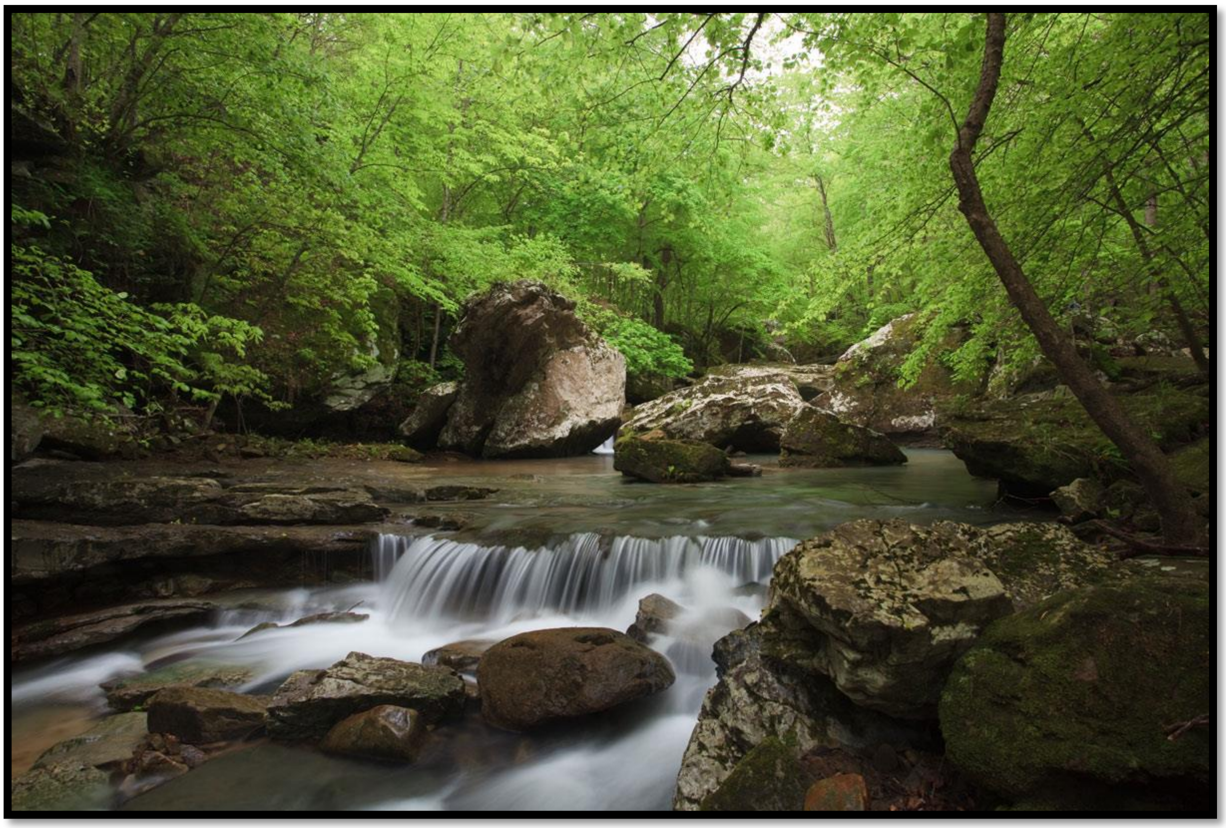
Integrated Water Quality Monitoring Assessment Report

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



2020

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

Table of Contents .... **iii**

List of Tables....... .... **v**

List of Figures........ **vi**

Part A: Introduction **1**

Part B: Background **4**

B.1 Total Waters **4**

Ecoregions 7

River Basins / Total River Miles........ 10

Publically Owned Lakes and Reservoirs........ 12

Summary of Classified Uses........ 12

B.2 Water Pollution Control Programs **20**

Water Quality Standards........ 20

Point Source Control Program........ 21

Nonpoint Source Control Program........ 27

B.3 Cost / Benefit Analysis **29**

Cost Information 29

Benefits Information 30

Part C: Surface Water Monitoring Program........ **33**

C.1 Monitoring Program........ **33**

Water Quality Monitoring Program........ 33

C.2 Data Usage 35

DEQ Data 36

Data from Outside DEQ 36

Data Not Used........ 37

C.3 Assessment Results **41**

Rivers and Streams Assessment Summary........ 41

Lakes Assessment Summary 43

Section 303(d)........ 50

Assessment Categories........ 52

TMDL Prioritization 54

New and Removed Listings........ 57

Waterbodies in Category 4b 62
Waterbodies in Category 5-Alt 63
Key to Tables XII-C through XVIII-C 64
Literature Cited 100
Map Information 101
Appendix A – 4b and 5-Alt Rationale 102
Category 4b Rationale Buffalo River Watershed 102
Category 4b Rationale Cove Creek Watershed 111
Category 5-Alt Rationale Beaver Lake Pathogens, Turbidity, and PH 116
Category 5-Alt Rationale Illinois River Watershed Pathogens 120
Appendix B – The 2020 Assessment Methodology 124

LIST OF TABLES

Table I-B. Stream names corresponding to numerical identifier in Figure 4-B. 15

Table II-B. Stream names corresponding to numerical identifier in Figure 5-B. 17

Table III-B. Stream names corresponding to numerical identifier in Figure 6-B. 19

Table IV-B: Estimate of tourism revenue in AR that benefits from implementation of the CWA 31

Table I-C: DEQ Water Planning projects during the 2020 POR 35

Table II-C: Entities submitting outside data for the 2020 cycle 38

Table III-C: Designated use and water quality standards support in Arkansas's rivers and streams 41

Table IV-C: Support of assessed rivers and streams by use type 41

Table V-C: Total river and stream miles not attaining water quality standards by parameter 42

Table VI-C: Lake names and characteristics corresponding to numerical identifier in Figure 10-C 45

Table VII-C: Designated use and water quality standards support in Arkansas's lakes............... 49

Table VIII-C: Support of assessed lakes by use type 50

Table IX-C: Total lake acres not attaining water quality standards by parameter........................ 50

Table X-C: Pollutant pairs de-listed from the 2018 303(d) list 58

Table XI-C: Waterbody pollutant pairs added and removed for the 2020 period of record......... 62

Table XII-C: Water quality limited waters – streams (Category 4a).. 66

Table XIII-C: Water quality limited waters – lakes (Category 4a) 74

Table XIV-C: Water quality limited waterbodies – streams (Category 4b) 75

Table XV-C: Water quality limited waters – streams (Category 5) – 303(d) list......................... 76

Table XVI-C: Water quality limited waters –lakes (Category 5) – 303(d) list 98

Table XVII-C: Water quality limited waters – streams (Category 5-Alt) – 303(d) list................ 99

Table XVIII-C: Water quality limited waters –lakes (Category 5-Alt) – 303(d) list 99

LIST OF FIGURES

Figure 1-B: Land Use in Arkansas 6

Figure 2-B: Arkansas's Ecoregions 9

Figure 3-B: DEQ Planning Segments 11

Figure 4-B: Arkansas's Extraordinary Resource Waters. Key in Table I-B 14

Figure 5-B: Arkansas's Ecologically Sensitive Waters. Key in Table II-B 16

Figure 6-B: Arkansas's Natural and Scenic Waters. Key in Table III-B 18

Figure 7-B: Active NPDES Permitted Facilities 22

Figure 8-C: Sample Sites Collected by DEQ during the 2020 POR 34

Figure 9-C: Data from Outside Sources 40

Figure 10-C: Significant Publicly-Owned Lakes. Key in Table VI-C 44

Figure 11-C: Arkansas's Waterbodies and Completed TMDLs (Categories 4a and 1b) 55

Figure 12-C: Arkansas's Impaired Waterbodies without Completed TMDLs (Category 5, 5-Alt, and 4b) 56

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
LRMN	Lakes and Reservoirs 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, and 2017).

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 180 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 Lakes and Reservoirs Monitoring Network (LRMN) comprises 78 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 LRMN focuses on identifying potential reference lakes, verifying reference lakes, and developing WQSs for lakes.

The Ambient Groundwater Monitoring Network (AGWN) comprises approximately 200 stations sampled triennially for major ions, metals, nutrients, total organic carbon, and pesticides at selected sites. The AGWN 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 B.

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

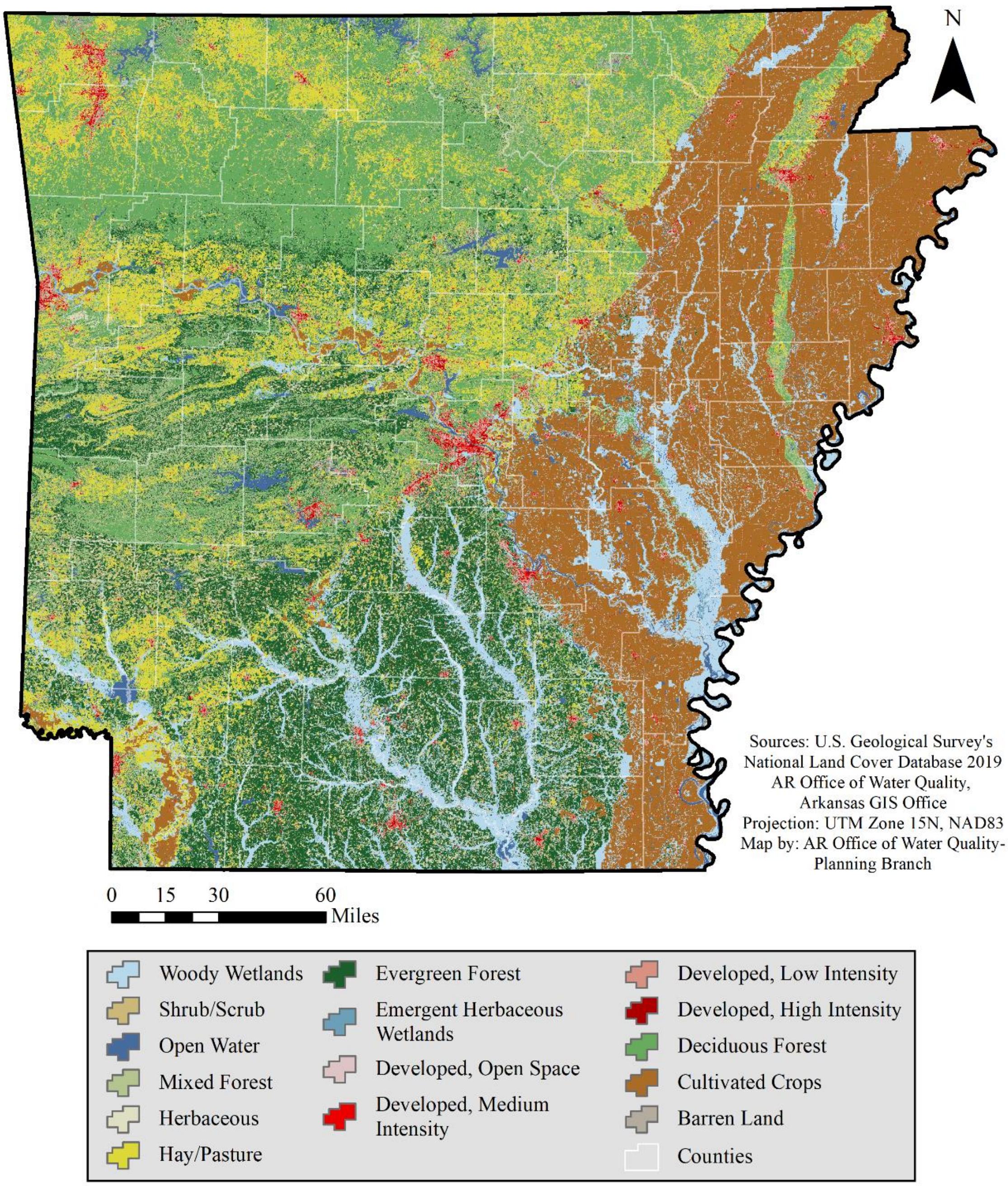
The State of Arkansas covers approximately 53,155 square miles of land. Land use and land cover were summarized for the state using the National Land Cover Database (NLCD) 2019 (www.mrlc.gov/data). Agriculture is the most prominent land use in Arkansas, comprising 33.5% of the state's land cover. Cultivated 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 Gulf Coastal Plains ecoregion (2.7%) and in the Arkansas River 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 River Valley ecoregion (28.4%), and the western Gulf Coastal Plain 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 Gulf Coastal Plain 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 Gulf Coastal Plain 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 Gulf Coastal Plain (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 Delta 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 Gulf Coastal 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.

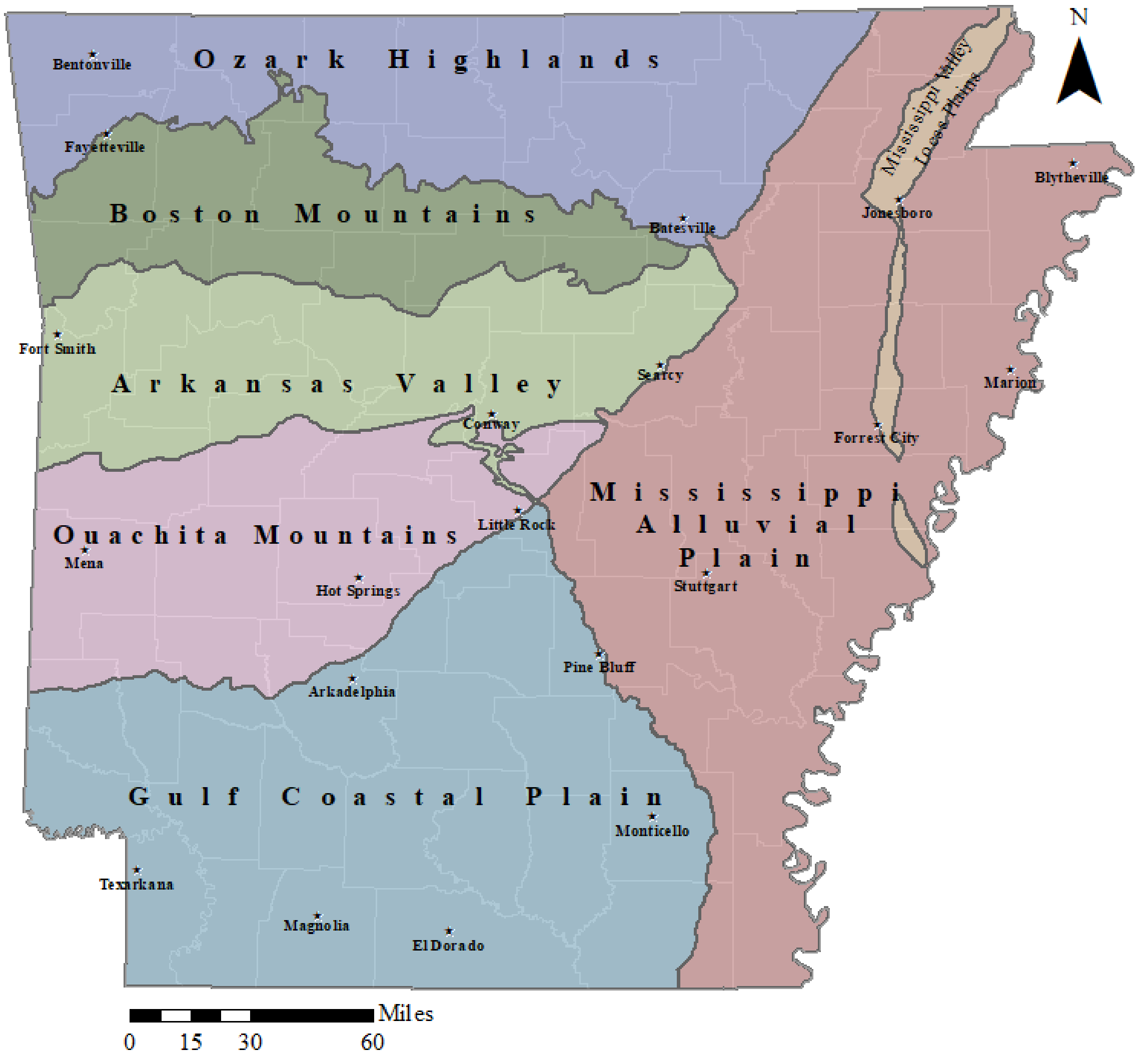
The Arkansas River Valley ecoregion exhibits distinct seasonal characteristics of its surface waters with zero flows common during summer critical conditions. Peak runoff events from within this region tend to introduce contaminants from the predominantly agricultural land uses, which are primarily pasture 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 ~17,890 miles of rivers and streams digitized in the DEQ Water Base Layer. The DEQ Water Base Layer was created from the High Resolution (1:24,000-scale) National Hydrography Dataset (NHD). In 2018, DEQ began using high resolution NHD for determination of assessment unit (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.

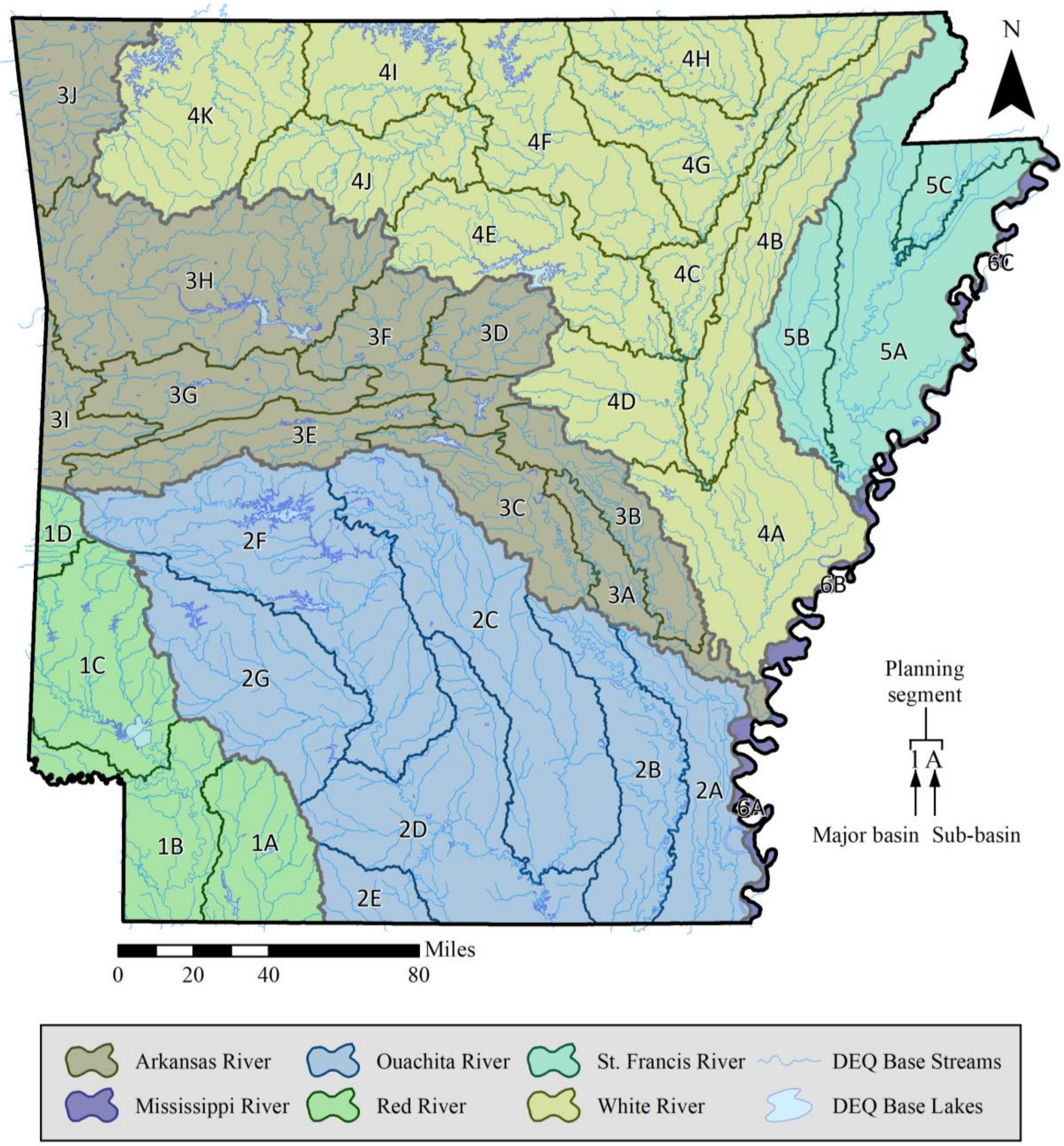
The NHD combines elements of the Digital Line Graph (DLG) and EPA River Reach File (RF3): spatial accuracy and comprehensiveness from the DLG and network relationships, names, and a unique identifier (reach code) for surface water features from RF3. The NHD supersedes DLG and RF3 by incorporating them, 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).

Arkansas has ~4,203[1] miles of streams and ~95,207[1] acres of lakes digitized on the DEQ outstanding resource water bodies (ORW) layers (Extraordinary Resource Waters, Ecologically Sensitive Waterbody, and/or Natural and Scenic Waterways)

[1] Some waterbodies are designated as more than one of the three ORWs and the lengths of each designation are included in the total, even if they overlap.

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 ~326,965 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 a total of ~1,506,107 acres of lakes, ponds, and other impounded waters in the State. This value is calculated on waterbodies that range from 0.0002 acres to 44,978 acres. This 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

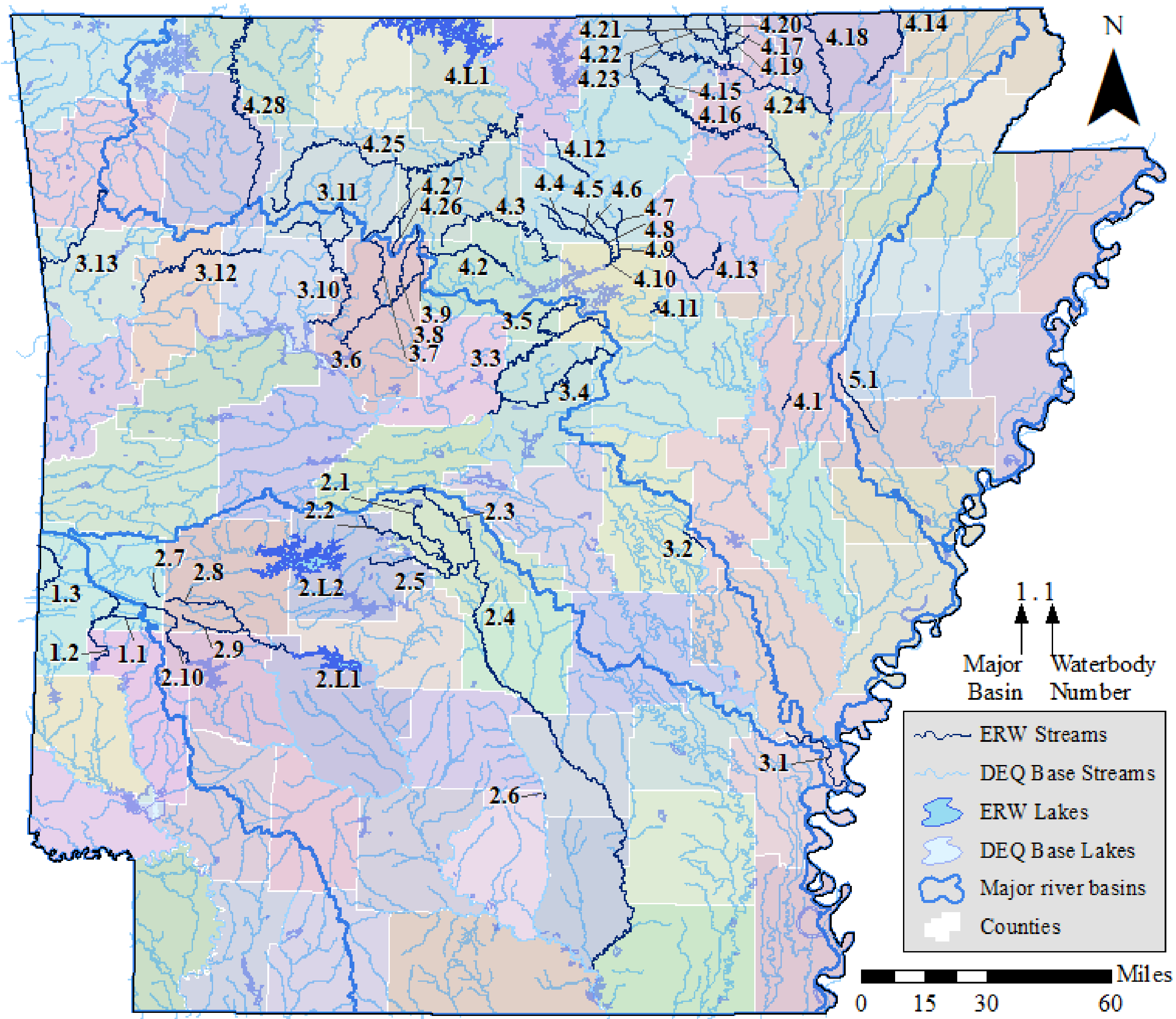


Table I-B. Stream names corresponding to numerical identifier in Figure 4-B.

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	

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

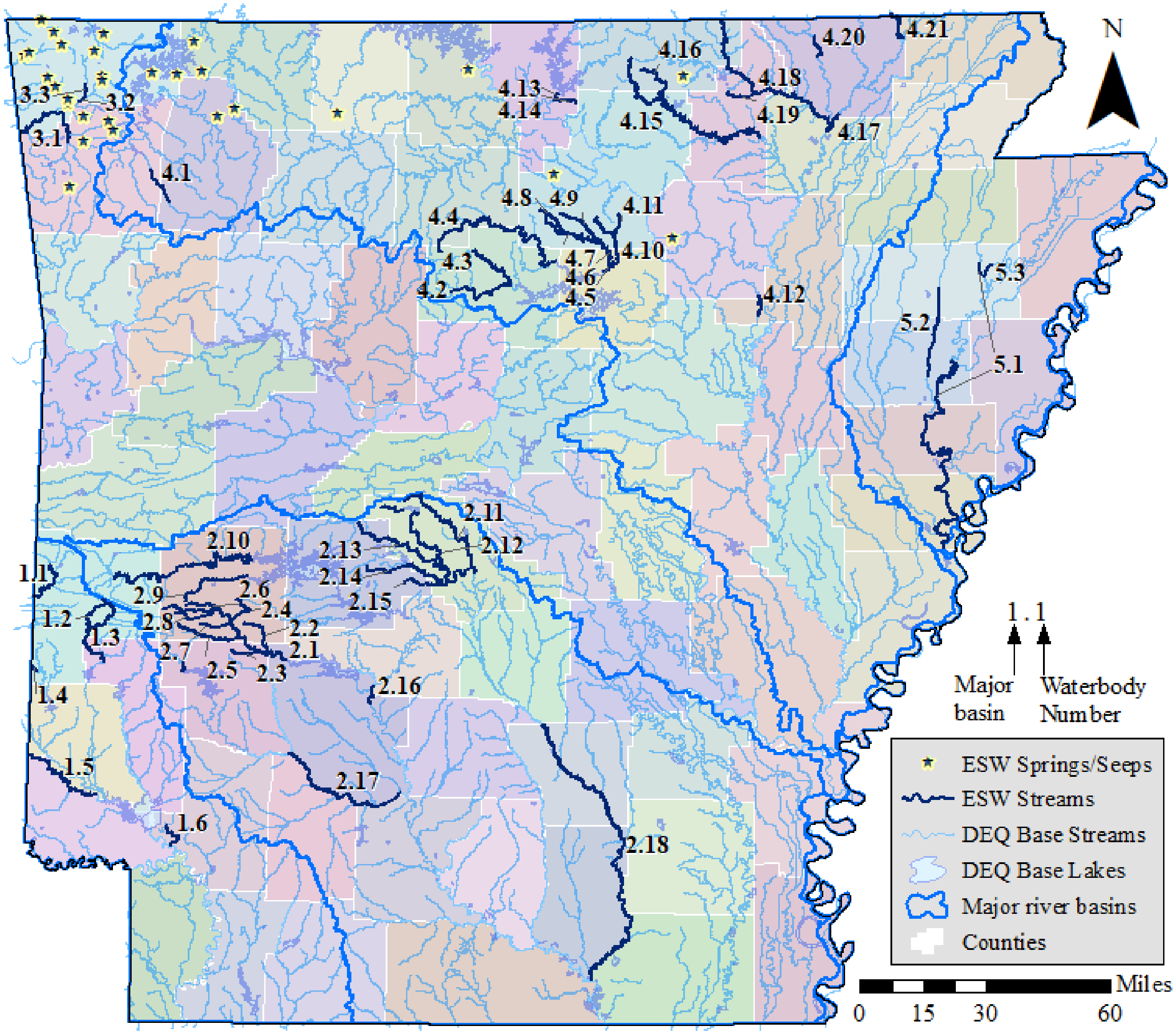


Table II-B. Stream names corresponding to numerical identifier in Figure 5-B.

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	

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

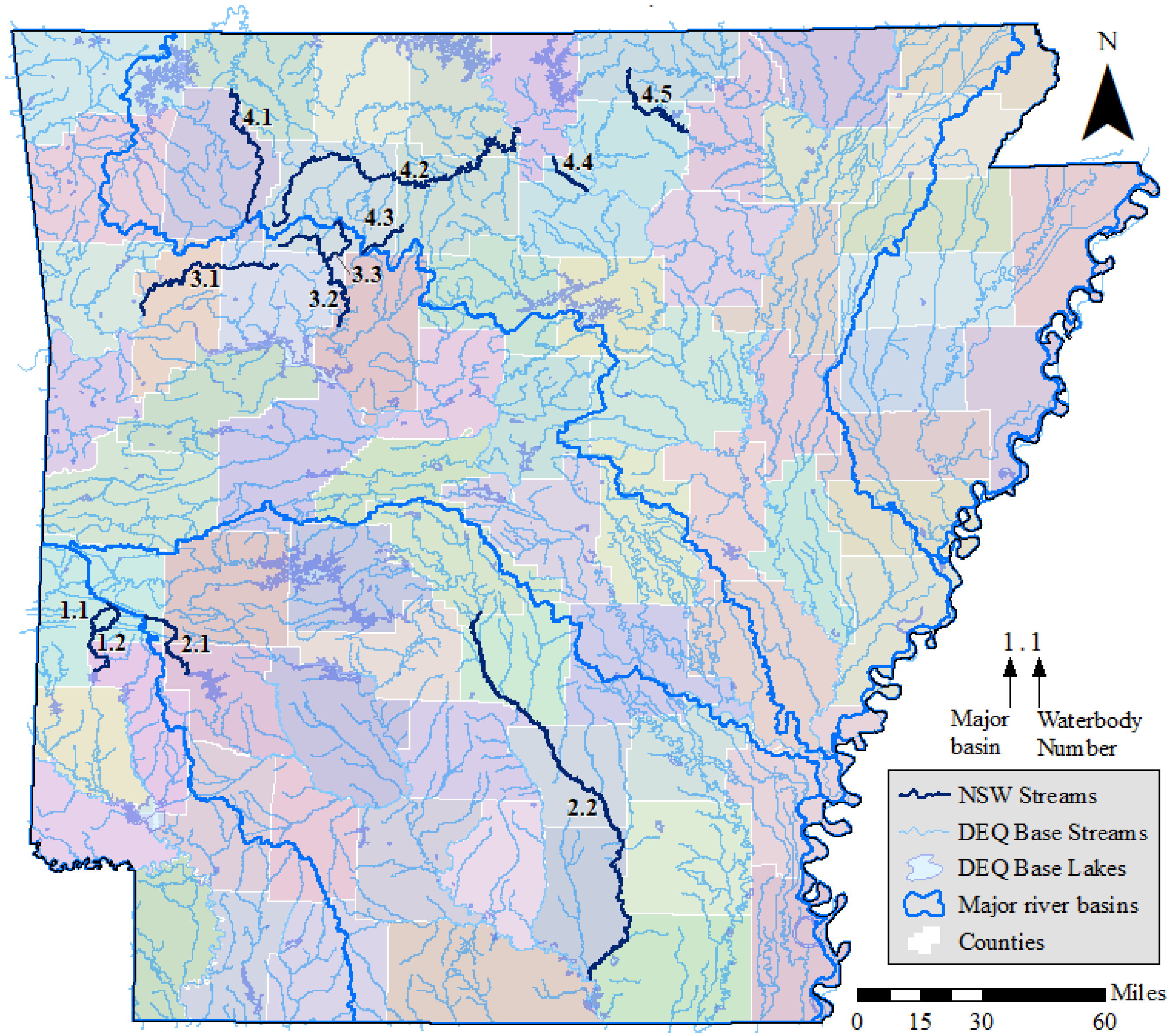


Table III-B. Stream names corresponding to numerical identifier in Figure 6-B.

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

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, flow 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.

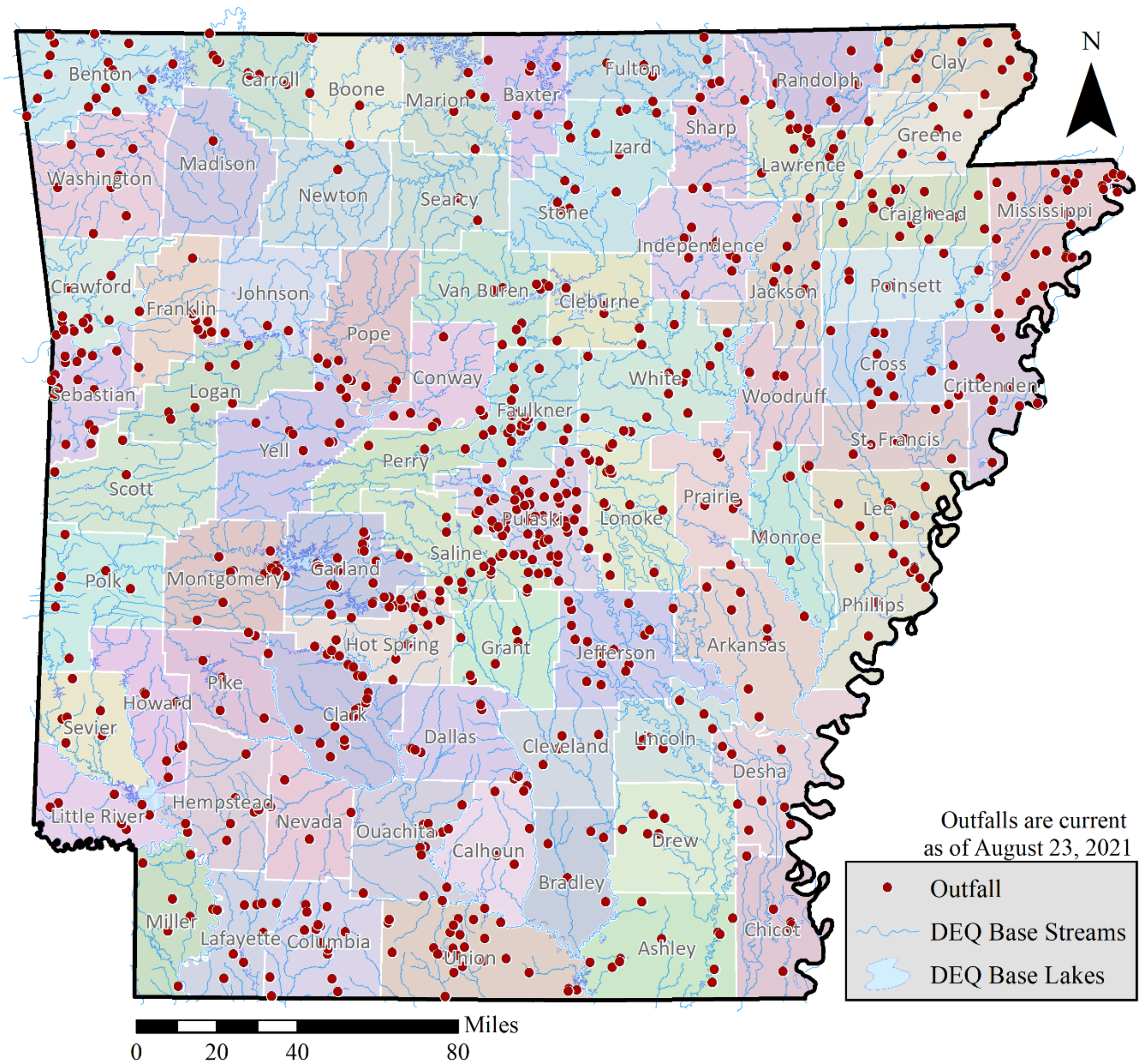
Point Source Control Program

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 flow, receiving stream name, and critical flow 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 Highway and Transportation Department. 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 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 task force (task force) 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 available.

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 confined animal facilities, 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…."

The Office of Land Resources within DEQ has regulations pertaining to groundwater protections. DEQ's Brownfields Program uses the 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 $100 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 $10 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 over 87,600 miles of streams and rivers, and 515,000 acres of 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 experienced a year of growth in 2018 (Table IV-B). Travel expenditures increased from approximately $7.06 billion in 2017 to $7.37 billion in 2018, up 4.4% (https://www.arkansas.com/industry-insider/research-and-development/research-services)). A conservative estimate for tourism revenue that directly benefited from implementation of the CWA (fishing, boating, canoeing, etc.) would be 10% or approximately $737 million. Using data from previous 305(b) reports, a conservative estimate of tourism revenue that directly benefited from implementation of the CWA, for the 2020 POR, is over $3.36 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)
2014	$6.70	$670
2015	$7.28	$728
2016	$7.66	$766
2017	$7.06	$706
2018	$7.37	$737
Total		**$3,607**

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) $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 70 surface water intake systems that produce (collectively) an average of 284 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 nearly $27,000 per day or $9.8 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, $5.86 in tax revenue is generated. (https://www.fws.gov/norfork/) For every tax dollar spent for recreational fish production at Mammoth Spring NFH, $12 of net economic value is created resulting in a total economic output of more than $1.5 million every year by way of taxes, jobs, and sales. (https://www.fws.gov/mammothspring/). Based on 2017 economic data, for every $1 of hatchery operational budget Greers Ferry hatchery spends, $44 is put back into the economy (https://www.fws.gov/greersferry/documents/Economics-2017Greers_factsheetrev4-3-2018.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 78 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 only the 16 United States Army Corps of Engineers (USACE) lakes 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 2020 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 2020 POR can be found in Figure 8-C.

Figure 8-C: Sample Sites Collected by DEQ during the 2020 POR

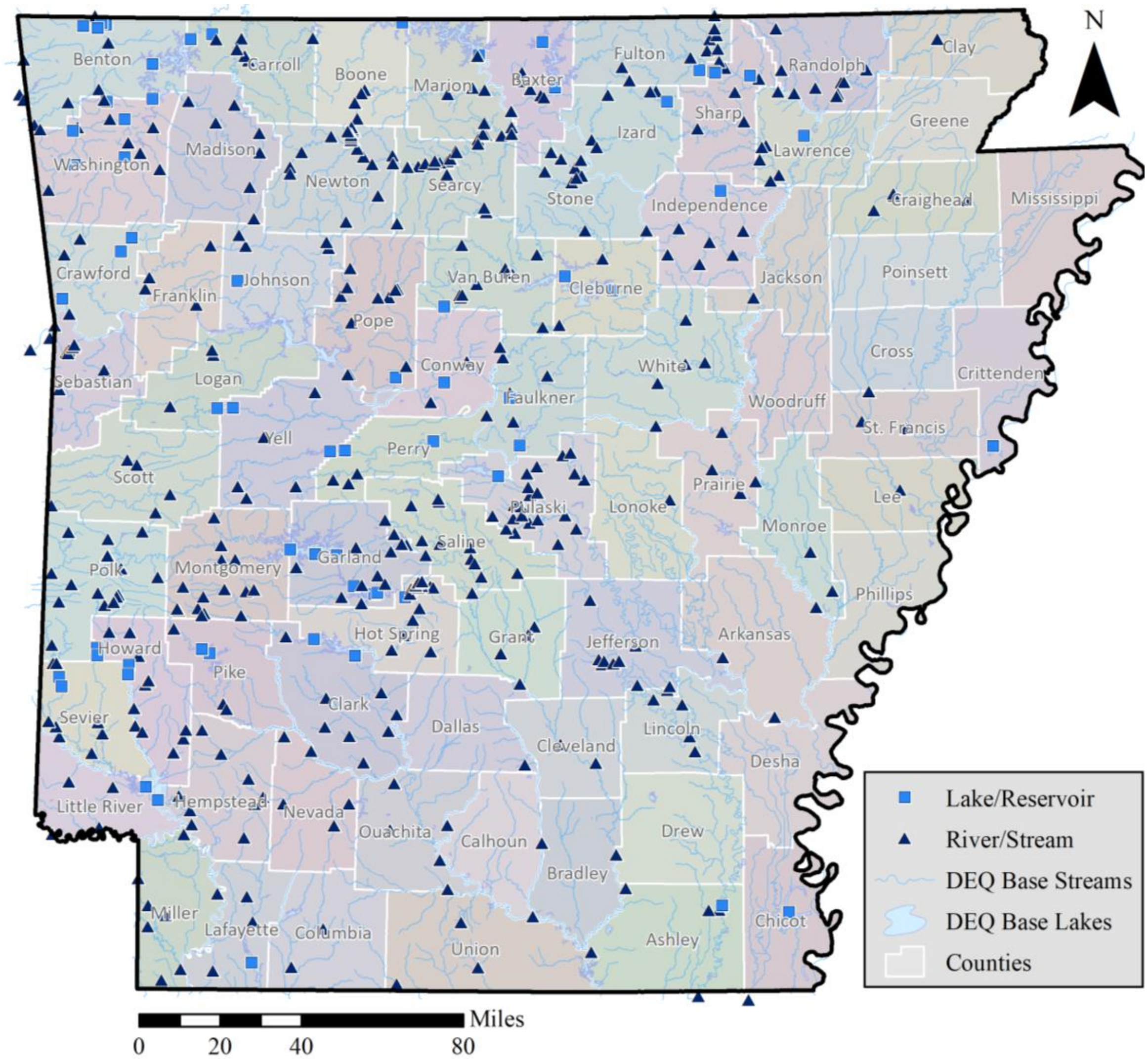


Table I-C: DEQ Water Planning Branch special projects during the 2020 POR

Name	Project Year(s)
Type B Reference Lake Identification	2010 to 2015
White Oak Bayou	2010 to 2015
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
Reyburn Creek Toxicity Study	2013-2015
2014 Ambient Toxicity Study	2014
Data Collection for the Development of Nutrient Criteria for Extraordinary Resource Waterbodies in the Boston Mountain Ecoregion of Arkansas	2013-2016
Preliminary Evaluation of Designated Use Attainment for the Black River near Pocahontas, Arkansas	2014-2015
2015 Ambient Toxicity Study	2015
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

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 2020 Assessment Methodology used for assessments can be found in Appendix B.

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.

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 (WQP) (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). For the 2020 cycle, DEQ directly contacted 132 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 back water.
- 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 QA/QC protocol equivalent to or more stringent than that of DEQ or the USGS. Data collection protocols (Quality Assurance Project Plan (QAPP) and standard operating procedure (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 an 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 B) 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 B), some existing and readily available data were evaluated, but not used for assessments during the 2020 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 2020 assessment cycle are described below.

Applicable dates for data submitted during the 2018 call for data that was not resubmitted/pulled from WQP/USGS for the 2020 call for data was extracted from the dataset that passed Phase 1 during the 2018 assessment.

The following describes data not used for each entity that submitted data in the 2020 POR:

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

Arkansas State University – data for sites not addressed in a QAPP or for water quality parameters analyzed in labs without State accreditation.

Arkansas Water Resources Center – data from sites not addressed in a QAPP or for water quality parameters analyzed in labs without State accreditation.

Beaver Water District – data from citizen science programs not accompanied by a QAPP or a detailed description of training or site metadata. Data from lake depths below the epilimnion (for all applicable parameters) and sites with no available metadata

Buffalo River Watershed Alliance – data collected during targeted storm samples.

Future Fuels – pH data provided as daily minimum or maximum and could not be paired with ammonia or metals.

GBMc & Associates – data collected from effluent or targeted stormwater 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 – data reported as summary statistics.

Oklahoma Conservation Commission – water quality parameters analyzed in labs without State accreditation and data collected during targeted storm water sampling.

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.

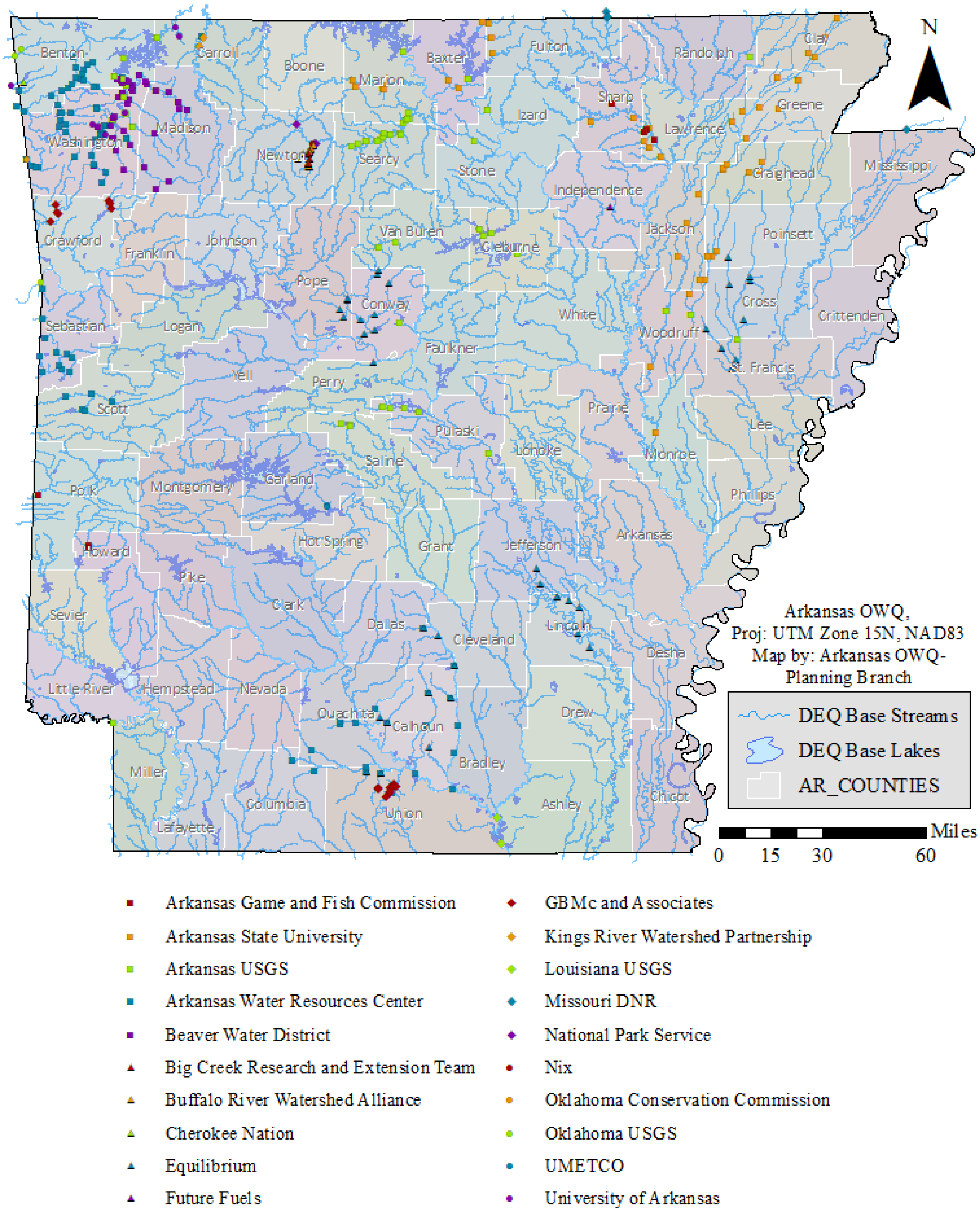
UMETCO Minerals Corporation – data collected during active remediation and construction events.

White River Waterkeeper – water quality parameters analyzed in labs without State accreditation.

Table II-C: Entities submitting outside data for the 2020 cycle

Entity Name
Arkansas Game and Fish Commission
Arkansas State University
Arkansas Water Resources Center
Beaver Water District
Big Creek Research Extension Team
Buffalo River Watershed Alliance
Cherokee Nation
Equilibrium
Future Fuel Chemical
GBMc and Associates
Joe Nix – Ouachita Baptist University
Kings River Watershed Partnership
Missouri Department of Natural Resources
National Park Service
Oklahoma Conservation Commission
Texas Commission on Environmental Quality
UMETCO Minerals Corporation
United States Geological Survey - Arkansas
United States Geological Survey - Louisiana
United States Geological Survey - Oklahoma

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. Tables III-C through V-C can have overlapping mileage, for example, if the same stream segment that is 10 miles long is listed as non-support for both primary and secondary contact recreation, it would appear as 20 miles, not 10.

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

Degree of Use Support	Assessed Total (miles)
River miles with no known use impairments	2,757
River miles that don't support at least one use	5,369
Total Waters with insufficient data for all uses (Category 3)	9,763

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

Use Type	Support (miles)	Non-Support (miles)
Agricultural & industrial water supply	4,335	108
Aquatic life	3,626	3,571
Domestic water supply	4615	133
Other	3,878	2,903
Outstanding resource water	420	763
Primary contact	796	500
Fish consumption [2]	NA	709

[2] Fish consumption is not a designated use.

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

Cause Categories	Stream Miles
Ammonia	28
Aluminum	3
Beryllium	3
Biological Integrity	87
Copper	43
Chlorides	346
Dissolved Oxygen	2,237
Lead	897
Mercury	401
Nitrogen	76
E. coli	630
pH	1,093
Phosphorus	31
Priority Organics	56
Selenium	9
Siltation/Turbidity	2,153
Sulfates	307
Temperature	361
Total Dissolved Solids	417
Toxicity	6
Zinc	124

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. A few 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 78 significant publicly owned lakes (Figure 10-C) ranging in size from 40 to over ~40,000 acres; totaling ~314,070 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 78 significant public lakes, which utilizes a 3-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 9–12 years. Before the establishment of the rotating program, DEQ had been sampling only the 16 United States Army Corps of Engineers (USACE) lakes since 2011.

.

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

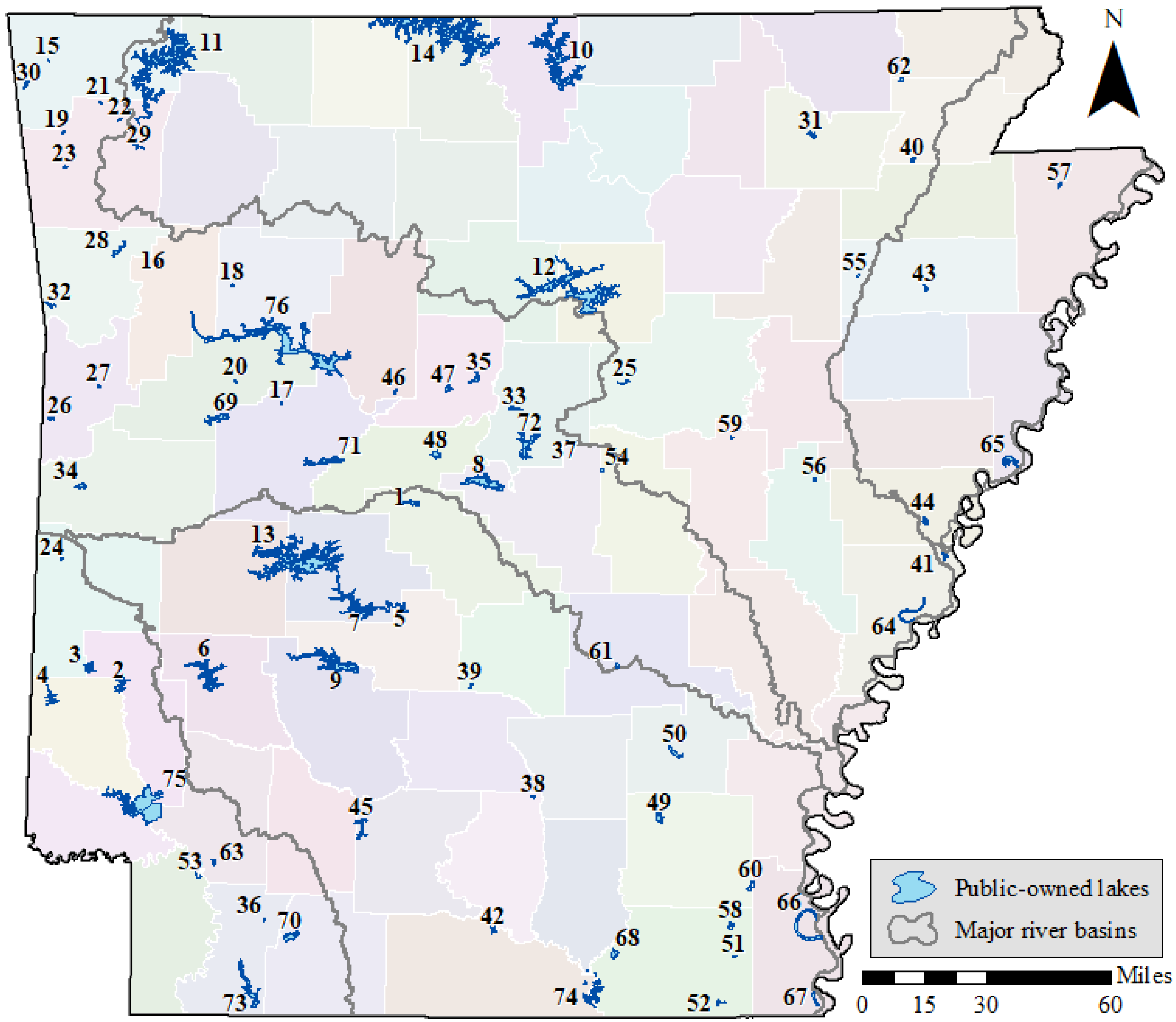


Table VI-C: Lake names and characteristics corresponding to numerical identifier in Figure 10-C

Number	Lake	County	Acres	Average Depth (m)	Watershed (mi^2)	W/A[3]	Ecoregion[4]	Primary Purpose[5]
1	Winona	Saline	1170	30	44.3	24.2	OM	W
2	Dierks	Howard	1363	22	112	52.6	OM	F
3	Gillham	Howard	1157	21	273	151.0	OM	F
4	DeQueen	Sevier	1625	21	171	67.3	OM	F
5	Catherine	Hot Spring	1528	18	1500	628.3	OM	H
6	Greeson	Pike	7085	39	238	21.5	OM	H
7	Hamilton	Garland	6706	26	1460	139.3	OM	H
8	Maumelle	Pulaski	8960	23	138	9.9	OM	W
9	DeGray	Clark	11521	49	432	24.0	OM	H
10	Norfork	Baxter	17960	57	1810	64.5	OH	H
11	Beaver	Benton	28117	58	1190	27.1	OH	H
12	Greers Ferry	Cleburne	31034	60	1150	23.7	BM	H
13	Ouachita	Garland	38184	51	1100	18.4	OM	H
14	Bull Shoals	Marion	33544	67	6036	115.2	OH	H
15	Crystal	Benton	38	12	5.3	89.3	OH	A
16	Shores	Franklin	72	10	49.9	443.6	BM	R
17	Spring	Yell	81	23	17	134.3	ARV	R
18	Horsehead	Johnson	109	16	17.3	101.6	BM	R
19	Wedington	Washington	86	16	3.96	29.5	OH	R
20	Cove	Logan	126	10	9.87	50.1	ARV	R

[3] Watershed (acres)/area of lake
[4] OM=Ouachita Mountains; BM=Boston Mountains; OH=Ozark Highlands; ARV=Arkansas River Valley; GCP=Gulf Coastal Plain; D=Delta
[5] Primary purpose corresponds with lake creation needs. This does not correspond with Designated Use(s) for the lake. W=Water Supply; F=Flood Control; H=Hydropower; A=Angling (Public Fishing); N=Navigation; R=Recreation

Number	Lake	County	Acres	Average Depth (m)	Watershed (mi^2)	W/A[3]	Ecoregion[4]	Primary Purpose[5]
21	Elmdale	Washington	146	8	7.77	34.1	OH	A
22	Fayetteville	Washington	171	15	9.38	35.1	OH	R
23	Budd Kidd	Washington	193	13	3.94	13.1	OH	A
24	Wilhelmina	Polk	197	10	13.4	43.5	OM	A
25	Barnett	White	257	27	37.5	93.4	ARV	A
26	Sugarloaf	Sebastian	291	12	2.33	5.1	ARV	A
27	Jack Nolan	Sebastian	182	9	3.1	10.9	ARV	A
28	Ft. Smith	Crawford	1313	58	75	36.6	BM	W
29	Sequoyah	Washington	425	8	274	412.6	OH	R
30	Flint Creek	Benton	416	17	14	21.5	OH	W
31	Charles	Lawrence	550	8	19.7	22.9	OH	A
32	Lee Creek	Crawford	582	11	465	511.3	BM	W
33	Beaver Fork	Faulkner	722	10	11	9.8	ARV	R
34	Hinkle	Scott	969	15	27.8	18.4	ARV	A
35	Brewer	Conway	131	20	36.4	177.8	ARV	W
36	June	Lafayette	75	5	6.35	54.2	GCP	A
37	Bailey/Roosevelt	Conway	111	8	9.27	53.4	ARV	R
38	Tricounty	Calhoun	287	7	15.3	34.1	GCP	A
39	Cox Creek	Grant	245	6	9.09	23.7	GCP	A
40	Frierson	Greene	343	8	10.2	19.0	D	A
41	Storm Creek	Phillips	273	7	9.13	21.4	D	R
42	Calion	Union	495	6	18.4	23.8	GCP	A
43	Poinsett	Poinsett	338	7	4.4	8.3	D	A
44	Bear Creek	Lee	493	10	6.04	7.8	D	R
45	Upr White Oak	Ouachita	608	8	21	22.1	GCP	A

Number	Lake	County	Acres	Average Depth (m)	Watershed (mi^2)	W/A[3]	Ecoregion[4]	Primary Purpose[5]
46	Atkins	Pope	129	6	10.8	53.6	ARV	A
47	Overcup	Conway	805	4	16.6	13.2	ARV	A
48	Lwr White Oak	Ouachita	1044	8	43.2	26.5	GCP	A
49	Harris Brake	Perry	1260	6	11.2	5.7	ARV	A
50	Monticello	Drew	1476	12.5	6.8	2.9	GCP	A
51	Cane Creek	Lincoln	1734	6	23.8	8.8	GCP	A
52	Wilson Break	Ashley	148	5	1	4.3	D	A
53	Enterprise	Ashley	198	5	2	6.5	D	A
54	First Old River	Miller/Hempstead	220	4	5.07	14.7	GCP	A
55	Pickthorne	Lonoke	325	5	13.2	26.0	D	A
56	Hogue	Poinsett	237	4	2	5.4	D	A
57	Greenlee	Monroe	270	6	0.5	1.2	D	A
58	Mallard	Mississippi	318	6	0.5	1.0	D	A
59	Grampus	Ashley	335	6	2	3.8	D	A
60	Des Arc	Prairie	295	6	1	2.2	D	A
61	Wallace	Drew	321	5	7.05	14.1	D	A
62	Saracen	Jefferson	467	6	42.2	57.8	D	A
63	Ashbaugh	Greene	437	5	5.59	8.2	D	A
64	Bois D'Arc	Hempstead	642	4	4	4.0	GCP	A
65	Old Town	Phillips	2135	4	29.2	8.8	D	R
66	Horseshoe	Crittenden	2388	10	13.5	3.6	D	R
67	Upper Chicot	Chicot	1312	15	17.4	8.5	D	R
68	Grand	Chicot	1192	7	9.81	5.3	D	A
69	Georgia Pacific	Ashley	1559	4	4	1.6	GCP	W
70	Blue Mountain	Logan	2972	9	488	105.1	ARV	F

Number	Lake	County	Acres	Average Depth (m)	Watershed (mi^2)	W/A[3]	Ecoregion[4]	Primary Purpose[5]
71	Columbia	Columbia	2380	11	48	12.9	GCP	W
72	Nimrod	Yell	2594	8	680	167.8	ARV	F
73	Lower Chicot	Chicot	3828	15	408	68.2	D	R
74	Conway	Faulkner	878	5	136	99.1	ARV	A
75	Erling	Lafayette	5929	7	398	43.0	GCP	W
76	Jake	Bradley	14000	7	10852	496.1	GCP	R
77	Millwood	Little River	27920	5	4120	94.4	GCP	F
78	Dardanelle	Pope	34041	14	153666	2889.1	ARV	N

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. Tables VII-C through IX-C can have overlapping mileage, for example, if the same stream segment that is 10 miles long is listed as non-support for both primary and secondary contact recreation, it would appear as 20 miles, not 10. 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	231,578
Lake acres that don't support at least one use	24,089
Total lake acres with insufficient data for all uses (Cat. 3)	71,297

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

Designated Use Type	Support (acres)	Non-Support (acres)
Agricultural and Industrial Water Supply	210,399	0
Aquatic life	227,349	9,828
Fish consumption[6]	NA	6,287
Domestic water supply	240,590	0
Other uses	231,899	11,012
Primary contact recreation	2,473	1,692

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

Cause Categories	Number of Lake Assessment Units	Lake Acres
Copper	1	313
Dissolved oxygen	2	2414
E. coli	2	2620
Mercury	12	5818
Nutrients (nitrogen & phosphorus)	6	6746
Polychlorinated biphenyl (PCB)	1	467
pH	10	7234
Siltation/Turbidity	6	7949
Unknown	1	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 2020 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.

The 2020 303(d) list format had 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 de-listed in the future. DEQ also hopes that this extra level of detail will help guide future sampling or implementation of best management practices.

[6] Ibid., 41

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 2020 list is set up to reflect both of those conditions. This additional information can be found in the column called “Descriptor” on the 2020 303(d) list.

Deviations from Methodology

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 2020 assessment, deviations from methodology 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) Section 6.9 of the Assessment Methodology states that “[Long-term] Continuous data must cover consecutive months.” All long-term continuous data was assessed as stated in preceding sections of the methodology, requiring a number of months, but not that they be consecutive.
3) AR_08040201_726 did not pass Phase 2 distribution requirements, but was put on the list due to the high exceedance rate of available data.
4) The most protective criteria were applied to waterbody segments that crossed ecoregion borders.

For macroinvertebrate assessments, Community Loss Index was not used for assessments based on updated guidance from Barbour *et* al. 1999. Reference sites were selected from the pool of sites available during the 2020 POR, which were all collected in the Ouachita Mountain ecoregion. Hilsenhoff Biotic Index (HBI), one percent dominance, and Ephemeroptera/Plecoptera/Trichoptera (EPT) were calculated as described in the Assessment Methodology. Streams were selected that had HBIs of < 4.25, did not have single taxa > 20%, and within the top 10% of EPT scores, which resulted in seven reference sites. Total taxa, the ratio of scrapers to filter-collectors and the ratio of chironomid abundance were not used in selecting reference sites as they are not always directly indicative of stream health. Averages were calculated for all metrics described in the Assessment Methodology (except for Community Loss Index, which was not used) and used as the reference value.

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 de-listed 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 2020 list of impaired waterbodies are depicted on Figure 11-C (Category 4a 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 2020 list 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

Current TMDL prioritization focuses on revising existing TMDLs, particularly those written as part of the May, 2000 Consent Decree. These TMDLs often do not include room for future growth and the load allocations need to be revised.

In 2015, DEQ created a "Long-Term Vision for Assessment, Restoration, and Protection under the Clean Water Act (CWA) 303(d) Program" (4/17/2015) in accordance with the new measures set forth by EPA. This prioritization plan is also known as the Vision.
https://www.adeq.state.ar.us/water/planning/integrated/tmdl/pdfs/long-term-vision-for-arkansas-20150417.pdf

DEQ has been working to finish five TMDLs started under this prioritization plan:

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

Figure 11-C: Arkansas's Waterbodies and Completed TMDLs (Categories 4a and 1b)

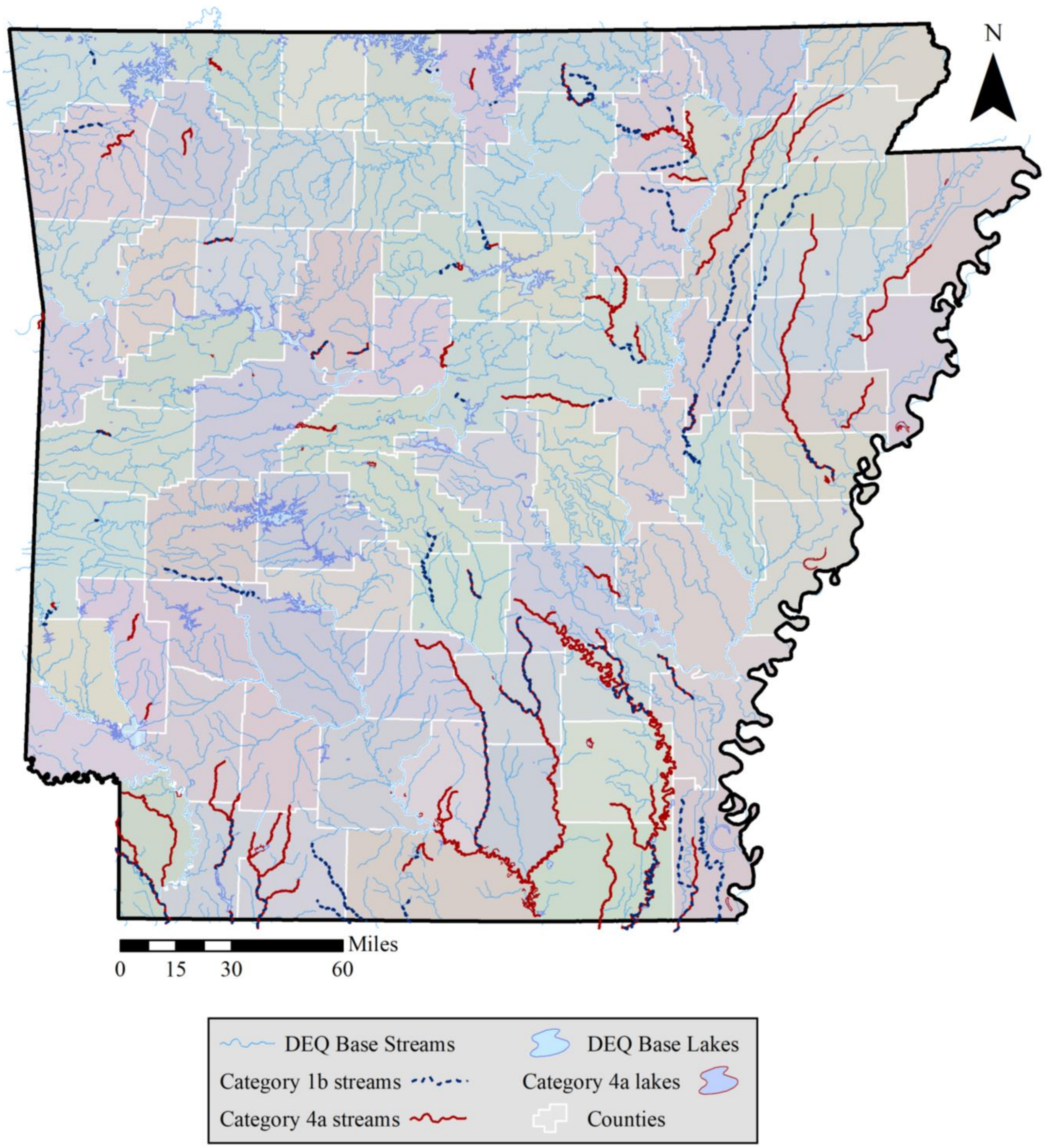
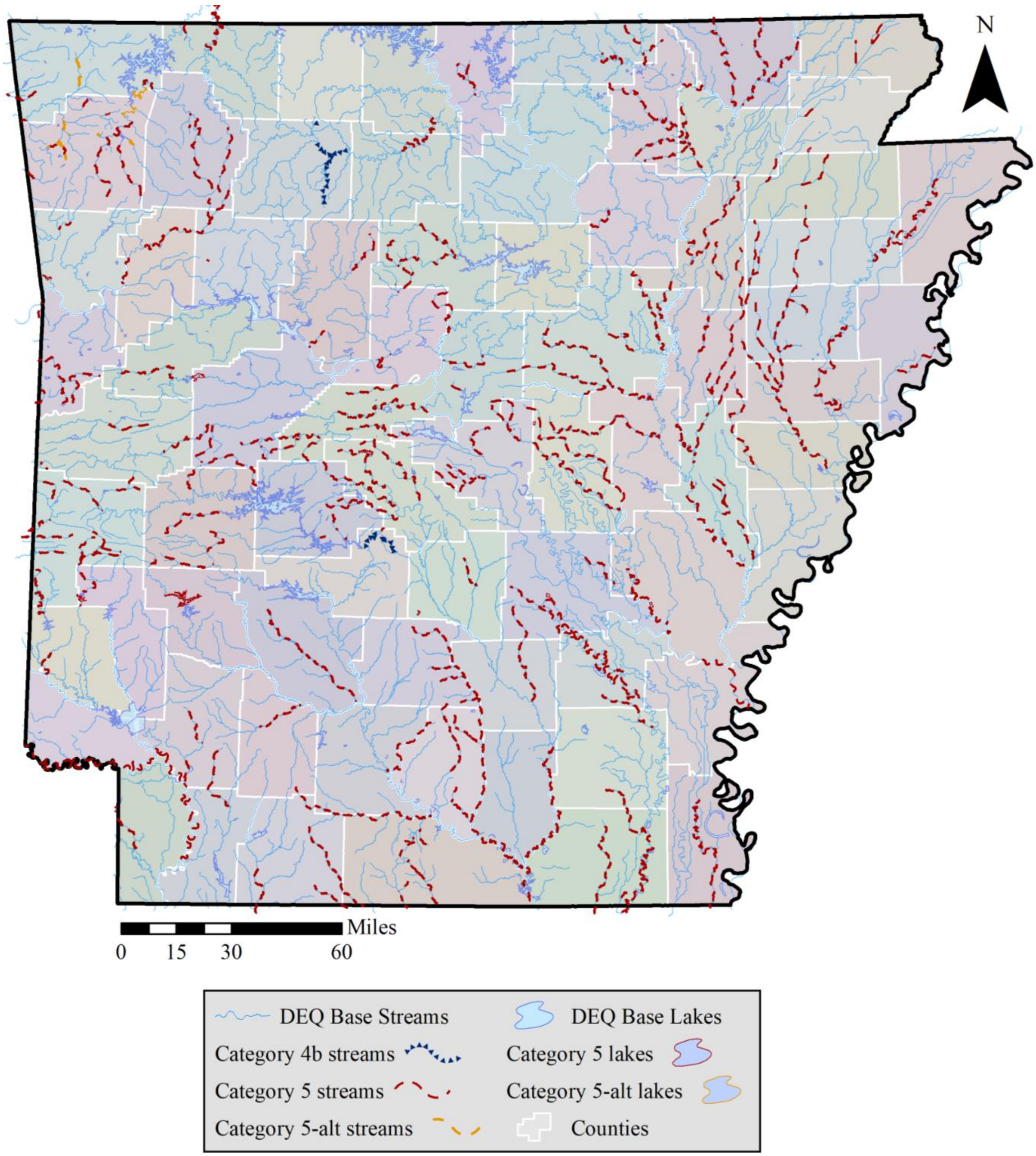


Figure 12-C: Arkansas's Impaired Waterbodies without Completed TMDLs (Category 5, 5-Alt, and 4b)



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 de-listed from the 2018 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 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. For 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 de-listing. As stated in the Assessment Methodology for metals, "An AU can only be de-listed 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 de-listed using the Rule 2.512(A) acute criterion de-listing 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 de-listing table (Table X-C).

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

Table X-C: Pollutant pairs de-listed from the 2018 303(d) list

Planning Segment	Assessment Unit	Stream Name	Parameter	Descriptor	2018 Category
1C	AR_11140109_014	Saline River	Dissolved Oxygen	Primary season	5-Medium
1C	AR_11140109_018	Cossatot River	Dissolved Oxygen	Primary season	5-Medium
1C	AR_11140109_927	Rolling Fork	Nitrate[7]		4a
1C	AR_11140109_927	Rolling Fork	Total Phosphorus		4a
2B	AR_08040205_001	Bayou Bartholomew	Dissolved Oxygen	Primary season	5-Low
2B	AR_08040205_013	Bayou Bartholomew	Dissolved Oxygen	Primary season	5-Low
2C	AR_08040203_913	Saline River	Turbidity	Base flows	5-Medium
2C	AR_08040204_005	Big Creek	Lead	Chronic	5-Low
2D	AR_08040201_001	Caney Creek	Dissolved Oxygen	Primary season	5-Low
2D	AR_08040201_005	Ouachita River	Lead	Chronic	5-Medium
2D	AR_08040201_406	Smackover Creek	Dissolved Oxygen	Critical season	5-Low
2D	AR_08040201_406	Smackover Creek	Dissolved Oxygen	Primary season	5-Low
2D	AR_08040202_006	Bayou Loutre	Zinc	Acute	5-High
2D	AR_08040202_006	Bayou Loutre	Zinc	Chronic	5-High
2F	AR_08040101_033	Ouachita River	Dissolved Oxygen	Critical season	5-Low
2F	AR_08040101_033	Ouachita River	Dissolved Oxygen	Primary season	5-Low
2F	AR_08040101_048	Prairie Creek	Turbidity	Base flows	4a

[7] Water quality standards have not been adopted for nitrate or silt in Rule 2. These listings were promulgated by EPA.

Planning Segment	Assessment Unit	Stream Name	Parameter	Descriptor	2018 Category
2F	AR_08040102_970	Cove Creek	Zinc	Acute	4b
2F	AR_08040102_970	Cove Creek	Zinc	Chronic	4b
2F	AR_08040102_976	Cove Creek	Dissolved Oxygen	Primary season	5-Medium
3B	AR_08020402_907	Bayou Meto	Dissolved Oxygen	Critical season	5-Low
3D	AR_11110205_014	Cadron Creek	Dissolved Oxygen	Critical season	5-Low
3D	AR_11110205_014	Cadron Creek	Dissolved Oxygen	Primary season	5-Low
3D	AR_11110205_015	North Fork Cadron Creek	Dissolved Oxygen	Critical season	5-Low
3D	AR_11110205_015	North Fork Cadron Creek	Dissolved Oxygen	Primary season	5-Low
3E	AR_11110206_007	Fourche LaFave River	pH	Listed as _008 in error	5-Low
3E	AR_11110206_007	Fourche LaFave River	Temperature	Listed as _008 in error	5-Low
3E	AR_11110206_4052	Lake Nimrod	Dissolved Oxygen	Lake	5-Low
3H	AR_11110201_006	Mulberry River	pH	Short-term continuous	5-High
3I	AR_11110105_031	Poteau River	Sulfates		5-Medium
3I	AR_11110105_031	Poteau River	Turbidity	Base flows	5-Medium
3I	AR_11110105_031	Poteau River	Turbidity	Storm flows	5-Medium
3J	AR_11110103_020	Illinois River	Chloride	Site specific	5-Medium
3J	AR_11110103_024	Illinois River	Chloride	Site specific	5-Medium
4B	AR_08020302_011	Flag Slough Ditch	Dissolved Oxygen	Critical season	5-Low
4B	AR_08020302_012	Cow Lake Ditch	Dissolved Oxygen	Critical season	5-Low

Planning Segment	Assessment Unit	Stream Name	Parameter	Descriptor	2018 Category
4B	AR_08020302_012	Cow Lake Ditch	Dissolved Oxygen	Primary season	5-Low
4B	AR_08020302_016	Cache River	Lead	Acute	5-Low
4B	AR_08020302_016	Cache River	Lead	Chronic	5-Low
4D	AR_08020301_006	Bayou Des Arc	Turbidity	Base flows	5-Low
4D	AR_08020301_006	Bayou Des Arc	Turbidity	Storm flows	5-Low
4D	AR_08020301_007	Bayou Des Arc	Dissolved Oxygen	Critical season	5-Low
4D	AR_08020301_007	Bayou Des Arc	Dissolved Oxygen	Primary season	5-Low
4D	AR_08020301_010	Cypress Bayou	*E. coli*		4a
4D	AR_08020301_015	Wattensaw Bayou	Dissolved Oxygen	Primary season	5-Low
4E	AR_11010014_007	Little Red River	*E. coli*	Primary contact	4a
4E	AR_11010014_028	Middle Fork Little Red	*E. coli*	Primary contact	4a
4E	AR_11010014_038	South Fork Little Red River	*E. coli*	Primary contact	4a
4G	AR_11010009_902	Dota Creek	*E. coli*	Primary contact	4a
4G	AR_11010012_006	Strawberry River	pH		5-Low
4G	AR_11010012_010	Little Strawberry River	*E. coli*	Primary contact	4a
4G	AR_11010012_011	Strawberry River	*E. coli*	Primary contact	4a
4G	AR_11010012_014	Reeds' Creek	*E. coli*	Primary contact	4a
4G	AR_11010012_016	Mill Creek	*E. coli*	Primary contact	4a
4I	AR_11010003_049	Crooked Creek	Temperature		5-Low

Planning Segment	Assessment Unit	Stream Name	Parameter	Descriptor	2018 Category
4K	AR_11010001_023	White River	Sulfates	Site specific	5-Low
4K	AR_11010001_4040	Beaver Lake	Turbidity	Base flows	5 Alt.-Low
4K	AR_11010001_4041	Beaver Lake	pH		5 Alt.-Low
4K	AR_11010001_4042	Beaver Lake	*E. coli*	Primary contact	5 Alt.-Low
4K	AR_11010001_4042	Beaver Lake	Turbidity	Base flows	5 Alt.-Low
4K	AR_11010001_4042	Beaver Lake	Turbidity	Storm flows	5 Alt.-Low
4K	AR_11010001_824	Town Branch	Turbidity	Storm flows	5-Low
5A	AR_08020203_008	St. Francis River	Chloride		5-Low
5B	AR_08020205_001	L'Anguille River	Chloride		5-Low
5B	AR_08020205_001	L'Anguille River	Total Dissolved Solids		5-Low
5B	AR_08020205_004	L'Anguille River	Chloride		5-Low

Table XI-C: Waterbody pollutant pairs added and removed for the 2020 period of record

Pollutant	Number of Pollutant Pairs Added	Number of Pollutant Pairs Removed
Ammonia-N	1	0
Biological Integrity	8	0
Dissolved Oxygen	38	24
Metals (Cu, Pb, Zn, Se)	8	8
Minerals (Cl, SO_4, TDS)	0	8
Nitrate[8]	0	1
Pathogens (*E. coli*)	0	15
pH	36	5
Temperature	10	3
Total Phosphorous	0	1
Turbidity	40	12
TOTAL	**141**	**77**

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 2020 assessment cycle, ten AUs consisting of twenty-four pollutant pairs were placed in category 4b for multiple parameters (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 (8) 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 2020 assessment cycle, ten AUs consisting of thirteen pollutant pairs were placed in category 5-Alt for multiple parameters (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 or silt; listings for these parameters were 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
DW = domestic water supply
ORW = outstanding resource water
OU = other use
SC = secondary contact
A&I = agricultural and/or industrial water supply
FC = fish consumption[8]

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

AG = agriculture activities
IP = industrial point source
SE[9] = surface erosion
UR = urban runoff
RE = resource extraction (mining; oil and gas extraction)
HP = hydropower
MP = municipal point source
UN = unknown

[8] Ibid., 41.

[9] 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.

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: Water quality limited waters – streams (Category 4a)

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 4a	Designated Use(s) Not Supported	Source of Contamination	Year Listed
1A	AR_11140203_020	Dorcheat Bayou	Hg (Mercury)		11.4	FC, AL	UN	-
1A	AR_11140203_020	Dorcheat Bayou	Lead		11.4	AL	UN	-
1A	AR_11140203_020	Dorcheat Bayou	pH		11.4	OU	UN	-
1A	AR_11140203_021	Horsehead Creek	Lead		31.1	AL	UN	-
1A	AR_11140203_021	Horsehead Creek	pH		31.1	OU	UN	-
1A	AR_11140203_022	Dorcheat Bayou	Hg (Mercury)		11.5	FC, AL	UN	-
1A	AR_11140203_022	Dorcheat Bayou	Lead	Chronic	11.5	AL	UN	-
1A	AR_11140203_022	Dorcheat Bayou	pH		11.5	OU	UN	-
1A	AR_11140203_023	Big Creek	Chloride		4.4	DW, A&I	UN	-
1A	AR_11140203_023	Big Creek	Lead		4.4	AL	UN	-
1A	AR_11140203_023	Big Creek	Sulfates		4.4	DW, A&I	UN	-
1A	AR_11140203_023	Big Creek	Total Dissolved Solids		4.4	DW, A&I	UN	-
1A	AR_11140203_023	Big Creek	Dissolved Oxygen	Short-term Continuous	21.1	AL	SE, UN	-
1A	AR_11140203_024	Dorcheat Bayou	Hg (Mercury)		7.6	FC, AL	UN	-
1A	AR_11140203_024	Dorcheat Bayou	pH		7.6	OU	UN	-
1A	AR_11140203_025	Beech Creek	Lead		4.6	AL	SE, UN	-
1A	AR_11140203_025	Beech Creek	Turbidity		4.6	OU	SE, UN	-
1A	AR_11140203_026	Dorcheat Bayou	Hg (Mercury)		9.6	FC, AL	UN	-
1A	AR_11140203_026	Dorcheat Bayou	Lead		9.6	AL	UN	-
1A	AR_11140203_026	Dorcheat Bayou	pH		9.6	OU	UN	-
1A	AR_11140203_923	Big Creek	Lead		35.1	AL	UN	-
1A	AR_11140203_923	Big Creek	pH		35.1	OU	UN	-
1A	AR_11140205_002	Bodcau Creek	Lead		5.1	AL	SE, UN	-
1A	AR_11140205_002	Bodcau Creek	pH		5.1	OU	SE, UN	-
1A	AR_11140205_002	Bodcau Creek	Turbidity		5.1	OU	SE, UN	-
1A	AR_11140205_006	Bodcau Creek	Lead	Chronic	23.3	AL	SE, UN	-

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 4a	Designated Use(s) Not Supported	Source of Contamination	Year Listed
1A	AR_11140205_006	Bodcau Creek	pH		23.3	OU	SE, UN	-
1A	AR_11140205_006	Bodcau Creek	Turbidity	Base Flows	23.3	OU	SE, UN	-
1A	AR_11140205_007	Bodcau Creek	Lead		11.7	AL	UN	-
1A	AR_11140205_010	Little Bodcau Creek	Lead	Acute	33.1	AL	UN	-
1A	AR_11140205_010	Little Bodcau Creek	Lead	Chronic	33.1	AL	UN	-
1B	AR_11140201_003	Red River	Turbidity	Base Flows	8.5	OU	SE	-
1B	AR_11140201_012	McKinney Bayou	Chloride	Site specific	17.8	AL	UN	-
1B	AR_11140201_012	McKinney Bayou	Sulfates	Site specific	17.8	AL	UN	-
1B	AR_11140201_012	McKinney Bayou	Total Dissolved Solids	Site specific	17.8	AL	UN	-
1B	AR_11140201_014	McKinney Bayou	Sulfates	Site specific	27.0	AL	UN	-
1B	AR_11140201_014	McKinney Bayou	Total Dissolved Solids	Site specific	27.0	AL	UN	-
1B	AR_11140302_001	Sulphur River	Turbidity		7.9	OU	SE	-
1B	AR_11140302_002	Sulphur River	Turbidity		10.4	OU	SE	-
1B	AR_11140302_003	Days Creek	Nitrate[8]		17.6	DW	MP, AG	-
1B	AR_11140302_004	Sulphur River	Turbidity		0.2	OU	SE	-
1B	AR_11140302_006	Sulphur River	Turbidity	Base Flows	8.2	OU	SE	-
1B	AR_11140302_006	Sulphur River	Turbidity	Storm Flows	8.2	OU	SE	-
1B	AR_11140302_008	Sulphur River	Turbidity		3.0	OU	SE	-
1C	AR_11140109_033	Mine Creek	*E. coli*		6.6	PC	MP	-
1C	AR_11140109_913	Holly Creek	*E. coli*		11.2	PC	MP	-
1C	AR_11140109_919	Rolling Fork	Nitrate[8]		7.3	AL	IP, MP	-
1C	AR_11140109_919	Rolling Fork	Total Phosphorus		7.3	AL	IP, MP	-
2A	AR_08050001_018	Boeuf River	Turbidity	Storm Flows	16.4	OU	SE	-
2A	AR_08050001_019	Boeuf River	Chloride	Site specific	15.6	AL	SE, UN	-
2A	AR_08050001_019	Boeuf River	Sulfates	Site specific	15.6	AL	SE, UN	-

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 4a	Designated Use(s) Not Supported	Source of Contamination	Year Listed
2A	AR_08050001_019	Boeuf River	Total Dissolved Solids	Site specific	15.6	AL	SE, UN	-
2A	AR_08050001_019	Boeuf River	Turbidity		15.6	OU	SE, UN	-
2A	AR_08050002_910	Oak Bayou	Total Dissolved Solids		24.0	DW, A&I	SE, UN	-
2A	AR_08050002_910	Oak Bayou	Turbidity		24.0	OU	SE, UN	-
2B	AR_08040205_001	Bayou Bartholomew	Turbidity	Base Flows	54.0	OU	SE	-
2B	AR_08040205_002	Bayou Bartholomew	Chloride	Site specific	17.5	AL	SE, UN	-
2B	AR_08040205_002	Bayou Bartholomew	Hg (Mercury)		17.5	FC, AL	SE, UN	-
2B	AR_08040205_002	Bayou Bartholomew	Sulfates	Site specific	17.5	AL	SE, UN	-
2B	AR_08040205_002	Bayou Bartholomew	Total Dissolved Solids	Site specific	17.5	AL	SE, UN	-
2B	AR_08040205_002	Bayou Bartholomew	Turbidity		17.5	OU	SE, UN	-
2B	AR_08040205_005	Deep Bayou	*E. coli*		33.2	PC	SE, UN	-
2B	AR_08040205_006	Bayou Bartholomew	Turbidity	Base Flows	97.0	OU	SE, UN	-
2B	AR_08040205_006	Bayou Bartholomew	Turbidity	Storm Flows	97.0	OU	SE, UN	-
2B	AR_08040205_007	Cutoff Creek	Hg (Mercury)		19.4	FC, AL	SE, UN	-
2B	AR_08040205_007	Cutoff Creek	Turbidity		19.4	OU	SE, UN	-
2B	AR_08040205_012	Bayou Bartholomew	Hg (Mercury)		49.4	FC, AL	SE, UN	-
2B	AR_08040205_012	Bayou Bartholomew	Turbidity		49.4	OU	SE, UN	-
2B	AR_08040205_013	Bayou Bartholomew	*E. coli*		34.4	PC	SE, UN	-
2B	AR_08040205_013	Bayou Bartholomew	Turbidity	Base Flows	34.4	OU	SE, UN	-

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 4a	Designated Use(s) Not Supported	Source of Contamination	Year Listed
2B	AR_08040205_013	Bayou Bartholomew	Turbidity	Storm Flows	34.4	OU	SE, UN	2020
2B	AR_08040205_901	Bearhouse Creek	*E. coli*		34.5	PC	UN	-
2B	AR_08040205_902	Harding Creek	*E. coli*		4.3	PC	UR	-
2B	AR_08040205_903	Melton's Creek	*E. coli*		5.4	PC	UN	-
2B	AR_08040205_904	Jack's Bayou	*E. coli*		7.4	PC	UN	-
2B	AR_08040205_905	Cross Bayou	*E. coli*		2.5	PC	UN	-
2B	AR_08040205_907	Chemin-A-Haut Cr.	*E. coli*		51.2	PC	UN	-
2B	AR_08040205_912	Bayou Bartholomew	Chloride	Site specific	47.1	AL	SE, UN	-
2B	AR_08040205_912	Bayou Bartholomew	Sulfates	Site specific	47.1	AL	SE, UN	-
2B	AR_08040205_912	Bayou Bartholomew	Total Dissolved Solids	Site specific	47.1	AL	SE, UN	-
2B	AR_08040205_912	Bayou Bartholomew	Turbidity		47.1	OU	SE, UN	-
2C	AR_08040203_001	Saline River	Hg (Mercury)		1.5	FC, AL, ORW	UN	-
2C	AR_08040203_904	Big Creek	Dissolved Oxygen	Critical season	15.6	AL	AG	-
2C	AR_08040203_904	Big Creek	Turbidity	Base Flows	15.6	OU	SE	-
2C	AR_08040203_904	Big Creek	Turbidity	Storm Flows	15.6	OU	SE	-
2C	AR_08040204_001	Saline River	Hg (Mercury)		3.8	FC, AL, ORW	UN	-
2C	AR_08040204_002	Saline River	Hg (Mercury)		60.1	FC, AL	UN	-
2C	AR_08040204_004	Saline River	Hg (Mercury)		20.6	FC, AL, ORW	UN	-
2C	AR_08040204_005	Big Creek	Turbidity	Base Flows	48.7	OU	SE	-
2C	AR_08040204_006	Saline River	Hg (Mercury)		17.3	FC, AL, ORW	UN	-
2D	AR_08040201_001	Moro Creek	Hg (Mercury)		56.4	FC, AL	SE, UN	-
2D	AR_08040201_001	Moro Creek	Turbidity	Base Flows	56.4	OU	SE, UN	-

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 4a	Designated Use(s) Not Supported	Source of Contamination	Year Listed
2D	AR_08040201_002	Ouachita River	Hg (Mercury)		23.4	FC, AL	UN	-
2D	AR_08040201_003	Champagnolle	Hg (Mercury)		19.7	FC, AL	UN	-
2D	AR_08040201_004	Ouachita River	Hg (Mercury)		2.8	FC, AL	UN	-
2D	AR_08040201_606	Haynes Creek	Ammonia-N	Acute	5.2	AL	IP	-
2D	AR_08040201_606	Haynes Creek	Ammonia-N	Chronic - No Early Life Stages	5.2	AL	IP	-
2D	AR_08040201_606	Haynes Creek	Chloride		5.2	DW, A&I	IP	-
2D	AR_08040201_606	Haynes Creek	Sulfates		5.2	DW, A&I	IP	-
2D	AR_08040201_606	Haynes Creek	Total Dissolved Solids		5.2	DW, A&I	IP	-
2D	AR_08040201_626	ECC Tributary	Chloride		5.2	A&I	IP	-
2D	AR_08040201_626	ECC Tributary	Sulfates		5.2	A&I	IP	-
2D	AR_08040201_626	ECC Tributary	Total Dissolved Solids		5.2	A&I	IP	-
2D	AR_08040201_706	Flat Creek	Chloride		9.9	A&I	IP	-
2D	AR_08040201_706	Flat Creek	Sulfates		9.9	A&I	IP	-
2D	AR_08040201_706	Flat Creek	Total Dissolved Solids		9.9	A&I	IP	-
2D	AR_08040201_806	Salt Creek	Chloride		7.2	DW, A&I	IP	-
2D	AR_08040201_806	Salt Creek	Total Dissolved Solids		7.2	DW, A&I	IP	-
2D	AR_08040201_901	Moro Creek	Turbidity		57.0	OU	SE	-
2D	AR_08040201_903	L. Champagnolle Cr.	Hg (Mercury)		14.6	FC, AL	UN	-
2D	AR_08040202_002	Ouachita River	Hg (Mercury)		10.3	FC, AL	UN	-
2D	AR_08040202_003	Ouachita River	Hg (Mercury)		9.0	FC, AL	UN	-
2D	AR_08040202_004	Ouachita River	Hg (Mercury)		32.5	FC, AL	UN	-
3A	AR_08020401_003	Wabbaseka Bayou	Turbidity		42.3	OU	SE	-
3D	AR_11110205_011	Cadron Creek	Turbidity		2.8	OU, ORW	SE	-
3D	AR_11110205_012	Cadron Creek	Turbidity		13.0	OU, ORW	SE	-

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 4a	Designated Use(s) Not Supported	Source of Contamination	Year Listed
3E	AR_11110206_002	Fourche LaFave	Hg (Mercury)		10.1	FC, AL	UN	-
3F	AR_11110203_927	White Oak Creek	Turbidity	Base Flows	7.6	OU	UN	-
3F	AR_11110203_931	Whig Creek	Nitrate[8]		10.1	DW	MP, AG	-
3H	AR_11110201_009	Mulberry River	pH		9.8	OU	UN	-
3I	AR_11110105_001	Poteau River	Turbidity	Base Flows	4.9	OU	UR	-
3I	AR_11110105_001	Poteau River	Turbidity	Storm Flows	4.9	OU	UR	-
3I	AR_11110105_031	Poteau River	Total Phosphorus		6.7	AL	IP	-
4B	AR_08020302_017	Cache River	Turbidity	Base Flows	22.9	OU	UN	-
4B	AR_08020302_027	Cache River	Turbidity		2.2	OU	SE	-
4B	AR_08020302_028	Cache River	Turbidity		6.0	OU	SE	-
4B	AR_08020302_029	Cache River	Turbidity		5.4	OU	SE	-
4B	AR_08020302_031	Cache River	Turbidity		2.9	OU	SE	-
4B	AR_08020302_032	Cache River Ditch	Turbidity		11.0	OU	SE	-
4C	AR_11010013_006	Village Creek	Turbidity		29.1	OU	SE	-
4C	AR_11010013_007	Village Creek	Turbidity		1.2	OU	SE	-
4C	AR_11010013_008	Village Creek	Turbidity		12.2	OU	SE	-
4C	AR_11010013_012	Village Creek	Turbidity		7.7	OU	SE	-
4C	AR_11010013_014	Village Creek	Turbidity		25.7	OU	SE	-
4D	AR_08020301_011	Cypress Bayou	*E. coli*		11.3	PC	UN	-
4D	AR_08020301_012	Cypress Bayou	*E. coli*		28.2	PC	UN	-
4E	AR_11010014_004	Overflow Creek	*E. coli*		0.9	PC	UN	-
4E	AR_11010014_006	Overflow Creek	*E. coli*		12.0	PC	UN	-
4E	AR_11010014_008	Little Red River	*E. coli*		8.4	PC	UN	-
4E	AR_11010014_009	Ten Mile Creek	*E. coli*		23.5	PC	SE, UN	
4E	AR_11010014_009	Ten Mile Creek	Turbidity		23.5	OU	SE, UN	-
4E	AR_11010014_010	Little Red River	*E. coli*		3.7	PC	UN	-
4E	AR_11010014_012	Little Red River	*E. coli*		8.4	PC	UN	-

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 4a	Designated Use(s) Not Supported	Source of Contamination	Year Listed
4E	AR_11010014_027	M. Fk. Little Red	*E. coli*		3.4	PC, ORW	UN	-
4E	AR_11010014_036	S. Fk. L. Red River	Hg (Mercury)		4.0	FC, AL	UN	-
4F	AR_11010004_015	Hicks Creek	Nitrate[8]		13.2	OU	MP	-
4G	AR_11010012_003	Cooper Creek	*E. coli*		20.2	PC	AG	-
4G	AR_11010012_004	Strawberry River	Turbidity		0.1	OU, ORW	SE	-
4G	AR_11010012_005	Strawberry River	Turbidity		1.8	OU, ORW	SE	-
4G	AR_11010012_006	Strawberry River	Turbidity	Base Flows	20.3	OU, ORW	SE	-
4G	AR_11010012_006	Strawberry River	Turbidity	Storm Flows	20.3	OU, ORW	SE	-
4G	AR_11010012_008	Strawberry River	*E. coli*		12.4	PC, ORW	SE	-
4G	AR_11010012_008	Strawberry River	Turbidity		12.4	OU, ORW	SE	-
4G	AR_11010012_011	Strawberry River	Turbidity	Base Flows	27.1	OU, ORW	SE, AG	-
4G	AR_11010012_011	Strawberry River	Turbidity	Storm Flows	27.1	OU, ORW	SE, AG	-
4G	AR_11010012_015	Caney Creek	*E. coli*		12.4	PC	AG	-
4K	AR_11010001_023	White River	Turbidity	Base Flows	1.9	OU	UN	-
4K	AR_11010001_023	White River	Turbidity	Storm Flows	1.9	OU	UN	-
4K	AR_11010001_024	West Fork White River	Turbidity	Base Flows	10.7	OU	UN	-
4K	AR_11010001_024	West Fork White River	Turbidity	Storm Flows	10.7	OU	UN	-
4K	AR_11010001_059	Holman Creek	Nitrate[8]		10.6	AL	MP	-
4K	AR_11010001_823	White River	Turbidity	Base Flows	5.1	OU	UN	-
4K	AR_11010001_823	White River	Turbidity	Storm Flows	5.1	OU	UN	-
4K	AR_11010001_923	White River	Turbidity		0.4	OU	UN	-
4K	AR_11010001_945	Osage Creek	Total Phosphorus		7.8	AL	MP	-
4K	AR_11010001_959	Town Branch	Nitrate[8]		2.6	AL	MP	-
5A	AR_08020203_003	Blackfish Bayou	Turbidity		2.1	OU	SE	-
5A	AR_08020203_005	Blackfish Bayou	Turbidity		2.6	OU	SE	-
5A	AR_08020203_007	Blackfish Bayou	Turbidity		16.8	OU	SE	-

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 4a	Designated Use(s) Not Supported	Source of Contamination	Year Listed
5A	AR_08020203_012	Tyronza River	Turbidity		35.4	OU	SE	-
5A	AR_08020203_909	Tyronza River	Turbidity		30.3	OU	SE	-
5A	AR_08020203_912	Tyronza River	Turbidity		4.7	OU	SE	-
5B	AR_08020205_001	L'Anguille River	Turbidity	Base Flows	17.2	OU	SE	-
5B	AR_08020205_002	L'Anguille River	Turbidity		23.0	OU	SE	-
5B	AR_08020205_003	L'Anguille River	Turbidity		2.9	OU	SE	-
5B	AR_08020205_004	L'Anguille River	*E. coli*		17.0	PC	SE, UN	-
5B	AR_08020205_004	L'Anguille River	Turbidity	Base Flows	17.0	OU	SE, UN	-
5B	AR_08020205_004	L'Anguille River	Turbidity	Storm Flows	17.0	OU	SE, UN	-
5B	AR_08020205_005	L'Anguille River	*E. coli*		53.4	PC	SE, UN	-
5B	AR_08020205_005	L'Anguille River	Turbidity		53.4	OU	SE, UN	-

Table XIII-C: Water quality limited waters – lakes (Category 4a)

Planning Segment	Assessment Unit	Lake Names	Parameter	Descriptor	Acres in Cat. 4a	Designated Use(s) Not Supported	Source of Contamination	Year Listed
1A	AR_11140203_4011	Columbia	Hg (Mercury)		1692	FC	UN	2002
1B	AR_11140201_4020	First Old River	Nutrients		220	AL	UN	2004
2A	AR_08050002_4020	Grand	Nutrients		1192	AL	UN	2004
2C	AR_08040203_4090	Grays	Hg (Mercury)		25	FC	UN	2002
2C	AR_08040203_4101	Winona	Hg (Mercury)		843	FC	UN	2002
2C	AR_08040204_4020	Monticello	Hg (Mercury)		1476	FC	UN	2002
2D	AR_08040201_4040	Big Johnson	Hg (Mercury)		39	FC	UN	2002
2D	AR_08040201_4XXX	Ouachita River Oxbows below Camden	Hg (Mercury)		UN	FC	UN	2002
2D	AR_08040202_4XXX	Felsenthal Complex	Hg (Mercury)		UN	FC	UN	2002
2D	AR_08040202_4XXX	Ouachita River Oxbows below Camden	Hg (Mercury)		UN	FC	UN	2002
3E	AR_11110206_4052	Nimrod	Hg (Mercury)		1370	FC	UN	2002
3E	AR_11110206_4060	Dry Fork	Hg (Mercury)		165	FC	UN	2002
3G	AR_11110204_4070	Spring	Hg (Mercury)		82	FC	UN	2002
3H	AR_11110202_4030	Cove Creek	Hg (Mercury)		126	FC	UN	2002
4A	AR_08020303_4010	Old Town	Nutrients		2135	AL	UN	2004
4B	AR_08020302_4020	Frierson	Silt[8]		343	OU	UN	2004
5A	AR_08020203_4020	Bear Creek	Nutrients		493	AL	UN	2004
5A	AR_08020203_4060	Horseshoe	Nutrients		2388	AL	UN	2004
5C	AR_08020204_4010	Mallard	Nutrients		318	AL	UN	2004

Table XIV-C: Water quality limited waterbodies – streams (Category 4b)

Planning Segment	Assessment Unit	Stream Name	Parameter	Descriptor	Miles in Cat. 4b	Designated Use(s) Not Supported	Source of Contamination	Year Listed
2C	AR_08040203_824	Skull Creek	pH		0.5	OU	IP, RE	2020
2C	AR_08040203_924	Reyburn Creek	pH		8.1	OU	IP, RE	2020
2F	AR_08040102_970	Cove Creek	pH		3.7	OU	RE	-
2F	AR_08040102_970	Cove Creek	Toxicity		3.7	AL	RE	-
2F	AR_08040102_970	Cove Creek	Biological Integrity	Macroinvertebrates	3.7	AL	IP	2020
2F	AR_08040102_971	Chamberlain Creek	Aluminum		2.5	AL	IP, RE	-
2F	AR_08040102_971	Chamberlain Creek	Copper	Acute	2.5	AL	IP, RE	-
2F	AR_08040102_971	Chamberlain Creek	Copper	Chronic	2.5	AL	IP, RE	-
2F	AR_08040102_971	Chamberlain Creek	Dissolved Oxygen	Primary season	2.5	AL	IP, RE	-
2F	AR_08040102_971	Chamberlain Creek	pH		2.5	OU	IP, RE	-
2F	AR_08040102_971	Chamberlain Creek	Sulfates		2.5	DW, A&I	IP, RE	-
2F	AR_08040102_971	Chamberlain Creek	Total Dissolved Solids		2.5	DW, A&I	IP, RE	-
2F	AR_08040102_971	Chamberlain Creek	Toxicity		2.5	AL	IP, RE	-
2F	AR_08040102_971	Chamberlain Creek	Zinc	Acute	2.5	AL	IP, RE	-
2F	AR_08040102_971	Chamberlain Creek	Zinc	Chronic	2.5	AL	IP, RE	-
2F	AR_08040102_971	Chamberlain Creek	Total Recoverable Beryllium		2.5	DW	IP, RE	-
2F	AR_08040102_975	Lucinda Creek	pH		2.3	OU	RE	-
4J	AR_11010005_010	Buffalo River	*E. coli*		10.7	PC, ORW	UN	-
4J	AR_11010005_011	Buffalo River	*E. coli*		7.5	PC, ORW	UN	-
4J	AR_11010005_020	Big Creek	Dissolved Oxygen	Critical season	3.7	AL	UN	-
4J	AR_11010005_020	Big Creek	Dissolved Oxygen	Short-term continuous	3.7	AL	UN	-

Planning Segment	Assessment Unit	Stream Name	Parameter	Descriptor	Miles in Cat. 4b	Designated Use(s) Not Supported	Source of Contamination	Year Listed
4J	AR_11010005_020	Big Creek	Dissolved Oxygen	Critical season, long-term continuous	3.7	AL	UN	-
4J	AR_11010005_022	Big Creek	*E. coli*		3.7	PC	UN	-
4J	AR_11010005_712	Unnamed Trib. of Mill Creek	Dissolved Oxygen	Primary season	1.6	AL	UN	2020

Table XV-C: Water quality limited waters – streams (Category 5) – 303(d) list

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 5	Designated Use(s) Not Supported	Source of Contamination	Priority	Year Listed
1A	AR_11140203_020	Dorcheat Bayou	Turbidity		9.8	OU	SE	Low	-
1A	AR_11140203_022	Dorcheat Bayou	Turbidity	Base flows	11.6	OU	SE	Low	-
1A	AR_11140205_010	Little Bodcau Creek	Dissolved Oxygen	Primary season	26.5	AL	UN	Low	-
1B	AR_11140106_001	Red River	Turbidity		36.5	OU	SE	Low	-
1B	AR_11140106_003	Red River	Turbidity		17.0	OU	SE	Low	-
1B	AR_11140106_005	Red River	Turbidity	Base flows	20.8	OU	SE	Low	-
1B	AR_11140106_025	Red River	Turbidity		5.5	OU	SE	Low	-
1B	AR_11140201_007	Red River	Turbidity	Base flows	41.0	OU	SE	Low	-
1B	AR_11140201_008	Bois D'Arc Creek	Dissolved Oxygen		10.0	AL	UN	Low	-
1B	AR_11140201_009	Bois D'Arc Creek	Dissolved Oxygen		18.7	AL	UN	Low	-
1B	AR_11140201_011	Red River	Turbidity	Base flows	14.9	OU	SE	Low	-
1B	AR_11140302_003	Days Creek	Lead	Chronic	17.6	AL	IP	Medium	-
1C	AR_11140109_001	Little River	Temperature		4.9	AL	UN	Low	-

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 5	Designated Use(s) Not Supported	Source of Contamination	Priority	Year Listed
1C	AR_11140109_018	Cossatot River	Temperature	Long-term continuous	18.5	AL, ORW	UN	Low	2020
1C	AR_11140109_019	Cossatot River	pH		17.2	OU, ORW	UN	Medium	2020
1C	AR_11140109_020	Brushy Creek	pH	Short-term continuous	11.6	OU, ORW	UN	Medium	2020
1C	AR_11140109_024	Bear Creek	Copper	Acute	6.4	AL	IP	Medium	2020
1C	AR_11140109_024	Bear Creek	Copper	Chronic	6.4	AL	IP	Medium	2020
1C	AR_11140109_025	Bear Creek	Copper		11.3	AL	IP	Medium	-
1C	AR_11140109_029	Robinson Creek	Dissolved Oxygen	Critical season	18.6	AL[10]	UN	Medium	2020
1C	AR_11140109_029	Robinson Creek	Dissolved Oxygen	Short-term continuous	18.6	AL[10]	UN	Medium	2020
1C	AR_11140109_029	Robinson Creek	pH		18.6	OU	UN	Medium	2020
1C	AR_11140109_719	Short Creek	pH	Short-term continuous	7.3	OU	UN	Medium	-
1C	AR_11140109_719	Short Creek	pH		7.1	OU	UN	Medium	2020
1C	AR_11140109_921	Caney Creek	pH	Short-term continuous	8.2	OU	UN	Low	-
1C	AR_11140109_921	Caney Creek	pH		8.2	OU	UN	Low	-
1C	AR_11140109_929	Cross Creek	Dissolved Oxygen	Critical season	11.2	AL[10]	UN	Medium	2020
1C	AR_11140109_929	Cross Creek	pH		11.2	OU	UN	Medium	2020
1D	AR_11140108_012	Sixmile Creek	pH	Short-term continuous	17.5	OU	AG, UN	Medium	2020
1D	AR_11140108_012	Sixmile Creek	pH		17.5	OU	AG, UN	Medium	2020
1D	AR_11140108_014	Mountain Fork	Temperature	Long-term continuous	11.3	AL, ORW	UN	Low	2020

[10] Biological data indicate aquatic life uses are being met.

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 5	Designated Use(s) Not Supported	Source of Contamination	Priority	Year Listed
1D	AR_11140108_019	Mill Creek	pH	Short-term continuous	12.3	OU	UN	Low	-
1D	AR_11140108_019	Mill Creek	pH		12.3	OU	UN	Low	-
1D	AR_11140108_907	Barren Creek	Dissolved Oxygen	Primary season	11.7	AL	UN	Medium	2020
1D	AR_11140108_907	Barren Creek	pH		11.7	OU	UN	Low	-
1D	AR_11140108_907	Barren Creek	Turbidity	Base flows	11.7	OU	UN	Medium	2020
2A	AR_08050002_003	Bayou Macon	Chloride	Site specific	23.3	AL	UN	Low	-
2A	AR_08050002_006	Bayou Macon	Chloride	Site specific	37.8	AL	UN	Low	-
2B	AR_08040205_001	Bayou Bartholomew	Dissolved Oxygen	Critical season	54.0	AL	UN	Low	-
2B	AR_08040205_001	Bayou Bartholomew	Lead	Chronic	54.0	AL	UN	Low	-
2B	AR_08040205_006	Bayou Bartholomew	Lead		97.0	AL	UN	Low	-
2B	AR_08040205_006	Bayou Bartholomew	Temperature	Long-term continuous	97.0	AL	UN	Low	2020
2B	AR_08040205_013	Bayou Bartholomew	Lead	Chronic	34.4	AL	UN	Low	2020
2B	AR_08040205_901	Bearhouse Creek	Dissolved Oxygen		34.6	AL	UN	Low	-
2B	AR_08040205_902	Harding Creek	Lead		4.3	AL	UR	Low	-
2B	AR_08040205_905	Cross Bayou	Dissolved Oxygen		2.5	AL	UN	Low	-
2B	AR_08040205_907	Chemin-A-Haut Creek	Dissolved Oxygen		51.3	AL	UN	Low	-
2B	AR_08040205_908	Overflow Creek	Chloride	Site specific	8.3	AL	SE	Low	-
2B	AR_08040205_908	Overflow Creek	Turbidity		8.3	OU	SE	Low	-
2B	AR_08040205_909	Main Street Ditch	Dissolved Oxygen	Critical season	3.3	OU	UR, UN	Low	-

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 5	Designated Use(s) Not Supported	Source of Contamination	Priority	Year Listed
2B	AR_08040205_909	Main Street Ditch	Dissolved Oxygen	Primary season	3.3	AL	UR, UN	Low	-
2B	AR_08040205_909	Main Street Ditch	Lead		3.3	AL	UR, UN	Low	-
2B	AR_08040205_910	Bayou Imbeau	Dissolved Oxygen	Primary season	5.3	AL	UR	High	-
2B	AR_08040205_910	Bayou Imbeau	*E. coli*		5.3	PC	UR	High	-
2B	AR_08040205_910	Bayou Imbeau	Lead		5.3	AL	UR	High	-
2B	AR_08040205_911	Able's Creek	Turbidity		28.0	OU	SE	Low	-
2C	AR_08040203_011	North Fork Saline River	Dissolved Oxygen	Short-term continuous	37.5	AL, ORW	UN	Medium	-
2C	AR_08040203_014	Alum Fork Saline River	Dissolved Oxygen	Critical season	19.3	AL[10], ORW	UN	Medium	-
2C	AR_08040203_014	Alum Fork Saline River	Dissolved Oxygen	Short-term continuous	19.3	AL[10], ORW	UN	Medium	-
2C	AR_08040203_014	Alum Fork Saline River	pH		19.3	OU, ORW	UN	Medium	-
2C	AR_08040203_018	Alum Fork Saline River	pH		7.7	OU, ORW	UN	Medium	-
2C	AR_08040203_019	Middle Fork Saline River	Dissolved Oxygen	Short-term continuous	37.1	AL[10], ORW	UN	Medium	-
2C	AR_08040203_020	South Fork Saline River	Biological Integrity	Macroinvertebrates	16.4	AL, ORW	UN	Medium	2020
2C	AR_08040203_021	Cedar Creek	Dissolved Oxygen	Critical season	1.2	AL[10]	UN	Medium	2020
2C	AR_08040203_021	Cedar Creek	Dissolved Oxygen	Short-term continuous	1.2	AL[10]	UN	Medium	2020
2C	AR_08040203_022	South Fork Saline River	Biological Integrity	Fish	13.6	AL, ORW	UN	Medium	2020
2C	AR_08040203_022	South Fork Saline River	Biological Integrity	Macroinvertebrates	13.6	AL, ORW	UN	Medium	2020

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 5	Designated Use(s) Not Supported	Source of Contamination	Priority	Year Listed
2C	AR_08040203_611	North Fork Saline River	Dissolved Oxygen	Short-term continuous	37.5	AL[10], ORW	UN	Medium	2020
2C	AR_08040203_611	North Fork Saline River	pH		37.5	OU, ORW	UN	High	2020
2C	AR_08040203_904	Big Creek	pH		15.6	OU	UR	Low	2020
2C	AR_08040203_922	Lockett Creek	Dissolved Oxygen	Critical season	8.8	AL[10]	UN	Low	2020
2C	AR_08040203_922	Lockett Creek	Dissolved Oxygen	Short-term continuous	8.8	AL[10]	UN	Low	-
2C	AR_08040203_922	Lockett Creek	pH	Short-term continuous	8.8	OU	UN	Medium	2020
2C	AR_08040204_002	Saline River	Lead	Chronic	60.2	AL, ORW	IP	Low	2020
2C	AR_08040204_002	Saline River	Temperature		60.2	AL	UN	Medium	-
2C	AR_08040204_002	Saline River	Turbidity	Base flows	60.2	OU, ORW	SE, UN	Low	2020
2C	AR_08040204_005	Big Creek	pH		48.7	OU	UN	Low	-
2D	AR_08040201_001	Moro Creek	Lead	Chronic	56.4	AL	UN	Low	-
2D	AR_08040201_006	Smackover Creek	Dissolved Oxygen		4.7	AL	IP, UN	Low	-
2D	AR_08040201_006	Smackover Creek	Lead		4.7	AL	IP, UN	Low	-
2D	AR_08040201_006	Smackover Creek	pH		4.7	OU	IP, UN	Low	-
2D	AR_08040201_006	Smackover Creek	Turbidity		4.7	OU	IP,UN	Low	-
2D	AR_08040201_007	Smackover Creek	Dissolved Oxygen		49.8	AL	IP, UN	Low	-
2D	AR_08040201_007	Smackover Creek	Lead		49.8	AL	IP, UN	Low	-
2D	AR_08040201_007	Smackover Creek	pH		49.8	OU	IP, UN	Low	-
2D	AR_08040201_007	Smackover Creek	Turbidity	Base flows	49.8	OU	IP, UN	Low	-
2D	AR_08040201_007	Smackover Creek	Turbidity	Storm flows	49.8	OU	IP, UN	Low	-
2D	AR_08040201_406	Smackover Creek	Lead	Chronic	17.5	AL	IP	Low	-
2D	AR_08040201_406	Smackover Creek	pH		17.5	OU	IP	Low	-

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 5	Designated Use(s) Not Supported	Source of Contamination	Priority	Year Listed
2D	AR_08040201_406	Smackover Creek	Turbidity	Base flows	17.5	OU	IP	Low	-
2D	AR_08040201_406	Smackover Creek	Turbidity	Storm flows	17.5	OU	IP	Low	-
2D	AR_08040201_501	Bryant Creek	Turbidity	Base flows	13.8	OU	UN	High	2020
2D	AR_08040201_601	Guice Creek	Turbidity	Base flows	11.4	OU	UN	High	2020
2D	AR_08040201_606	Haynes Creek	Nitrate[8]		5.2	AL	IP	High	-
2D	AR_08040201_606	Haynes Creek	Copper	Acute	5.2	AL	IP	High	-
2D	AR_08040201_606	Haynes Creek	Copper	Chronic	5.2	AL	IP	High	-
2D	AR_08040201_606	Haynes Creek	pH		5.2	OU	IP	High	-
2D	AR_08040201_616	Haynes Creek	Turbidity	Base flows	4.7	OU	IP	Medium	2020
2D	AR_08040201_701	Lloyd Creek	Turbidity	Base flows	19.1	OU	IP, SE	High	2020
2D	AR_08040201_726	EDCC Creek (UT-1)	pH		4.9	OU	UN	Medium	2020
2D	AR_08040201_801	Whitewater Creek	Turbidity	Base flows	2.4	OU	UN	High	2020
2D	AR_08040201_801	Whitewater Creek	Turbidity	Storm flows	21.4	OU	UN	High	2020
2D	AR_08040201_803	Champagnolle Creek	Turbidity	Base Flows	37.5	OU	SE	High	2020
2D	AR_08040201_803	Champagnolle Creek	Turbidity	Storm flows	37.5	OU	SE	High	2020
2D	AR_08040201_806	Salt Creek	pH		7.2	OU	UN	Low	-
2D	AR_08040201_901	Moro Creek	Dissolved Oxygen		57.0	AL	UN	Low	-
2D	AR_08040201_901	Moro Creek	Lead		57.0	AL	UN	Low	-
2D	AR_08040201_905	East Two Bayou	*E. coli*		35.7	PC	UN	High	-
2D	AR_08040201_905	East Two Bayou	Lead	Chronic	35.7	AL	IP	Medium	2020
2D	AR_08040201_905	East Two Bayou	pH		35.7	OU	UN	High	-
2D	AR_08040201_910	Jug Creek	Lead	Chronic	7.2	AL	IP, UR	Medium	2020
2D	AR_08040202_002	Ouachita River	Lead		10.3	AL	UN	Medium	-
2D	AR_08040202_003	Ouachita River	Dissolved Oxygen	Critical season	9.0	AL	UN	Low	2020

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 5	Designated Use(s) Not Supported	Source of Contamination	Priority	Year Listed
2D	AR_08040202_003	Ouachita River	Lead	Chronic	9.0	AL	UN	Low	2020
2D	AR_08040202_004	Ouachita River	Dissolved Oxygen	Critical season	32.5	AL	UN	Medium	-
2D	AR_08040202_006	Bayou De L'outre	Lead	Chronic	13.2	AL	IP	High	-
2D	AR_08040202_006	Bayou De L'outre	pH		13.2	OU	IP	High	-
2D	AR_08040202_006	Bayou De L'outre	Turbidity	Base flows	13.2	OU	IP	High	-
2D	AR_08040202_007	Bayou De L'outre	Lead		4.0	AL	IP	High	-
2D	AR_08040202_007	Bayou De L'outre	pH		4.0	OU	IP	High	-
2D	AR_08040202_007	Bayou De L'outre	Turbidity		4.0	OU	IP	High	-
2D	AR_08040202_007	Bayou De L'outre	Zinc		4.0	AL	IP	High	-
2D	AR_08040202_008	Bayou De L'outre	Lead		5.8	AL	IP	High	-
2D	AR_08040202_008	Bayou De L'outre	pH		5.8	OU	IP	High	-
2D	AR_08040202_008	Bayou De L'outre	Total Recoverable Selenium		5.8	AL	IP	High	-
2D	AR_08040202_008	Bayou De L'outre	Turbidity		5.8	OU	IP	High	-
2D	AR_08040202_008	Bayou De L'outre	Zinc		5.8	AL	IP	High	-
2D	AR_08040202_909	Loutre Creek	Chloride		3.3	DW, A&I	IP	High	-
2D	AR_08040202_909	Loutre Creek	Sulfates		3.3	DW, A&I	IP	High	-
2D	AR_08040202_909	Loutre Creek	Total Dissolved Solids		3.3	DW, A&I	IP	High	-
2D	AR_08040202_909	Loutre Creek	Total Recoverable Selenium		3.3	AL	IP	High	-
2E	AR_08040206_015	Cornie Bayou	Dissolved Oxygen	Critical season	55.1	AL	IP, UN	Low	2020
2E	AR_08040206_015	Cornie Bayou	Lead	Chronic	55.1	AL	IP, UN	Low	-
2E	AR_08040206_015	Cornie Bayou	pH		55.1	OU	IP, UN	Low	-
2E	AR_08040206_015	Cornie Bayou	Turbidity	Base flows	55.1	OU	IP, UN	Low	-

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 5	Designated Use(s) Not Supported	Source of Contamination	Priority	Year Listed
2E	AR_08040206_016	Little Cornie Creek	Lead		18.5	AL	IP	Low	-
2E	AR_08040206_716	Little Cornie Creek	Lead		16.4	AL	IP	Low	-
2E	AR_08040206_816	Little Cornie Creek	Lead		3.3	AL	IP	Low	-
2E	AR_08040206_916	Walker Branch	Lead		4.5	AL	IP	Low	-
2F	AR_08040101_032	Fiddlers Creek	Biological Integrity	Fish	12.8	AL	UN	Medium	2020
2F	AR_08040101_032	Fiddlers Creek	Dissolved Oxygen	Short-term continuous	12.8	AL	UN	Low	-
2F	AR_08040101_032	Fiddlers Creek	pH		12.8	OU	UN	Low	-
2F	AR_08040101_032	Fiddlers Creek	Turbidity	Base flows	12.8	OU	UN	Low	2020
2F	AR_08040101_039	Ouachita River	Dissolved Oxygen	Short-term continuous	17.5	AL[10]	UN	Medium	2020
2F	AR_08040101_039	Ouachita River	pH		17.5	OU	UN	Medium	2020
2F	AR_08040101_043	South Fork Ouachita River	Dissolved Oxygen	Critical season	25.7	AL[10], ORW	UN	Low	2020
2F	AR_08040101_043	South Fork Ouachita River	Dissolved Oxygen	Short-term continuous	25.7	AL[10], ORW	UN	Low	-
2F	AR_08040101_048	Prairie Creek	Dissolved Oxygen	Critical season	2.8	AL[10]	UN	High	-
2F	AR_08040101_048	Prairie Creek	Dissolved Oxygen	Short-term continuous	2.8	AL[10]	UN	High	-
2F	AR_08040101_501	Gulpha Creek	pH		6.0	OU	UR	High	2020
2F	AR_08040101_838	Irons Fork	Dissolved Oxygen	Short-term continuous	10.4	AL[10]	UN	Low	-
2F	AR_08040101_838	Irons Fork	pH	Short-term continuous	10.4	OU	UN	Medium	-
2F	AR_08040101_838	Irons Fork	pH		10.4	OU	UN	Medium	-

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 5	Designated Use(s) Not Supported	Source of Contamination	Priority	Year Listed
2F	AR_08040101_838	Irons Fork	Turbidity	Base flows	10.4	OU	UN	Low	2020
2F	AR_08040101_902	Indian Springs Creek	Dissolved Oxygen		0.7	AL	UN	Medium	-
2F	AR_08040101_902	Indian Springs Creek	Sulfates		0.7	DW, A&I	UN	Medium	-
2F	AR_08040101_902	Indian Springs Creek	Total Dissolved Solids		0.7	DW	UN	Medium	-
2F	AR_08040101_907	Stokes Creek	Biological Integrity	Macroinvertebrates	1.8	AL	UR, MP	Medium	2020
2F	AR_08040101_929	Irons Fork	Biological Integrity	Fish	28.4	AL	UN	Medium	2020
2F	AR_08040101_929	Irons Fork	Dissolved Oxygen	Critical season	28.4	AL	UN	Medium	2020
2F	AR_08040101_929	Irons Fork	Dissolved Oxygen	Short-term continuous	28.4	AL	UN	Medium	2020
2F	AR_08040101_929	Irons Fork	pH		28.4	OU	UN	Low	-
2F	AR_08040102_023	South Fork Caddo	Dissolved Oxygen	Short-term continuous	18.6	AL[10]	UN	Low	-
2F	AR_08040102_821	Collier Creek	Dissolved Oxygen	Critical season	12.7	AL[10], ORW	UN	Low	2020
2F	AR_08040102_976	Cove Creek	Dissolved Oxygen	Critical season	3.3	OU	UN	Medium	-
2F	AR_08040102_976	Cove Creek	pH		3.3	OU	UN	Medium	-
2G	AR_08040103_002	Terre Noir Creek	pH		38.9	OU	UN	Low	-
2G	AR_08040103_003	Terre Noir Creek	pH		23.5	OU	UN	Low	-
2G	AR_08040103_023	North Fork Ouachita River	Dissolved Oxygen	Short-term continuous	15.1	AL[10], ORW	UN	Medium	2020
2G	AR_08040103_031	Terre Rouge Creek	Turbidity		26.0	OU	SE	Low	-

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 5	Designated Use(s) Not Supported	Source of Contamination	Priority	Year Listed
3A	AR_08020401_001	Arkansas River	Dissolved Oxygen	Critical season	28.6	AL	UN	Low	-
3A	AR_08020401_001	Arkansas River	Dissolved Oxygen	Primary season	28.6	AL	UN	Low	-
3A	AR_08020401_003	Wabbaseka Bayou	Dissolved Oxygen		42.3	AL	UN	Low	-
3B	AR_08020402_001	Bayou Meto	Dissolved Oxygen		5.8	AL	UN	Low	-
3B	AR_08020402_003	Bayou Meto	Dissolved Oxygen	Critical season	41.4	AL	UN	High	-
3B	AR_08020402_003	Bayou Meto	Dissolved Oxygen	Primary season	41.4	AL	UN	High	-
3B	AR_08020402_006	Bayou Two Prairie	Dissolved Oxygen		5.2	AL	UN	Low	-
3B	AR_08020402_007	Bayou Meto	Priority Organics		56.5	FC	IP, UN	Low	-
3B	AR_08020402_007	Bayou Meto	Total Dissolved Solids	Site specific	56.5	AL	IP, UN	Low	-
3B	AR_08020402_007	Bayou Meto	Turbidity	Base flows	56.5	OU	IP, UN	High	2020
3B	AR_08020402_106	Bayou Two Prairie	Dissolved Oxygen		1.9	AL, ORW	UN	Low	-
3B	AR_08020402_206	Bayou Two Prairie	Dissolved Oxygen	Critical season	11.1	AL	UN	Low	-
3B	AR_08020402_306	Bayou Two Prairie	Dissolved Oxygen		43.3	AL	UN	Low	-
3B	AR_08020402_806	Bayou Two Prairie	Dissolved Oxygen		6.7	AL, ORW	UN	Low	-
3B	AR_08020402_807	Bridge Creek	Dissolved Oxygen	Primary season	8.4	AL	UN	Medium	2020
3B	AR_08020402_807	Bridge Creek	pH		8.4	OU	UN	Medium	2020

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 5	Designated Use(s) Not Supported	Source of Contamination	Priority	Year Listed
3B	AR_08020402_907	Bayou Meto	Dissolved Oxygen	Primary season	25.8	AL	UN	Low	-
3B	AR_08020402_907	Bayou Meto	pH		25.8	OU	UN	High	2020
3C	AR_11110207_018	Maumelle River	DO Critical	Long-term continuous	29.8	AL	UR, UN	Low	2020
3C	AR_11110207_018	Maumelle River	pH	Long-term continuous	29.8	OU	UR, UN	Low	2020
3C	AR_11110207_024	Fourche Creek	Dissolved Oxygen	Critical season	22.1	AL	SE, UR, UN	Medium	-
3C	AR_11110207_024	Fourche Creek	Turbidity	Base flows	22.1	OU	SE, UR, UN	Medium	-
3C	AR_11110207_724	McHenry Creek	Copper	Chronic	8.9	AL	UR, UN	Low	2020
3C	AR_11110207_724	McHenry Creek	pH		8.9	OU	UR, UN	Low	2020
3C	AR_11110207_822	Fourche Creek	Dissolved Oxygen	Critical season	3.6	AL	UR, UN	High	2020
3C	AR_11110207_822	Fourche Creek	pH		3.6	OU	UR, UN	High	2020
3C	AR_11110207_822	Fourche Creek	Turbidity	Base flows	3.6	OU	UR, UN	High	2020
3C	AR_11110207_824	Brodie Creek	Biological Integrity	Macroinvertebrates	10.5	AL	UR, UN	Medium	2020
3C	AR_11110207_824	Brodie Creek	pH		10.5	OU	UR, UN	Medium	2020
3C	AR_11110207_912	White Oak Bayou	Dissolved Oxygen	Primary season	19.5	AL	UN	Low	-
3C	AR_11110207_912	White Oak Bayou	pH		19.5	OU	UR, UN	Low	2020
3D	AR_11110205_002	East Fork Cadron Creek	Turbidity	Base flows	19.6	OU	SE, UN	Low	-
3D	AR_11110205_016	Cove Creek	pH		25.2	OU	AG, UN	Low	2020
3E	AR_11110206_001	Fourche LaFave River	Dissolved Oxygen		51.6	AL	UN	Low	-

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 5	Designated Use(s) Not Supported	Source of Contamination	Priority	Year Listed
3E	AR_11110206_007	Fourche LaFave River	Dissolved Oxygen	Critical season	23.5	AL	UN	Low	-[11]
3E	AR_11110206_012	West Gafford Creek	pH		14.6	OU	UN	Low	-
3E	AR_11110206_012	West Gafford Creek	Turbidity	Base flows	14.6	OU	UN	Low	2020
3E	AR_11110206_014	South Fourche LaFave River	Dissolved Oxygen	Critical season	30.2	AL	UN	Low	-
3E	AR_11110206_015	Bear Creek	pH		12.3	OU	UN	Medium	2020
3E	AR_11110206_514	Negro Branch	pH		5.0	OU	UN	Low	-
3E	AR_11110206_514	Negro Branch	Turbidity	Base flows	5.0	OU	UN	Low	2020
3E	AR_11110206_808	Turner Creek	pH	Short-term continuous	4.8	OU	UN	Low	-
3E	AR_11110206_808	Turner Creek	pH		4.8	OU	UN	Low	-
3E	AR_11110206_808	Turner Creek	Turbidity	Storm flows	4.8	OU	UN	Low	2020
3E	AR_11110206_914	Dry Fork	Dissolved Oxygen	critical season	12.2	AL	UN	Low	2020
3E	AR_11110206_914	Dry Fork	pH	Short-term continuous	12.2	OU	UN	Low	-
3E	AR_11110206_914	Dry Fork	pH		12.2	OU	UN	Low	-
3F	AR_11110203_011	Point Remove Creek	Turbidity	Base flows	13.9	OU	UN	High	2020
3F	AR_11110203_018	West Fork Point Remove Creek	Dissolved Oxygen	Critical season	11.1	AL	UN	Low	2020
3F	AR_11110203_018	West Fork Point Remove Creek	pH		11.1	OU	UN	Low	-
3F	AR_11110203_033	Cypress Creek	Turbidity	Base flows	19.9	OU	SE	Low	-

[11] This assessment unit was mistakenly listed as AR_11110206_008 in previous 303(d) lists.

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 5	Designated Use(s) Not Supported	Source of Contamination	Priority	Year Listed
3F	AR_11110203_904	Stone Dam Creek	Dissolved Oxygen	Primary season	4.8	AL	UN	Low	-
3F	AR_11110203_904	Stone Dam Creek	Turbidity	Base flows	4.8	OU	UN	Medium	2020
3F	AR_11110203_918	Trimble Creek	pH		3.5	OU	UN	Low	-
3F	AR_11110203_931	Whig Creek	Ammonia-N	Chronic - early life stages	10.1	AL	IP	Low	-
3F	AR_11110203_931	Whig Creek	Ammonia-N	Chronic - no early life stages	10.1	AL	IP	Low	-
3F	AR_11110203_931	Whig Creek	Dissolved Oxygen	Critical season	10.1	AL	IP, UN	Low	-
3F	AR_11110203_931	Whig Creek	Dissolved Oxygen	Primary season	10.1	AL	IP, UN	Low	-
3G	AR_11110204_011	Petit Jean River	Turbidity	Base flows	24.1	OU	SE	Low	-
3H	AR_11110104_006	Lee Creek	pH		5.3	OU, ORW	UN	Low	2020
3H	AR_11110201_006	Mulberry River	pH		6.1	OU, ORW	UN	Medium	2020
3H	AR_11110201_008	Mulberry River	pH		30.0	OU, ORW	UN	High	-
3H	AR_11110201_012	Little Mulberry Creek	pH		19.3	OU	UN	High	-
3H	AR_11110201_912	Friley Creek	pH	Short-term continuous	7.2	OU	UN	High	-
3H	AR_11110201_912	Friley Creek	pH		7.2	OU	UN	High	-
3H	AR_11110202_013	East Fork Illinois Bayou	Dissolved Oxygen	Critical season	16.5	AL	UN	Medium	-
3H	AR_11110202_013	East Fork Illinois Bayou	Dissolved Oxygen	Primary season	16.5	AL	UN	Medium	-
3H	AR_11110202_013	East Fork Illinois Bayou	Dissolved Oxygen	Short-term continuous	16.5	AL	UN	Medium	-
3I	AR_11110105_001	Poteau River	Dissolved Oxygen	Critical season	4.9	AL	UN	Medium	-
3I	AR_11110105_033	James Fork	Turbidity	Base flows	28.2	OU	AG, UN	Low	2020

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 5	Designated Use(s) Not Supported	Source of Contamination	Priority	Year Listed
3I	AR_11110105_034	Upper Sugar Loaf Creek	Turbidity	Storm flows	6.9	OU	UN	Low	2020
3I	AR_11110105_035	Prairie Creek	Turbidity	Storm flows	14.0	OU	UR, UN	Low	2020
3I	AR_11110105_036	Cherokee Creek	Turbidity	Storm flows	10.6	OU	AG, UN	Low	2020
3I	AR_11110105_731	Poteau River	Turbidity	Base flows	13.4	OU	IP, MP, SE, AG	Low	2020
3I	AR_11110105_831	Unnamed Tributary to Poteau	Chloride	Site specific	1.1	AL	UN	Low	-
3I	AR_11110105_831	Unnamed Tributary to Poteau	Total Dissolved Solids	Site specific	1.1	AL	UN	Low	-
3I	AR_11110105_925	Briery Creek	pH		3.8	OU	UN	Medium	2020
3J	AR_11110103_020	Illinois River	Sulfates	Site specific	1.6	AL, ORW	UN	Medium	-
3J	AR_11110103_024	Illinois River	Sulfates	Site specific	2.8	AL, ORW	UN	Medium	-
3J	AR_11110103_026	Moores Creek	Sulfates		4.8	DW, A&I	UN	Medium	-
3J	AR_11110103_027	Illinois River	Sulfates		7.1	DW, A&I	UN	Medium	-
3J	AR_11110103_733	Unnamed Trib. to Brush Creek	Dissolved Oxygen	Primary season	3.5	AL	UN	Medium	2020
3J	AR_11110103_813	Baron Fork	Dissolved Oxygen	Critical season	7.3	AL	UN	Low	2020
3J	AR_11110103_932	Sager Creek	Ammonia-N	Chronic - early life stages	12.3	AL	UN	Low	2020
4A	AR_08020303_005	White River	Dissolved Oxygen	Critical season	50.7	AL	UN	Low	-
4A	AR_08020303_005	White River	Dissolved Oxygen	Primary season	50.7	AL	UN	Low	-
4A	AR_08020303_014	Boat Gunwale Slash	Dissolved Oxygen	Critical season	15.5	AL	UN	Low	2020
4A	AR_08020303_014	Boat Gunwale Slash	Dissolved Oxygen	Primary season	15.5	AL	UN	Low	2020

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 5	Designated Use(s) Not Supported	Source of Contamination	Priority	Year Listed
4A	AR_08020303_914	Boat Gunwale Slash	Dissolved Oxygen		10.0	AL	UN	Low	-
4A	AR_08020304_010	Big Creek	Chloride		40.7	DW, A&I	UN	Low	-
4A	AR_08020304_010	Big Creek	Total Dissolved Solids		40.7	DW, A&I	UN	Low	-
4A	AR_08020304_014	Prairie Cypress Creek	Copper	Acute	14.1	AL	UN	Low	-
4A	AR_08020304_014	Prairie Cypress Creek	Copper	Chronic	14.1	AL	UN	Low	-
4A	AR_08020304_014	Prairie Cypress Creek	Dissolved Oxygen	Critical season	14.1	AL	UN	Low	-
4A	AR_08020304_014	Prairie Cypress Creek	Dissolved Oxygen	Primary season	14.1	AL	UN	Low	-
4B	AR_08020302_002	Bayou DeView	Dissolved Oxygen		15.8	AL	UN	Low	-
4B	AR_08020302_004	Bayou DeView	Dissolved Oxygen	Critical season	25.3	AL	AG, UN	Low	-
4B	AR_08020302_004	Bayou DeView	Sulfates	Site specific	25.3	AL	AG, UN	Low	-
4B	AR_08020302_005	Bayou DeView	Dissolved Oxygen		8.3	AL	AG, UN	Low	-
4B	AR_08020302_005	Bayou DeView	Sulfates	Site specific	8.3	AL	AG, UN	Low	-
4B	AR_08020302_006	Bayou DeView	Dissolved Oxygen	Critical season	10.2	AL	AG, UN	Low	-
4B	AR_08020302_006	Bayou DeView	Sulfates	Site specific	10.2	AL	AG, UN	Low	-
4B	AR_08020302_007	Bayou DeView	Dissolved Oxygen	Critical season	6.2	AL	AG, UN	Low	-
4B	AR_08020302_007	Bayou DeView	Sulfates	Site specific	6.2	AL	AG, UN	Low	-
4B	AR_08020302_011	Flag Slough Ditch	Dissolved Oxygen	Primary season	16.3	AL	UN	Low	-
4B	AR_08020302_012	Cow Lake Ditch	Turbidity	Base flows	18.2	OU	AG, UN	High	2020

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 5	Designated Use(s) Not Supported	Source of Contamination	Priority	Year Listed
4B	AR_08020302_014	Buffalo Creek	Dissolved Oxygen		10.5	AL	UN	Low	-
4B	AR_08020302_016	Cache River	Dissolved Oxygen	Critical season	25.0	AL	AG, UN	Low	-
4B	AR_08020302_016	Cache River	Dissolved Oxygen	Primary season	25.0	AL	AG, UN	Low	-
4B	AR_08020302_018	Cache River	Dissolved Oxygen	Critical season	20.6	AL	UN	Low	2020
4B	AR_08020302_030	Swan Pond Ditch	Temperature		5.7	AL	AG, UN	Low	2020
4B	AR_08020302_038	Little Cache River Ditch	Turbidity	Base flows	3.8	OU	AG, UN	High	2020
4B	AR_08020302_041	Cache River Ditch	Turbidity	Base flows	8.9	OU	AG, UN	High	2020
4B	AR_08020302_055	Locust Creek Ditch	Dissolved Oxygen	Primary season	13.2	AL	AG, UN	Low	2020
4B	AR_08020302_901	Unnamed trib. to Cache	Dissolved Oxygen	Critical season	0.7	AL	AG, UN	Low	2020
4B	AR_08020302_901	Unnamed trib. to Cache	Dissolved Oxygen	Primary season	0.7	AL	AG, UN	Low	2020
4B	AR_08020302_903	Caney Creek	Dissolved Oxygen		18.0	AL	UN	Low	-
4B	AR_08020302_909	Lost Creek	Chloride	Site specific	14.1	AL	IP, MP	Low	-
4B	AR_08020302_921	West Cache River Slough	Turbidity	Base flows	10.2	OU	AG, UN	High	2020
4B	AR_08020302_937	East Slough	Turbidity	Base flows	7.2	OU	AG, UN	High	2020
4B	AR_08020302_937	East Slough	Turbidity	Storm flows	7.2	OU	AG, UN	High	2020
4C	AR_11010013_006	Village Creek	Dissolved Oxygen		29.2	AL	UN	Low	-
4C	AR_11010013_007	Village Creek	Dissolved Oxygen		1.2	AL	UN	Low	-

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 5	Designated Use(s) Not Supported	Source of Contamination	Priority	Year Listed
4C	AR_11010013_008	Village Creek	Dissolved Oxygen		12.2	AL	UN	Low	-
4C	AR_11010013_017	White River	Temperature		12.8	AL	UN	Low	-
4C	AR_11010013_020	Departee Creek	Dissolved Oxygen		21.9	AL	AG, UN	Low	-
4C	AR_11010013_020	Departee Creek	Zinc		21.9	AL	AG, UN	Low	-
4C	AR_11010013_021	Glaise Creek	Dissolved Oxygen		43.1	AL	AG, UN	Low	-
4C	AR_11010013_021	Glaise Creek	Zinc		43.1	AL	AG, UN	Low	-
4D	AR_08020301_006	Bayou Des Arc	Dissolved Oxygen	Critical season	22.7	AL	SE,UN	Low	-
4D	AR_08020301_006	Bayou Des Arc	Temperature		22.7	AL	SE,UN	Low	-
4D	AR_08020301_007	Bayou Des Arc	Lead	Chronic	50.1	AL	UN	Low	-
4D	AR_08020301_009	Bull Creek	Dissolved Oxygen		46.8	AL	UN	Low	-
4D	AR_08020301_009	Bull Creek	Zinc		46.8	AL	UN	Low	-
4D	AR_08020301_010	Cypress Bayou	Dissolved Oxygen	Critical season	7.8	AL	UN	Low	-
4D	AR_08020301_010	Cypress Bayou	Dissolved Oxygen	Primary season	7.8	AL	UN	Low	-
4D	AR_08020301_015	Wattensaw Bayou	Dissolved Oxygen	Critical season	69.5	AL	UN	Low	-
4E	AR_11010014_007	Little Red River	pH		22.0	OU	UN	Low	2020
4E	AR_11010014_036	South Fork Litle Red River	pH		4.0	OU	UN	Low	-
4E	AR_11010014_037	Archey Fork Little Red River	pH		18.1	OU, ORW	UN	Low	2020
4E	AR_11010014_038	South Fork Litle Red River	pH		9.7	OU	UN	Low	-

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 5	Designated Use(s) Not Supported	Source of Contamination	Priority	Year Listed
4E	AR_11010014_040	South Fork Litle Red River	Dissolved Oxygen	Critical season, long-term continuous	7.7	AL, ORW	UN	Low	-
4E	AR_11010014_940	South Fork Litle Red River	pH	Long-term continuous	13.8	OU	UN	Low	-
4F	AR_11010004_015	Hicks Creek	*E. coli*		13.3	PC	MP, UR, UN	High	-
4F	AR_11010004_017	Greenbrier Creek	Dissolved Oxygen	Critical season	13.1	AL	UN	Low	-
4F	AR_11010004_017	Greenbrier Creek	Dissolved Oxygen	Primary season	13.1	AL	UN	Low	-
4F	AR_11010004_915	Big Creek	pH	Short-term continuous	14.6	OU	UN	Low	2020
4G	AR_11010008_001	Current River	Turbidity	Base flows	23.0	OU, ORW	AG	Medium	2020
4G	AR_11010009_005	Black River	Turbidity	Base flows	20.7	OU, ORW	SE, AG	Medium	2020
4G	AR_11010009_005	Black River	Turbidity	Storm flows	20.7	OU, ORW	SE, AG	Medium	2020
4G	AR_11010009_008	Fourche River	Turbidity		31.4	OU	SE	Low	-
4G	AR_11010012_002	Strawberry River	Temperature	Long-term continuous	10.4	AL, ORW	AG, UN	Low	2020
4G	AR_11010012_003	Cooper Creek	Turbidity	Base flows	20.2	OU	AG, UN	Low	2020
4G	AR_11010012_006	Strawberry River	Temperature	Long-term continuous	20.3	AL, ORW	AG, UN	Low	2020
4G	AR_11010012_007	North Big Creek	Temperature	Long-term continuous	24.8	AL	UN	Low	2020
4G	AR_11010012_013	South Big Creek	Temperature	Long-term continuous	26.7	AL	AG, UN	Low	2020
4G	AR_11010012_014	Reeds Creek	Turbidity	Base flows	17.9	OU	AG, UN	High	2020
4G	AR_11010012_806	Clayton Creek	Dissolved Oxygen	Primary season	6.4	AL	UN	Medium	2020
4H	AR_11010010_003	Spring River	Turbidity	Base flows	10.6	OU, ORW	UN	Low	2020
4H	AR_11010010_006	Spring River	Temperature	Trout water	5.2	AL, ORW	UN	Low	-

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 5	Designated Use(s) Not Supported	Source of Contamination	Priority	Year Listed
4H	AR_11010010_009	English Creek	Dissolved Oxygen	Short-term continuous	9.6	AL, ORW	UN	Low	-
4H	AR_11010010_012	South Fork Spring River	Dissolved Oxygen	Critical season	16.1	AL, ORW	AG	Low	2020
4H	AR_11010010_906	Gut Creek	Dissolved Oxygen	Short-term continuous	9.4	AL	UN	Low	-
4H	AR_11010011_001	Eleven Point River	Turbidity	Base flows	41.7	OU, ORW	AG, SE	Low	2020
4J	AR_11010005_004	Buffalo River	Temperature		29.7	AL, ORW	UN	Medium	2020
4K	AR_11010001_023	White River	Dissolved Oxygen	Critical season	1.9	AL	UN	Low	2020
4K	AR_11010001_024	West Fork White	Dissolved Oxygen	Critical season	10.7	AL	UN	Low	2020
4K	AR_11010001_024	West Fork White	Sulfates	Site specific	10.7	AL	UN	Low	-
4K	AR_11010001_024	West Fork White	Temperature	Long-term continuous	10.7	AL	UN	Low	2020
4K	AR_11010001_024	West Fork White	Total Dissolved Solids	Site specific	10.7	AL	UN	Low	-
4K	AR_11010001_026	Middle Fork White River	Dissolved Oxygen	Critical season	8.1	AL	UN	Low	2020
4K	AR_11010001_027	White River	Turbidity	Base flows	5.1	OU	UN	Low	2020
4K	AR_11010001_037	Kings River	Total Dissolved Solids	Site specific	38.2	AL[10]	UN	Low	-
4K	AR_11010001_060	War Eagle Creek	Dissolved Oxygen	Critical season	33.7	AL	AG, UN	Low	2020
4K	AR_11010001_442	Kings River	pH	Short-term continuous	4.9	OU, ORW	UN	Low	2020
4K	AR_11010001_442	Kings River	pH		4.9	OU, ORW	UN	Low	2020
4K	AR_11010001_542	Kings River	Dissolved Oxygen	Short-term continuous	18.2	AL	UN	Medium	-

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 5	Designated Use(s) Not Supported	Source of Contamination	Priority	Year Listed
4K	AR_11010001_624	West Fork White River	Dissolved Oxygen		19.2	AL	UN	Medium	-
4K	AR_11010001_624	West Fork White River	Sulfates	Site specific	19.2	AL	UN	Medium	-
4K	AR_11010001_823	White River	Dissolved Oxygen	Critical season	5.1	AL	UN	Low	2020
4K	AR_11010001_824	Town Branch	Turbidity	Base flows	3	OU	SE	Low	-
4K	AR_11010001_834	War Eagle Creek	Dissolved Oxygen	Critical season	19.6	AL	AG, UN	Low	2020
4K	AR_11010001_916	Leatherwood Creek	Dissolved Oxygen		5.5	AL	UN	Medium	-
4K	AR_11010001_926	Middle Fork White River	Dissolved Oxygen		15.5	AL	UN	Medium	-
4K	AR_11010001_959	Town Branch	Total Dissolved Solids		2.6	DW, A&I	IP, MP	Low	-
5A	AR_08020203_008	St. Francis River	Dissolved Oxygen	Critical season	42.9	AL, ORW	UN	Low	-
5A	AR_08020203_008	St. Francis River	Dissolved Oxygen	Primary season	42.9	AL, ORW	UN	Low	-
5A	AR_08020203_009	St. Francis River	Chloride	Site specific	13.7	AL, ORW	UN	Low	-
5A	AR_08020203_009	St. Francis River	Dissolved Oxygen		13.7	AL, ORW	UN	Low	-
5A	AR_08020203_906	Ten Mile Bayou	Dissolved Oxygen		10.7	AL	UN	Low	-
5B	AR_08020205_001	L'Anguille River	Dissolved Oxygen	Critical season	17.2	AL	UN	Low	-
5B	AR_08020205_001	L'Anguille River	Dissolved Oxygen	Primary season	17.2	AL	UN	Low	-
5B	AR_08020205_002	L'Anguille River	Chloride	Site specific	23.1	AL	UN	Low	-

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 5	Designated Use(s) Not Supported	Source of Contamination	Priority	Year Listed
5B	AR_08020205_002	L'Anguille River	Dissolved Oxygen		23.1	AL	UN	Low	-
5B	AR_08020205_002	L'Anguille River	Total Dissolved Solids	Site specific	23.1	AL	UN	Low	-
5B	AR_08020205_003	L'Anguille River	Chloride	Site specific	2.9	AL	UN	Low	-
5B	AR_08020205_003	L'Anguille River	Dissolved Oxygen		2.9	AL	UN	Low	-
5B	AR_08020205_003	L'Anguille River	Total Dissolved Solids	Site specific	2.9	AL	UN	Low	-
5B	AR_08020205_004	L'Anguille River	Dissolved Oxygen	Critical season	17.0	AL	UN	Low	-
5B	AR_08020205_004	L'Anguille River	Dissolved Oxygen	Primary season	17.0	AL	UN	Low	-
5B	AR_08020205_005	L'Anguille River	Chloride	Site specific	53.4	AL	UN	Low	-
5B	AR_08020205_005	L'Anguille River	Dissolved Oxygen		53.4	AL	UN	Low	-
5B	AR_08020205_005	L'Anguille River	Sulfates	Site specific	53.4	AL	UN	Low	-
5B	AR_08020205_005	L'Anguille River	Total Dissolved Solids	Site specific	53.4	AL	UN	Low	-
5B	AR_08020205_007	First Creek	Dissolved Oxygen		31.2	AL	UN	Low	-
5B	AR_08020205_008	Second Creek	Dissolved Oxygen	Critical season	26.0	AL	UN	Low	-
5B	AR_08020205_008	Second Creek	Dissolved Oxygen	Primary season	26.0	AL	UN	Low	-
5B	AR_08020205_901	Caney Creek	Dissolved Oxygen		7.1	AL	UN	Low	-
5B	AR_08020205_902	Prairie Creek	Total Dissolved Solids		8.4	DW, A&I	UN	Low	-

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 5	Designated Use(s) Not Supported	Source of Contamination	Priority	Year Listed
5C	AR_08020204_001	Little River	Dissolved Oxygen		17.6	AL	UN	Low	-
5C	AR_08020204_002	Little River	Dissolved Oxygen		51.0	AL	UN	Low	-

Table XVI-C: Water quality limited waters – lakes (Category 5) – 303(d) list

Planning Segment	Assessment Unit	Lake Names	Parameter	Descriptor	Acres in Cat. 5	Designated Use(s) Not Supported	Source of Contamination	Priority	Year Listed
1C	AR_11140109_4071	Gillham	pH		833	OU	UN	High	2020
2C	AR_08040203_4100	Winona	pH		327	OU	UN	Medium	2020
2C	AR_08040203_4101	Winona	pH		843	OU	UN	Medium	2020
2C	AR_08040203_4110	Cox Creek	pH		245	OU	UN	Low	-
2G	AR_08040103_4030	Greeson	pH		3987	OU	UN	Low	2020
3B	AR_08020402_4010	Pickthorne	UN		325	AL	UN	Low	-
3B	AR_08020402_4020	Rogers	Dissolved Oxygen		562	AL	UN	Low	-
3C	AR_11110207_4010	Saracen	PCB		467	FC	IP	Low	-
3F	AR_11110203_4020	Driver Creek	pH		28	OU	UN	Low	-
3G	AR_11110204_4061	Blue Mountain	Dissolved Oxygen	Lake	1852	AL	UN	Low	-
3G	AR_11110204_4061	Blue Mountain	Turbidity	Base flows	1852	OU	UN	Low	-
3G	AR_11110204_4061	Blue Mountain	Turbidity	Storm flows	1852	OU	UN	Low	-
3H	AR_11110104_4020	Lee Creek	pH		582	OU	UN	Low	-
3H	AR_11110202_4050	Horsehead	pH	Short-term continuous	109	OU	UN	Low	-
3H	AR_11110202_4050	Horsehead	pH		109	OU	UN	Low	-
3J	AR_11110103_4080	Fayetteville	pH	Short-term continuous	171	OU	UN	Medium	-
4B	AR_08020302_4020	Frierson	Copper		343	AL	UN	Low	-

Table XVII-C: Water quality limited waters – streams (Category 5-Alt) – 303(d) list

Planning Segment	Assessment Unit	Stream Names	Parameter	Descriptor	Miles in Cat. 5-Alt	Designated Use(s) Not Supported	Source of Contamination	Priority Ranking	Year Listed
3J	AR_11110103_024	Illinois River	Turbidity	Base flows	2.8	OU, ORW	UN	Low	2020
3J	AR_11110103_026	Moores Creek	*E. coli*		4.8	PC	IP, MP, SE, AG	Low	-
3J	AR_11110103_027	Illinois River	*E. coli*		7.1	PC	IP, MP, SE, AG	Low	-
3J	AR_11110103_028	Illinois River	*E. coli*		2.9	PC	IP, MP, SE, AG	Low	-
3J	AR_11110103_630	Little Osage Creek	*E. coli*		7.2	PC	IP, MP, SE, AG	Low	-
3J	AR_11110103_933	Little Osage Creek	*E. coli*		4.3	PC, ORW	IP, MP, SE, AG	Low	-

Table XVIII-C: Water quality limited waters – lakes (Category 5-Alt) – 303(d) list

Planning Segment	Assessment Unit	Lake Names	Parameter	Descriptor	Acres in Cat. 5-Alt	Designated Use(s) Not Supported	Source of Contamination	Priority Ranking	Year Listed
4K	AR_11010001_4040	Beaver Lake	*E. coli*		1338	PC	SE	Low	-
4K	AR_11010001_4040	Beaver Lake	Turbidity	Storm flows	1338	OU	SE	Low	-
4K	AR_11010001_4041	Beaver Lake	*E. coli*		1282	PC	SE, UN	Low	-
4K	AR_11010001_4041	Beaver Lake	Turbidity	Base flows	1282	OU	SE, UN	Low	-
4K	AR_11010001_4041	Beaver Lake	Turbidity	Storm flows	1282	OU	SE, UN	Low	-

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). Regulation No. 2: Regulation Establishing Water Quality Standards for Surface Waters of the State of Arkansas.

Barbour, M. T., J, Gerritsen, B.D. Snyder, and J. B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Steams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U. S. Environmental Protection Agency; Office of Water; Washington, D.C.

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. (2021). 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.

MAP INFORMATION

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

http://arkansasdeq.maps.arcgis.com/apps/MapJournal/index.html?appid=edf6259f9c8840e7b686287bc2c29799

APPENDIX A – 4B AND 5-ALT RATIONALE

CATEGORY 4B RATIONALE BUFFALO RIVER WATERSHED

Buffalo River Watershed 4b Plan for Pathogens and Dissolved Oxygen

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

Two parameters were assessed as not attaining water quality criteria within the Buffalo River watershed—pathogens (*Escherichia coli (E. coli)*) and dissolved oxygen (DO).

1a. Pathogens

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

- AR_11010003_010 (Buffalo River) Use: Primary contact - *E.coli*
- AR_11010003_011 (Buffalo River) Use: Primary contact - *E.coli*
- AR_11010003_022 (Big Creek) Use: Primary contact - *E.coli*

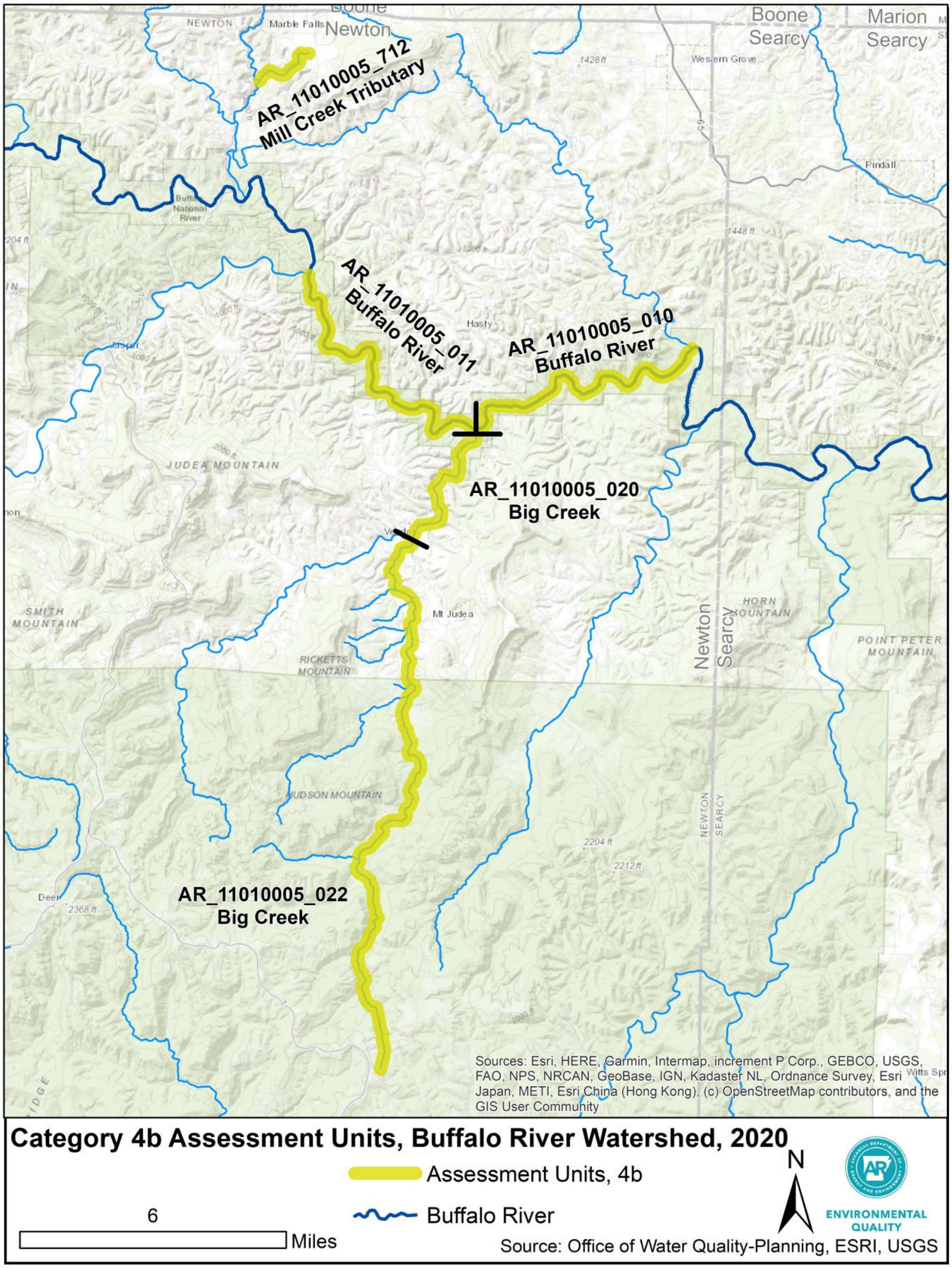
These AUs are shown on the map below. The percent exceedance rate of the data indicated the AUs were not supporting the primary contact recreation designated use.

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 the Table below. 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, flows. 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).

Assessment Unit	Name	Monitoring Station(s)	HUC12(s) in which the AU is located	Selected land uses in HUC12 (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_022	Big Creek upstream of the Left Fork	BC6, BC7	110100050302	Pasture = 6% Developed = 3% Forest = 88% Other = 1%
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.
NLCD = National Land Cover Database.

Future surveys using Phylo-chip technology are planned for the Buffalo River watershed to help identify *E. coli* sources. 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). The USGS is currently conducting 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 results of the Mill Creek study may provide insight into the pathogen impairments in the 4b Assessment Units due to the proximity of Mill Creek, which joins the Buffalo River approximately 3.6 miles upstream of Assessment Unit AR_11010005_011.


AR_11010005_712
Mill Creek Tributary
AR_11010005_011
Buffalo River
AR_11010005_010
Buffalo River
AR_11010005_020
Big Creek
AR_11010005_022
Big Creek
Boone
Searcy
Marion
Searcy
Newton
Searcy
Western Grove
Pindall
Hasty
Jasper
JUDEA MOUNTAIN
SMITH MOUNTAIN
Mt Judea
RICKETTS MOUNTAIN
HORN MOUNTAIN
POINT PETER MOUNTAIN
HUDSON MOUNTAIN
Deer
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Category 4b Assessment Units, Buffalo River Watershed, 2020
Assessment Units, 4b
Buffalo River
6
Miles
N
ENVIRONMENTAL QUALITY
Source: Office of Water Quality-Planning, ESRI, USGS

1b. Dissolved Oxygen

Dissolved oxygen (DO) concentrations in Assessment Unit AR_11010005_020 (Big Creek downstream of the Left Fork; shown on the map above) do not meet water quality criteria at times. Monitoring stations that are located on this Assessment Unit 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 Assessment Unit. Land use in the HUC12 associated with AR_11010005_020 is shown in the table above (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 Assessment Unit 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 Assessment Unit. 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.

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

The water quality target for *E. coli* in the 4b Assessment Units is the state water quality criteria for primary contact recreation. Since there is no definitive indication that the low DO conditions in the 4b Assessment Unit 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 Assessment Units 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 the Buffalo River Conservation Committee (BRCC). BRCC is the next step in the process that began in 2016 with the Beautiful Buffalo Action Committee (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; Becky Keogh, Secretary of Energy and Environment; Stacy Hurst, Secretary of Parks, Heritage, and Tourism; and Dr. Nathaniel Smith, Secretary of Health. $1 million in state general revenue funds and $1 million matched private funds will be allocated for conservation and water quality grants within the Buffalo River Watershed.

Two suspected permitted sources of pathogens to the listed Assessment Units 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 Assessment Units.

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 Assessment Units 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.

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.

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 is expected to become active in late 2021, and 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 towards 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 for Category 4b Rationale Buffalo River Watershed

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

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 mine 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 Mine Site, Site Investigation (SI) Report identifies the stream segments and problems leading to the 303(d) listing of these stream segments. A complete version of the DIM SI report 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

• SI, 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.

- SI, 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.

- SI, 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

- SI, 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 Former Mine Site stormwater run-off and shallow groundwater, which contain ARD, negatively affects Chamberlain Creek.

- SI, 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

- SI, 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 former mining 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 Former Mine 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 Former Mine 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 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 - White River Arm previously part of area known as Beaver Lake upper (AR_11010001_4040) Turbidity and Pathogens
- Beaver Lake - War Eagle Arm previously part of area known as Beaver Lake upper (AR_11010001_4041) pH (> 9.0 standard units (s.u.)), Turbidity, and Pathogens
- Beaver Lake at Hickory Creek - previously part of area known as Beaver Lake upper (AR_11010001_4042) Turbidity and Pathogens

Turbidity

The upper portion of Beaver Lake, that portion of the lake from near the community of Hickory Creek to the upstream portion in the White River and War Eagle Creek arms, has been listed as not attaining the turbidity criteria for many years. The source of the turbidity is identified as surface erosion. 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.

pH

During the 2018 period of record used for the development of the list of impaired waterbodies, April 2012 through March 2017, at AR_11010001_4041, five (5) out of twenty-seven (27) pH samples were above 9.0 s.u., therefore the AU was listed as not-attaining the pH water quality criteria. It should be noted that these five (5) samples ranged from 9.1 to 9.2 s.u and were taken in May and July of 2012 and July of 2013 within the upper portion of the epilimnion. Beaver Watershed District's (BWD) 2013 report on lake water quality (Avery 2014) near the BWD intake structure notes that "In the months from June through September pH was above 8.0 s.u. near the surface."

2. Analysis to support why the State believes the implementation of the alternative restoration approach is expected to achieve attainment of water quality criteria.

The WPS has been in place prior to 2012 and is currently implemented with the support of the Beaver Watershed Alliance (BWA). https://www.beaverwatershedalliance.org/

BWA is an active steward 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." According to BWA's website they had eight (8) activities from January 2019 thru April 2019, 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, and seventeen (17) educational brochures available for download.

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**

BWA is the primary entity for implementing the Beaver Lake WPS.

https://www.beaverwatershedalliance.org/strategy/watershed-protection-strategy.aspx

The WPS outlines five (5) components: Beaver Lake Watershed Council, Core BMPs, Developer and Contractor Lake Protection Certification Program, Education and Stewardship Program, and Monitoring and Adaptive Management. Refer to Section 4.2 and Table 5-1 for additional details.

Table 5-2 under Adaptive Management "Beaver Lake Watershed Protection Strategy Implementation Timeline: Assuming five-year Adaptive Management cycle beginning January 2012 or at hiring of Council Executive Director." outlines milestones for the WPS's five (5) components. The table also outlines a proposed implementation timeline for the WPSs.

4. Identify funding to implement

From 2011 to 2018, the total of all monetary grant awards to the BWA since the Beaver Lake WPS has been put in place is $1,751,225.

BWA has received funding for three (3) Section 319 non-point source projects in the Beaver Lake Watershed, totaling $922,194, which has $695,396 of associated match.

BWA has a contract to deliver watershed protection services to the Beaver Water District that has had a total value of $1,268,745.

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.

Although BWD does not directly administer funds, the watershed benefits tremendously from the United States Department of Agriculture (USDA) Natural Resources Conservation Service (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.

Table 5-1 under Adaptive Management provides 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.

5. Identify all parties committed or needed to take actions that are expected to result in the attainment of water quality criteria

Table 5-1 under Adaptive Management identifies the following responsible groups needed to implement the WPS: Beaver Watershed Alliance, 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, Ozark Water Watch, Kings River Watershed Partnership, conservation groups, landowners, and USGS.

6. Estimate of time when water quality criteria are expected to be attained

Table 4-1 of the WPS list the estimated total reduction in sediment load, 23,450 tons/year that will be necessary to attain the turbidity water quality criterion. It is estimated that this goal will be attained by 2055.

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 sampling includes:

- DEQ currently collects quarterly samples in Beaver Lake and tests for sixty-seven (67) water quality parameters at two (2) monitoring stations. One (1) monitoring station is sampled within the epilimnion. The other monitoring station is sampled within the epilimnion, metalimnion, and hypolimnion.
- 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.

- 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. The StreamSmart program was developed by the Beaver Water District, Audubon Arkansas, and the Arkansas Water Resources Center (AWRC).

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 total maximum daily load (TMDL) in the near-term, and if the impaired water should be assigned as a higher priority for TMDL development.

Beaver Watershed Alliance states, "The Beaver Watershed Alliance has adopted the 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)

It should also be noted that the current May 2012 WPS is an update of the 2009 version. Dependent on funding, BWA aims to begin revision of the WPS in 2020 and have a final revised WPS by 2021.

Water quality in Beaver Lake is routinely monitored as part of the DEQ's Ambient Water Quality Monitoring Network. Every two years the data are compiled and evaluated 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.

Literature Cited for Category 5-Alt Rationale Beaver Lake Pathogens, Turbidity, and pH

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. P.O. Box 319, Goshen AR. 72735.

Beaver Watershed Alliance, Watershed Protection Strategy. Accessed September 24, 2019). (https://www.beaverwatershedalliance.org/strategy/watershed-protection-strategy.aspx)

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 impairment per AU**

   - Moores Creek (AR_11110103_026)
   - Muddy Fork Illinois River (AR_11110103_025), (AR_11110103_027)
   - Illinois River (AR_1110103_023) (AR_11110103_024), (AR_11110103_028)
   - Little Osage Creek (AR_11110103_630), (AR_11110103_933)

   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).

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 pathogen impairment sources are primarily from non-point source contributions. The WBP reports that rural land use in the pathogen-impaired stream reaches ranged from 58% forested with 34% pasture to 11% forested and 70% pasture. Discharges from point sources are regulated through the National Pollution Discharge Elimination System. Any corrective actions that may be needed 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 states' watershed based management plans.

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 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, much work is still needed to bring the Illinois River and its tributaries into attainment for pathogens.

4. Identify funding sources to implement the Plan

To date, almost forty million dollars ($40,000,000) has 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.

On September 10, 2018, the Arkansas Department of Agriculture - Natural Resource Division (ADA-NRD) and the Illinois River Watershed Partnership (IRWP) announced a new agreement to improve water quality in the Illinois River. 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 will be 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, and legislative appropriations.

5. Identify potential partners to implement to Plan

Table 7.6 of the 2012 Upper Illinois River Watershed Based Management Plan identifies twenty-five (25) potential partners that may share common goals within the watershed.

Potential partners include non-government organizations; city, state, and federal agencies; academia; and industries.

6. Estimate of time when WQS will be met

Implementation of effective nonpoint source best management practices (BMP) to address this issue is strictly on a voluntary basis. However, implementation of the BMPs could lead to timely attainment of the primary contact recreation designated use in the Illinois River watershed.

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 draft 2018 303(d) list, data from thirty-six (36) water quality monitoring stations was used to assess seventeen (17) AUs, approximately 122 river miles, 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. Water quality samples collected on a monthly basis 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 total phosphorus criterion. Delegates from Arkansas and Oklahoma have convened on several occasions since January 2019. The determination of base flow, sampling methodologies, data quality objectives, 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 states watershed based management plans.

Literature Cited for Category 5-Alt Rationale Illinois River Watershed Pathogens

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.

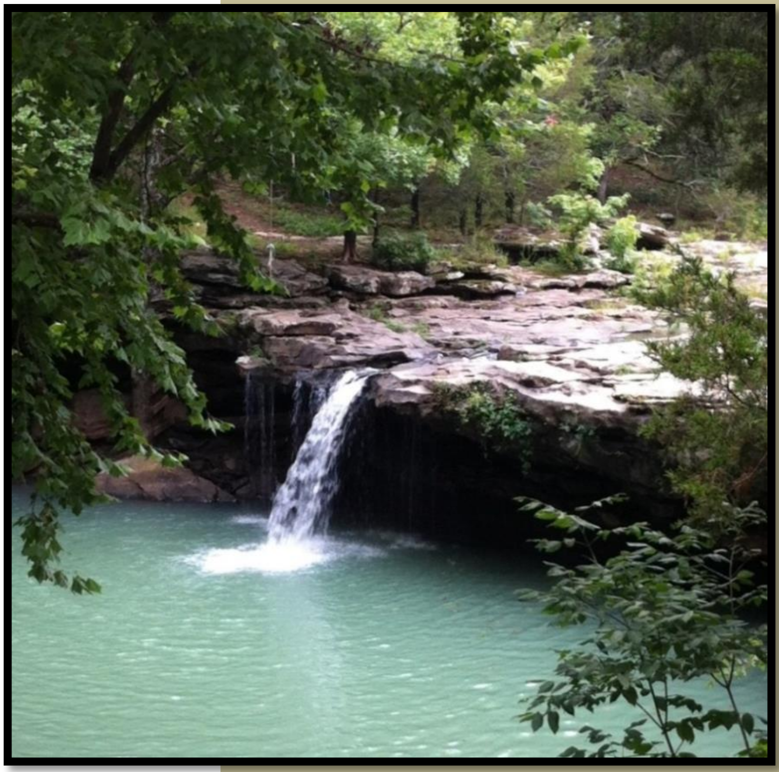
FTN Associates, Ltd. July 17, 2012. Watershed-Based Management Plan for the Upper Illinois River Watershed, Northwest Arkansas.

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

APPENDIX B – THE 2020 ASSESSMENT METHODOLOGY

ASSESSMENT METHODOLOGY

2020



For the Preparation of:

The 2020 Integrated Water Quality Monitoring and Assessment Report

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

TABLE OF CONTENTS

1.0 ASSESSMENT BACKGROUND 128

2.0 INTEGRATED REPORTING CATEGORIES 129

3.0 DATA MANAGEMENT 132

3.1 Water Quality Data Types and conditions 132

3.2 Data Assembly 133

3.3 Data Quality Considerations 134

3.4 Data Quantity Considerations 137

3.5 Data Representativeness Considerations 138

3.6 Statistical Confidence 138

3.7 Internal Data Assessment Method 143

3.8 External Data Assessment Method 143

3.9 Impairment Source Determination 143

3.10 Final Attainment Decision Process 143

4.0 WATER QUALITY STANDARDS 145

4.1 Antidegradation 145

4.2 Designated Uses 145

4.3 Water Quality Criteria 147

5.0 BIOLOGICAL INTEGRITY 148

6.0 SPECIFIC STANDARDS 156

6.1 Temperature 158

6.2 Turbidity 161

6.3 pH 164

6.4 Dissolved Oxygen 166

6.5 Radioactivity 171

6.6 Bacteria 172

6.7 Toxic Substances 177

6.8 Fish Consumption 180

6.9 Nutrients.. 181

6.10 Site Specific Mineral Quality.. 186

6.11 Non-Site Specific Mineral Quality; and Domestic, Agricultural, and Industrial Water Supply Uses… 187

6.12 Ammonia.. 189

REFERENCES CITED.. 195

LIST OF TABLES AND FIGURES

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 water body is greater than or equal to 10%, 20%, or 25%. 141

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 water body is greater than or equal to 10%, 20%, 25%. 142

Table 3: Designated Uses for Arkansas's surface waters and rules used for assessment. 146

Table 4: Macroinvertebrate bioassessment metrics and scoring criteria[1]. 149

Table 5: Scoring criteria for macroinvertebrate community attainment decisions (modified from Plafkin et al. 1989). 150

Table 6: Fish Community Structure Index (CSI) ecoregion values. 151

Table 7: Biological community assessment determination. 154

Table 8: Aquatic life designated use listing protocol. 155

Table 9: Ambient toxicity listing protocol. 155

Table 10: Statewide bacteria assessment criteria. 176

Figure 1: Determining Aquatic Life Use designated use attainment Step 1. 152

Figure 2: Determining Aquatic Life Use designated use attainment Step 2. 153

Figure 3: Nutrient assessment flowchart for wadeable streams and rivers. 185

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 water body 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's 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, and 2018 305(b) Reports (EPA 2006, 2009, 2011, 2013, 2015, and 2017 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] No. 2 *Water Quality Standards for Surface Waters of the State of Arkansas* (Rule 2) (APC&EC 2017), 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, as adopted in 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, or other defined water bodies 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, and 2017) 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 an attainment decision. Historically, Category 2 is rarely used in Arkansas.

Waters not attaining one or more water quality criteria, or not supporting one or more designated uses may be placed in Category 4 or 5. 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). 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 water bodies; however, a list of Category 4 waters are public noticed along with the 303(d) list (Category 5).

The 303(d) list of impaired water bodies (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 § CFR 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 water body 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 water bodies in Category 3 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.

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 water body is impaired, or one or more water quality standards are not attained. Water bodies 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 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 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 water bodies 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.

3.0 DATA MANAGEMENT

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 2017) 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 72 – 96 hour period. These time periods target diurnal shifts in certain water quality parameters and readings 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. Long-term and short-term continuous data must span 90% of the 24 hour period to be used for that day. Similarly, long-term continuous data must span 90% of the month, for that month to be considered.

3.1.2 Data Conditions

At times, data results are "censored," meaning they are reported as less than some value, greater than some value, or as an interval or range of numbers. 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 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 5* (ADEQ 2013). Additionally, local, state, and federal agencies, and other entities are solicited by DEQ to provide water quality data that meets or exceeds DEQ's or USGS' 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 2020 305(b) Report:

Metals and ammonia toxicity analysis: *April 1, 2016 through March 31, 2019*

Beaver Lake site specific nutrient criteria: *January 1, 2014 through December 31, 2018*

All other analyses: *April 1, 2014 through March 31, 2019*

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.

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 back water, 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 QA/QC protocol equivalent to or more stringent than that of DEQ or the USGS. 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 an 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) 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 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 water body for that distance upstream and downstream in which there are no significant influences to the water body 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.

3.6 STATISTICAL CONFIDENCE

Past EPA guidelines (EPA 1996 and 2002) have recommended listing water body 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 water body 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 water body. 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 water body 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 water bodies. 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 water body 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 water body is greater than or equal to 10%, 20%, 25%.

10% Exceedance Rate	
Sample Size	Maximum Number of Exceedances Needed 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 Exceedances Needed 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 Exceedances Needed 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). 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 is used for evaluating attainment, are identified as "evaluated" and the AU containing the station data is 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 Excel or Excel compatible format and are evaluated using tools available through the Excel program.

3.9 IMPAIRMENT SOURCE DETERMINATION

For any monitored AU where a water quality standard has been evaluated 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 water body).

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 Excel (or similar software for external data, biological data, WET data, etc.) 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.

4.0 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 water bodies may be listed as non-support if the chemical, physical, and/or biological characteristics for which the water body 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 water bodies 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 4 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 standards so it is not included in Table 4. Fish Consumption is not a designated use in Rule 2; however it can be used to list a water body 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 Water body, 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 water body. At a minimum, paired biological and physical data must be collected using methods outlined in a Quality Assurance Project Plan with requirements equal to or more stringent than that of DEQ or USGS. Chemical data for biological integrity analysis should be collected as per methods outlined within Section 6.1 - 6.12 of this document. 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.

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) community loss index, 6) ratio of EPT to Chironomid taxa, and 7) ratio of scrapers to filter-collectors. See *Arkansas's Water Quality and Compliance Monitoring Quality Assurance Project Plan* (ADEQ 2016) 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 seven metric values (Table 5) 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 seven metrics to calculate a percent comparison to reference value. Community loss index is already a comparison of study site to reference so there is no need for additional comparison in this step. 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 seven 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). See Figures 1 and 2 below for an overview on how aquatic life designated use is determined.

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%
Community Loss Index[5]	<0.5	0.5-<1.5	1.5-<4.0	≥4.0
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.
Support	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-Support	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.

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 (>10mi^2) outlined in *Arkansas's Water Quality and Compliance Monitoring Quality Assurance Project Plan* (ADEQ 2016), 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 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.

Results from fish and macroinvertebrate community analysis, along with evaluation of chemical and physical data, and toxicity test date if available, will be used to determine support or non-support of the aquatic life designated use.

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.

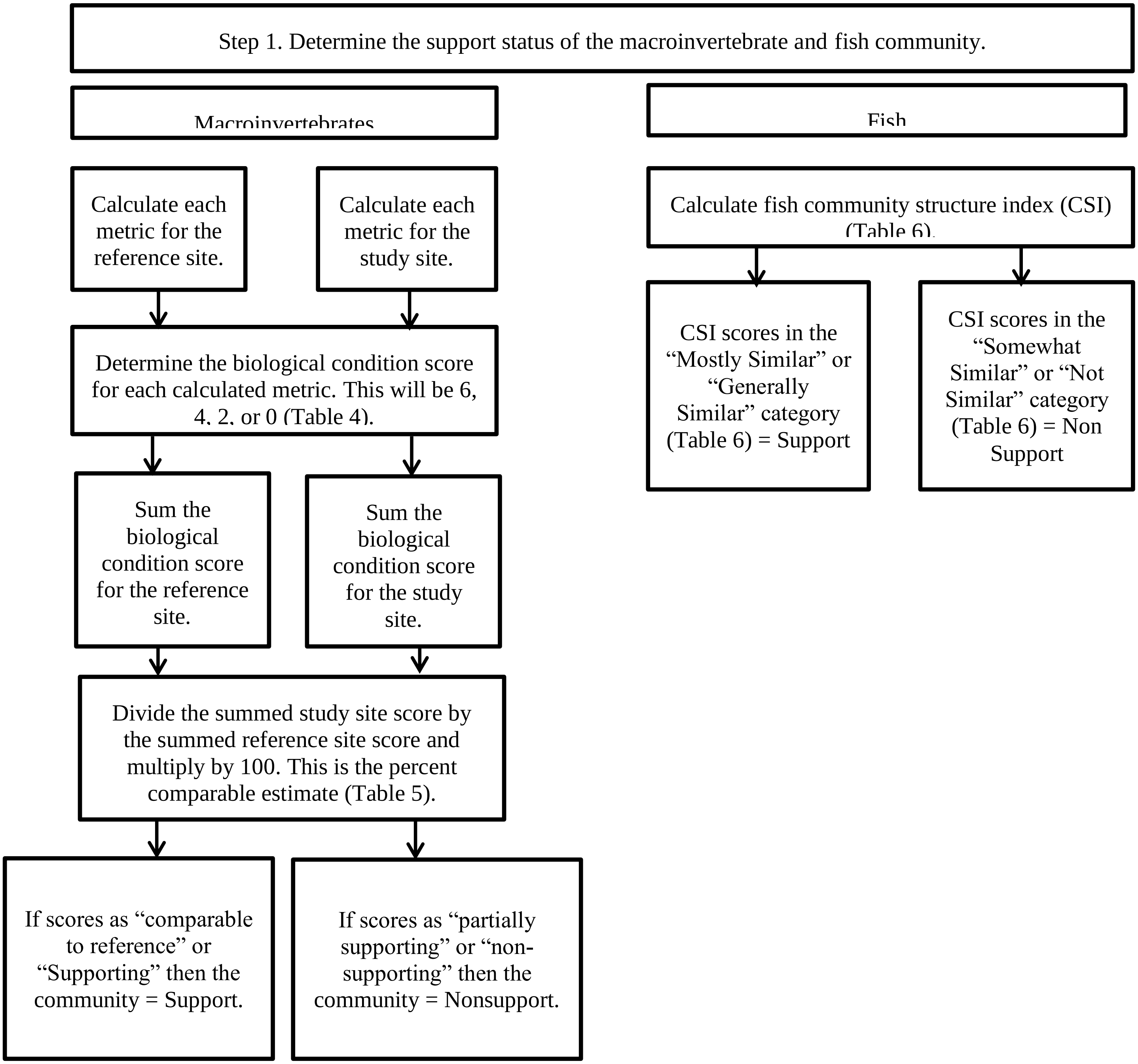


Figure 1: Determining Aquatic Life Use designated use attainment Step 1.

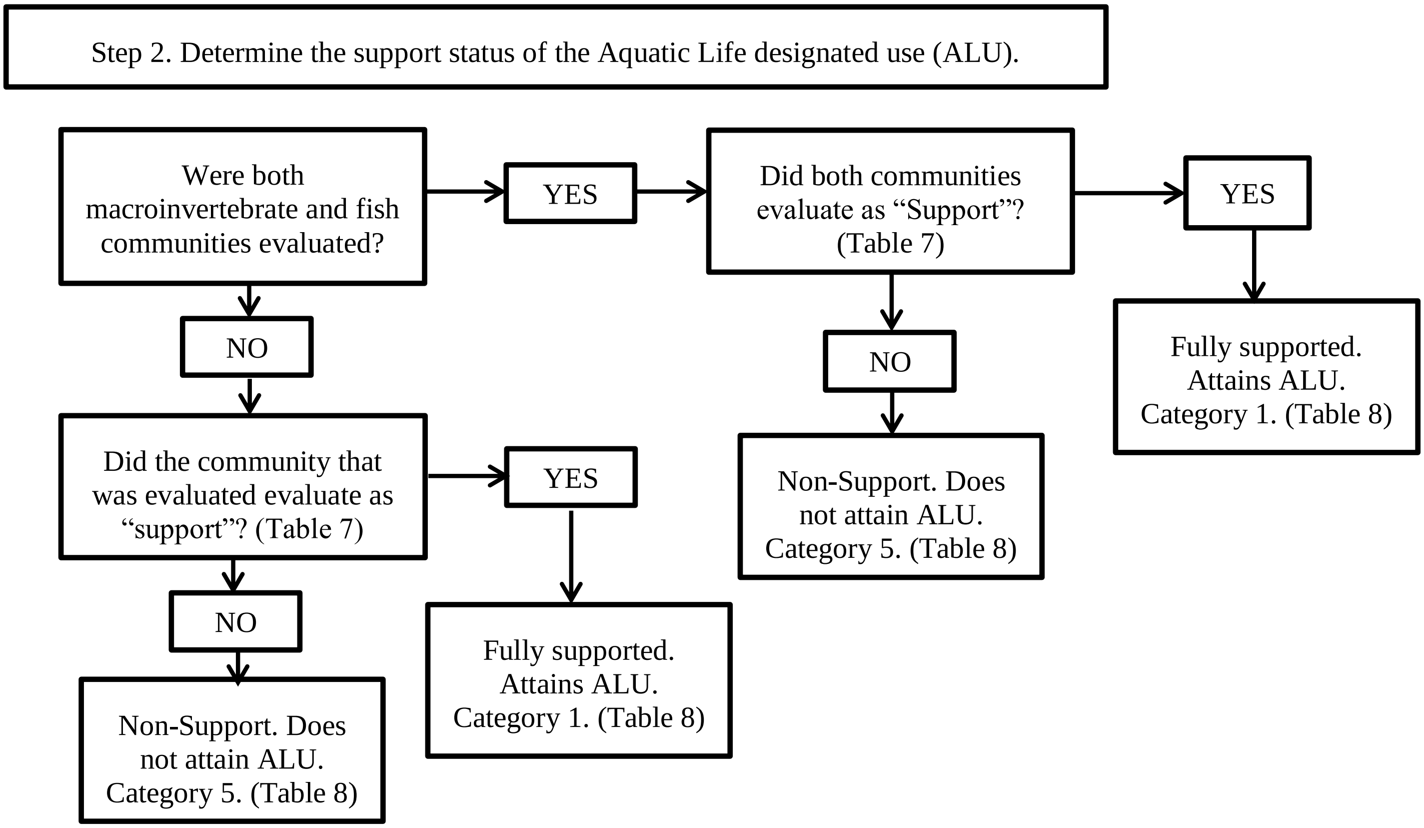


Figure 2: Determining Aquatic Life Use designated use attainment Step 2.

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 (Table 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 post-assessment 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 in the subsequent assessment cycle.

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 6) indicates comparable to reference or supporting	Macroinvertebrate community structure analysis (Table 6) indicates partially supporting or non-supporting*
Fish Community Data Available	Community Structure Index score (Table 7) is either mostly or generally similar; general presence of sensitive and indicator species	Community Structure Index score (Table 7) 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 reach), which could trigger an inaccurate ‘non-support’ determination.
- Transitional areas between ecoregions.

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 standards 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 standards 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 water body, 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 spelled out 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.

Long-term and short-term continuous data must span 90% of the 24 hour period to be used for that day. Similarly, long-term continuous data must span 90% of the month, for that month to be considered.

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 72-96 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
    - 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, meter must be deployed and taking readings for three (3) of the five (5) months that typically exceed critical season temperatures in Arkansas (usually May through September),
    - For Trout Waters Long-term continuous data must cover ten (10) of the twelve (12) calendar months with continuous readings taken at least hourly. Individual days missing more than 10% of values do not meet minimum quantity requirements for that day.
    - At least 90% of each day (as defined by 90% of readings) must be present for that day to be used.
    - At least 90% of each month (as defined by 90% of readings) must be present for that month to be used.

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 over not less than three (3) years.
- Long-term Continuous Data
    - Meter must be deployed during three (3) of the five (5) months that typically exceed critical season temperatures in Arkansas (generally May through September).
    - At least 90% of each month (as defined by 90% of readings) must be present for that month to be used.

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. 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 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 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 percent exceedance rate within Table 2, 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 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 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 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 seventy-two (72) hours each with at least hourly readings are required for pH attainment decisions.
     - Diel deployments must be spaced at least two weeks (14 days) apart.
   - Long-term Continuous Data
     - Long-term continuous data must cover ten (10) of the twelve (12) calendar months with continuous readings taken at least hourly readings. Individual days missing more than 10% of values do not meet minimum quantity requirements.
     - At least 90% of each day (as defined by 90% of readings) must be present for that day to be used.
     - At least 90% of each month (as defined by 90% of readings) must be present for that month to be used.
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 over not less than three (3) years.

- Long-term Continuous Data
    - Long-term continuous data must cover ten (10) of the twelve (12) calendar months with continuous readings taken at least hourly. Individual days missing more than 10% of values do not meet minimum quantity requirements.
    - At least 90% of each day (as defined by 90% of readings) must be present for that day to be used.
    - At least 90% of each month (as defined by 90% of readings) must be present for that month to be used.

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 percent exceedance rate in Table 3, 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 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.
- Short-term continuous data
  - Two (2) diel deployments of no less than seventy-two (72) hours each with at least hourly readings are required for attainment decisions.
  - Diel deployments must be taken at least two weeks (14 days) apart during mid-May to mid-September.
  - 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.
- Long-term continuous data
  - Data must cover ten (10) of twelve (12) calendar months.
  - At least 90% of each day (as defined by 90% of readings) must be present for that day to be used.
  - At least 90% of each month (as defined by 90% of readings) must be present for that month to be used.

  - Readings must be at least hourly. Data sets with sub-hourly readings (every 15 minutes, for example) will be calculated into an hourly average.

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.

<u>Non-Trout Waters</u>

Primary Season – Streams and Rivers

1. Temporal requirements
   - Discrete 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 primary seasons.
   - Long-term continuous data
     - Data must be evenly distributed throughout the primary season.
     - At least 90% of each day (as defined by 90% of readings) must be present for that day to be used.
     - At least 90% of each month (as defined by 90% if readings) must be present for that month to be used.
     - Readings must be at least hourly. Data sets with sub-hourly readings (15 minutes, for example) will be calculated into an hourly average.

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.
   - Long-term continuous data
     - Year round.

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 seasons.
- Short-term continuous data
  - Two (2) diel deployments of no less than seventy-two (72) hours each with at least hourly readings are required for attainment decisions.
    - 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.
- Long-term continuous data
  - Data must be evenly distributed throughout the primary season.
  - At least 90% of each day (as defined by 90% of readings) must be present for that day to be used.
  - At least 90% of each month (as defined by 90% of readings) must be present for that month to be used.
  - Readings must be at least hourly. Data sets with sub-hourly readings (every 15 minutes, for example) will be calculated into hourly averages.

3. Spatial requirements

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

Lakes and Reservoirs

1. Temporal requirements

- Discrete Data
  - Year round.
- Short-term continuous and long-term continuous data
  - Collect short-term and long-term continuous data during the critical season.
    - Only data above 22 degrees Celsius will be utilized for assessments made using long-term continuous data.

2. Minimum data distribution and quantity requirements

- Discrete data
  - A minimum of ten (10) quarterly samples over not less than three (3) years.
- Short-term continuous data
  - Two (2) diel deployments of no less than seventy-two (72) 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.
- Long-term continuous data
  - Data must be evenly distributed throughout the critical season.

- At least 90% of each day (as defined by 90% of readings) must be present for that day to be used.
- At least 90% of each month (as defined by 90% of readings) must be present for that month to be used.

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 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 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) 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.

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 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.

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 a 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
  - <u>Individual Samples</u> - 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.
  - <u>Geometric Mean</u> - 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
  - <u>Individual Samples</u> - 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.
  - <u>Geometric Mean</u> - 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 Lakes, Reservoirs	GM 126 col/100 mL*	≤ criteria	> criteria
		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 Lakes, Reservoirs	GM 630 col/100 mL*	≤ criteria	> criteria
		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*

Substance	***Acute Criteria (CMC) - µg/L(ppb)*** Formula	X Conversion	***Chronic Criteria (CCC) - µg/L(ppb)*** 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.

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 over not less than three (3) years.
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

Total Nitrogen (TN) and Total Phosphorus (TP) data will be screened per respective ecoregion using the 75th percentile of TN and TP for the appropriate period of record. Data used in calculation of 75th percentiles must meet the following requirements:

- Discrete Data
    - Ten (10) or more discrete TN and TP samples per monitoring station, and
    - Data are representative of at least three (3) quarters per year.

Mean TN and mean 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 2.

PHASE II DATA QUALITY REQUIREMENTS FOR NUTRIENTS

Continuous and biological data requirements must be met for full nutrient assessment. 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 calendar year.

Streams and Rivers

1. Temporal requirements:

- Short-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.
- Long-term Continuous Data
  - Long-term dissolved oxygen and pH data must be collected within the same critical season (same year) as the discrete 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 either fall or spring base flow conditions. Fall macroinvertebrate collections are preferred.

2. Minimum distribution and quantity requirements
- Short-term Continuous Data
  - Two (2) diel deployments of at least 72 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
  - Continuous data must cover consecutive months for at least two-thirds of critical season with at least hourly readings.
- Biological Communities
  - One (1) fish community and one (1) macroinvertebrate community data set are required per year.

3. Spatial and other 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.
   - Chlorophyll *a* sample depth shall not exceed two (2) meters.
   - All other parameter (DO, pH, temperature, etc.; excluding Secchi disk) samples are to be taken within the epilimnion (if present). Sample depth shall be 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 2) 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 datasets 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, 72-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 datasets 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.

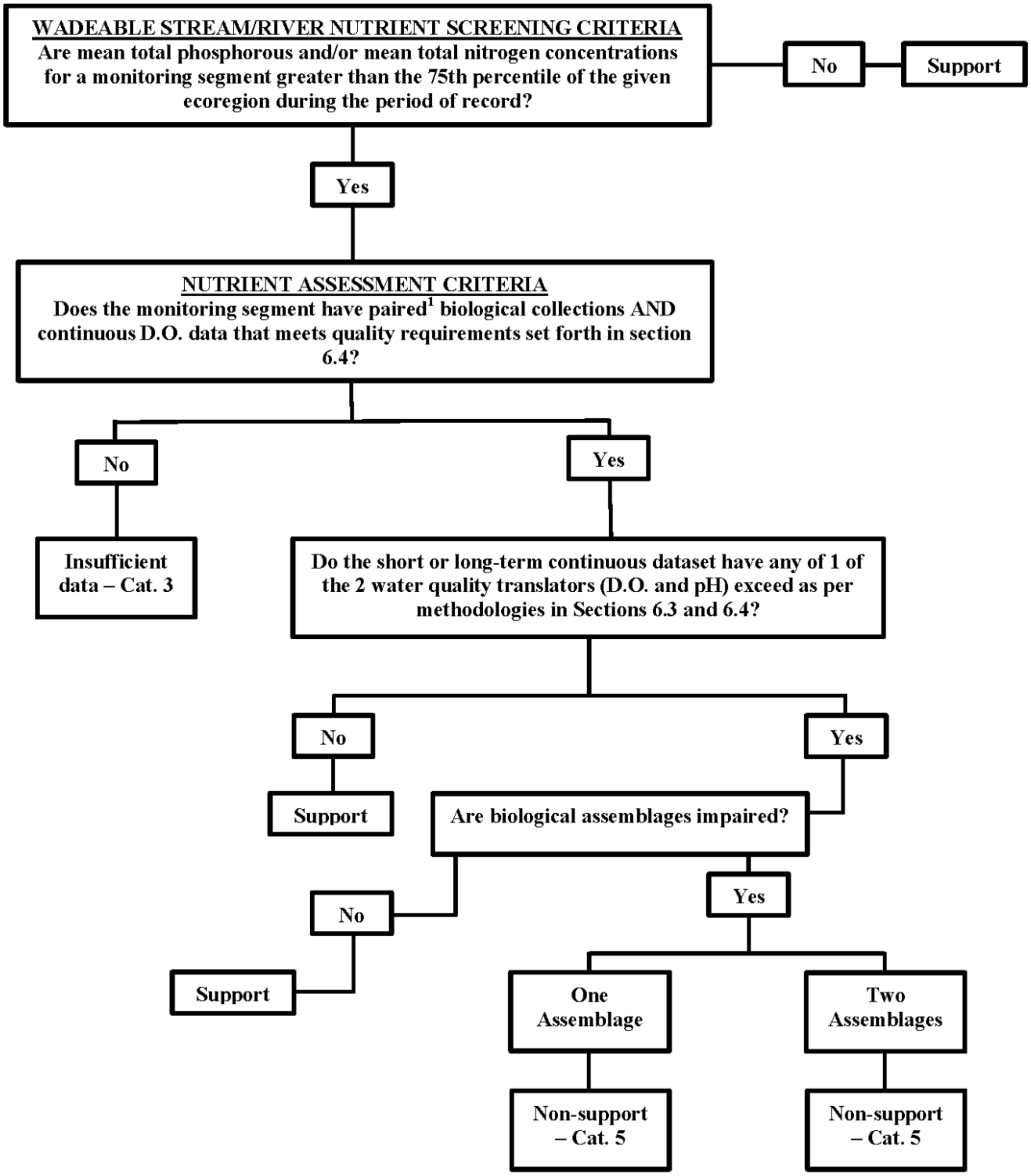
LISTING METHODOLOGY FOR BEAVER LAKE:

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 SITE SPECIFIC MINERAL QUALITY

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

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.
   - 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.

ASSESSMENT METHODOLOGY FOR SITE SPECIFIC MINERAL QUALITY

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 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 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).

6.11 NON-SITE SPECIFIC MINERAL QUALITY; AND DOMESTIC, AGRICULTURAL, AND INDUSTRIAL WATER SUPPLY USES

This section establishes the protocol for assessment of non-site specific mineral quality criteria and domestic 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 NON-SITE SPECIFIC MINERAL QUALITY; AND DOMESTIC, AGRICULTURAL, AND INDUSTRIAL WATER SUPPLY USES

Minerals data (chloride, sulfates, TDS) will be used to assess non-site specific minerals quality as 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 over not less than three (3) years.
3. Spatial requirements
   - Take samples within the epilimnion (if present). Sample depth shall be between 0.33 and 2.0 meters.

ASSESSMENT METHODOLOGY FOR NON-SITE SPECIFIC MINERALS QUALITY; AND 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 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 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.

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; 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
   - Samples can be taken anywhere within the water column for lakes and reservoirs.

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. The actual months will vary for specific water bodies.
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 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
   - 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. The actual months will vary for specific water bodies.

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 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

- 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. 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.

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.

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. September 3, 2013. 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