STATE OF ARKANSAS

WATER QUALITY MONITORING

and

ASSESSMENT PROGRAM

Revision 6

ARKANSAS ENERGY & ENVIRONMENT

DIVISION OF ENVIRONMENTAL QUALITY
OFFICE OF WATER QUALITY

2020

Arkansas Department of Energy and Environment

In 2019, the Arkansas Department of Environmental Quality was combined with other state agencies to form the Arkansas Department of Energy and Environment (ADEE). ADEE is dedicated to the development and implementation of policies and programs that provide effective and efficient energy and environmental solutions informed by science. It promotes responsible management of resources and protects the environment for the benefit of all Arkansans.

The Department of Environmental Quality is now the Division of Environmental Quality (DEQ) under the newly created ADEE. It is the mission of DEQ to protect, enhance, and restore the natural environment for the well-being of all Arkansans. The Office of Water Quality (OWQ) resides within DEQ and is comprised of four branches, Water Quality Planning, Compliance, Enforcement and Permits. Each of the branches shares the common goal of protecting and enhancing Arkansas's waterways.

The Water Quality Planning Branch (WQPB) consists of professional environmental scientists with advanced degrees and training in ecology, biology, geology, toxicology, limnology, aquatic entomology, ichthyology, and fisheries biology, among others. The staff has extensive experience in water quality related environmental processes. In addition, the staff has received training in topics such as; surface and ground water hydrology, modeling, permitting, water quality standards, quality assurance, total maximum daily loads, microbiology, geographical information systems, best management practices for abatement of nonpoint source pollution, and numerous aspects related to management.

Responsibilities of the WQPB include:

- Development and revision of Arkansas's water quality regulations, Rule No. 2;
- Development and management of the list of impaired water bodies;
- Review of, and consultation in, use attainability analysis studies and reports;
- Developing, revising, reviewing, and consultation in total maximum daily loads;
- Assisting in the development of NPDES discharge limits;
- Review of NPDES point source discharge limits and applications;
- Review of storm water permits and applications;
- Review of state permits and applications;
- Review, permitting, and enforcement of whole effluent toxicity testing;
- Review, permitting, and consultation of short term activity authorizations;
- Review, permitting, and consultation of water quality certifications;
- Reviewing and consulting as it pertains to USCOE dredge and fill permits;
- Development and enhancement of ecoregion based biological assessment criteria;
- Investigations of the physical, chemical, and/or biological characteristics of state waters;
- Assists with enforcement and surveillance activities;
- Management of the state water quality monitoring networks:
- Management of ground water remediation activities;
- Oversees a portion of the Ground Water Protection Program;
- Management and implementation of the Office Of Water Quality grants; and
- Staff represent DEQ are vital members of numerous, federal, state, local, academic, and watershed-based advisory boards and technical support committees.

Environmental Protection Agency

Public Law 92-500, commonly referred to as the Clean Water Act (CWA), was passed by Congress in 1972 and reauthorized in 1987. The objective of the Act was to "restore and maintain the chemical, physical, and biological integrity of the Nations waters." Section 106 of the CWA funds programs to develop water quality standards and designated uses (Section 303); develop pollutant discharge limits (Section 301 and 302); monitor waters of the State (Sections 305 and 406); report on the conditions of those waters (Section 305); and compile a list of those waters that are not supporting designated uses and develop total maximum daily loads for those waters (Section 303) (EPA Working Together, FY2018-2022 U.S. EPA Strategic Plan. February 2018.)

The United States Environmental Protection Agency (EPA) Strategic Plan lists the strategic goals and objectives that are designed to meet the EPA Mission "To Protect Human Health and the Environment." The activities and tasks in this work plan are designed to help achieve

Strategic Goal #1, A Cleaner, Healthier Environment

> "Deliver a cleaner, safer, and healthier environment for all Americans and future generations by carrying out the Agency's core mission."

Objective 1.2. Provide for Clean and Safe Water

> "Ensure waters are clean through improved water infrastructure and, in partnership with states and tribes, sustainably manage programs to support drinking water, aquatic ecosystems, and recreational, economic, and subsistence activities."

EPA has developed two strategies to achieve the strategic goal, "Protect Human Health" and "Protect and Restore Water Quality." The protection of human health includes activities designed to strengthen water quality protection programs for surface and groundwater drinking water sources, safeguarding water resources against current and emerging contaminants, and providing financial and technical support to entities implementing such programs.

Protecting and restoring water quality may be obtained by developing and revising water quality criteria, protect and restore wetlands, reduce the discharge of pollutants, perform monitoring activities, and provide financial and technical support to entities implementing such programs.

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LIST OF ACRONYMS

ADEE	Arkansas Department of Energy and Environment
AWQMN	Ambient Water Quality Monitoring Network
BMN	Biological Monitoring Network
CWA	Clean Water Act
DEQ	ADEE-Division of Environmental Quality
EPA	United States Environmental Protection Agency
GWQMN	Ground Water Quality Monitoring Network
LWQMN	Lakes Water Quality Monitoring Network
Mgal/d	Million gallons per day
NHD	National Hydrologic Dataset
NPDES	National Pollutant Discharge Elimination System
OWQ	Office of Water Quality
QAPP	Quality Assurance Project Plan
QA	Quality Assurance
SOP	Standard Operating Procedures
STORET	Storage and Retrieval System
TMDL	Total Maximum Daily Load
WQPB	Water Quality Planning Branch

Introduction

Surface water quality monitoring in the State of Arkansas was first initiated in the early 1960s by the Arkansas Oil and Gas Commission. In the late 1960's, monitoring and management of the State's water resources became the responsibility of the Arkansas Department of Pollution Control and Ecology, now known as the Arkansas Department of Energy and Environment (ADEE), Division of Environmental Quality (DEQ). With the creation of the Environmental Protection Agency (EPA) and the passage of the Clean Water Act in 1972, new federal and state mandates were implemented. Expansion of the monitoring activities in the state occurred to address the mandates and better characterize the State's water bodies. However, since the 1960's the basic objectives of the water monitoring programs have changed very little;

1) to provide water quality data to determine natural, seasonal and chronological water quality conditions;
2) determination of long-term and short-term trends;
3) evaluation of pollution control efforts;
4) development of reliable assessment methodologies; and
5) development of defensible water quality regulations.

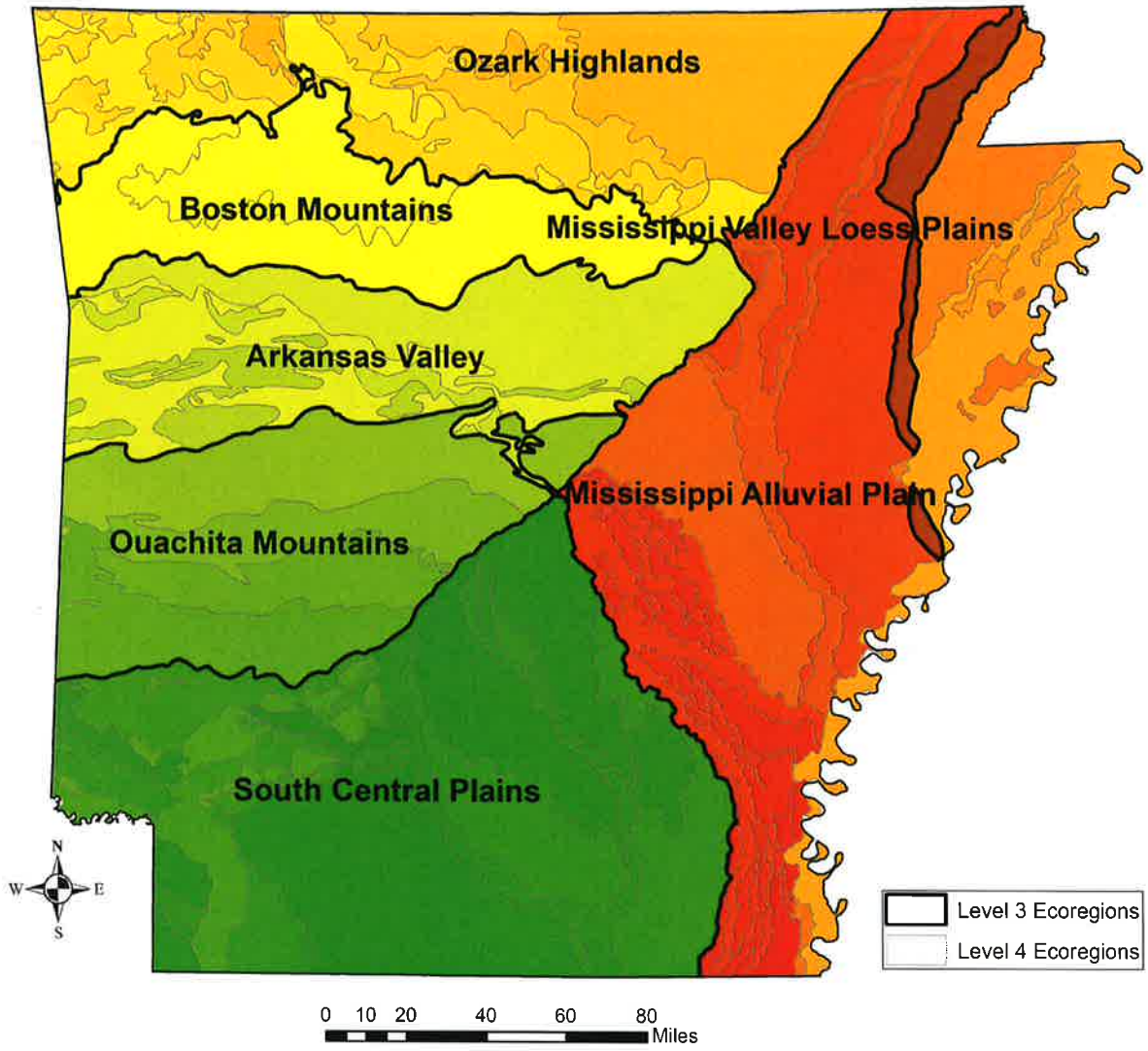
Examples of the expansions include watershed targeted studies, site-specific studies, water quality constituent specific studies, ground water monitoring, and lakes monitoring programs. These monitoring programs are designed to fulfill not only the specific needs of the state, but also the needs of other federal, state and local environmental agencies.

A significant expansion occurred in the 1980's when the ecoregion concept was incorporated into the management of state water quality programs. The concept accepts the premise that water bodies reflect the character of the land they drain (watershed), and that where watersheds are physically comparable, chemical and biological conditions should also be comparable. Physically comparable attributes include: 1) the homogeneity of land surface forms; 2) potential natural vegetation; 3) soil types; and 4) land use (APC&E, 1987). A watershed that contains all (mostly-typical) or most (generally-typical) of these attributes within a given ecoregion can serve as benchmarks for other watersheds within the same ecoregion with similar characteristics.

The state is divided into six distinct ecoregions, Ozark Highlands, Boston Mountains, Arkansas River Valley, Ouachita Mountains, South Central Plains and the Mississippi Alluvial Plains (Delta). Each ecoregion has distinct physical, chemical and biological characteristics. Monitoring least-disturbed water bodies within these regions is of significant value in assessing the results from both chemical and biological monitoring in other waters within the ecoregion.

In 2004, a diverse group of scientists convened to better define the boundaries of the six ecoregions and subdivide them into smaller areas with even more distinct attributes. A seventh ecoregion, Mississippi Valley Loess Plains (Crowley's Ridge) was delineated. These seven ecoregions were then divided into thirty-two (32) smaller distinct areas. Figure 1 – Arkansas's Level Three and Level Four Ecoregions, depicts the seven major ecoregions and the 32 sub-regions.

Figure 1 – Arkansas Level Three and Level Four Ecoregions

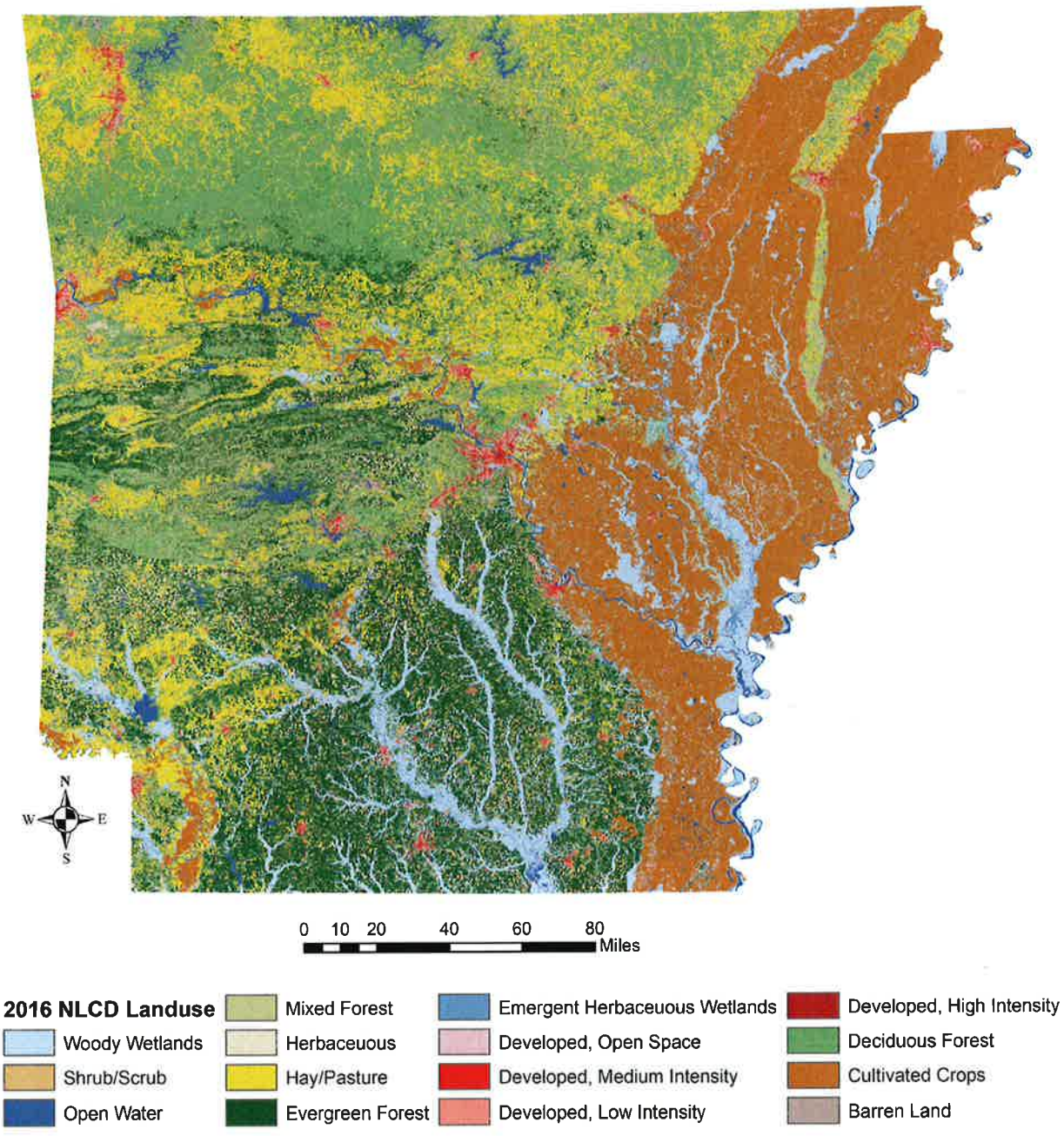


State Land and Water Use Statistics

Land Use

There are approximately 34 million acres of land and water inside Arkansas's boundaries. Of this, approximately eleven (11) million acres are in agriculture production, seven (7) million acres in crop production and other agricultural, and approximately sixteen (16) million acres of forests, however not all of these acres are managed for timber production. Figure 2 – Arkansas Land Use is a depiction of the land use within Arkansas's borders. In addition, according to the 2019 U.S. Census Bureau Estimate, there is approximately 700,000 acres of water, 820,000 acres of wetlands, and 200,000 acres of developed land (Arkansas Department of Health, 2019).

Figure 2: Arkansas Land Use



Water Resources

The State is divided by six major river basins: Red River, Ouachita River, Arkansas River, White River, St. Francis River, and the Mississippi River. For management purposes, these six river basins are sub-divided into smaller units, mainly along 8-digit hydrologic units, called Planning Segments. A map depicting these divisions is located in Appendix A. The DEQ base water layer, which contains the river and stream miles primarily managed for Clean Water Act purposes, contains approximately 17,200 miles. In addition, the DEQ base water layer for lakes and reservoirs includes approximately 335,645 acres (135,831 hectares) of the 700,000 acres of open waters.

2018 DEQ Base Water Layer Stream Miles	17,200	(27,680 Km)
2018 DEQ Base Lakes Layer Acres	335,645	(135,831 Hectares)
Wetlands Acres (Arkansas Department of Health, 2019)	820,000	(331,844 Hectares)

Arkansas is a water rich state with over 92 million acre-feet of water flowing through the major basins every year. Approximately 3.2 billion gallons of surface water per day are used by Arkansas residents. The majority of the water is used for irrigation purposes. Other uses are for domestic water supply, ecosystem viability and thermoelectric production (Arkansas Department of Agricultural, 2014).

With this enormous amount of surface water resources, it is essential to maintain a monitoring strategy that can provide the information necessary to properly manage these resources so that the physical, chemical, and biological integrity of all Arkansas's waters are protected and enhanced.

Ground Water Usage

Shallow fresh-water aquifer systems are found throughout Arkansas and supply an abundance of high-quality ground water for a wide range of uses including industrial, municipal, agricultural and domestic. Ground water is one of the most important sources of water supply in Arkansas and accounts for more than half of the total water use in the state. Ground water in Arkansas occurs in two general geologic settings which are represented by five major physiographic regions of the state: the Ozarks, the Arkansas River Valley, the Ouachita Mountains, the South Central Plains, and the Mississippi Alluvial Valley. The aquifer systems in eastern Arkansas (South Central Plains and the Mississippi Alluvial Valley) are characterized by alternating sequences of gravel, sand, silt, and clay, which form both confining layers and aquifers. The main aquifer systems are located in the Quaternary deposits (the alluvial aquifer), the Cockfield Formation, the Sparta Formation, the Wilcox Group, the Nacatoch Sand, and the Tokio Formation. The Mississippi River Valley alluvial aquifer and the Sparta aquifer are the most important aquifers in eastern Arkansas, together supplying more than 95% of the ground water used in this region of the state. The Sparta is used mainly for municipal supply and industrial use, although declining levels in the alluvial aquifer in some areas have resulted in more frequent use of the Sparta aquifer for irrigation uses.

There are approximately 50,000 registered wells in the state of which 97% are used for agricultural. This number does not include domestic wells that produce less than 50,000 gallons per day. In 2015 it was estimated that approximately 8,200 million gallons per day (Mgal/d) of ground water was pumped from the State's aquifers. The greatest volume, more than 7,500 Mgal/d, is pumped from eastern Arkansas aquifers and primarily used for irrigation purposes. Municipal and industrial purposes account for a small fraction of ground water use in the state. (Arkansas Department of Agriculture, March 2020).

Approximately 97% of the state's population relies on one or more of the 687 public water systems in the state for their water supply. As of 2019, 586 (85%) used ground water resources for their water supply. The average daily water use by water system was 450 Mgal/d (Arkansas Department of Health, 2019).

Federal Clean Water Act

Public Law 92-500, commonly referred to as the Clean Water Act (CWA), was passed by Congress in 1972 and reauthorized in 1987. The overall goal of the Act is to "restore and maintain the chemical, physical, and biological integrity of the Nations waters". Section 106 of the Act funds programs to the States to achieve this goal. Examples are outlined in the Act and include programs to assist in achieving the following objectives:

- Establish, review, and revise water quality standards (Section 303);
- Determine water quality standards attainment (Section 305(b));
- Identify impaired waters (Section 303(d));
- Identify causes and sources of water quality impairments (Sections 303(d) & 305(b));
- Support the implementation of water management programs (Sections 303, 314, et. al.);
- Support the evaluation of program effectiveness (Sections 303, 305, 314, 319, et. al.).

State Water Quality Management and Monitoring Goals

The DEQ is charged with protecting, enhancing, and restoring Arkansas's natural environment for all Arkansans. The mission of the Office of Water Quality (OWQ) is to protect and manage Arkansas's waterways for Arkansas's citizens. As such, the following goals and objectives have been developed to help attain the mission of the OWQ.

State Water Quality Management Goals

- Comply with all Clean Water Act requirements.
- Maintain State water quality management programs that protect all of the State's waters for the citizens of Arkansas.
- Continue updating and revising the State's water quality regulations, assessment methodologies, and other tools to better protect the State's water resources.
- Maintain and enhance the State's water quality monitoring programs to continue supplying the information necessary to make informed decisions.
- Establish and/or enhance working partnerships and collaborations with local, state, federal and private sector agencies/entities regarding water resources management.

- Inform the citizens of Arkansas of monitoring plans and data results and encourage/assist them to take individual and collective action to prevent and reduce all types of water pollution.
- Ensure compliance of quality assurance protocols and standard operating procedures.

State Water Quality Monitoring Goals

- Ascertain water quality standards attainment.
- Identify impaired waters.
- Establish, review, and refine water quality standards to
  - better reflect individual waterbody characteristics;
  - better reflect level four ecoregion characteristics; and
  - address emerging issues.
- Establish geographic trends in water quality.
- Determine and refine ecoregion boundaries.
- Refine physical, chemical, and biological assessment tools to improve water quality assessments.
- Evaluate water quality and designated use attainment for development of the bi-annual Integrated Water Quality Monitoring and Assessment Report (305(b) Report).
- Establish management actions to protect all of the State's waters for the citizens of Arkansas.
- Identify management strategies for impaired water bodies.
- Assess the effects of point source dischargers upon water quality.
- Monitor the impact of nonpoint source pollution over the long term.
- Monitor all of the waters of the State.
- Establish long-term physical, chemical, and biological data.
- Monitor the State's least-disturbed ecoregion reference waterbodies.

Water Quality Monitoring Program Overview

The water quality monitoring program is designed to meet the goals and objectives listed above. The monitoring program consists of routine (ambient) and non-routine monitoring components that have been designed to work either independently or together to provide a robust data set for decision making.

The data produced from these monitoring activities is incorporated into the biennial "Integrated Water Quality Monitoring and Assessment Report" (305(b)). It is also used to prepare the list of impaired water bodies (303(d)). In addition, federal, state, and local government agencies, as well as private entities, use the data and the associated reports to help prioritize watersheds and restoration activities for their associated management programs. These programs include the State Nonpoint Source Program, the Natural Resources Conservation Service Environmental Quality Incentive Program and local watershed group planning.

Routine Water Quality Monitoring

Arkansas's water quality monitoring program, which began in 1974, was an expansion and modification of an earlier interstate network. Some of its basic purposes were to establish background levels and baseline water quality data; including physical, chemical, and biological data as well as seasonal and chronological variations. In 1982, DEQ evaluated the monitoring network and four goals were established:

- to better assess the effects of point source dischargers upon water quality;
- observe the impact of known nonpoint source inputs;
- monitor the State's major rivers; and
- monitor the high quality (least impaired) streams to provide long term chemical data by ecoregion for use in future water quality standards revisions.

Arkansas's routine water quality monitoring programs are designed to meet these goals and consist of the following networks.

Surface Water

- **Ambient Surface Water Quality Monitoring Network (AWQMN):** Water samples are systematically collected monthly or bi-monthly to provide an overview of water quality conditions and trends at specific sites across the entire state.
- **Lakes Water Quality Monitoring Network (LWQMN):** This network is designed to supply water quality information from Arkansas's significant publicly-owned lakes.
- **Biological Monitoring Network (BMN):** This network is designed to provide biological community information, bacteria, periphyton, and macroinvertebrate and fish community assemblages, from select stations across the state.

Ground Water

- **Ambient Ground Water Quality Monitoring Network (GWQMN):** Designed to evaluate background chemistry and trends of numerous aquifers and detect various anthropogenic impacts or trends.

Non-Routine Water Quality Monitoring

Surface Water

- **Intensive Surveys:** These surveys are implemented to assess the physical, chemical, and/or biological conditions of a specific water body, watershed, ecoregion, etc. These studies may or may not be limited to a specific geographic area but may have a very specific objective (e.g., Total Maximum Daily Load (TMDL) development, specific designated use attainment determination, water quality standards development or revisions).
- **Special Studies:** These studies may be necessary if a short-term investigation is needed as a rapid response to an environmental issue, or as a special long-term investigation that may arise because of an environmental concern (e.g., harmful algal blooms, fish tissue evaluation, toxicity testing, monitoring the effects of an acute incident).
- **National Monitoring Initiatives:** These studies are nationwide and are implemented by EPA to produce a generalized assessment of water conditions at a national or regional scale. DEQ generally participates in these studies only on a very limited scale.

Ground Water

- **Special studies:** These studies are often conducted in collaboration with other agencies or organizations to achieve specific objectives, e.g. to assess conditions of general scientific interest or address developing ground water issues.

Quality Assurance (QA)

It is the policy of DEQ that there shall be sufficient QA activities conducted to ensure that all environmental data generated and processed will be scientifically valid; of known precision and accuracy; of acceptable completeness, representativeness, and comparability; and, where appropriate, legally defensible (APC&EC, January 2020).

DEQ demonstrates competency in generating environmental data by maintenance of quality assurance project plans and an agency quality management plan. Sampling and analysis methods are based on EPA approved methods outlined in 40 CFR, Part 136. Methods for sampling and analysis are continually improving; therefore, training field and laboratory personnel and updating field and laboratory equipment is an ongoing activity. All data collection and analyses are accomplished under a quality assurance project plan (QAPP) and associated standard operating procedures (SOP). When the need for unique sampling and or analysis arises, quality assurance procedures are developed and implemented. This is discussed further in the section titled "Quality Assurance".

Water Quality Monitoring Program Components

Routine Water Quality Monitoring

Ambient Water Quality Monitoring Network

The Ambient Water Quality Monitoring Network was initiated in 1974. It was an expansion and modification of an earlier network and has been modified and changed minimally over the years. The basic objectives of the network are to provide background water quality data, as well as information on seasonal and chronological water quality variations. Systematically collected samples over a long period of time allow for long-term trend analysis, as well as determination of pollution control efforts, reliable assessment methodologies, and the development of defensible water quality regulations. Appendix A includes a list of the water quality monitoring network sites and a map depicting the locations of the sites.

Core and Supplemental Water Quality Indicators

Routine water quality parameters are analyzed from the samples collected at each of the monitoring stations. In addition, field parameter data are also collected. Specialized compounds are analyzed when necessary.

Core Indicators

- General water quality parameters analyzed from all monitoring stations
  - pH, dissolved oxygen, temperature, specific conductance
  - total and ortho-phosphorus, ammonia, nitrate + nitrite nitrogen, total Kjeldahl nitrogen, total organic carbon, turbidity, total suspended solids, total dissolved solids, chlorides, and sulfates
  - total and dissolved metals

Supplemental Indicators

- Water quality parameters collected at selected monitoring stations as needed
  - pesticides
  - biochemical oxygen demand
  - bacteria (*Escherichia coli)*
  - flow

Lakes Monitoring Network

Arkansas's lakes have been categorized into "Types" based on morphology, ecoregion, and the primary use or purpose for lake construction. The lakes range in size from 60 acres to over 45,000 acres and occur in each ecoregion and water basin in the state. There are hundreds of smaller privately and publicly-owned lakes across the state primarily being used for recreation activities, fisheries, and domestic water supply.

Surveying Arkansas's publicly-owned lakes was initiated in 1989. Every five years each of the lakes were sampled. Water samples were collected from various transects and at different depths

and analyzed for routine water quality parameters, as well as chlorophyll a, bacteria, metals, and plankton. In addition, temperature, pH, and dissolved oxygen profiles were routinely taken.

In 2011 the lakes water quality monitoring program was revamped. The purpose was to implement a program that will build a more robust database to help attain the goals and objectives of the OWQ; ...protecting, enhancing and restoring Arkansas's natural environment for all Arkansans." Monitoring only significant-publicly owned lakes, as identified in the previous program, doesn't meet the goals and objectives of the OWQ.

The new program is designed to monitor many more publicly-owned lakes more frequently to better attain the goals of the OWQ as well as provide information on seasonal and chronological water quality variations. In the new program, select lakes are monitored quarterly for three years. After three years a new group of lakes is selected. The information gathered from the previous group of lakes is evaluated to determine the attainment of water quality criteria and the support of designated uses. The data may also be used to better delineate designated uses and water quality criteria for each of the lakes. Appendix B has list of the lakes currently being monitoring and a map depicting the location of each lake.

Selection of Lakes

The criteria used in the selection process includes:

- the importance of the lake to the state
  - those currently being used as a drinking water supply,
  - those that supply a significant economic benefit to the state, and
  - those that provide ecological habitat for important state species.
- lakes currently listed on the impaired water body list;
- lakes with an established total maximum daily load;
- lakes with a history of harmful algal blooms;
- lakes with minimal data;
- lakes with little to no current data; and/or
- lakes that have never been monitored.

Core and Supplemental Water Quality Indicators

Routine water quality parameters are analyzed from the samples collected at each of the monitoring stations. In addition, field parameter data are also collected. Specialized compounds are analyzed when necessary.

Core Indicators

- General water quality parameters analyzed from all monitoring stations
  - pH, dissolved oxygen, temperature, specific conductance
  - total and ortho-phosphorus, ammonia, nitrate + nitrite nitrogen, total Kjeldahl nitrogen, total organic carbon, turbidity, total suspended solids, total dissolved solids, chlorides, sulfates, and total and dissolved metals

Supplemental Indicators

- Water quality parameters collected at selected monitoring stations as needed
  - pesticides
  - biochemical oxygen demand
  - bacteria (*Escherichia coli)*
  - algal toxins

Ground Waters Water Quality Monitoring Network

In the early 1980s, increased concerns with ground water quantity and quality issues resulted in the formulation of a ground water quality management strategy. DEQ led a multi-agency taskforce to assist in the development of the monitoring strategy, and funding began in 1981 for full development of the statewide monitoring strategy.

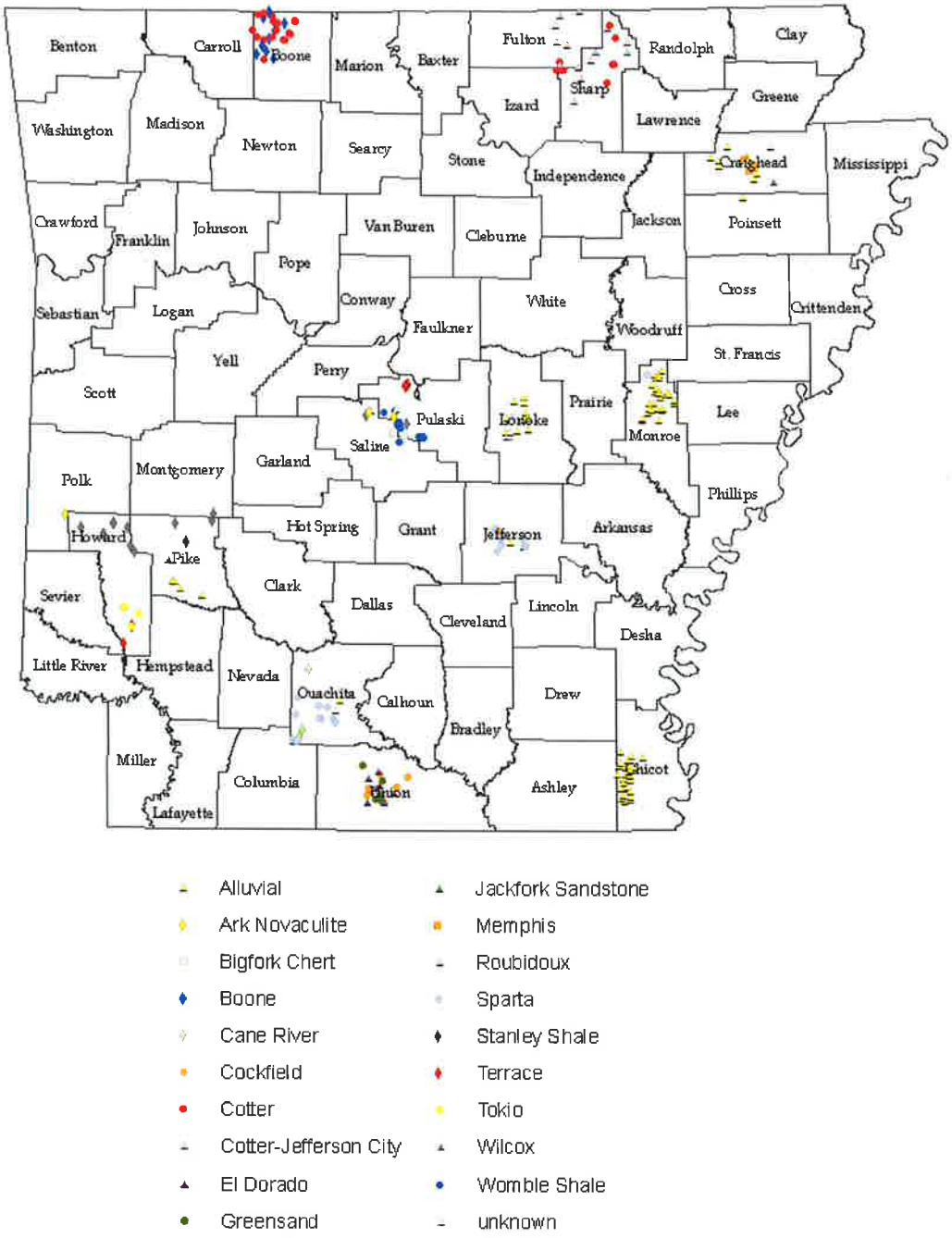
The Ambient Ground Water Quality Monitoring Program was initiated in 1985 to monitor overall ground water quality in the State of Arkansas. Initially, sampling occurred on seven "prototype" areas of the State, designed to reflect high ground water use areas and areas with high potential for degradation by various land-use practices including industry, agriculture, and other uses. With the addition of new areas, the program currently consists of eleven monitoring areas throughout Arkansas (Figure 3: Arkansas's Ground Water Monitoring Wells) with a total of approximately 280 sampling sites, with the ultimate goal of sampling all major and minor aquifer systems in the State by 2010.

The monitoring areas were selected to gather water quality data from various aquifers in representative areas of the State and to evaluate potential impacts from various land uses. Each monitoring area is sampled on a minimum three-year cycle.

Most of the monitoring areas are potentially affected by agricultural, industrial, nonpoint source practices, or a combination of these sources. Potential impacts from anthropogenic sources include organic and inorganic compounds, and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA - Superfund) facilities, Resource Conservation and Recovery Act facilities, Municipal Solid Waste landfills, and underground storage tank sites that potentially threaten or have impacted ground water.

Because of the various potential sources of contamination among the different monitoring areas and the costs and time associated with laboratory analysis, each area has a specific parameter list to best evaluate water quality. The current monitoring procedures include field measurement of pH, conductivity, oxidation-reduction potential, and temperature, and laboratory analysis of nutrients, major cations and anions, dissolved and total metals, total organic carbon, and total dissolved solids. Ground water samples obtained from areas potentially impacted by industry are analyzed for volatile organic compounds and semi-volatile organic compounds. Ground water samples obtained from areas potentially impacted by agricultural activities are analyzed for pesticides.

Figure 3: Arkansas's Ground Water Monitoring Wells



To help ensure quality of the data, trip blanks are analyzed and duplicate samples are collected once per day or approximately every tenth sample. Following receipt of the analyses from the lab, data validation procedures such as electrical balance calculations (Cation-Anion balance) are conducted for each analysis, followed by graphical analysis techniques where warranted.

Results of water quality assessments have identified specific problem areas resulting from both anthropogenic and natural sources of contamination. Nonpoint sources of contamination result in large areas of impact, although contaminant concentrations are generally lower than those resulting from point source contamination impacts. In Arkansas, the more pervasive nonpoint source impacts include nutrients and bacteria associated with the land application of manure from CAFOs, septic tanks, and other sources, and pesticide impacts in the eastern and southeastern portion of the State, associated with row-crop agriculture. Natural sources of contamination include elevated arsenic in some areas of the alluvial aquifer of eastern Arkansas, associated with the reductive dissolution of iron oxyhydroxides with its associated (adsorbed) load of arsenic and other trace metals. A large area of saltwater intrusion exists in the extreme southern part of the State, possibly due to upwelling of brine from deeper formations. High salinity also affects areas of ground water in the Brinkley monitoring area, though the source and mode of contamination has not been identified. DEQ has been observing these sources for a number of years. Specific studies related to each source can take many years, although each component has been part of an ongoing monitoring program.

Non-Routine Water Quality Monitoring

Special and intensive studies to develop and refine water quality criteria are implemented to collect physical, chemical, and biological data of the state's waters. The studies are implemented on level three ecoregion scales to assist in the development and refinement of water quality criteria. The data may also help in determining if significant differences occur between level four ecoregion delineations. Development and refinement of water quality criteria is imperative to protect the aquatic and semi-aquatic resources of the state.

Special and intensive studies are implemented to determine, verify, and refine attainment of water quality criteria and/or the support of designated uses. Many of the state's waters identified as not attaining water quality criteria are done so based on limited water quality data only. These studies are designed to provide physical, chemical, and biological data to increase the confidence level of decision makers in making water quality criteria attainment determinations.

Another possible purpose of these studies is to expand water quality databases for the development and refinement of total maximum daily loads. The discussion provided above also applies to this activity.

Surface Waters

Intensive Surveys

Data from the intensive surveys are routinely used to 1) accurately assess designated use support and water quality criteria attainment; 2) delineate water quality impairment cause(s); 3) identify

the sources of the impairment(s); 4) prioritize sub-watersheds for restoration activities; 5) recommend corrective actions; 6) enhance physical, chemical, and biological databases for total maximum daily load (TMDL) development decisions; and 7) for the development of and/or the revision of water quality standards.

Intensive surveys are usually short-term, two to three years, and watershed based. Activities included in these surveys are watershed land use delineation; intensive water quality sampling based on flow events; diurnal dissolved oxygen, pH, and temperature profiling; biological sampling for fish and macroinvertebrate communities; physical habitat surveys; stream bank stability investigations; ground water quality sampling; and specialized water quality parameter sampling.

Prioritization of intensive survey activities is essential because of limited resources and importance of the survey. Factors such as water body uses and citizen protection (drinking water supply, Extraordinary Resource Waterbody), state importance (Natural and Scenic Waterbody), economic value (tourism, water supply), biological importance (ecologically sensitive waters, threatened and endangered species, fish spawning habitat, threatened game fishes, wetlands), and degree of impairment are all used to prioritize water bodies for intensive surveys.

Lakes Criteria Development

The current water quality standards for lakes have been adapted from the surface water quality standards for stream and rivers. The development of lake-specific, lake-type, or lake-use water quality standards and criteria was initiated in 2008. Four lake studies have been completed to assist in the design of, and test a process by which lake water quality standards can be developed. A basic process has been developed and was implemented and further tested.

Special Studies

Most special studies are very short-term single purpose investigations (fish kills, complaints, emergency response, human health related) with very specific objectives. They are initiated with very short-term planning, and in many circumstances, the objective and deliverables are modified as data is collected and analyzed. However, some are long-term or continuous projects with multiple objectives (e.g., protection of human health, fish tissue contamination, response to spills, etc.).

Toxicity Testing

The objective of the Ambient Toxicity Testing Program is to monitor and assess the presence and magnitude of toxicity at specific sites on selected stream segments. Historically, monitoring below point sources with chronic toxicity issues, and stream segments listed as impaired, were targeted. Currently, the program has been paused as the water bodies in the state with toxicity issues have been recently monitored. After the source of toxicity in the individual water bodies has been identified and reduced, monitoring and assessment activities may resume, dependent on available resources.

National Monitoring Initiative

This program is implemented and managed by the EPA. The purpose of these surveys is to report on the water quality conditions of similar types of waterbodies on a national scale. DEQ cooperatively participates with these projects when adequate resources are available.

Ground Waters

Ground Waters Intensive Surveys

One-time ground water investigations are conducted to improve the understanding of transport mechanisms of certain ground water quality constituents. They are also designed to provide a better definition of the sources of particular ground water constituents or to provide high-resolution data about ambient geochemical conditions.

Ground Waters Special Studies

Short-term ground water investigations are associated with numerous events related to spills, complaints, and sources identified through ambient monitoring program, which result in short- and long-term studies. These investigations are not necessarily part of work plan activities, as they are related to single-event, emergency-response situations, and long-term studies associated with natural sources of contamination. Where the contamination results in longer-term monitoring, these investigations may later be folded into work plans.

Core and Supplemental Water Quality Indicators

The water quality constituents collected and analyzed in conjunction with these surveys are highly variable and depend on the objectives of the survey. The list of constituents for any given survey is usually in the associated quality assurance document for the study.

Data Management/Analysis/Reporting

Data Management

The EPA STORET data base is used for data management. In addition, an in-house database system is used to store the data and allow for Quality Assurance checks to ensure an accurate and defensible data set.

The physical and biological data produced by DEQ are stored in in-house databases. Databases exist for macroinvertebrate and fish community information. Station location, habitat analysis, and community data are all included in the databases. These databases are available on the DEQ website.

Data Analysis and Assessment

Water quality data is used by DEQ for designated use support and water quality criteria attainment decisions. These decisions are used to develop the biannual Integrated Water Quality Monitoring and Assessment Report, (305(b)) which includes the list of impaired waterbodies (303(d) list). The data is also used to assess the accuracy and appropriateness of water quality standards, assess in-stream aquatic life use, the effectiveness of pollution control programs and activities, as well as used to develop NPDES permit limits and TMDLs.

Data analysis is based on the parameters, criteria, and processes outlined in the State's assessment methodology for the development of the 303(d) list and 305(b) report. The methodology is reviewed and revised, if necessary, every two years. Core indicators, primarily water chemistry, are used to assess the majority of the State's waters. The collection, analysis, and assessment of physical and biological indicators require a large amount of resources and are therefore only sampled in conjunction with the special and intensive projects.

Reporting

The Office of Water Quality routinely produces a variety of reports associated with the ongoing programs listed in this document. Many of the reports are required by CWA reporting requirements or grant requirements. Summaries of the reporting required under the CWA are located in Table 1 - Reporting under the Federal Clean Water Act and other federal mandates.

Integrated Water Quality Monitoring and Assessment Report, 305(b)

The most comprehensive water quality report produced by the Office of Water Quality is the Integrated Water Quality Monitoring and Assessment Report. As required by Section 305(b) of the CWA, the State is required to produce the report every two years. The report summarizes the assessments of all of the monitored and evaluated waterbodies in the state. It identifies those waterbodies not currently supporting designated uses nor attaining water quality criteria. Also found in the report are short descriptions of the water pollution control programs and a discussion of special State, public health, and aquatic life concerns.

Table 1 - Reporting under the Federal Clean Water Act and other federal mandates.

Report	Source	Timeframe	Comments
Integrated Water Quality Monitoring and Assessment Report (305(b))	40 CFR 130.8 and 130.10	Biennial, due April 1st of even numbered years.	The primary water quality report reporting on either the designated use support or water quality criteria attainment of all assessed waters. Also contains a list of impaired water bodies.
Federal Government Grant Reporting	Variable	Reports prepared as per grant conditions or as needed.	Reporting the progress toward completion of grant tasks.
List of Impaired Waterbodies, 303(d) list	40 CFR 130.7 and 130.10	Biennial, due April 1st of even numbered years.	A list of water bodies not fully supporting designated uses or attaining water quality criteria. It also identifies the probable causes and sources of impairments and prioritizes water bodies for additional investigations or TMDL development.

List of Impaired Water Bodies (303(d))

Section 303(d) of the CWA and the Water Quality Planning and Management regulation in 40 CFR Part 130 requires the states to report on the waters of the state that are not supporting designated use nor attaining water quality criteria. This list is incorporated into the biennial 305(b) Report. It identifies water quality limited water bodies, the suspected causes of the impairment, and the probable sources. It also prioritizes the listed water bodies for TMDL development and restoration activities.

Quality Assurance (QA)

EPA requires all non-EPA entities "to develop and implement quality systems to support their environmental programs and projects funded or regulated by EPA" (EPA 2002). Quality Systems are the policies and programmatic management systems developed that pertain to quality. The primary goal of a Quality System is to ensure that environmental programs and decisions are supported by data of the type and quality needed for their intended uses. "Effective implementation of the EPA Quality Systems leads to...*Scientific Data Integrity* and *Reliable and Defensible Data*, among others" (EPA 2002). "A Quality Management Plan documents how an organization structures its quality systems...(EPA 2001) and "The process of planning, implementing and assessing the management system...(EPA 2002)" utilized to attain the primary goal of the quality system (EPA 2001).

ADEE utilizes a quality management plan to ensure that all data are valid and accurate. The document also ensures that data produced by ADEE are done so in accordance with all EPA monitoring and QA requirements. ADEE's QA and management policies are clearly defined and used to develop and implement quality assurance project plans (QAPP) (DEQ 2019). A QAPP is the blueprint for identifying how the quality system is implemented in monitoring projects.

Quality Assurance Goals and Objectives

The objective of DEQ's Quality System is to certify that all data collection, analysis, and reporting activities performed by DEQ or on behalf of DEQ result in data of known and documented quality, is suitable for DEQ use, and can be used with a high degree of confidence to support specific decisions and/or actions.

Quality Management Plan

The purpose of the "Quality Management Plan for the Department of Energy and Environment, Division of Environmental Quality" is to establish consistency in the application of QA practices to ensure that all monitoring and measurement data are valid and accurate for use in DEQ's decision-making, policy development, and possible litigation. It also ensures that the generation of data will be conducted in accordance with EPA's monitoring and QA requirements. It serves as the base document for the various DEQ QA project plans. This document clearly delineates DEQ's QA policy and management structure which will be used to implement the QA strategy and the monitoring requirements for environmental data.

DEQ's Quality Management Plan is routinely reviewed and sent to EPA for approval. It outlines the tools and practices the DEQ utilizes to ensure quality assurance attainment. The plan is revised annually.

Quality Assurance Project Plans

A Quality Assurance Project Plan (QAPP) integrates all technical and quality aspects for the life-cycle of the project, including planning, implementation, and assessment. The EPA documents

"EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations, EPA QA/R-5, 2001" and supplemental updates, and "Guidance for Data Quality Objectives Process, EPA QA/G-4, 2006," explain the objectives and requirements for a QAPP.

DEQ develops and routinely updates QAPPs and Standard Operating Procedures for all monitoring, evaluation, and assessment activities involving environmental data collection. The latest version, "Arkansas Water Quality and Compliance Monitoring Quality Assurance Project Plan" is reviewed annually and revised as needed. The QAPP and associated SOPs discuss all aspects of quality assurance, including methods of sample collection, analysis, evaluation, and QA assessment procedures employed to ensure the most accurate and scientifically defensible data possible.

Quality Assurance Plans

Quality Assurance Plans (QAP) are developed as addendums to the DEQ QAPP. A QAP is a project specific document identifying the goals and objectives of a project. It includes a description of the project, the design of the project, the data quality objectives necessary to meet the objectives, and the quality assurance protocols to be attained. Also, information about sampling methods, sampling handling and custody, and analytical procedures is included.

These documents can be obtained upon request.

Support and Infrastructure

Staff Resources

DEQ currently supports the water quality monitoring activities using a variety of state and federal funding sources. State funding sources include the Arkansas General Revenue Fund and others, while federal grant funds include CWA Sections 104(b)(3), 106, and 604(b). Approximately 35 DEQ staff members are either directly associated with the water quality monitoring and assessment program, or provide support for the program.

Future Resource Needs

In order to fully implement this monitoring strategy and expand monitoring activities will required increasing the current resources at DEQ, including the monetary, personnel, and equipment.

- **Staffing** – Additional staff and/or funding will be necessary to expand this monitoring and assessment program. Expansion of the program may be necessary to address any program data gaps, continue to respond to emergent issues, and to maintain activities while implementing additional investigations as priorities are revised.

- **Training** – Continually educating program staff is a necessity in order to keep abreast of new and innovative monitoring and assessment techniques. This would include items such as updated meters and equipment, computer programs, revisions in taxonomy, and safety and first aid. Training for new staff members is a must. To carry out this training, funding and other resources need to remain available. It is difficult to estimate what level of funding will be required.

- **Concerns** – Federal funding levels are failing to keep up with Federal mandates and program costs increases. Increases in the funding to keep pace with the ever increasing cost of doing business are non-existent.

- **Equipment** - Additional equipment is required to carry out the programs in this Monitoring Strategy. This includes replacement, as needed, of existing equipment to perform the current activities, as well as new equipment for new monitoring activities and updated monitoring and sampling procedures. Equipment would include: (1) routine supplies (e.g., sample bottles, batteries, probes, filters, ice chests, preservation chemicals, buckets, glassware, membranes, calibration materials, pens, notebooks, labels, etc.); (2) field equipment (e.g., waders, rain gear, life jackets, etc.); (3) instrumentation (e.g., DO meters, pH meters, data sondes, conductivity meters, lap top computers, GPS units, flow meters, hand-held data loggers, etc.); fish collection equipment (e.g., backpack shockers, barge/boat shockers, various nets, seines, communication equipment, etc.); (4) water sampling equipment (e.g., secchi discs, Kemmerer devices, etc.); (5) boats and motors, barge shocking boat, and motorized 4-wheel drive vehicles; and (6) laboratory equipment.

- **Laboratory** – Staffing needs will need to be increased with the identification and development of program gaps. The DEQ laboratory provides a significant portion of its capacity and budget to meet the existing monitoring needs. Also, replacement of aging analysis equipment and for general maintenance and upkeep of existing equipment is always needed.

- **Technical Assistance/Guidance** – The development and upgrade of computer software and management systems for assessment programs and data storage is always necessary to keep pace with the ever changing needs and to further enhance the Office of Water Quality efforts.

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Appendices

Appendix A – Ambient Water Quality Monitoring Stations

Basin Code	Waterbody	Station Location	Planning Segment	Ecoregion	Latitude Decimal	Longitude Decimal
AFS0001	Alum Fork Saline River	Hwy 5 E. of Crows, AR	2C	OM	34.616400	-92.749200
ARK0001	Little Sugar Creek	US71 near Caverna, MO	3J	OZH	36.502800	-94.275000
ARK0003	Spavinaw Creek	Hwy 43 N of Cherokee, AR	3J	OZH	36.341900	-94.587500
ARK0004A	Flint Creek	OK Co Rd 553 NW of Siloam Springs	3J	OZH	36.217313	-94.602371
ARK0005	Sager Creek	Beaver Springs Rd in OK, NW of Siloam Springs AR	3J	OZH	36.198900	-94.583600
ARK0006	Illinois River	Hwy 59 S of Siloam Springs, AR	3J	OZH	36.108600	-94.533300
ARK0007A	Baron Fork	Co Rd 11 near Dutch Mills, AR	3J	OZH	35.876484	-94.454037
ARK0010C	Clear Creek	Hwy. 112 Bridge W of Johnson, AR	3J	OZH	36.134400	-94.202200
ARK0011B	Short Mountain Creek	Short Mountain Rd NW of Paris, AR	3H	ARV	35.309700	-93.743800
ARK0014	Poteau River	OK Hwy 9A SW of Ft. Smith, AR	3I	ARV	35.347400	-94.453500
ARK0015	James Fork	Hwy 45 near Hackett, AR	3I	ARV	35.162600	-94.407200
ARK0020	Arkansas River	Dam No. 2 near Pendleton, AR	3A	Delta	33.986440	-91.315973
ARK0023	Bayou Meto	Hwy11/276 near Bayou Meto, Arkansas	3B	CAD	34.201900	-91.530600
ARK0029	Arkansas River	Murray Lock and Dam (Dam 7) near Little Rock, AR	3C	ARV	34.790800	-92.358900
ARK0030B	Arkansas River	Toad Suck Lock and Dam (Dam 8) near Conway, AR	3C	ARV	35.077640	-92.543610
ARK0031B	Arkansas River	Ormond Lock and Dam (Dam 9) near Morrilton, AR	3F	ARV	35.127080	-92.788140
ARK0032	Arkansas River	Hwy 7 near Dardanelle, AR	3H	ARV	35.225920	-93.148810
ARK0033	Arkansas River	Ozark Lock and Dam Dam 12) near Ozark, AR	3H	ARV	35.472500	-93.812780
ARK0034	Petit Jean River	Hwy 23 near Booneville, AR	3G	ARV	35.107200	-93.923700
ARK0037	Fourche LaFave River	Hwy 28 east Gravelly, AR	3E	ARV	34.872500	-93.656500
ARK0038	Arkansas River	upstream of Hwy 7 near Van Buren, AR	3H	ARV	35.432400	-94.369800
ARK0040	Illinois River	Hwy 16 near Savoy, AR	3J	OZH	36.101700	-94.345000
ARK0042	Mulberry River	Interstate 40 N of Mulberry, AR	3H	ARV	35.528100	-94.037200
ARK0043	Big Piney Creek	Hwy. 164 NW of Dover, AR	3H	ARV	35.505530	-93.181220
ARK0044	Illinois River	Hwy 7 NW Dover, AR	3J	BM	35.410830	-93.133330
ARK0046	Arkansas River	David D. Terry Lock and Dam (Dam 6) S of Little Rock, AR	3C	Delta	34.668600	-92.155000
ARK0048	Arkansas River	Lock and Dam No. 4 near Pine Bluff	3C	Delta	34.248800	-91.906100
ARK0049	Arkansas River	Lock and Dam No. 5 near Redfield, AR	3C	Delta	34.413300	-92.101900
ARK0050	Bayou Meto	Hwy. 161 near Jacksonville, AR	3B	Delta	34.844200	-92.122100
ARK0051	Stone Dam Creek	Sturgis Rd, S of Conway, AR	3F	ARV	35.054530	-92.429080
ARK0052	South Fourche LaFave River	Hwy 7 near Hollis, AR	3E	OM	34.871370	-93.110440
ARK0053	White Oak Creek	Union Groove Rd NE of Atkins, AR	3H	ARV	35.254750	-92.894190
ARK0054	Poteau River	Hwy 80 east of Waldron, AR	3I	ARV	34.896100	-94.066200
ARK0055	Poteau River	Why 28 NW of Waldron, AR	3I	ARV	34.913100	-94.107000

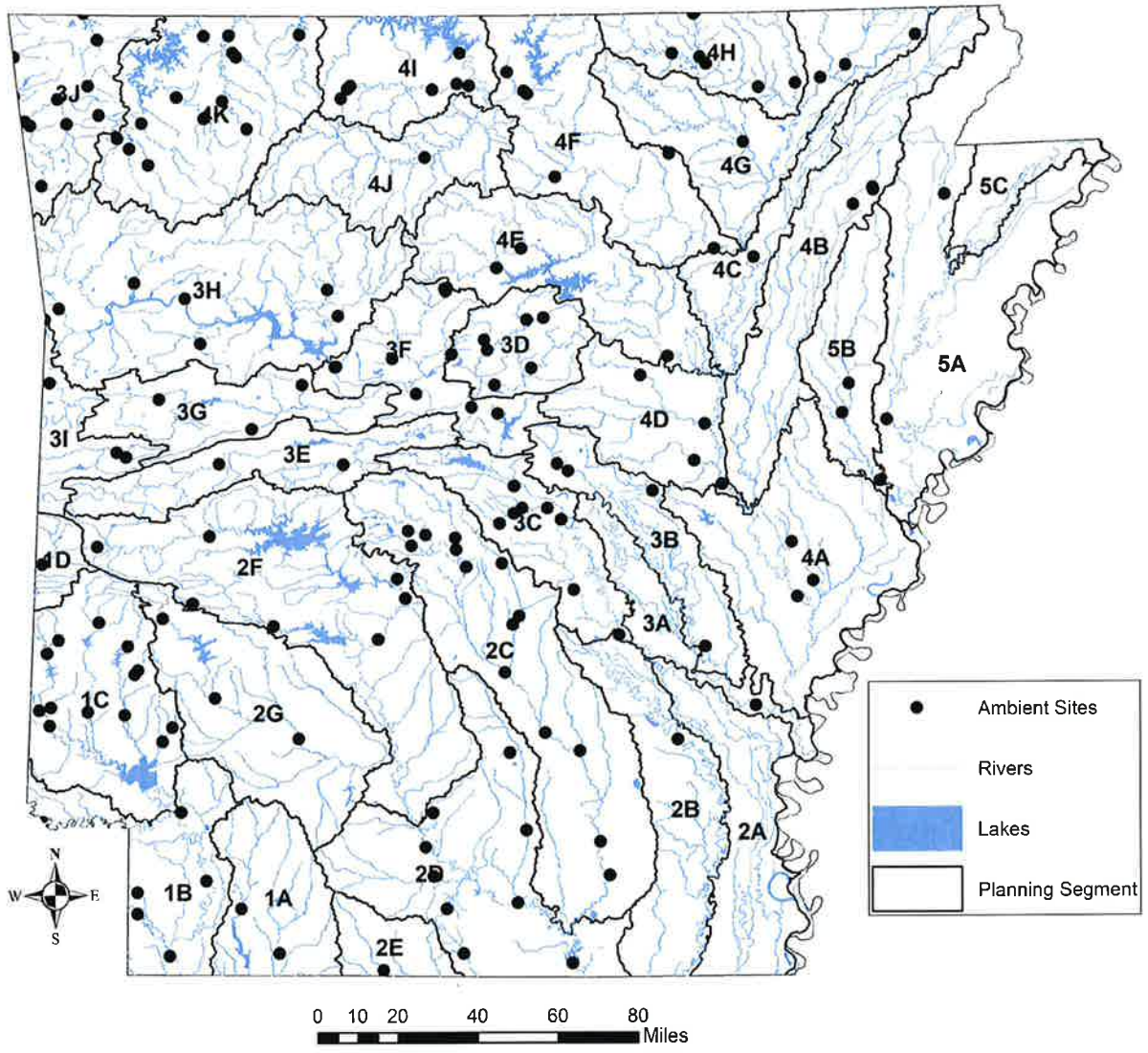
Basin Code	Waterbody	Station Location	Planning Segment	Ecoregion	Latitude Decimal	Longitude Decimal
ARK0056	Little Sugar Creek	NW A Street N. of Bentonville, AR	3J	OZH	36.407400	-94.212900
ARK0057	Dutch Creek	Co Rd 17 SW of Shark, AR	3H	ARV	34.999890	-93.514420
ARK0058	Chickalah Creek	Hwy 27 SW of Chickalah, AR	3H	ARV	35.160250	-93.292920
ARK0060	Bayou Meto	Jacksonville Cutoff Rd W of Jacksonville, AR	3B	Delta	34.870900	-92.169300
ARK0067	Whig Creek	off Robinson Ln. north of Russellville, AR	3H	ARV	35.226318	-93.142410
ARK0082	Osage Creek	Hwy 9, Logan Rd, east of Siloam Springs, AR	3J	OZH	36.191400	-94.387500
ARK0097	Bayou Two Prarie	Hwy. 13 south of Carlisle, AR	3B	Delta	34.769400	-91.751400
ARK0131	Fourche Creek	Interstate 440 east of Little Rock, AR	3C	ARV	34.710700	-92.213600
ARK0132	Cypress Creek	at Hwy 9, near Cypress Valley, AR	3F	ARV	35.271000	-92.630000
ARK0141	Cincinnati Creek	Hwy 244 south of Siloam Springs, AR	3J	OZH	36.093900	-94.508900
ARK0147C	Fourche Creek	Benny Craig Park, Little Rock, AR	3C	ARV	34.711100	-92.325600
ARK0147F	Fourche Creek	Otter Creek Road, Little Rock, AR	3C	ARV	34.655800	-92.423600
ARK0147H	Fourche Creek	Hindman Park, Little Rock, AR	3C	OM	34.691940	-92.361390
ARK0154	Arkansas River	Hwy. 64 Bridge (Garrison Avenue), Ft. Smith, AR	3H	ARV	35.391610	-94.431420
ARK0158	East Fork Cadron Creek	Hwy 25 near Wooster, AR	3D	ARV	35.158940	-92.441750
ARK0163	East Fork Cadron Creek	Clinton Mountain east of Greenbier, AR	3D	ARV	35.218262	-92.279243
ARK0164	Cadron Creek	Cadron Creek Road north of Quitman, AR	3D	ARV	35.399999	-92.224037
ARK0165	Cove Creek	Hwy 50, Cole Mountain Rd, W of Damascus, AR	3D	ARV	35.321362	-92.485641
ARK0166	Candron Creek	Hwy 285 N of Wooster, AR	3D	ARV	35.285548	-92.472452
ARK0167	West Fork Point Remove	Co Rd 8 (Dayton Road) SW os Scotland, AR	3D	ARV	35.499649	-92.655907
ARK0168	Trimble Creek	Co Rd 389 SW of Scotland, AR	3D	ARV	35.510479	-92.648933
ARK0169	West Fork Point Remove	Co Rd 389 SW of Scotland, AR	3D	ARV	35.508450	-92.660011
ARK0170	SF Little Red River	on County Road 23	4E	BM	35.582649	-92.427917
FRA0008	St. Francis River	Hwy 23 near Lake City, AR	5A	CAD	35.821100	-90.432200
FRA0010	L'Anguille River	Hwy 79 north of Marianna, AR	5B	CAD	34.790216	-90.751925
FRA0012	Second Creek	Hwy 261north of Palestine, AR	5B	LAD	35.038900	-90.911100
FRA0013	St. Francis River	Hwy. 50 east of Madison, AR	5A	CAD	35.011400	-90.716700
MFS0002	MF Saline River	Vance Road Bridge north of Owensville, AR	2C	OM	34.630260	-92.826729
NFS0004	N. Fork Saline River	Hwy 5 east of Benton, AR	2C	OM	34.605000	-92.618300
OSC0004	Osage Creek	Co Rd 71 west of Bethel Heights, AR	3J	OZH	36.240600	-94.253100
OUA0002	Cornie Bayou	Hwy 15 SW of El Dorado, AR	2E	GCP	33.039200	-92.937500
OUA0005	Bayou de Loutre	Hwy 27 SE of El Dorado, AR	2D	GCP	33.098600	-92.592200
OUA0006	Ouachita River	Hwy 84 at Rockport, AR	2F	GCP	34.386100	-92.838900
OUA0008B	Ouachita River	Felsenthal Lock and Dam SW of Crossett, AR	2D	GCP	33.060800	-92.123300
OUA0010A	Saline River	Hwy 8 west of Fountain Hill, AR	2C	GCP	33.378300	-91.958900
OUA0013	Bayou Bartholomew	LA Hwy 834 NE of Jones, LA	2B	GCP	35.990144	-91.655667
OUA0015A	Boeuf River	LA Hwy 835 near Concord, LA	2A	GCP	32.973600	-91.440300
OUA0018	Big Creek	Hwy 204 near Sheridan, AR	2C	GCP	34.289400	-92.370000

Basin Code	Waterbody	Station Location	Planning Segment	Ecoregion	Latitude Decimal	Longitude Decimal
OUA0021	Ouachita River	Hwy 270 SE of Pencil Bluff, AR	2F	OM	34.611002	-93.697882
OUA0022	Little Missouri River	HWY 84 west of Langley, AR	2G	OM	34.311670	-93.899835
OUA0023	Caddo River	Hwy 84 NE of Amity, AR	2F	OM	34.284700	-93.415600
OUA0026	Saline River	Hwy 229 west or Benton, AR	2C	OM	34.562800	-92.615300
OUA0027	Smackover Creek	Hwy 67 north of Smackover, AR	2D	GCP	33.379400	-92.719200
OUA0028	Moro Creek	Hwy 278 east of Hampton, AR	2D	GCP	33.543300	-92.318300
OUA0030	Ouachita River	Hwy 67 west of Donaldson, AR	2F	GCP	34.237800	-92.958900
OUA0031	Hurricane Creek	S. Sardis Road south of Sardis, AR	2C	GCP	34.511100	-92.415000
OUA0035	Little Missouri River	Hwy 67 north of Prescott, AR	2G	GCP	33.878053	-93.304399
OUA0037	Ouachita River	Co Rd south ofCamden, AR	2D	GCP	33.484200	-92.753900
OUA0039B	Little Missouri River	Poy Road south of Murfreesboro, AR	2G	GCP	34.023600	-93.669400
OUA0040	Priarie Creek	Co Rd 54 south of Mena, AR	2F	OM	34.570400	-94.187900
OUA0041	Saline River	Shaw Road east of Haskel, AR	2C	GCP	34.498800	-92.571500
OUA0042	Saline River	Hwy 167 south of Sheridan, AR	2C	GCP	34.115400	-92.405600
OUA0043	Big Creek	Hwy 35 west of Pansy, AR	2C	GCP	33.828900	-92.082900
OUA0044	South Fork Caddo River	Co Rd 517 near Fancy Hill, AR	2F	OM	34.366800	-93.768900
OUA0044T	Unamed Tributary to South Fork Caddo River	Co Rd 517 near Fancy Hill, AR	2F	OM	34.364277	-93.772916
OUA0047	Jug Creek	Barne Street NE of Fordyce, AR	2D	GCP	33.824700	-92.386900
OUA0052B	East Two Bayou	East two bayou bl. Highland Public Services NPDES Outfall	2D	GCP	33.608300	-92.721400
OUA0100	Cove Creek	Hwy 51 north of Magnet Cove, AR	2F	OM	34.456860	-92.874159
OUA0116	Hurricane Creek	Hwy. 270 east of Sheridan, AR	2C	GCP	34.319940	-92.341754
OUA0117	Saline River	Co Rd 141 SE of Warren, AR	2C	GCP	33.500000	-91.998600
OUA0118	Saline River	Hwy. 79 south of Rison, AR	2C	GCP	33.896100	-92.232800
OUA0124B	Ouachita River	Game & Fish Pigeon Hill Access, NE of El Dorado, AR	2F	GCP	33.280810	-92.356900
OUA0137A	Unnamed Tributary of Flat Creek	Hwy 7, north of El Dorado, AR	2D	GCP	33.260800	-92.663100
RED0001	Mountain Fork of Little River	Hwy 246 NE of Hatfield, AR	1D	OM	34.505200	-94.430600
RED0002	Little River	Hwy 41 SW of Horatio, AR	1C	GCP	33.919600	-94.387400
RED0004A	Days Creek	Hwy 237 SE of Texarkana, AR	1B	GCP	33.318600	-93.999000
RED0005	Sulphur River	Hwy 237 SE of Texarkana, AR	1B	GCP	33.241900	-93.999000
RED0009	Red River	Hwy 160 east of Doddridge, AR	1B	GCP	33.089700	-93.858700
RED0015A	Dorcheat Bayou	Hwy 160 east of Taylor, AR	1A	GCP	33.100200	-93.386200
RED0018B	Mine Creek	Hwy355 south of Nashville, AR	1C	GCP	33.865800	-93.896900
RED0021	Saline River	Hwy 371 east of Lockesburg, AR	1C	GCP	33.962100	-94.061400
RED0022	Cossatot River	Hwy 24 west of Lockesburg, AR	1C	GCP	33.971600	-94.222200

Basin Code	Waterbody	Station Location	Planning Segment	Ecoregion	Latitude Decimal	Longitude Decimal
RED0023A	Rolling Fork River	Hwy 3 SW of DeQueen, AR	1C	GCP	33.974800	-94.434800
RED0025	Red River	Hwy 41 south of Foreman, AR	1B	GCP	33.571000	-94.410000
RED0027	Bodcau Creek	Hwy 313 south Lewisville, AR	1A	GCP	33.262100	-93.551800
RED0030	Rolling Fork Creek	Co Rd 206 west of Gillham, AR	1C	GCP	34.182200	-94.403200
RED0031	Cossatot River	Hwy 278 east of Wickes, AR	1C	OM	34.296100	-94.177600
RED0032	Saline River	Hwy 278 north of Dierks, Arkansas	1C	OM	34.210953	-94.050803
RED0033	Bear Creek	Hwy 7 SE of DeQueen, AR	1C	GCP	33.986100	-94.383700
RED0034A	Holly Creek	Hwy 278 east of Dierks, AR	1C	GCP	34.124300	-94.005400
RED0034B	Holly Creek	S. Arkansas Ave south of Dierks, AR	1C	GCP	34.108600	-94.019600
RED0045	Red River	Hwy 82 at Garland, AR	1B	GCP	33.361830	-93.703190
RED0046	Red River	Railroad Bridge off Little River Street at Fulton, AR	1B	GCP	33.610800	-93.814700
RED0048B	Mine Creek	Buck Range Road south of Nashville, AR	1C	GCP	33.917600	-93.854600
RED0058	Rolling Fork River	Co Rd 475 west of Grannis, AR (Same as RED0041B)	1C	OM	34.229500	-94.354100
SFS0002	SF Saline River	Co Rd 268 south of Owensville, AR	2C	OM	34.577251	-92.811592
UWBYB03	Bayou Bartholomew	Hwy 54, Garrett Bridge west of Dumas, AR	2B	LAD	33.866476	-91.656370
UWLGR01	L'Anguille River	Hwy 306 west of Colt, AR	5B	CAD	35.144782	-90.878564
UWNCC02	North Fork Cadron Creek	Co Rd 610 east of Gravesville, AR	3D	ARV	35.393654	-92.297173
WHI0003	Black River	Hwy 62 east of Corning, AR	4G	LAD	36.401900	-90.541400
WHI0004	Current River	Hwy 62 east of Pocahontas, AR	4G	LAD (OZH)	36.298600	-90.858300
WHI0005B	Eleven Point River	at end of Kilo Vist Road west of Pocahontas, AR	4H	OZH	36.236900	-91.084700
WHI0006A	Warm Fork of Spring River	Co Rd 268 NE of Mammoth Springs, MO	4H	OZH	36.502800	-91.525300
WHI0009A	Kings River	Hwy 143 north of Berryville, AR	4K	OZH	36.426500	-93.623300
WHI0011	South Sylamore Creek	Double Bridge Loop north of Mountain View, AR	4F	BM	35.910270	-92.165600
WHI0012B	Leatherwood Creek	Hwy 23 south of Eureka Springs, AR	4K	OZH	36.423500	-93.736200
WHI0021	Spring River	South First Street south of Ravenden, AR	4H	OZH	36.225000	-91.250800
WHI0022	Spring River	Co Rd 48 NE of Hardy, AR	4H	OZH	36.338352	-91.508701
WHI0023	South Fork Spring River	Hwy 289 north of Ash Flat, AR	4H	OZH	36.352627	-91.634370
WHI0024	Strawberry River	Hwy 115 south of Smithville, AR	4G	OZH	36.027800	-91.325300
WHI0025	Black River	Hwy 67 at Pocahontas, AR	4G	LAD	36.253900	-90.970000
WHI0026	Big Creek	Hwy 226 west of Jonesboro, AR	4B	CAD	35.792998	-90.839647
WHI0029	White River	Ferry Road north of Oil Trough, AR	4F	LAD	35.643144	-91.461721
WHI0031	White River	Hwy 324 at DeValls Bluff, AR	4D	LAD	34.790300	-91.445800
WHI0036	White River	end of Belnap Ave in St. Charles, AR	4A	LAD	34.377200	-91.125600
WHI0043	Middle Fork Little Red River	Hwy 9 south of Shirley, AR	4E	BM	35.652291	-92.319736
WHI0045	North Fork White River	Hwy 5 at Norfork, AR	4F	OZH	36.213100	-92.286100
WHI0046	White River	Hwy 341 north of Norfork, AR	4F	OZH	36.223300	-92.301700
WHI0047	White River	below Bull Shoals Dam at Bull Shoals, AR	4I	OZH	36.362187	-92.586668

Basin Code	Waterbody	Station Location	Planning Segment	Ecoregion	Latitude Decimal	Longitude Decimal
WHI0048B	Crooked Creek	Co Rd 6002 south of Flippin, AR	4I	OZH	36.250600	-92.600300
WHI0048C	Crooked Creek	Hwy 101 north of Rea Valley, AR	4I	OZH	36.243300	-92.546100
WHI0049A	Buffalo River	Hwy 6 south of St. Joe, AR	4J	BM	35.983900	-92.745600
WHI0052	White River	Hwy 45 west of Goshen, AR	4K	OZH	36.106000	-94.011400
WHI0056	Bayou Des Arc	Hwy 11 north of Des Arc, AR	4D	LAD	35.008900	-91.516700
WHI0059	Little Red River	Hwy 367 north of Searcy, AR	4E	ARV	35.255300	-91.676000
WHI0065	Hicks Creek	Hwy 55 south of Mountain Home, AR	4F	OZH	36.292200	-92.375800
WHI0066	Crooked Creek	Silver Valley Road east of Harrison, AR	4I	OZH	36.244300	-93.077700
WHI0067	Crooked Creek	Hwy 65 east of Harrison, AR	4I	OZH	36.232900	-93.091400
WHI0068	Osage Creek	Hwy 221 south of Berryville, AR	4K	OZH	36.348800	-93.591100
WHI0069	Osage Creek	off Co Rd 38 north of Berryville, AR	4K	OZH	36.364000	-93.607100
WHI0070	Holman Creek	Hwy 23 north of Huntsville, AR	4K	OZH	36.124800	-93.733900
WHI0071	Long Creek	Co Rd 824 north of Denver, AR	4K	OZH	36.429600	-93.306702
WHI0072	Wattensaw Bayou	Hwy 11 north of Hazen, AR	4D	LAD	34.876100	-91.565400
WHI0073	Prairie Cypress Creek	Hwy 1 near Crossroads, AR	4A	LAD	34.433300	-91.053100
WHI0074	Boat Gunwale Slash	Hwy 146 SE of Holly Grove, AR	4A	LAD	34.574900	-91.145800
WHI0088	Spring River	North Spring Street at Hardy, AR	4H	OZH	36.313100	-91.482800
WHI0089	Spring River	Mammoth Spring at mouth, Mammoth Spring, AR	4H	OZH	36.495300	-91.534700
WHI0100	West Fork White River	Hwy 55 south of Fayetteville, AR	4K	OZH	36.050600	-94.118900
WHI0103	Middle Fork White River	Middle Fork White River southwest of Elkins, Arkansas	4K	OZH	36.014200	-94.064400
WHI0106	White River	off Co Rd 183 north Durham, AR	4K	OZH	35.955463	-93.979122
WHI0116	War Eagle Creek	Hwy 45 north of Hindsville, AR	4K	OZH	36.201700	-93.856900
WHI0121	Kings River	Hwy 21 north of Kingston	4K	OZH	36.088300	-93.541700
WHI0123	Kings River	Hwy 25 north Alabam, AR	4K	OZH	36.188900	-93.651600
WHI0138	White River	Hwy. 14 bridge west of Newport, Arkansas	4C	LAD	35.609498	-91.287383
WHI0172	Lost Creek	Hwy 21, Lacy Drive, west of Jonesboro, AR	4B	CAD	35.843900	-90.748300
WHI0193	Crooked Creek	Cd Rd 4002 west of Yellville, AR at Kelly's Slab	4I	OZH	36.229300	-92.710650
WHI0196	Big Creek Ditch	Why 91, Dan Avenue, NW of Jonesboro, AR	4B	CAD	35.852497	-90.750679
WHI0197C	Bayou Des Arc	Hwy 267 south of Searcy, AR	4D	CAD	35.188000	-91.797699
WHI0200	Crooked Creek	Hudson Road south of Harrison, AR	4I	OZH	36.198128	-93.120811

Figure A1 –Ambient Water Quality Monitoring Stations



1 – Red River Basin
2 – Ouachita River Basin
3 – Arkansas River Basin
4 – White River Basin
5 – St. Francis river Basin
6 – Mississippi River Basin

Appendix B – Lake Water Quality Monitoring Stations

Lake No.	Lake_Name	Ecoregion	Plan_Seg	Assessment Unit	Hectares
11	Beaver Lake	Ozark Highlands	4K	AR_11010001_4045	5481.75
18	Horsehead Lake	Arkansas River Valley	3H	AR_11110202_4050	44.06
22	Fayetteville Lake	Ozark Highlands	3J	AR_11110103_4080	69.39
26	Jack Nolan Lake	Arkansas River Valley	3H	AR_11110201_4030	73.47
27	Sequoya Lake	Ozark Highlands	4K	AR_11010001_4050	171.79
29	Charles Lake	Delta	4G	AR_11010009_4040	222.39
30	Lee Creek Reservoir	Boston Mountains	3H	AR_11110104_4020	235.38
31	Beaver Fork Lake	Arkansas River Valley	3D	AR_11110205_4020	292.37
33	Brewer Lake	Arkansas River Valley	3D	AR_11110205_4011	331.43
38	Cox Creek Lake	Gulf Coastal Plain	2C	AR_08040203_4110	99.15
39	Frierson Lake	Delta	4B	AR_08020302_4020	138.61
46	Overcup Lake	Arkansas River Valley	3F	AR_11110203_4030	325.61
48	Harris Brake	Arkansas River Valley	3E	AR_11110206_4030	509.77
54	Pickthorne Lake	Arkansas River Valley	3B	AR_08020402_4010	131.67
56	Greenlee Lake	Delta	4A	AR_08020304_4060	109.29
63	Bois d'Arc Lake	Gulf Coastal Plain	1B	AR_11140201_4010	259.63
72	Lake Chicot	Delta	2A	AR_08050002_4011	1549.16
73	Conway Lake	Arkansas River Valley	3F	AR_11110203_4061	759.14
74	Lake Erling	Gulf Coastal Plain	1A	AR_11140205_4022	1050.02
80	Austell Lake	Delta	5A	AR_08020203_4030	24.28
85	Bennett Lake	Arkansas River Valley	3D	AR_11110205_4030	13.14
119	Driver Creek Lake	Arkansas River Valley	3F	AR_11110203_4020	11.44
217	Wilson Lake	Ozark Highlands	4K	AR_11010001_4030	11.86

Figure B1 - Ambient Lake Water Quality Monitoring Stations