temperature °C

pH	***0-7***	***8***	***9***	***10***	***11***	***12***	***13***	***14***	***15****	***16****
6.5	*10.8*	*10.1*	*9.51*	*8.92*	*8.36*	*7.84*	*7.35*	*6.89*	*6.46*	*6.06*
6.6	*10.7*	*9.99*	*9.37*	*8.79*	*8.24*	*7.72*	*7.24*	*6.79*	*6.36*	*5.97*
6.7	*10.5*	*9.81*	*9.20*	*8.62*	*8.08*	*7.58*	*7.11*	*6.66*	*6.25*	*5.86*
6.8	*10.2*	*9.58*	*8.98*	*8.42*	*7.90*	*7.40*	*6.94*	*6.51*	*6.10*	*5.72*
6.9	*9.93*	*9.31*	*8.73*	*8.19*	*7.68*	*7.20*	*6.75*	*6.33*	*5.93*	*5.56*
7.0	*9.60*	*9.00*	*8.43*	*7.91*	*7.41*	*6.95*	*6.52*	*6.11*	*5.73*	*5.37*
7.1	*9.20*	*8.63*	*8.09*	*7.58*	*7.11*	*6.67*	*6.25*	*5.86*	*5.49*	*5.15*
7.2	*8.75*	*8.20*	*7.69*	*7.21*	*6.76*	*6.34*	*5.94*	*5.57*	*5.22*	*4.90*
7.3	*8.24*	*7.73*	*7.25*	*6.79*	*6.37*	*5.97*	*5.60*	*5.25*	*4.92*	*4.61*
7.4	*7.69*	*7.21*	*6.76*	*6.33*	*5.94*	*5.57*	*5.22*	*4.89*	*4.59*	*4.30*
7.5	*7.09*	*6.64*	*6.23*	*5.84*	*5.48*	*5.13*	*4.81*	*4.51*	*4.23*	*3.97*
7.6	*6.46*	*6.05*	*5.67*	*5.32*	*4.99*	*4.68*	*4.38*	*4.11*	*3.85*	*3.61*
7.7	*5.81*	*5.45*	*5.11*	*4.79*	*4.49*	*4.21*	*3.95*	*3.70*	*3.47*	*3.25*
7.8	*5.17*	*4.84*	*4.54*	*4.26*	*3.99*	*3.74*	*3.51*	*3.29*	*3.09*	*2.89*
7.9	*4.54*	*4.26*	*3.99*	*3.74*	*3.51*	*3.29*	*3.09*	*2.89*	*2.71*	*2.54*
8.0	*3.95*	*3.70*	*3.47*	*3.26*	*3.05*	*2.86*	*2.68*	*2.52*	*2.36*	*2.21*
8.1	*3.41*	*3.19*	*2.99*	*2.81*	*2.63*	*2.47*	*2.31*	*2.17*	*2.03*	*1.91*
8.2	*2.91*	*2.73*	*2.56*	*2.40*	*2.25*	*2.11*	*1.98*	*1.85*	*1.74*	*1.63*
8.3	*2.47*	*2.32*	*2.18*	*2.04*	*1.91*	*1.79*	*1.68*	*1.58*	*1.48*	*1.39*
8.4	*2.09*	*1.96*	*1.84*	*1.73*	*1.62*	*1.52*	*1.42*	*1.33*	*1.25*	*1.17*
8.5	*1.77*	*1.66*	*1.55*	*1.46*	*1.37*	*1.28*	*1.20*	*1.13*	*1.06*	*0.990*
8.6	*1.49*	*1.40*	*1.31*	*1.23*	*1.15*	*1.08*	*1.01*	*0.951*	*0.892*	*0.836*
8.7	*1.26*	*1.18*	*1.11*	*1.04*	*0.976*	*0.915*	*0.858*	*0.805*	*0.754*	*0.707*
8.8	*1.07*	*1.01*	*0.944*	*0.885*	*0.829*	*0.778*	*0.729*	*0.684*	*0.641*	*0.601*
8.9	*0.917*	*0.860*	*0.806*	*0.756*	*0.709*	*0.664*	*0.623*	*0.584*	*0.548*	*0.513*
9.0	*0.790*	*0.740*	*0.694*	*0.651*	*0.610*	*0.572*	*0.536*	*0.503*	*0.471*	*0.442*

**At 15^{o} C and above, the criterion for fish Early Life Stage absent is the same as the criterion for fish Early Life Stage present.*

(C) The highest four-day average within a 30-day period should not exceed 2.5 times the chronic values shown above.

(D) Temperature values used will be 14^{o} C when fish early life stages are absent and the ecoregion temperature standard for the season when fish early life stages are present. The pH values will be the ecoregion mean value from least-disturbed stream data.

PHASE II DATA QUALITY REQUIREMENTS FOR AMMONIA:

Only discrete data will be used for ammonia assessments. Total ammonia nitrogen discrete samples must be paired with concurrently measured *in situ* pH and temperature data, as applicable unless ammonia data falls below minimum criterion from APC&EC Rule 2.512(A)–(C).

Acute Criterion – Rule 2.512(A)

1. Data temporal requirements
   - Discrete data should be collected year-round.
2. Minimum data distribution and quantity requirements
   - Ten (10) discrete samples are required to make attainment decisions for ammonia; unless an assessment of non-attainment can be reached in fewer than ten (10) samples.
   - For streams and rivers:
     - Discrete samples must be evenly distributed over at least two (2) years and three (3) seasons per year; unless an assessment of non-attainment can be reached in fewer than ten (10) samples.
   - For lakes and reservoirs:
     - A minimum of ten (10) quarterly samples over not less than three (3) years; unless an assessment of non-attainment can be reached in fewer than ten (10) samples.
3. Spatial requirements
   - None that are not already covered in Phase I requirements.
   - Take samples within the epilimnion (if present). Sample depth shall be between 0.33 and 2.0 meters.

Chronic Criterion – Rule 2.512(B) Fish Early Life Stage Present

1. Data temporal requirements
   - Assessments can be made with discrete samples collected when early life stage fishes are present (year-round for brown-trout waters; April – October for all other waters).
2. Minimum data distribution and quantity requirements
   - Ten (10) discrete samples are required to make attainment decisions for ammonia; unless an assessment of non-attainment can be reached in fewer than ten (10) samples.
   - For streams and rivers, discrete samples must be evenly distributed over at least two (2) years evenly distributed throughout applicable season; unless an assessment of non-attainment can be reached in fewer than ten (10) samples.
   - For lakes and reservoirs, a minimum of ten (10) quarterly; unless an assessment of non-attainment can be reached in fewer than ten (10) samples
3. Spatial requirements
   - For streams and rivers, none that are not already covered in Phase I requirements.
   - For lakes and reservoirs, take samples within the epilimnion (if present). Sample depth shall be between 0.33 and 2.0 meters.

Chronic Criterion – Rule 2.512(C) Fish Early Life Stage Absent

1. Data temporal requirements
   - Assessments can be made with discrete samples collected when early life stage fish are absent(year-round for brown trout waters, November 1 – March 31 for all other waters)
2. Minimum data distribution and quantity requirements
   - Ten (10) discrete samples are required to make attainment decisions for ammonia; unless an assessment of non-attainment can be reached in fewer than ten (10) samples.
   - For streams and rivers, discrete samples must be evenly distributed over at least two (2) years and three (3) seasons; unless an assessment of non-attainment can be reached in fewer than ten (10) samples.
   - For lakes and reservoirs, a minimum of ten (10) quarterly samples; unless an assessment of non-attainment can be reached in fewer than ten (10) samples.
3. Spatial requirements
   - For streams and rivers, none that are not already covered in Phase I requirements.
   - For lakes and reservoirs, take samples within the epilimnion (if present). Sample depth shall be between 0.33 and 2.0 meters.

ASSESSMENT METHODOLOGY FOR AMMONIA:

Like data sets (e.g. discrete and discrete) from various sources may be combined into an aggregate data set as per Section 3.3.2. Total ammonia nitrogen will be evaluated based on concurrently measured instream pH and temperature, as applicable, at the time of sample collection using APC&EC Rule 2.512(A)–(C) criteria. In instances where pH, temperature, or both, as applicable fall between the values in APC&EC Rule 2.512(A)–(C), the most protective values will be used. The Chronic Criterion for fish early life stages present (Rule 2.512(B)) apply when early life stage fishes are present in rivers and streams, or within the epilimnion of lakes and reservoirs. The criterion shall be applied as 1) the arithmetic mean of the analytical results of consecutive-day samples when available, or 2) the result of individual grab samples. In the event there is only one sample per month, that sample will serve as the "monthly average" for purposes of ammonia assessment.

LISTING METHODOLOGY:

Stream, river, reservoir, and lake AUs may be listed as non-support for ammonia toxicity if any one of the following criteria are violated:

For Rule 2.512(A) Acute Criterion - If more than one (>1) violation of the 1-hour average concentration of total ammonia nitrogen exceeds the calculated acute criterion within the 3-year period of record, even if the minimum of ten (10) samples has not been reached.

For Rule 2.512(B) Chronic Criterion Fish Early Life Stage Present - If the monthly average concentration of total ammonia nitrogen exceeds the chronic criterion, even if the minimum of ten (10) samples has not been reached. To get the chronic criterion, use the monthly average of corresponding pH and temperature values.

For Rule 2.512(C) Chronic Criterion Fish Early Life Stage Absent - If the highest 4-day average within a 30-day period exceeds 2.5 times the chronic criterion, even if the minimum of ten (10)

samples has not been reached. To get the chronic criterion, use the 4-day average of corresponding pH and temperature values.

DELISTING METHODOLOGY:

An AU can only be delisted by the same criterion that was used to list it. For example, if an AU was listed using the Rule 2.512(A) acute criterion, it can only be delisted using the Rule 2.512(A) acute criterion delisting methodology. Stream and river AUs, as well as lakes and reservoirs, may be listed as support for ammonia toxicity criteria:

For Rule 2.512(A) Acute Criterion - If no more than one violation of the 1-hour average concentration of total ammonia nitrogen exceeds the calculated acute criterion within the 3-year period of record. A minimum of ten (10) samples must be reached to make an assessment of attainment.

For Rule 2.512(B) Chronic Criterion Fish Early Life Stage Present - If the monthly average concentration of total ammonia nitrogen does not exceed the chronic criterion. A minimum of ten (10) samples must be reached to make an assessment of attainment.

For Rule 2.512(C) Chronic Criterion Fish Early Life Stage Absent - If the highest 4-day average within a 30-day period does not exceed 2.5 times the chronic criterion. A minimum of ten (10) samples must be reached to make an assessment of attainment.

REFERENCES CITED

Arkansas Department of Environmental Quality (ADEQ). 2016. Arkansas's Water Quality and Compliance Monitoring Quality Assurance Project Plan (QTRAK #16-155).

Arkansas Department of Environmental Quality (ADEQ). 2013. State of Arkansas Water Quality Monitoring and Assessment Program, Revision 5.

Arkansas Department of Pollution Control and Ecology. 1987. Physical, Chemical, and Biological Characteristics of Least-Disturbed Reference Streams in Arkansas's Ecoregions. Volume 1: Data Compilation.

Arkansas Pollution Control and Ecology Commission (APC&EC). 2017. Rule 2: Rule Establishing Water Quality Standards for Surface Waters of the State of Arkansas.

Clarke, Joan U. 1998. Evaluation of Censored Data Methods to Allow Statistical Comparisons Among Very Small Samples with Below Detection Limit Observations. Environ. Sci. Technol: 32(1), pp 177 – 183.

Croghan, C. and P. P. Egeghy. 2003, Methods of Dealing with Values Below the Limit of Detection Using SAS. Presented at Southeastern SAS user group, St. Petersburgh, FL. September 22-24, 2003.

Dixon, P.M. 2005. A statistical test to show negligible trend. Ecology 86:1751-1756.

Environmental Protection Agency (EPA). 1996. Guidance for data quality assessment: practical methods for data analysis. EPA QA/G-9. EPA/600/R-96/084. July 1996. Washington, D.C.

Environmental Protection Agency (EPA). 2002. Consolidated Assessment and Listing Methodology(CALM): Towards a compendium of best practices. Office of Wetlands, Oceans, and Watersheds. Washington, D.C.

Environmental Protection Agency (EPA). 2005. Guidance for 2006 assessment, listing and reporting requirements pursuant to sections 303(d), 305(b), and 314 of the Clean Water Act. Watershed Branch, Assessment and Watershed Protection Division, Office of Wetlands, Oceans, and Watersheds. Washington, D.C.

Environmental Protection Agency (EPA). 2006. Information concerning 2008 Clean Water Act sections 303(d), 305(b), and 314 integrated reporting and listing decisions. Memorandum from the Office of Wetlands, Oceans, and Watersheds. October 12, 2006. Washington, D.C.

Environmental Protection Agency (EPA). 2009. Information concerning 2010 Clean Water Act sections 303(d), 305(b), and 314 integrated reporting and listing decisions. Memorandum from the Office of Wetlands, Oceans, and Watersheds. May 5, 2009. Washington, D.C.

Environmental Protection Agency (EPA). 2011. Information concerning 2012 Clean Water Act sections 303(d), 305(b), and 314 integrated reporting and listing decisions. Memorandum from the Office of Wetlands, Oceans, and Watersheds. REVIEW DRAFT. Washington, D.C.

Environmental Protection Agency (EPA). 2013. Information concerning 2014 Clean Water Act sections 303(d), 305(b), and 314 integrated reporting and listing decisions. Memorandum from the Office of Wetlands, Oceans, and Watersheds. September 3, 2013. Washington, D.C.

Environmental Protection Agency (EPA). 2014. Method 1603: *Escherichia coli* (*E. coli*) in Water b Membrane Filtration Using Modified membrane-Thermotolerant Escherichia *coli* Agar (Modified mTEC). September 2014. EPA-821-R-14-010. Office of Water.

Environmental Protection Agency (EPA). 2015. Information concerning 2016 Clean Water Act sections 303(d), 305(b), and 314 integrated reporting and listing decisions. Memorandum from the Office of Wetlands, Oceans, and Watersheds. August 13, 2015. Washington, D.C.

Environmental Protection Agency (EPA). 2017. Information concerning 2018 Clean Water Act sections 303(d), 305(b), and 314 integrated reporting and listing decisions. Memorandum from the Office of Wetlands, Oceans, and Watersheds. December 22, 2017. Washington, D.C.

Environmental Protection Agency (EPA). 2021. Information concerning 2022 Clean Water Act sections 303(d), 305(b), and 314 integrated reporting and listing decisions. Memorandum from the Office of Wetlands, Oceans, and Watersheds. March 31, 2021. Washington, D.C.

Plafkin, J.L. M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers: Benthic macroinvertebrates and fish. U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Washington D.C. EPA 440-4-89-001

Scott, J. T., B. E. Haggard, and E. M. Grantz. 2016. Database Analysis to Support Nutrient Criteria Development (Phase III). Arkansas Water Resources Center, Fayetteville, AR, MSC Publication 383:445 pp.

Strahler, A. N. 1952. Hyposometric (area-altitude) analysis of erosional topology. Geological Society of America Bulletin. 63(11): 1117-1142.

Washington State Department of Ecology. 2002. *Additional Clarification of the Binomial Distribution Method*. Addendum to 2002 Water Quality Policy 1-11. Accessed online at: http://www.ecy.wa.gov/programs/wq/303d/2002/2004_documents/binomialclarification.pdf