

2014

# ASSESSMENT METHODOLOGY



for the Preparation of

## *The 2014 Integrated Water Quality Monitoring and Assessment Report*

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





**ADEQ WATER DIVISION**  
**WATER QUALITY PLANNING BRANCH**

The Water Quality Planning Branch consists of biologists, ecologists, and geologists who manage activities related to both surface and ground water. Among the numerous activities is the management of the State Water Quality Monitoring Networks for both surface and subsurface waters. Other activities include routine monitoring and intensive, special investigations of the physical, chemical, and biological characteristics of waterbodies and/or aquifers. The data generated from these activities, as well as all other existing and readily available data, are evaluated in the preparation of the biennial “Integrated Water Quality Monitoring and Assessment Report (305(b) Report),” and the “List of Impaired Waterbodies (303(d) list),” to establish priority ranking of Total Maximum Daily Loads for impaired waterbodies. The data may also be used to develop water quality standards and criteria for the evaluation of designated use attainment and to prioritize restoration and remediation activities.

The staff continues to develop and/or enhance ecoregion-based, biological assessment criteria for both fish and macroinvertebrates. The staff are active in the development and updating of water quality standards and the technical review and administration of the National Pollutant Discharge Elimination System Permits Whole Effluent Toxicity Program. Staff members represent the Department on numerous federal, state, local, and watershed-based advisory boards and technical support groups. The Groundwater Section is currently engaged in development of statewide groundwater standards and management of remediation projects that do not fall under the purview of other Arkansas Department of Environmental Quality divisions. The section also oversees portions of the Groundwater Protection Program that are delegated to the Arkansas Department of Health (Wellhead Protection Program) and the Arkansas Natural Resources Commission (Groundwater Protection and Management Program).

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To learn more about the Water Division of the Arkansas Department of Environmental Quality, and to view a list of publications by the Water Quality Planning Branch, visit [www.adeq.state.ar.us](http://www.adeq.state.ar.us) or call (501) 682-0744.

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## 1.0 ASSESSMENT BACKGROUND

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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 (2) years. The report provides information on the quality of the state’s waters; the extent to which state waters provide for the protection and propagation of a balanced population of fish, shellfish, and wildlife, and allow recreational activities in and on the water; and how pollution control measures are leading to water quality standards attainment.

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

Current EPA guidance recommends producing an integrated report 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* (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. 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; TMDL-01-03*, which is supplemented by memoranda regarding development of the 2008, 2010, and 2012 305(b) Reports (EPA 2006, 2009, and 2011, respectively). Arkansas’ waters are evaluated in terms of whether their assigned water quality standards and designated uses, as delineated in the Arkansas Pollution Control and Ecology Commission’s (APC&EC) Regulation 2, are being attained.

APC&EC Regulation 2, *Water Quality Standards for Surface Waters of the State of Arkansas*, provides the foundation for the 305(b) Report. APC&EC Regulation 2 establishes: water quality standards for surface waters of the State of Arkansas, designated uses associated with those water quality standards, and criteria as well as policies established to protect, maintain, and restore designated uses. Monitoring data are assessed for compliance with APC&EC Regulation 2 to determine impairment and designated use support, based upon the frequency, duration, and/or magnitude of water quality standard exceedances.

The Arkansas Department of Environmental Quality’s (ADEQ’s) assessment methodology constitutes the process that the State of Arkansas employs to determine to which of the five (5) integrated reporting categories a waterbody segment belongs, considering EPA’s most current 305(b) reporting and 303(d) listing requirements and guidance. In addition, ADEQ follows the specific requirements of 40 C.F.R. § 130.7-130.8.

## 2.0 INTEGRATED REPORTING CATEGORIES

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ADEQ bases its water quality and designated use assessments on the ability of a waterbody to support the state's water quality standards (APC&EC Regulation 2). Monitoring segments are the basic unit of record for conducting and reporting water quality assessments. Assessment of monitoring segments is based on individual stream reaches grouped by planning segments and based on watersheds (see Section 3.5 for more detail).

Upon assessment, stream segments will be categorized as 'support' or 'non-support.' Monitoring segments will be assessed as support if the segment meets all water quality and designated use criteria for which data are available. A monitoring segment will be assessed as non-support if any water quality standard or designated use is not attained. Monitoring segments assessed as non-support, or not attaining water quality standard(s), will be categorized based on the quality and quantity of data available for assessment.

Arkansas' 303(d) list is formatted to reflect the most current EPA guidance (EPA 2011), which suggests placing monitoring segments into one of the following five (5) integrated reporting categories. Category 5 is further subdivided by ADEQ for planning and management purposes.

**Category 1.** Attaining water quality standards for all designated uses, no use is threatened.

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

**Category 3.** Insufficient data and information are available to determine if any water quality standards are being attained.

- No data available;
- Data do not meet the spatial and/or temporal 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 stream segment requires confirmation of impairment before a TMDL is scheduled.

**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);
- 4b.** Other pollution control requirements 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 may not be 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 Regulation 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 all designated uses are determined to be supported; or
- There is insufficient data to make a scientifically defensible decision concerning designated use attainment; or
- Waters ADEQ assessed as unimpaired, but were assessed as impaired by EPA.



### 3.0 ASSESSMENT PROCESS

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Data assessment forms the basis of water quality standard and designated use attainment decisions. In order to conduct accurate assessments, evaluated data must reflect current surface water quality conditions. Data types evaluated may include chemical, physical, biological, habitat, bacteriological, or toxicological. These data are compared to current EPA-approved water quality standards for the State of Arkansas (APC&EC 2011).

#### 3.1 DATA ASSEMBLY

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Pursuant to 40 C.F.R. § 130.7(b)(5), ADEQ assembles and evaluates all existing and readily available water quality data and information to make water quality and designated use attainment decisions. The primary data used in the assessment of Arkansas' water quality are generated as part of ADEQ's water quality monitoring activities, described in the *State of Arkansas' Water Quality Monitoring and Assessment Program*. In addition, with a minimum 30-day response period before the draft 303(d) list is prepared, state and federal agencies and other entities are solicited for water quality data that meets or exceeds ADEQ's or USGS' QA/QC protocols.

ADEQ requests data and information including, but not limited to:

- Closures, restrictions, and/or advisories applicable to swimming, fish consumption, and drinking water
- Violations of Safe Drinking Water Act Standards
- Segment-specific ambient monitoring
- Large-scale probabilistic monitoring designs
- Landscape analysis
- Complaints from the public

**The period of record for the 2014 305(b) Report is:**

**Metals and ammonia toxicity analysis:** *April 1, 2010 to March 31, 2013*

**All other analyses:** *April 1, 2008 to March 31, 2013*

Any data developed prior to the period of record will be used for long-term trend analysis. Data developed after the period of record will be evaluated during the next assessment period, this includes: water quality data, completed surveys (including completion of the final report), revisions in water quality standards, and the completion of TMDLs.

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### 3.1.1 NO NEW DATA

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If no new water quality data have been generated for a monitoring segment 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 the water quality standards or the assessment methodology has occurred. If substantial changes in the water quality standards or the 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 will be re-assessed using the newly-defined water quality standards/methodology to determine current water quality standard attainment.

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### 3.1.2 ABSENCE OF DATA

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Water quality standard and designated use attainment assessments can be made for monitoring segments, in the absence of data, if it can be reasonably established that non-monitored segments are similar in watershed characteristic and condition to contiguous monitored segments. ADEQ will consider land use practices, the location of tributaries, impoundments, and other hydrological alterations that could impact the water quality between the station site and the adjacent non-monitored segment. If similarity in watershed characteristic and/or condition cannot be established, contiguous non-monitored segments will remain unassessed.

Water quality standard and designated use 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 segments 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 segments evaluated using data from monitored segments will be delineated in the Impaired Waterbodies 303(d) list, which can be found at the ADEQ website: <http://www.adeg.state.ar.us>.

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## 3.2 DATA QUALITY CONSIDERATIONS

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ADEQ maintains a strong commitment to the collection and use of high quality data to support environmental decisions and regulatory programs. ADEQ uses data submitted by various entities in different ways, depending on the QA/QC of the data; however, all data submitted to ADEQ will be evaluated.

For data to be utilized in making water quality standard and designated use attainment decisions, data must comply with the acceptability requirements below. Data that do not meet acceptability requirements below will not be used to determine impairments; however, these data may be used as a screening tool to determine whether additional monitoring is warranted. In order to be used for 305(b) reporting and 303(d) listing assessments, data must:

- Represent actual spatial and temporal annual ambient conditions;
- Be characteristic of the main water mass or distinct hydrologic areas;
- Not be biased toward specific conditions, such as flow, runoff, or season. The exceptions are the analysis of data for those designated uses that require seasonally based water quality data (e.g., primary contact recreation, biological community data, or critical season dissolved oxygen);
- Be reported in standard units recommended in the relevant approved method;
- Have been collected and analyzed under a QA/QC protocol equivalent to or more stringent than that of ADEQ or the USGS. Data collection protocols should either be readily available or accompany the data;
- Be distributed over at least three (3) seasons (to include inter-seasonal variation) and over at least two (2) years (to include temporal variation);
- Not have more than two-thirds of the samples be in one (1) year or one (1) season. The exceptions are the analysis of data for those designated uses that require seasonally based water quality data (e.g., primary contact recreation, biological community data, or critical season dissolved oxygen);
- Have been analyzed pursuant to the rules outlined in the State Environmental Laboratory Certification Program Act, Ark. Code Ann. § 8-2-201 *et seq.* The name and location of the laboratory should either be readily available or accompany the data;
- Be accompanied by precise sample site location(s) data, 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; and
- Have been collected within the period of record.

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### 3.3 TIERED APPROACH TO QUALIFYING DATA

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As stated above, data must, at a minimum, have been collected and analyzed under a QA/QC protocol equivalent to or more stringent than that of ADEQ or USGS to be considered for water quality and designated use assessments. Table I describes the defined levels of data quality for each type of data recognized in making support determinations. These tables are adapted from the *Consolidated Assessment and Listing Methodology: Towards a Compendium of Best Practices* guidance document (EPA 2002).

Tier III and Tier IV data meet acceptability requirements and will be considered for water quality and designated use assessments. Tier I and Tier II data do not meet acceptability requirements and will be used for screening purposes.

**Table I. Hierarchy of Data Quality Levels for Assessment Use**

| <b>Data Use</b>                    | <b>Data Level</b> | <b>Technical Component</b>  | <b>Spatial &amp; Temporal Coverage</b>   | <b>Data Quality</b>   |
|------------------------------------|-------------------|---|--|---|
| <b>Used for screening purposes</b> | <b>Tier I</b>     | Water quality monitoring using grab samples   | <p>Low spatial and temporal coverage:</p> <ul style="list-style-type: none"> <li>• Only a few sites within a basin</li> <li>• Quarterly or less frequent sampling with limited period of record (e.g., 1 day)</li> <li>• Limited data during key periods (e.g., critical hydrological regimes)</li> <li>• Data older than five (5) years that are not likely to reflect current conditions</li> </ul>  | <ul style="list-style-type: none"> <li>• Low precision and sensitivity</li> <li>• QA/QC protocols are not met or followed, or QA/QC results are inadequate</li> <li>• Methods not documented</li> <li>• Inadequate metadata</li> </ul>              |
|                                    | <b>Tier II</b>    | <p>One (1) of the following:</p> <ul style="list-style-type: none"> <li>• Water quality monitoring using grab samples</li> <li>• Rotating basin surveys involving single visits</li> <li>• Verified volunteer data</li> </ul>   | <p>Moderate spatial and temporal coverage:</p> <ul style="list-style-type: none"> <li>• Stream basin coverage, several sites within a basin</li> <li>• Quarterly or bimonthly sampling at fixed stations</li> <li>• Sampling only during a key period (e.g., high and/or low flow)</li> <li>• Data that are likely to reflect current conditions, but may be older than five (5) years</li> </ul>  | <ul style="list-style-type: none"> <li>• Low precision and sensitivity</li> <li>• QA/QC protocols followed, QA/QC results adequate</li> <li>• Approved SOPs used for field and lab</li> <li>• Adequate metadata*</li> </ul>                         |
| <b>Used for assessments</b>        | <b>Tier III</b>   | <p>One (1) of the following:</p> <ul style="list-style-type: none"> <li>• Water quality monitoring using grab samples</li> <li>• Rotating basin surveys involving multiple visits or automatic sampling</li> <li>• Calibrated models (calibration data greater than 5 years old)</li> <li>• Limited use of continuous monitoring instrumentation</li> </ul> | <p>Broad spatial and temporal coverage of sites with sufficient frequency and coverage to capture acute events:</p> <ul style="list-style-type: none"> <li>• Multiple sites within a basin</li> <li>• Quarterly, bimonthly, or monthly sampling during key periods (e.g., critical hydrological regimes), multiple samples at high and low flows.</li> <li>• Period of sampling adequate to monitor for chronic conditions for the specific parameter of concern (sampling over at least 3 seasons)</li> <li>• Data five (5) years old or less</li> </ul>                                      | <ul style="list-style-type: none"> <li>• Moderate precision and sensitivity</li> <li>• QA/QC protocols followed, QA/QC results adequate</li> <li>• Approved SOPs used for field and lab</li> <li>• Adequate metadata*</li> </ul>                    |
|                                    | <b>Tier IV</b>    | Water quality monitoring using composite samples, a series of grab samples, and/or continuous monitoring devices  | <p>Broad spatial and temporal (at least 2 years) coverage of fixed sites with sufficient frequency and coverage to capture acute events, chronic conditions, and all other potential chemical/ physical impacts:</p> <ul style="list-style-type: none"> <li>• Multiple sites within a basin</li> <li>• Bimonthly or monthly sampling during key periods (e.g., critical hydrological regimes), including multiple samples at high and low flows</li> <li>• Continuous monitoring (e.g., use of thermographs, sondes, or similar devices)</li> <li>• Data five (5) years old or less</li> </ul> | <ul style="list-style-type: none"> <li>• High precision and sensitivity</li> <li>• QA/QC protocols followed, QA/QC results adequate</li> <li>• Approved SOPs used for field and lab; samplers well trained</li> <li>• Adequate metadata*</li> </ul> |

\*Adequate metadata includes: time, date, stream name, latitude/longitude, parameters sampled, Chain of Custody from a State certified lab, and a reference to the QA/QC and standard operating procedures (SOPs) used.

### 3.4 BIOLOGICAL INTEGRITY DATA

The following tables describe defined levels of data quality for each type of data recognized in making fisheries use support determinations. These tables are adapted from the *Consolidated Assessment and Listing Methodology: Towards a Compendium of Best Practices* guidance document (EPA 2002). Tables for determining the level of data quality for biological, habitat, chemical/physical, and toxicological data types are presented below. It is important to evaluate data quality when an assessment performed with more than one data type results in conflicting designated use attainment decisions. These tables are included only for fisheries use determinations because it is the only designated use for which multiple data types are currently utilized.

**Table II. Hierarchy of Bioassessment Approaches for Fisheries Assessment**

| Data Use                    | Data Level | Technical Components   | Spatial & Temporal Coverage   | Data Quality   |
|-----------------------------|------------|--|---|--|
| Used for screening purposes | Tier I     | <ul style="list-style-type: none"> <li>• Visual observation of biota</li> <li>• Reference conditions not used</li> <li>• Simple documentation</li> </ul>   | Low spatial and temporal coverage: <ul style="list-style-type: none"> <li>• Extrapolation from other sites</li> <li>• Limited monitoring</li> <li>• No taxa identification</li> </ul>   | <ul style="list-style-type: none"> <li>• Low precision and sensitivity</li> <li>• Biologist not required</li> <li>• No biological assessment performed</li> </ul>                                    |
|                             | Tier II    | <ul style="list-style-type: none"> <li>• One (1) assemblage</li> <li>• Reference condition pre-established by a Biologist at site or in comparable watershed</li> <li>• Biotic index or narrative evaluation of historical records</li> </ul>                | Moderate spatial and temporal coverage: <ul style="list-style-type: none"> <li>• Minimum of one (1) site</li> <li>• Limited to a single sampling</li> <li>• Identifications to family level</li> </ul>  | <ul style="list-style-type: none"> <li>• Low precision and sensitivity</li> <li>• Biologist may provide correspondence</li> <li>• No biological assessment performed</li> </ul>                      |
| Used for assessments        | Tier III   | <ul style="list-style-type: none"> <li>• One (1) assemblage</li> <li>• Reference condition may be site specific, or composite of sites</li> <li>• Biotic index (interpretation may be supplemented by narrative evaluation of historical records)</li> </ul> | Broad spatial and temporal coverage: <ul style="list-style-type: none"> <li>• May include limited spatial coverage, with multiple sites, for watershed-level assessments</li> <li>• Monitoring of targeted sites during a single season, may be limited sampling for site-specific studies</li> <li>• Identification to lowest possible taxa*</li> </ul>        | <ul style="list-style-type: none"> <li>• Moderate precision and sensitivity</li> <li>• Biologist performs survey or provides training</li> <li>• Biologist performs biological assessment</li> </ul> |
|                             | Tier IV    | <ul style="list-style-type: none"> <li>• Two (2) assemblages</li> <li>• Regional reference conditions used</li> <li>• Biotic index (single dimension or multi metric index)</li> </ul>   | Broad spatial and temporal coverage: <ul style="list-style-type: none"> <li>• Broad coverage of sites for either site-specific or watershed assessments</li> <li>• Monitoring during two (2) sampling seasons</li> <li>• Identification to lowest possible taxa*</li> <li>• Conducive to regional assessments using targeted or probabilistic design</li> </ul> | <ul style="list-style-type: none"> <li>• High precision and sensitivity</li> <li>• Biologist performs survey</li> <li>• Biologist performs biological assessment</li> </ul>                          |

\*Identification to lowest possible taxa is generally genus for macroinvertebrates and species for fish.

**Table III. Hierarchy of Habitat Assessment Approaches for Fisheries Assessment**

| <b>Data Use</b>                    | <b>Data Level</b> | <b>Technical Components</b>  | <b>Spatial &amp; Temporal Coverage</b>   | <b>Data Quality</b>  |
|------------------------------------|-------------------|--|--|--|
| <b>Used for screening purposes</b> | <b>Tier I</b>     | <ul style="list-style-type: none"> <li>• Visual observation of habitat, no true assessment</li> <li>• Documentation of readily discernible land use characteristics that might alter habitat quality</li> <li>• Reference conditions not used</li> </ul>   | Low spatial and temporal coverage: <ul style="list-style-type: none"> <li>• Limited spatial coverage</li> <li>• Sporadic visits</li> </ul>   | <ul style="list-style-type: none"> <li>• Low precision and sensitivity</li> <li>• Biologist not required</li> </ul>                              |
|                                    | <b>Tier II</b>    | <ul style="list-style-type: none"> <li>• Visual observation of habitat, simple assessment</li> <li>• Use of land use maps for characterizing watershed condition</li> <li>• Reference conditions pre-established by a biologist</li> </ul>   | Moderate spatial and temporal coverage: <ul style="list-style-type: none"> <li>• Limited spatial coverage and/or site-specific studies</li> <li>• Limited to annual visits non-specific to season</li> </ul>   | <ul style="list-style-type: none"> <li>• Low precision and sensitivity</li> <li>• Biologist may provide correspondence</li> </ul>                |
| <b>Used for assessment</b>         | <b>Tier III</b>   | <ul style="list-style-type: none"> <li>• EPA's Rapid Bioassessment Protocol used; bioassessment performed</li> <li>• Data on land use may be compiled and used to supplement assessment</li> <li>• Reference condition may be site specific, or composite of sites</li> </ul>  | Broad spatial and temporal coverage: <ul style="list-style-type: none"> <li>• Spatial coverage may be limited sampling or broad and commensurate with biological sampling</li> <li>• Assessment during one (1) season usually the norm</li> <li>• Assessment may be regional or site-specific</li> </ul> | <ul style="list-style-type: none"> <li>• Moderate precision and sensitivity</li> <li>• Biologist performs survey or provides training</li> </ul> |
|                                    | <b>Tier IV</b>    | <ul style="list-style-type: none"> <li>• Habitat assessment based on quantitative measurements of in-stream parameters, channel morphology, and floodplain characteristics; bioassessment performed</li> <li>• Data on land use compiled and used to supplement assessment</li> <li>• Reference conditions used as a basis for assessment</li> </ul> | Broad spatial and temporal coverage: <ul style="list-style-type: none"> <li>• Spatial coverage broad and corresponding with biological sampling</li> <li>• Assessment during one to two (1-2) seasons</li> <li>• Assessment may be regional or site-specific</li> </ul>                                  | <ul style="list-style-type: none"> <li>• High precision and sensitivity</li> <li>• Biologist performs survey</li> </ul>                          |

**Table IV. Hierarchy of Chemical/Physical Data for Fisheries Assessment**

| <b>Data Use</b>                    | <b>Data Level</b> | <b>Technical Component</b>   | <b>Spatial &amp; Temporal Coverage</b>   | <b>Data Quality</b>  |
|------------------------------------|-------------------|--|--|--|
| <b>Used for screening purposes</b> | <b>Tier I</b>     | Water quality monitoring using grab samples  | Low spatial and temporal coverage: <ul style="list-style-type: none"> <li>• Only a few sites within a basin</li> <li>• Quarterly or less frequent sampling with limited period of record (e.g., 1 day)</li> <li>• Limited data during key periods (e.g., critical hydrological regimes)</li> <li>• Data older than five (5) years that are not likely to reflect current conditions</li> </ul>   | <ul style="list-style-type: none"> <li>• Low precision and sensitivity</li> <li>• QA/QC protocols are not followed, or QA/QC results are inadequate</li> <li>• Methods not documented</li> <li>• Inadequate metadata</li> </ul>                      |
|                                    | <b>Tier II</b>    | One (1) of the following: <ul style="list-style-type: none"> <li>• Water quality monitoring using grab sampling</li> <li>• Rotating basin surveys involving single visits or routine sampling</li> <li>• Verified volunteer data</li> </ul>  | Moderate spatial and temporal coverage: <ul style="list-style-type: none"> <li>• Stream basin coverage, several sites within a basin</li> <li>• Quarterly or bimonthly sampling at fixed stations</li> <li>• Sampling during a key period (e.g., high and/or low flow)</li> <li>• Data that are likely to reflect current conditions, but may be older than five (5) years</li> </ul>  | <ul style="list-style-type: none"> <li>• Low precision and sensitivity</li> <li>• QA/QC protocols followed, QA/QC results adequate</li> <li>• Approved SOPs used for field and lab</li> <li>• Adequate metadata*</li> </ul>                          |
| <b>Used for assessment</b>         | <b>Tier III</b>   | One (1) of the following: <ul style="list-style-type: none"> <li>• Water quality monitoring using grab samples</li> <li>• Rotating basin surveys involving multiple visits or routine sampling</li> <li>• Limited use of continuous monitoring instrumentation</li> <li>• Synthesis of existing or historical information on fish tissue contamination levels</li> </ul> | Broad spatial and temporal coverage of sites with sufficient frequency and coverage to capture acute events: <ul style="list-style-type: none"> <li>• Multiple sites within a basin</li> <li>• Quarterly, bimonthly, or monthly sampling during key periods (e.g., critical hydrological regimes), multiple samples at high and low flows.</li> <li>• Period of sampling adequate to monitor for chronic concerns for the specific parameter of concern (sampling over at least 3 seasons)</li> <li>• Data five 5 years old or less</li> </ul> | <ul style="list-style-type: none"> <li>• Moderate precision and sensitivity</li> <li>• QA/QC protocols followed, QA/QC results adequate</li> <li>• Approved SOPs used for field and lab</li> <li>• Adequate metadata*</li> </ul>                     |
|                                    | <b>Tier IV</b>    | All of the following: <ul style="list-style-type: none"> <li>• Water quality monitoring using composite samples, series of grab samples, and continuous monitoring devices</li> <li>• Follow-up sediment quality sampling or fish-tissue analyses at site with high probability of contamination</li> </ul>  | Broad spatial and temporal (at least 2 years) coverage of fixed sites with sufficient frequency and coverage to capture acute events, chronic conditions, and all other potential chemical/ physical impacts: <ul style="list-style-type: none"> <li>• Multiple sites within a basin</li> <li>• Bimonthly or monthly, including multiple samples at high and low flows</li> <li>• Continuous monitoring (e.g., use of thermographs, sondes, or similar devices)</li> <li>• Data five (5) years old or less</li> </ul>                          | <ul style="list-style-type: none"> <li>• High precision and sensitivity</li> <li>• QA/QC protocols followed, QA/QC results adequate</li> <li>• Approved SOPs used for field and lab; well-trained personnel</li> <li>• Adequate metadata*</li> </ul> |

\*Adequate metadata includes: time, date, stream name, latitude/longitude, parameters sampled, Chain of Custody from a State certified lab, and a reference to the QA/QC and standard operating procedures (SOPs) used.

**Table V. Hierarchy of Toxicological Approaches for Fisheries Assessment**

| <b>Data Use</b>                    | <b>Data Level</b> | <b>Technical Components</b>  | <b>Spatial &amp; Temporal Coverage</b>   | <b>Data Quality</b>  |
|------------------------------------|-------------------|--|--|--|
| <b>Used for screening purposes</b> | <b>Tier I</b>     | Any one (1) of the following: <ul style="list-style-type: none"> <li>• Acute <u>or</u> chronic WET* for effluent-dominated channel</li> <li>• Acute ambient water</li> </ul>                   | <ul style="list-style-type: none"> <li>• One (1) ambient water sample tested in a monitoring segment or site</li> <li>• A minimum of one (1) species</li> </ul>  | <ul style="list-style-type: none"> <li>• Low precision and sensitivity</li> <li>• Lab certification unknown</li> </ul>             |
|                                    | <b>Tier II</b>    | Any one (1) of the following: <ul style="list-style-type: none"> <li>• Acute <u>or</u> chronic WET for effluent-dominated channel</li> <li>• Acute or chronic ambient water</li> </ul>         | <ul style="list-style-type: none"> <li>• Two (2) ambient water samples tested in a monitoring segment or site</li> <li>• Two (2) different dates at least two (2) weeks apart using</li> <li>• A minimum of one (1) species</li> </ul>   | <ul style="list-style-type: none"> <li>• Low to moderate precision and sensitivity</li> <li>• Lab certification unknown</li> </ul> |
| <b>Used for assessment</b>         | <b>Tier III</b>   | Any one (1) of the following: <ul style="list-style-type: none"> <li>• Acute <u>and</u> chronic WET for effluent-dominated channel</li> <li>• Acute <u>or</u> chronic ambient water</li> </ul> | <ul style="list-style-type: none"> <li>• Three (3) ambient water samples tested in a monitoring segment or site</li> <li>• Three (3) different dates at least two (2) weeks apart</li> <li>• A minimum of two (2) species for at least two (2) of the tests</li> </ul>                                       | <ul style="list-style-type: none"> <li>• Moderate precision and sensitivity</li> <li>• Certified Lab</li> </ul>                    |
|                                    | <b>Tier IV</b>    | One (1) of the following: <ul style="list-style-type: none"> <li>• Acute <u>and</u> chronic WET for effluent-dominated channel</li> <li>• Acute <u>or</u> chronic ambient water</li> </ul>     | <ul style="list-style-type: none"> <li>• Four or more (<math>\geq 4</math>) tests in total, based on samples collected in a monitoring segment or site</li> <li>• Four (4) different dates at least two (2) weeks apart</li> <li>• A minimum of two (2) species for at least two (2) of the tests</li> </ul> | <ul style="list-style-type: none"> <li>• High precision and sensitivity</li> <li>• Certified Lab</li> </ul>                        |

\*Whole Effluent Toxicity (WET) test.



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### 3.5 DATA REPRESENTATIVENESS CONSIDERATIONS

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Spatial and temporal representativeness of data and information must be considered when characterizing annual ambient conditions for a given monitoring segment.

#### **SPATIAL DISTRIBUTION**

Arkansas is divided by six (6) major river basins: Red River, Ouachita River, Arkansas River, White River, St. Francis River, and Mississippi River. These six (6) river basins are subdivided into 38 water quality planning segments based on hydrological characteristics, anthropogenic activities, geographic characteristics, and other factors. Water quality planning segments are further broken down into approximately 1,600 smaller watersheds, based on discrete hydrological boundaries as defined by the USGS 12-digit hydrologic unit codes.

Assessment of the State's water quality is based on individual stream reaches grouped by planning segments and based on watersheds. Planning segments are congruent with 12-digit hydrologic unit code boundaries in EPA's River Reach File. This allows geographic information system support with designation, characterization, assessment, and management. Sample locations on streams and open waterbodies should be characteristic of the main water mass or distinct hydrologic areas. Data should not be biased toward specific conditions, such as flow, runoff, etc., unless otherwise stated for a specific standard.

Arkansas has approximately 13,490 miles of rivers and streams digitized in the ADEQ Water Base Layer. The ADEQ Water Base Layer was created from the Medium Resolution (1:100,000-scale) National Hydrography Dataset (NHD). The Medium Resolution NHD includes 2nd, 3rd, 4th and 5th order streams. 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. ADEQ continues to primarily use the Medium Resolution NHD for management and planning activities, but supplements the database primarily by utilizing the High Resolution NHD (1:24,000-scale). The High Resolution NHD includes 1st order streams, or intermittent streams and ephemeral drainages that flow only during a rainfall event.

#### **TEMPORAL DISTRIBUTION**

The primary database for the 305(b) Report is generated by ADEQ's Water Quality Monitoring Networks. The networks include the monthly-sampled Ambient Water Quality Monitoring Network (AWQMN) stations and the semi-monthly-sampled Roving Water Quality Monitoring Network (RWQMN). The RWQMN stations are divided into five (5) geographic groups that are sampled on a rotating two (2)-year schedule. Additional data, including but not limited to lakes sampling and special projects, developed by ADEQ will be evaluated and used if the sampling frequency and duration represent actual annual ambient conditions.

At a minimum, samples should be distributed over at least three (3) seasons (to include inter-seasonal variation) and over two (2) years (to include inter-year variation) to be utilized for assessment purposes. No more than two-thirds of the samples should be in one (1) year or one (1) season. The exception to this is analysis of data for those designated uses that require seasonally-based water quality data (e.g., primary contact recreation, biological community data, or critical season dissolved oxygen).

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

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### 3.6 INSTRUMENT ERROR

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Instrument error refers to the combined accuracy and precision of a measuring instrument, or the difference between the value indicated and the actual value. Instrument error must be taken into consideration when conducting water quality standard and use attainment assessments. Water quality data collected from ADEQ's monitoring programs will be evaluated for instrument error, such that values that exceed the numeric water quality standards, but fall within the precision/accuracy error range of the given field instrument, will not be considered an excursion from the water quality standard. See *Arkansas' Water Quality and Compliance Monitoring Quality Assurance Project Plan* for ADEQ's field instrument performance criteria and for precision/accuracy error range values.

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### 3.7 AGGREGATION OF SAMPLES WITHIN A MONITORING SEGMENT

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Monitoring segments are designed to represent homogenous waters with regard to water quality. ADEQ does not typically establish more than one sampling station in any particular monitoring segment for water quality monitoring programs, but there are occasions where more than one river or stream station with available data (typically chemical/physical data) is either established by ADEQ or another entity. If all monitoring segments were selected to be relatively homogenous, it follows that any independent sample taken from a monitoring segment is representative of conditions within that segment. Since each independent sample is considered to be representative of the monitoring segment, aggregation of independent samples within a monitoring segment to assess water quality and designated use support is appropriate.

If water quality data indicate that a monitoring segment is not homogenous (due to point or non-point source discharges), resulting in conflicting attainment conclusions, the monitoring segment 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 a monitoring segment. If data indicate that it is more appropriate to split a segment, the resulting monitoring segment(s) will be re-assessed based on data within the newly-defined boundaries for the applicable period of record.

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### 3.8 AGGREGATION OF EVALUATED CONTIGUOUS MONITORING SEGMENTS

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Aggregation of evaluated contiguous monitoring segments for water quality standard and designated use assessments can be made if it can be reasonably established that the segments are similar in watershed characteristic and condition. ADEQ will consider land use practices, the location of tributaries, impoundments, and other hydrological alterations that could impact the water quality between the monitoring segments. If similarity in watershed characteristic and/or condition cannot be established, contiguous stream segments will not be aggregated.

An assessment of non-support can be made for aggregated monitored and non-monitored segments if there is reason to believe that the segments are similar with respect to the potential cause and magnitude of impairment.

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### 3.9 DATA QUANTITY CONSIDERATIONS

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The State of Arkansas has abundant surface water resources; it is estimated that 87,617 stream and river miles, 356,254 acres of publicly-owned lakes, and 800,000 acres of wetlands occur in the state. With this amount of surface water, it is essential that ADEQ develop a monitoring strategy that can provide the information necessary to properly assess these resources so that the physical, chemical, and biological integrity of all Arkansas' waters are protected and enhanced.

**ADEQ water quality monitoring goals:**

- Identify impaired waters
- Support the evaluation of program effectiveness
- Establish, review, and revise water quality standards
- Establish geographic trends in stream quality
- Refine physical, chemical, and biological assessment tools to improve water quality assessments
- Evaluate water quality and designated use attainment for development of the 305(b) Report
- Characterize the performance of management actions
- Determine appropriate management strategies if designated uses are not being attained
- Assess the effects of point source dischargers upon water quality
- Observe the impact of known nonpoint source pollution trends
- Monitor all waters of the state
- Provide long-term physical, chemical, and biological data, and monitoring of the State's least-disturbed ecoregion reference waterbodies

ADEQ strives to follow EPA guidance, which encourages the collection of adequate data to make well-grounded attainment determinations (EPA 2005). The use of limited datasets 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).

In an effort to obtain adequate data sets for water quality and designated use attainment decisions, Arkansas' water quality monitoring programs consist of the following surface water networks:

### **ROUTINE WATER QUALITY MONITORING ACTIVITIES**

**Ambient Water Quality Monitoring Network:** Water samples are systematically collected monthly and analyzed for the parameters listed in the current *State of Arkansas Water Quality Monitoring and Assessment Program, Revision 4*. Flows are determined at a select number of sites taken either by continuous read gages, wire gages, or staff gages read by USGS or ADEQ personnel. The Ambient Water Quality Monitoring Network provides an overview of water quality conditions and trends at specific sites across the entire state, and generally produces 60 data points per site over a five (5)-year period.

**Roving Water Quality Monitoring Network:** Water samples are collected from a section of the state on a semi-monthly basis for a two (2)-year period. The samples are analyzed for the same parameters as the Ambient Water Quality Monitoring stations plus *Escherichia coli* bacteria. The Roving Water Quality Monitoring Network typically produces 12 data points per site. At the end of the two (2)-year period, the sampling effort moves to another section of the state.

### **NON-ROUTINE WATER QUALITY MONITORING ACTIVITIES**

**Intensive Surveys:** These surveys are implemented to assess the physical, chemical, and/or biological conditions of a specific waterbody or watershed.

**Special Studies:** These studies may or may not be limited to a specific geographic area but may have a very specific objective (e.g., fish tissue consumption, TMDL development, specific designated use attainment determination). In addition, these studies may be necessary if an investigation of a spill area or an area experiencing pollution due to a specific cause is identified.

**Ambient Toxicity Testing Program:** Water samples are collected at least on a quarterly basis in coordination with the EPA's Houston laboratory to determine the presence and magnitude of toxicity. These surveys are limited to specific streams or watersheds.

**Probabilistic Monitoring:** These studies are implemented to provide a general overview of the conditions of similar waterbodies, such as lakes of similar characteristics, within an ecoregion.

**National Monitoring Initiatives:** These studies are nationwide and are implemented to produce a survey of water conditions at a national or regional scale.

Through the current water quality monitoring programs, ADEQ strives for a minimum of 10 water quality samples to make water quality standard and designated use attainment decisions for physical and chemical parameters. The primary goal of obtaining 10 data points is to protect against the occurrence of false positives, which would result in Type I and Type II errors. A Type I error would result in assessing a monitoring segment as non-support when it is actually fully supporting its standards and uses. A Type II error occurs when a monitoring segment is assessed as support despite not meeting its standards or uses.

For water quality and designated use attainment decisions, data sets containing fewer than 10 ( $n < 10$ ) data points will be used as a screening sample. Surface water monitoring segments with fewer than 10 ( $n < 10$ ) data points and two or more ( $\geq 2$ ) exceedances will warrant additional monitoring and may be placed into Category 3 for further investigation; impairments based on this limited dataset may be assessed on a case-by-case basis. Once the sample size reaches 10 data points or greater ( $n \geq 10$ ) the appropriate rate of exceedance will apply.

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### 3.10 LAKES

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Arkansas has many diverse landforms that are distinctly divided into major ecoregions. This diversity in geology significantly influences the biological, physical, and chemical nature of the lakes within these regions. The lake area to watershed ratio, watershed land use and geology, primary purpose of the lake, lake construction, and lake management all influence a lake's characteristics.

Surveying Arkansas' significant publicly-owned lakes was initiated in 1989. Currently, Arkansas has 79 impoundments identified as significant publicly-owned lakes. These lakes range in size from 60 acres to over 45,000 acres. Sampling and assessment of each of the lakes has occurred generally once every five (5) years. Water samples were collected from various transects of each lake and at different depths and analyzed for routine water quality parameters, as well as chlorophyll *a*, bacteria, metals, plankton, and temperature and dissolved oxygen depth profiles.

In 2008, ADEQ revised its lakes monitoring program in order to generate the data necessary to develop appropriate lake-specific water quality standards and monitoring strategies. The *Beaver Reservoir Water Quality Standards and Assessment Criteria Development* and the *Water Quality of Potential Reference Lakes in Two Level-Three Ecoregions of Arkansas* projects have been completed, and two additional studies, *Data Collection of Type C and D Reference Lakes for Development of Water Quality Standards* and *Water Quality of Potential Reference Lakes for Type B Lakes in Arkansas*, have been initiated to help accomplish this task.

The completion of the *Beaver Reservoir Water Quality Standards and Assessment Criteria Development* project has led to the creation of site specific numeric nutrient criteria for Beaver Lake. ADEQ is moving forward with its Nutrient Criteria Development Plan, with the intention of adapting the methodology, tools, and procedures derived from the Beaver Lake study to establish numeric nutrient criteria (chlorophyll *a* and transparency) for additional lakes around the state. The goal of this project is to develop nutrient criteria that fully recognize localized conditions and protect the specific designated uses of these waterbodies. Lake classification and adoption of this classification into the state's water quality standards must also be completed.

Once appropriate water quality standards and criteria have been adopted into APC&EC Regulation 2, and compiled into the state's overall monitoring strategy plan, an assessment methodology will be developed to address lake water quality standards. Until this is accomplished, only those water quality standards currently listed in APC&EC Regulation 2 can be assessed.

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### 3.11 IMPAIRMENT SOURCE DETERMINATION

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

## 4.0 WATER QUALITY STANDARD ASSESSMENT METHODOLOGY

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. The APC&EC's Regulation 2 contains an antidegradation policy that applies to all surface waters of the state. Existing instream uses and the level of water quality necessary to protect the existing uses shall be maintained and protected. Arkansas' Outstanding Resource Waters, as delineated in APC&EC Reg. 2.203, are to be protected and maintained for those beneficial uses and water quality for which the outstanding resource designation was granted. These waterbodies will be listed as non-support if the chemical, physical, and/or biological characteristics for which the waterbody was designated have been determined to be impaired or absent, as defined by the following assessment criteria. Per APC&EC Reg. 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 310 of the Clean Water Act, 33 U.S.C. § 1326.

### 4.2 DESIGNATED USES

**Table VI. Designated Uses for Arkansas' Surface Waters**

| Designated Use  | Parameters   |
|---|--|
| <b>Fisheries</b><br>Reg. 2.302(F)                           | Biological Integrity (macroinvertebrate and/or fish) data.   |
| <b>Domestic Water Supply</b><br>Reg. 2.302(G)               | Compounds that are not easily removed by drinking water treatment facilities; compounds with established secondary maximum contaminant levels (e.g., chlorides, sulfates, & total dissolved solids).   |
| <b>Primary and Secondary Contact</b><br>Reg. 2.302(D) & (E) | <i>Escherichia coli</i> ( <i>E. coli</i> ) (Fecal Coliform bacteria data will be used in the absence of <i>E. coli</i> data).  |
| <b>Industrial Water Supply</b><br>Reg. 2.302(H)             | Compounds which interfere with industrial uses, such as cooling water or the water used in certain manufacturing processes; or waters unsuitable for livestock watering or crop irrigation; most often includes chlorides, sulfates, & total dissolved solids. |
| <b>Agriculture Water Supply</b><br>Reg. 2.302(I)            |  |

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## 4.3 NARRATIVE AND NUMERIC CRITERIA

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### 4.3.1 NARRATIVE CRITERIA

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APC&EC Regulation 2 contains narrative criteria (written descriptions) that apply to all waters of the state and are used to evaluate support of applicable uses. Narrative criteria include general descriptions, such as the existence of nuisance species, taste- and odor-producing substances, visible globules on surface waters, and toxins. Narrative criteria are evaluated by using screening levels, if they are available, as well as other information, including water quality studies, existence of fish kills or contaminant spills, and photographic evidence. Waters will be assessed as non-support when a violation of any narrative water quality standard has been verified by ADEQ. In addition, waters will be assessed as non-support if any associated numeric standard of a narrative criterion is violated pursuant to this assessment methodology.

### 4.3.2 NUMERIC CRITERIA

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Numeric criteria are values established in APC&EC Regulation 2 that provide a quantitative basis for evaluating designated use support and for managing point and nonpoint loadings in Arkansas' surface waters. Procedures for assessing instream water quality against numerical criteria are outlined in Section 6.0.



## 5.0 GENERAL STANDARDS

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### 5.1 BIOLOGICAL INTEGRITY

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

For all waters with specific fisheries 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 variety and abundance, 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. The reference stream should have similar habitat and hydrologic conditions. Such a comparison should consider the seasonal and natural variability of the aquatic biota community. It is the responsibility of the Department to collect and evaluate the data for an aquatic biota assessment and such data will not be used to develop or impose permit limits.

#### **ASSESSMENT METHODOLOGY FOR BIOLOGICAL INTEGRITY**

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The fisheries designated use is evaluated based on the biological integrity (macroinvertebrate and/or fish communities) of the waterbody, where biological data exist to make an assessment. At a minimum, biological and chemical/physical data must have been collected over two (2) seasons (preferably a minimum of 2 years) using methods outlined in a Quality Assurance Project Plan with requirements equal to or more stringent than that of ADEQ or USGS (See Section 3.2.1 Biological Integrity Data for additional information on data requirements). 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 ASSEMBLAGE ANALYSIS

Matrices set forth in Rapid Bioassessment Protocols for Use in Stream and Rivers (EPA/444/4-89-001, 1989) are used in analysis of macroinvertebrate assemblage samples. Each site will have a Rapid Bioassessment score derived from multi-metric analysis, which include: 1) Taxa Richness, 2) Ephemeroptera-Plecoptera-Tricoptera Index (EPT), 3) Hilsenhoff Biotic Index, 4) Percent Dominant Contribution. See *Arkansas' Water Quality and Compliance Monitoring Quality Assurance Project Plan* (ADEQ 2013) at the ADEQ website: <http://adeq.state.ar.us> for more information.

A total score consisting of macroinvertebrate assemblage analysis is calculated for each sample and sample site, as outlined in the following table.

**Table VII. Macroinvertebrate Community Structure Analysis**

| <b>Attainment Status</b>       | <b>% Comparable Estimate</b> | <b>Attribute</b>  |
|--------------------------------|------------------------------|---|
| <b>Comparable to reference</b> | ≥90%                         | Expected to support the community structure present at the reference site                           |
| <b>Supporting</b>              | 75-88%                       | Should support a diverse community similar to the reference site                                    |
| <b>Partially Supporting</b>    | 60-73%                       | Difference in the biological community may be due to the poor habitat. Comparisons may be difficult |
| <b>Non-supporting</b>          | <58%                         | Should not be expected to support the community present at the reference site                       |

## FISH ASSEMBLAGE ANALYSIS

ADEQ's Community Structure Index (CSI) will be used in the analysis of fish assemblages. 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 ADEQ personnel. A group of Arkansas ichthyologists reviewed the data and utilizing the prevailing deviations in the data set and employing best professional judgment, established the current metric scores and similarity ranking categories. Ecoregion specific metrics for watersheds (>10mi<sup>2</sup>) outlined in *Arkansas' Water Quality and Compliance Monitoring Quality Assurance Project Plan* (ADEQ 2013), available at the ADEQ website: <http://adeq.state.ar.us>, will be calculated for each site and total scores will be evaluated and assessed as follows:

**Table VIII. Fish Community Structure Index Ecoregion Values**

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

Results from fish and macroinvertebrate assemblage analysis, along with evaluation of chemical and physical data, will be used to determine support or non-support of the fisheries designated use.

**Table IX. Biological Assemblage Assessment Determination**

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

\* The fisheries 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 an environmental factor (low dissolved oxygen, low pH, toxicity); based on acceptable variances in ecoregion assemblage 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.

Best professional judgment 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 X. Fisheries Designated Use Listing Protocol**

| Type of Data Present                              | Evaluation Result |                             | Final Assessment | 303 (d) 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 = Supporting    NS = Non-Supporting    FS = Fully Supporting    NA = No Available Data    UA = Unassessed

**LISTING METHODOLOGY:**

Stream and river monitoring segments will be listed as non-support when one or both of the evaluated biological communities (macroinvertebrates and/or fish) indicate perturbation/degradation, or when one (1) or both of the toxicological test organisms (vertebrate and/or invertebrate) fail more than one (1) acute or chronic toxicity test in a three (3) year period.

**DELISTING METHODOLOGY:**

Stream and river monitoring segments will be listed as support when evaluated biological communities (macroinvertebrates and/or fish) do not indicate perturbation/degradation, and when there have been no acute or chronic toxicity test failures in a three (3) year period.

## 6.0 SPECIFIC STANDARDS

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Per APC&EC Reg. 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.

Unless otherwise stated for a specific standard, the number of samples needed for determination of non-support is calculated using the total number of samples collected, rounded up to the nearest 'tens' place (10, 20, 30...), then multiplied by the applicable percent exceedance criterion. For example, given a sample size of 18 and a greater than 10 percent exceedance rate, a total of three (3) exceedances are needed for the determination of non-support (18 samples is rounded up to 20, then multiplied by the 10% exceedance rate, which equals 2 samples; thus if 3 or more samples exceed the criterion, a non-support evaluation is assigned).

The rounding method used by the Department has been shown to be no less stringent than other methods approved by EPA for protecting water quality. This method allows the Department to assess the data in the same way as the samples are collected - as whole samples. Not using the rounding method would result in the assessment of partial samples, which does not reflect actual field sampling procedures.

Refer to Appendix A for ecoregion based Assessment Criteria Tables; Appendix B for the Assessment Criteria Table for Arkansas' lakes; and Appendix C for Assessment Criteria Tables for Arkansas' major rivers.

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## 6.1 TEMPERATURE

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This section establishes the protocol for determining impairment due to increases in temperature of Arkansas' surface waters, per APC&EC Reg. 2.502:

Heat shall not be added to any waterbody in excess of the amount that will elevate the natural temperature, outside the mixing zone, by more than 5°F (2.8°C) based upon the monthly average of the maximum daily temperatures measured at mid-depth or three feet (whichever is less) in streams, lakes or reservoirs. Maximum allowable temperatures from man-induced causes in the following waters are:

| <b>Waterbodies</b>                  | <b>Limit °C (°F)</b> |
|-------------------------------------|----------------------|
| <b>Streams</b>                      |                      |
| 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) |
| <b>Lakes and Reservoirs</b>                          | 32 (89.6) |
| <b>Trout waters</b>                                  | 20 (68.0) |

Temperature requirements shall not apply to off-stream privately-owned reservoirs constructed primarily for industrial cooling purposes and financed in whole or in part by the entity or successor entity using the lake for cooling purposes.

## **ASSESSMENT METHODOLOGY FOR TEMPERATURE**

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### **LISTING METHODOLOGY:**

Stream and river monitoring segments will be listed as non-support when ADEQ determines that more than 10 percent of the total samples (for the period of record) exceed the applicable temperature standard listed in APC&EC Reg. 2.502.

Lakes and reservoirs will be listed as non-support when ADEQ determines that more than 10 percent of the total samples (for the period of record) exceed the temperature standard of 32°C (89.6°F). Samples collected approximately one (1) meter below the surface of the water will be used to make lake and reservoir attainment decisions.

### **DELISTING METHODOLOGY:**

Stream and river monitoring segments will be listed as support when ADEQ determines that 10 percent or less of the total samples (for the period of record) exceed the applicable temperature standard listed in APC&EC Reg. 2.502.

Lakes and reservoirs will be listed as support when ADEQ determines that 10 percent or less of the total samples for the period of record (collected approximately 1 meter below the surface of the water) exceed the temperature standard of 32°C (89.6°F).

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## 6.2 TURBIDITY

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As established by APC&EC Reg. 2.503, turbidity will be evaluated for both base flows and all flows values. Base flows values represent the critical season, June 1 to October 31, when rainfall is infrequent; all flows values take into account samples collected throughout the year (including samples collected between June 1 to October 31). APC&EC Reg. 2.503 states:

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 all flows in more than 25% of samples taken in not less than 24 monthly samples.

| <b>Waterbodies</b>                     | <b>Base Flows<br/>Values<br/>(NTU)</b> | <b>All Flows<br/>Values<br/>(NTU)</b> |
|--|--|---------------------------------------|
| <b>Streams</b>                         |  |                                       |
| Ozark Highlands                        | 10                                     | 17                                    |
| Boston Mountains                       | 10                                     | 19                                    |
| Arkansas River Valley                  | 21                                     | 40                                    |
| Ouachita Mountains                     | 10                                     | 18                                    |
| Springwater-influenced<br>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                                    |
| <b>Lakes and Reservoirs</b>            | 25                                     | 45                                    |



## **ASSESSMENT METHODOLOGY FOR TURBIDITY**

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### ***Base Flows Values***

*Base flow values apply to data collected between June 1 and October 31.*

#### **STREAMS AND RIVERS LISTING METHODOLOGY:**

Stream and river monitoring segments will be listed as non-support when more than 20 percent of the total samples in the period of record exceed the applicable base flows values, listed in APC&EC Reg. 2.503.

#### **LAKES AND RESERVOIRS LISTING METHODOLOGY:**

Lakes and reservoirs will be listed as non-support when more than 20 percent of the total samples for the period of record (collected approximately 1 meter below the surface of the water) exceed the turbidity standard of 25 NTU.

#### **STREAMS AND RIVERS DELISTING METHODOLOGY:**

Stream and river monitoring segments will be listed as support when 20 percent or less of the total samples in the period of record exceed the applicable base flows values, listed in APC&EC Reg. 2.503.

#### **LAKES AND RESERVOIRS DELISTING METHODOLOGY:**

Lakes and reservoirs will be listed as support when 20 percent or less of the total samples for the period of record (collected approximately 1 meter below the surface of the water) exceed the turbidity standard of 25 NTU.

### ***All Flows Values***

*All flows values apply to data collected throughout the year, including data collected between June 1 and October 31.*

#### **STREAMS AND RIVERS LISTING METHODOLOGY:**

Stream and river monitoring segments will be listed as non-support when more than 25 percent of the total samples (sample set not to be fewer than 24 data points) for the period of record exceed the applicable all flows values, listed in APC&EC Reg. 2.503.

#### **LAKES AND RESERVOIRS LISTING METHODOLOGY:**

Lakes and reservoirs will be listed as non-support when more than 25 percent of the total samples (sample set not to be fewer than 24 data points) for the period of record (collected approximately 1 meter below the surface of the water) exceed the turbidity standard of 45 NTU.

#### **STREAMS AND RIVERS DELISTING METHODOLOGY:**

Stream and river monitoring segments will be listed as support when 25 percent or less of the total samples (sample set not to be fewer than 24 data points) for the period of record exceed the applicable all flows values listed in APC&EC Reg. 2.503.

#### **LAKES AND RESERVOIRS DELISTING METHODOLOGY:**

Lakes and reservoirs will be listed as support when 25 percent or less of the total samples (sample set not to be fewer than 24 data points) for the period of record (collected approximately 1 meter below the surface of the water) exceed the turbidity standard of 45 NTU.

If a monitoring segment is assessed as not meeting either the base flows or all flows values, or both, it will be listed as non-support for turbidity.

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## 6.3 PH

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This section establishes the protocol for determining impairment due to fluctuations in pH, per APC&EC Reg. 2.504:

As a result of waste discharges, the pH of water in streams or lakes must not fluctuate in excess of 1.0 unit over a period of 24 hours and pH values shall not be below 6.0 or above 9.0.

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### **ASSESSMENT METHODOLOGY FOR PH**

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#### **LISTING METHODOLOGY:**

Stream and river monitoring segments will be listed as non-support when ADEQ determines that anthropogenic activities result in a variance from the pH standard (between 6.0 and 9.0 standard units) in more than 10 percent of the total samples for the period of record.

Lakes and reservoirs will be listed as non-support when ADEQ determines that anthropogenic activities result in a variance from the pH standard (between 6.0 and 9.0 standard units) in more than 10 percent of the total samples for the period of record. Samples collected approximately one (1) meter below the surface of the water will be used to make lake and reservoir attainment decisions.

If the pH value for lakes, rivers, or streams varies from the pH standard due to natural conditions, (i.e., anthropogenic activities cannot be identified by ADEQ as the source) the waterbody will not be listed as non-support, but will be noted in the 305(b) Report.

#### **DELISTING METHODOLOGY:**

Stream and river monitoring segments will be listed as support when ADEQ determines that anthropogenic activities result in variance from the pH standard (between 6.0 and 9.0 standard units) in 10 percent or less of the total samples for the period of record.

Lakes and reservoirs will be listed as support when ADEQ determines that anthropogenic activities result in variance from the pH standard (between 6.0 and 9.0 standard units) in 10 percent or less of the total samples (collected approximately 1 meter below the surface of the water) for the period of record.

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## 6.4 DISSOLVED OXYGEN

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This section establishes the protocol for determining impairment due to variations in dissolved oxygen, per APC&EC Reg. 2.505:

In streams with watersheds of less than 10 mi<sup>2</sup>, it is assumed that insufficient water exists to support a fishery during the critical season. During this time, a D.O. 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<sup>2</sup> are expected to support a fishery during the primary season when stream flows, including discharges, equal or exceed 1 cubic foot per second (CFS); however, when site verification indicates that a fishery exists at flows below 1 CFS, such fishery will be protected by the primary standard.

Also, in these streams with watersheds of less than 10 mi<sup>2</sup>, where waste discharges are 1 CFS or more, they are assumed to provide sufficient water to support a perennial fishery and, therefore, must meet the dissolved oxygen standards of the next size category of streams.

For purposes of determining effluent discharge limits, the following conditions shall apply:

- (A) The primary season dissolved oxygen standard is to be met at a water temperature of 22°C (71.5°F) and at the minimum stream flow for that season. At water temperatures of 10°C (50°F), the dissolved oxygen standard is 6.5 mg/l.
- (B) During March, April and May, when background stream flows are 15 CFS or higher, the D.O. standard is 6.5 mg/l in all areas except the Delta Ecoregion, where the primary season D.O. standard will remain at 5 mg/l.
- (C) The critical season dissolved oxygen standard is to be met at maximum allowable water temperatures and at Q7-10 flows. However, when water temperatures exceed 22°C (71.6°F), a 1 mg/l diurnal depression will be allowed below the applicable critical standard for no more than 8 hours during any 24-hour period.

The following dissolved oxygen standards must be met:

| <b>Waterbodies</b>             | <b>Limit (mg/l)</b> |          |
|--------------------------------|---------------------|----------|
|                                | Primary             | Critical |
| <b>Streams</b>                 |                     |          |
| Ozark Highlands                |                     |          |
| <10 mi <sup>2</sup> watershed  | 6                   | 2        |
| 10 to 100 mi <sup>2</sup>      | 6                   | 5        |
| >100 mi <sup>2</sup> watershed | 6                   | 6        |
| <br>                           |                     |          |
| Boston Mountains               |                     |          |
| <10 mi <sup>2</sup> watershed  | 6                   | 2        |
| >10 mi <sup>2</sup> watershed  | 6                   | 6        |

| <b>Waterbodies</b>                         | <b>Limit (mg/l)</b> |   |
|--|---------------------|---|
| Arkansas River Valley                      |                     |   |
| <10 mi <sup>2</sup> watershed              | 5                   | 2 |
| 10 mi <sup>2</sup> to 150 mi <sup>2</sup>  | 5                   | 3 |
| 151 mi <sup>2</sup> to 400 mi <sup>2</sup> | 5                   | 4 |
| >400 mi <sup>2</sup> watershed             | 5                   | 5 |
| Ouachita Mountains                         |                     |   |
| <10 mi <sup>2</sup> watershed              | 6                   | 2 |
| >10 mi <sup>2</sup> watershed              | 6                   | 6 |
| Typical Gulf Coastal                       |                     |   |
| <10 mi <sup>2</sup> watershed              | 5                   | 2 |
| 10 mi <sup>2</sup> to 500 mi <sup>2</sup>  | 5                   | 3 |
| >500 mi <sup>2</sup> watershed             | 5                   | 5 |
| Springwater-influenced Gulf Coastal        |                     |   |
| All size watersheds                        | 6                   | 5 |
| Delta (least-altered and channel altered)  |                     |   |
| <10 mi <sup>2</sup> watershed              | 5                   | 2 |
| 10 mi <sup>2</sup> to 100 mi <sup>2</sup>  | 5                   | 3 |
| >100 mi <sup>2</sup> watershed             | 5                   | 5 |
| Trout Waters                               |                     |   |
| All size watersheds                        | 6                   | 6 |

### **Lakes and Reservoirs**

Specific dissolved oxygen standards for lakes and reservoirs shall be 5 mg/l. Effluent limits for oxygen-demanding discharges into impounded waters are promulgated in Regulation #6 of the Arkansas Pollution Control and Ecology Commission. However, the Commission may, after full satisfaction of the intergovernmental coordination and public participation provisions of the state's continuing planning process, establish alternative limits for dissolved oxygen in lakes and reservoirs where studies and other relevant information can demonstrate that predominant ecosystem conditions may be more accurately reflected by such alternate limits; provided that these limits shall be compatible with all designated beneficial uses of named lakes and reservoirs.

## **ASSESSMENT METHODOLOGY FOR DISSOLVED OXYGEN**

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Dissolved oxygen standards are divided into two (2) categories:

- 1) **Primary season:** Water temperatures are at or below 22°C.
- 2) **Critical season:** Water temperatures exceed 22°C.

### **LISTING METHODOLOGY:**

Stream and river monitoring segments will be listed as non-support when more than 10 percent of the total samples in the period of record fail to meet the minimum applicable dissolved oxygen standard listed in APC&EC Reg. 2.505.

Lakes and reservoirs will be listed as non-support when more than 10 percent of the samples in the period of record falls below five (5) mg/L. Samples collected approximately one (1) meter below the surface of the water will be used to make lake and reservoir attainment decisions.

### **DELISTING METHODOLOGY:**

Stream and river monitoring segments will be listed as support when 10 percent or less of the total samples in the period of record fail to meet the minimum applicable dissolved oxygen standard listed in APC&EC Reg. 2.505.

Lakes and reservoirs will be listed as support when 10 percent or less of the total samples (collected approximately 1 meter below the surface of the water) in the period of record do not fall below five (5) mg/L.

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## 6.5 RADIOACTIVITY

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This section establishes the protocol for determining impairment due to exceedance of limits for Radioactivity, per APC&EC Reg. 2.506:

The Rules and Regulations 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.

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### **ASSESSMENT METHODOLOGY FOR RADIOACTIVITY**

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#### **LISTING METHODOLOGY:**

Stream and river monitoring segments will be listed as non-support when a single sample in the period of record exceeds the concentration of 3 picocuries/Liter for radium-226, or the concentration of 10 picocuries/Liter for strontium-90.

Lakes and reservoirs will be listed as non-support when a single sample in the period of record exceeds the concentration of 3 picocuries/Liter for radium-226, or the concentration of 10 picocuries/Liter for strontium-90.

#### **DELISTING METHODOLOGY:**

Stream and river monitoring segments will be listed as support 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.

Lakes and reservoirs will be listed as support when no samples in the period of record exceed the concentration of 3 picocuries/Liter for radium-226, or the concentration of 10 picocuries/Liter for strontium-90.

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## 6.6 BACTERIA

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This section establishes the protocol for assessment of ambient waters, primary and secondary contact recreation designated uses will be evaluated using *Escherichia coli* as outlined in Reg. 2.507:

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.

For the purposes of this regulation, all streams with watersheds less than 10 mi<sup>2</sup> 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.

- (A) Primary Contact Waters - Between May 1 and September 30, the maximum allowable fecal coliform criteria, calculated as a geometric mean, shall be 200 col/100 ml and the single-sample maximum shall be 400 col/100 ml. Alternatively, in these waters, the maximum allowable *Escherichia coli* criteria, calculated as a geometric mean, shall be 126 col/100 ml and the single-sample maximum shall be 298 col/100 ml in lakes, reservoirs, Extraordinary Resource Waters ("ERW"), Ecologically Sensitive Waterbodies ("ESW"), and Natural and Scenic Waterways ("NSW") or 410 col/100 ml in all other rivers and streams. During the remainder of the calendar year, these criteria may be exceeded, but at no time shall these counts exceed the level necessary to support secondary contact recreation (below).
- (B) Secondary Contact Waters - The maximum allowable fecal coliform criteria, calculated as a geometric mean, shall be 1000 col/100 ml and the single-sample maximum shall be 2000 col/100 ml. Alternatively, the maximum allowable *E. coli* criteria, calculated as a geometric mean, shall be 630 col/100 ml and the single-sample maximum shall be 1490 col/100 ml for lakes, reservoirs, ERWs, ESWs, and NSWs or 2050 col/100 ml for all other rivers and streams.
- (C) For assessment of ambient waters as impaired by bacteria, the above 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.

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### ASSESSMENT METHODOLOGY FOR BACTERIA

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In the absence of *Escherichia coli* (*E. coli*) bacteria data, fecal coliform bacteria data will be utilized. For the assessment of ambient waters, the geometric mean is calculated on a minimum of five (5) samples spaced evenly and within a 30-day period during either contact season. For all other standards, as per APC&EC Reg. 2.507, at least eight (8) data points must be taken during the primary contact season (May 1 through September 30) or during the secondary contact season (October 1 through April 30) of contiguous months to make an evaluation.

In either case, the most recent complete dataset (as described above) will be utilized for assessment evaluation.

**LISTING METHODOLOGY:**

Stream and river monitoring segments will be listed as non-support when the geometric mean for the applicable contact season is exceeded, or when the applicable standard is exceeded in greater than 25 percent of the samples collected during contiguous months within the applicable contact season (as described above).

**DELISTING METHODOLOGY:**

Stream and river monitoring segments will be listed as support when the geometric mean for the applicable contact season is not exceeded, or when the applicable standard is exceeded in 25 percent or less of the samples collected during contiguous months within the applicable contact season (as described above).

**Table XI. Statewide Bacteria Assessment Criteria**

| <i>Escherichia coli</i>                                   |                          | STANDARD                  | SUPPORT          | NON-SUPPORT     |
|---|--------------------------|---------------------------|------------------|-----------------|
| <b>PRIMARY CONTACT</b>                                    | ERW, ESW, and NSW Waters | GM 126 col/100 mL         | ≤ standard       | > standard      |
|   | Lakes, Reservoirs        | 298 col/100 mL (May-Sept) | ≤ 25% exceedance | >25% exceedance |
|   | All other waters         | 410 col/100 mL (May-Sept) | ≤ 25% exceedance | >25% exceedance |
| <b>SECONDARY CONTACT</b>                                  | ERW, ESW, and NSW Waters | GM 630 col/100 mL         | ≤ standard       | > standard      |
|   | Lakes, Reservoirs        | 1490 col/100 mL (anytime) | ≤ 25% exceedance | >25% exceedance |
|   | All other waters         | 2050 col/100 mL (anytime) | ≤ 25% exceedance | >25% exceedance |
| <b>FECAL COLIFORM</b>                                     |                          | STANDARD                  | SUPPORT          | NON-SUPPORT     |
| <b>PRIMARY CONTACT</b>                                    |                          | GM 200 col/100 mL         | ≤ standard       | > standard      |
| All Waters including ERW, ESW, NSW, Lakes, and Reservoirs |                          | 400 col/100 mL (May-Sept) | ≤ 25% exceedance | >25% exceedance |
| <b>SECONDARY CONTACT</b>                                  |                          | GM 1000 col/100 mL        | ≤ standard       | > standard      |
| All Waters including ERW, ESW, NSW, Lakes, and Reservoirs |                          | 2000 col/100 mL (anytime) | ≤ 25% exceedance | >25% exceedance |

**ERW:** Extraordinary Resource Water **NSW:** Natural and Scenic Waterway **ESW:** Ecologically Sensitive Water



## 6.7 TOXIC SUBSTANCES

This section establishes the protocol for assessing impairment due to exceedance of limits for toxic substances, per APC&EC Reg. 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. Acute toxicity standards may not be exceeded outside the zone of initial dilution. Within the ZID acute toxicity standards may be exceeded but acute toxicity may not occur. Chronic toxicity and chronic numeric toxicity standards shall not be exceeded at, or beyond, the edge of the mixing zone. Permitting of all toxic substances shall be in accordance with the toxic implementation strategy found in the Continuing Planning Process. For non permit issues and as a guideline for evaluating toxic substances not listed in the following tables, the Department may consider No Observed Effect Concentrations (NOECs) or other literature values as appropriate. For the substances listed below, the following standards shall apply:

### **ALL WATERBODIES - AQUATIC LIFE CRITERIA**

| <b><u>Substance</u></b> | <b><u>Acute Values (µg/L)</u></b> | <b><u>Chronic Values (µg/L)</u></b><br><b><u>(24-hr Average)</u></b> |
|-------------------------|-----------------------------------|--|
| 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       | $e^{[1.005(\text{pH})-4.869]}$    | $e^{[1.005(\text{pH})-5.134]}$                                       |
| Chlorpyrifos            | 0.083                             | 0.041  |

\* Total of all isomers

**DISSOLVED METALS \***

| <u>Acute Criteria (CMC) - ug/L(ppb)</u> |   |                     | <u>Chronic Criteria (CCC) - ug/L(ppb)</u> |                     |       |
|---|---|---------------------|---|---------------------|-------|
| <u>Substance</u>                        | <u>Formula</u>                            | <u>X Conversion</u> | <u>Formula</u>                            | <u>X Conversion</u> |       |
| Cadmium                                 | $e^{[1.128(\ln\text{hardness})]-3.828}$   | (a)                 | $e^{[0.7852(\ln\text{hardness})]-3.490}$  |                     | (c)   |
| Chromium(III)                           | $e^{[0.819(\ln\text{hardness})]+3.688}$   | 0.316               | $e^{[0.8190(\ln\text{hardness})]+1.561}$  |                     | 0.860 |
| Chromium (VI)                           | 16  | 0.982               | 11  |                     | 0.962 |
| Copper                                  | $e^{[0.9422(\ln\text{hardness})]-1.464}$  | 0.960               | $e^{[0.8545(\ln\text{hardness})]-1.465}$  |                     | 0.960 |
| Lead                                    | $e^{[1.273(\ln\text{hardness})]-1.460}$   | (b)                 | $e^{[1.273(\ln\text{hardness})]-4.705}$   |                     | (b)   |
| Mercury                                 | 2.4                                       | 0.85                | 0.012**                                   |                     | NONE  |
| Nickel                                  | $e^{[0.8460(\ln\text{hardness})]+3.3612}$ | 0.998               | $e^{[0.8460(\ln\text{hardness})]+1.1645}$ |                     | 0.997 |
| Selenium**                              | 20  | NONE                | 5   |                     | NONE  |
| Silver                                  | $e^{[1.72(\ln\text{hardness})]-6.52}$     | 0.85                | -----                                     |                     | NONE  |
| Zinc                                    | $e^{[0.8473(\ln\text{hardness})]+0.8604}$ | 0.978               | $e^{[0.8473(\ln\text{hardness})]+0.7614}$ |                     | 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:  $1.136672 - [(\ln \text{hardness})(0.041838)]$

(b) Calculated as:  $1.46203 - [(\ln \text{hardness})(0.145712)]$

(c) Calculated as:  $1.101672 - [(\ln \text{hardness})(0.041838)]$

\*\*Expressed as total recoverable. Mercury based on bioaccumulation of residues in aquatic organisms, rather than toxicity.

**ALL WATERBODIES - HUMAN HEALTH CRITERIA**

| <u>Substance</u>                 | <u>Criteria (ng/L)*</u> |
|----------------------------------|-------------------------|
| 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)]

The permittee shall have the option to develop site-specific numerical standards for toxic substances using EPA approved bioassay methodology and guidance. Such guidance may include but may not be limited to *Water Quality Standards Handbook; Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms*

*and Their Uses* (August, 1994); *Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms* (EPA 600/4-90/027F. 5<sup>th</sup> ed. December 2002); *Short Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms* (EPA/600/4-91/002. 4<sup>th</sup> ed. October 2002) or most recent update thereof.

Only ambient water quality data for dissolved metals generated or approved by ADEQ after March 1, 1993 will be considered in the documentation of background concentrations for the purpose of developing permit limitations.

## **ASSESSMENT METHODOLOGY FOR TOXIC SUBSTANCES**

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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:**

Monitoring segments will be listed as non-support when more than one (1) exceedance of the criterion occurs during the period of record.

### **DELISTING METHODOLOGY:**

Monitoring segments will be listed as support when there are one or fewer ( $\leq 1$ ) exceedances of the criterion during the period of record.

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## **6.8 FISH CONSUMPTION**

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This section establishes the protocol for assessing impairment due to exceedance of limits for fish consumption, based on numeric criteria in APC&EC Reg. 2.508 and narrative criteria in APC&EC Reg. 2.409.

Fish consumption listings are determined in conjunction with the Arkansas Department of Health.

## **ASSESSMENT METHODOLOGY FOR FISH CONSUMPTION**

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### **LISTING METHODOLOGY:**

Monitoring segments 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) is recommended for *non-consumption* by *any user group* (e.g., general population or high risk groups).

### **DELISTING METHODOLOGY:**

Monitoring segments 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).

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## 6.9 NUTRIENTS

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In 2001 EPA published recommended water quality criteria for nutrients under section 304(a) of the Clean Water Act (66 FR 1671) with the intention that this document would serve as a starting point for states, tribes, interstate commissions, and others to develop refined nutrient criteria (EPA 2001). According to the EPA, nutrient criteria are needed due to impairment of designated uses per the listing in Dobbs and Welch 2000: 1) adverse effects on humans and domestic animals; 2) aesthetic impairment; 3) interference with human use; 4) negative impacts on aquatic life; and 5) excessive nutrient input into downstream systems.

Currently, Arkansas maintains the following narrative nutrient standard, APC&EC Reg. 2.509:

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 are 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 established, numeric water quality standard, the waterbody will be determined to be impaired by nutrients.

All point source discharges into the watershed of waters officially listed on Arkansas' impaired waterbody list (303d) with phosphorus as the major cause shall have monthly average discharge permit limits no greater than those listed below. Additionally, waters in nutrient surplus watersheds as determined by Act 1061 of 2003 Regular Session of the Arkansas 84<sup>th</sup> General Assembly and subsequently designated nutrient surplus watersheds may be included under this Reg. if point source discharges are shown to provide a significant phosphorus contribution to waters within the listed nutrient surplus watersheds.

| <b><u>Facility Design Flow -</u></b> | <b><u>Total Phosphorus discharge limit -</u></b> |
|--------------------------------------|--|
| = or > 15                            | Case by case                                     |
| 3 to <15                             | 1.0  |
| 1 to <3                              | 2.0  |
| 0.5 to <1.0                          | 5.0  |
| <0.5                                 | Case by Case                                     |

For discharges from point sources which are greater than 15 mgd, reduction of phosphorus below 1 mg/L may be required based on the magnitude of the phosphorus load (mass) and the type of downstream waterbodies (e.g., reservoirs, Extraordinary Resource Waters). Additionally, any discharge limits listed above may be further reduced if it is determined that these values are causing impairments to special waters such as domestic water supplies, lakes or reservoirs or Extraordinary Resource Waters.

As part of *Arkansas' 2008 Nutrient Criteria Development Plan*, ADEQ developed pilot studies for the Upper Saline River watershed and Beaver Reservoir to test the methods for developing appropriate nutrient criteria for Arkansas' rivers/streams and lakes.

It was the purpose of these studies to set narrative or quantitative translators for rivers/streams on an ecoregional, watershed, or site specific basis. Qualitative criteria with numeric translators for parameters such as dissolved oxygen, dissolved oxygen percent saturation, pH, nitrite + nitrate-nitrogen (NO<sub>2</sub> +NO<sub>3</sub> – N), total phosphorus (TP), ortho-phosphate as phosphorus, turbidity, and biological community composition were also to be developed.

*Arkansas' 2008 Nutrient Criteria Development Plan* resulted in the following proposed changes to the 2013 APC&EC Regulation 2 narrative nutrient standard, APC&EC Reg. 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

ADEQ is continuing to work towards EPA's objective of developing refined nutrient criteria through the State's Level III ecoregion approach, which categorizes Arkansas' waters into six (6) ecoregions based on their physical, chemical, and biological features (APC&EC 1987). Currently, ADEQ is conducting a *Classification and Validation of Nutrient Criteria for the Extraordinary Resource Water Bodies in the Ozark Highlands Ecoregion of Arkansas* study to correlate water quality parameters to biological assemblages in the Ozark Highlands Ecoregion. The intent of this study is to develop appropriate effects-based nutrient criteria and translators on an ecoregion level. Upon completion of this study, ADEQ intends to apply its methodology to other ecoregions of the state and to continue its efforts to develop numeric criteria and/or translators to be adopted into the state's water quality standards.

Until numeric nutrient criteria has been adopted into Regulation 2.509, ADEQ will only assess nutrients for those segments with sufficient biological data to determine fisheries designated use attainment.

The relationship between nutrient enrichment and dissolved oxygen concentrations has long been established. Upon completion and validation of nutrient criteria translators from stressor/response studies, ADEQ will rely on the narrative nutrient criteria provided in Regulation 2.509. Based upon the nutrient narrative, impairments will be assessed by a combination of dissolved oxygen values, dissolved oxygen saturation, diurnal dissolved oxygen fluctuations, pH values, and aquatic life community structure.

## **ASSESSMENT METHODOLOGY FOR NUTRIENTS**

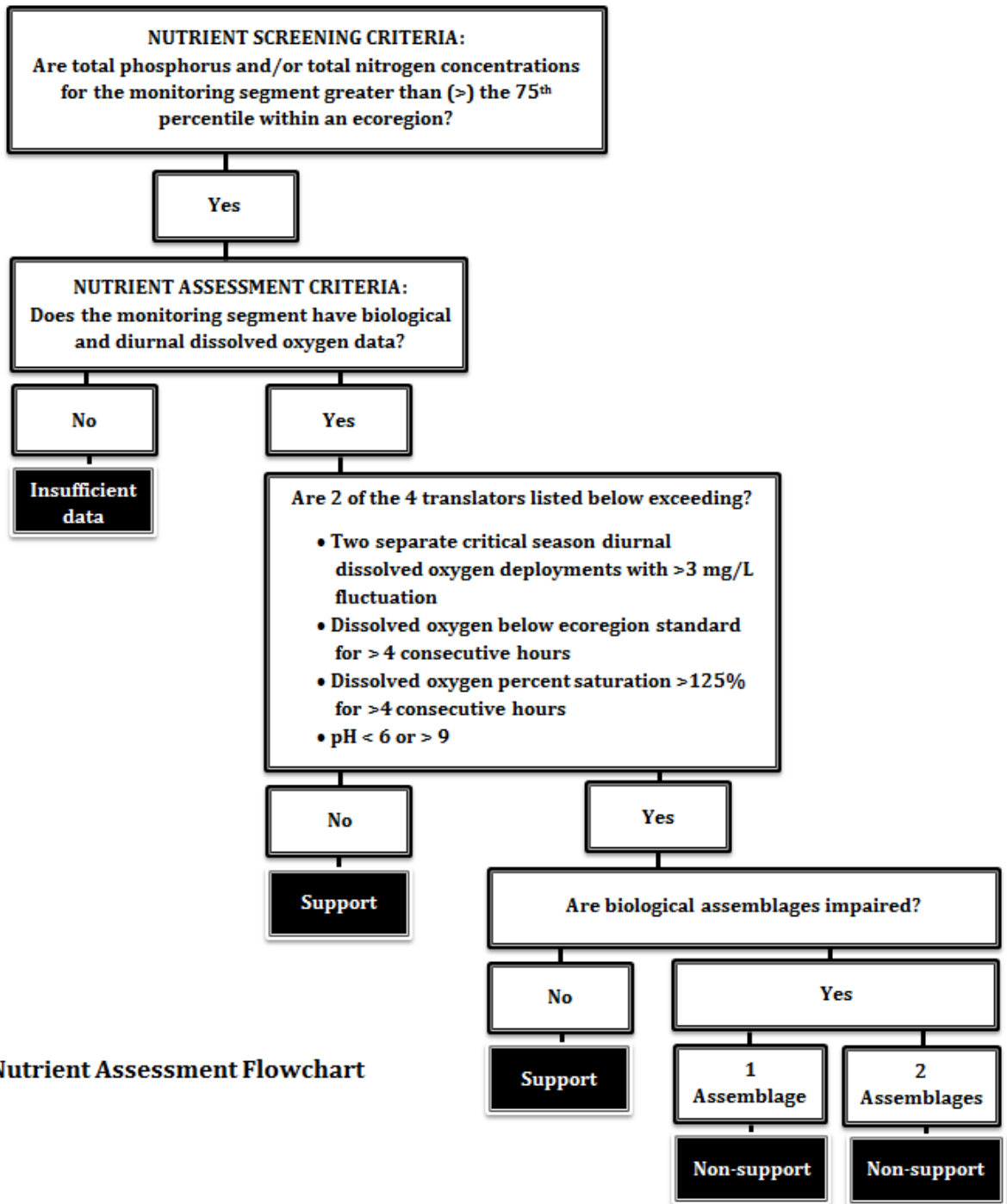
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### **LISTING METHODOLOGY:**

Monitoring segments will be listed as non-support for total phosphorus or total nitrogen if two (2) of the four (4) water quality translators are exceeded and one (1) or both biological assemblages are impaired. Water quality translators for total phosphorus and total nitrogen are two (2) separate critical season diurnal dissolved oxygen deployments (May-September) which indicate a greater than three (>3) mg/L fluctuation in concentration, dissolved oxygen saturation is >125% for four (4) consecutive hours, dissolved oxygen concentrations are below ecoregion standard for greater than four (4) consecutive hours, or pH varies from the standard of between 6.0 and 9.0 standard units. Monitoring segments that are greater than the 75<sup>th</sup> percentile for total phosphorus and total nitrogen concentrations within each ecoregion will serve as the screening criteria.

### **DELISTING METHODOLOGY:**

Monitoring segments will be listed as support for nutrients if there are fewer than two (<2) exceedances of nutrient translators and biological assemblages are fully supported.



**Nutrient Assessment Flowchart**

\*Section 5.1 discusses the determining factors for biological impairment.

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## 6.10 MINERAL QUALITY

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This section establishes the protocol for assessing impairment due to exceedance of limits for mineral quality. Assessment for mineral quality impairment in the State of Arkansas is written per APC&EC Reg. 2.511, Sections (A) and (C):

### **APC&EC Reg. 2.511, Sections (A) and (C):**

#### (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 limits apply to the streams indicated, and represent the monthly average concentrations of chloride (Cl<sup>-</sup>), sulfate (SO<sub>4</sub><sup>=</sup>) and total dissolved solids (TDS).

#### (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 limits in the streams to which they are a tributary, except in accordance with Reg. 2.306.

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## ASSESSMENT METHODOLOGY FOR MINERAL QUALITY

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Assessments for waterbodies with site specific criteria will be made according to the specific values listed in Reg. 2.511(A). For those waterbodies without site-specific criteria, the criteria of 250 mg/L of chlorides, 250 mg/L of sulfates, and 500 mg/L of total dissolved solids will apply. For Site Specific Standards, if greater than 25 percent of the total samples for the period of record exceed the applicable criteria, the waterbody will be included on the 303(d) list as non-support of the mineral standard(s). For waterbodies without site specific standards, if greater than 10 percent of the total samples for the period of record exceed the applicable criteria, the waterbody will be included on the 303(d) list as non-support of the mineral standard(s).

### **Statewide Minerals Assessment Criteria**

| Parameter                         | Standard          | Support | Non-Support |
|-----------------------------------|-------------------|---------|-------------|
| Site Specific Standards (mg/L)    | See Reg. 2.511(A) | ≤ 25%   | >25%        |
| No Site Specific Standards (mg/L) | 250/250/500       | ≤ 10%   | >10%        |

For waterbodies without site specific standards, any discharge which results in instream concentrations more than 1/3 higher than the values found in Reg.2.511(B) for chlorides (Cl<sup>-</sup>) and sulfates (SO<sub>4</sub><sup>=</sup>) or more than 15 mg/L, whichever is greater, is considered to be a significant modification of the maximum naturally occurring values. These waterbodies should be considered as candidates for site specific criteria development in accordance with Regs. 2.306 and 2.308. Similarly, site specific criteria development should be considered if the following TDS values are exceeded after being increased by the sum of the increases to Cl and SO<sub>4</sub>.



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## 6.11 DOMESTIC, AGRICULTURAL, AND INDUSTRIAL WATER SUPPLY USES

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This section establishes the protocol for assessing impairment due to exceedance of limits for domestic water supply designated uses, per APC&EC Reg. 2.511 Section (C), and is written in accordance with the Federal Safe Drinking Water Act (40 § C.F.R 143.3).

### **ASSESSMENT METHODOLOGY FOR DOMESTIC, AGRICULTURAL, AND INDUSTRIAL WATER SUPPLY USE**

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For assessment of ambient waters, the domestic, agricultural, and industrial water supply designated uses will be evaluated using (Reg. 2.511) chloride, sulfate, and total dissolved solids in accordance with the Federal Safe Drinking Water Act (40 § C.F.R 143.3). If greater than 10 percent of the total samples for the period of record exceed the criteria, the waterbody will be included on the 303(d) list as non-support of the mineral standard(s).

#### **STATEWIDE WATER SUPPLY ASSESSMENT CRITERIA**

| PARAMETER              | STANDARD | SUPPORT | NON-SUPPORT |
|------------------------|----------|---------|-------------|
| Chloride               | 250      | ≤ 10%   | >10%        |
| Sulfates               | 250      | ≤ 10%   | >10%        |
| Total Dissolved Solids | 500      | ≤ 10%   | > 10%       |

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## 6.12 AMMONIA

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This section establishes the protocol for determining impairment due to ammonia in Arkansas' surface waters, per APC&EC Reg. 2.512:

Total ammonia nitrogen (N) shall not exceed those values and frequency of occurrence established in the following tables:

- (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**

| <b><u>pH</u></b> | <b><u>Salmonids*</u></b> |                      |
|------------------|--------------------------|----------------------|
|                  | <b><u>Present</u></b>    | <b><u>Absent</u></b> |
| 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.  
Waters with salmonids present are delineated in Appendix A of APC&EC Regulation 2.

(B) The thirty-day 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**

| <b>pH</b> | <b><u>Temperature °C</u></b> |                  |                  |                  |                  |                  |                  |                  |                  |                  |
|-----------|------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
|           | <b><u>0</u></b>              | <b><u>14</u></b> | <b><u>16</u></b> | <b><u>18</u></b> | <b><u>20</u></b> | <b><u>22</u></b> | <b><u>24</u></b> | <b><u>26</u></b> | <b><u>28</u></b> | <b><u>30</u></b> |
| 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**

| <b>pH</b> | <b>Temperature °C</b> |                 |                 |                  |                  |                  |                  |                  |                   |                   |
|-----------|-----------------------|-----------------|-----------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
|           | <b><u>0-7</u></b>     | <b><u>8</u></b> | <b><u>9</u></b> | <b><u>10</u></b> | <b><u>11</u></b> | <b><u>12</u></b> | <b><u>13</u></b> | <b><u>14</u></b> | <b><u>15*</u></b> | <b><u>16*</u></b> |
| 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° C and above, the criterion for fish Early Life Stage absent is the same as the criterion for fish ELS present.

- (C) The highest four-day average within a 30-day period should not exceed 2.5 times the chronic values shown above.
- (D) For permitted discharges, the daily maximum or 7-day average permit limit shall be calculated using the four-day average value described above as an instream value, after mixing and based on a season when fish early life stages are present and a season when fish early life stages are absent. Temperature values used will be 14°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.

**ASSESSMENT METHODOLOGY FOR AMMONIA:**

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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 Reg. 2.512(A) – (D) standards. The Chronic Criterion for fish early life stages present apply during the critical season (April 1 thru October 31). The criterion shall be applied 1) the arithmetic mean of the analytical results of consecutive-day samples when available, or 2) the result of individual grab samples.

**LISTING METHODOLOGY:**

Stream and river monitoring segments, as well as lakes and reservoirs, will be listed as non-support for ammonia toxicity standards:

- I. If more than one (>1) violation of the one (1)-hour average concentration of total ammonia nitrogen exceeds the calculated Acute Criterion within the period of record; or
- II. If more than one (>1) violation of the 30-day average concentration of total ammonia nitrogen exceeds the Chronic Criterion within the period of record; or
- III. If more than one (>1) violation of the four (4)-day average within a 30-day period exceeds 2.5 times the Chronic Criterion value within the period of record.

**DELISTING METHODOLOGY:**

Stream and river monitoring segments, as well as lakes and reservoirs, will be listed as support for ammonia toxicity standards:

- I. If there is a maximum of one (1) violation of the one (1)-hour average concentration of total ammonia nitrogen exceeding the calculated acute criterion within the period of record; or
- II. If there is a maximum of one (1) violation of the four (4)-day average within a 30-day period exceeding 2.5 times the chronic criterion value within the period of record; or
- III. If there is a maximum of one (1) violation of the 30-day average concentration of total ammonia nitrogen exceeding the chronic criterion within the period of record.

**Statewide Total Ammonia Nitrogen Assessment Criteria**

| Assessment  | 1-hour average | 4-day average | 30-day average |
|-------------|----------------|---------------|----------------|
| Support     | 1 in 3 years   | 1 in 3 years  | 1 in 3 years   |
| Non-Support | >1 in 3 years  | >1 in 3 years | >1 in 3 years  |

APPENDIX A

**ASSESSMENT CRITERIA FOR STREAMS IN THE  
ARKANSAS RIVER VALLEY ECOREGION**

| PARAMETER                            | STANDARD                 |          | SUPPORT                        |          | NON-SUPPORT |          |
|--------------------------------------|--------------------------|----------|--------------------------------|----------|-------------|----------|
|                                      |                          |          | DATA POINTS EXCEEDING CRITERIA |          |             |          |
| TEMPERATURE <sup>1</sup>             | 31° C                    |          | ≤10%                           |          | >10%        |          |
| DISSOLVED OXYGEN <sup>1</sup> (mg/L) | Primary                  | Critical | Primary                        | Critical | Primar      | Critical |
| <10 mi <sup>2</sup>                  | 5                        | 2        | ≤ 10%                          |          | >10%        |          |
| 10-150 mi <sup>2</sup>               | 5                        | 3        | ≤ 10%                          |          | >10%        |          |
| 151-400 mi <sup>2</sup>              | 5                        | 4        | ≤ 10%                          |          | >10%        |          |
| >400 mi <sup>2</sup>                 | 5                        | 5        | ≤ 10%                          |          | >10%        |          |
| pH                                   | 6 to 9 standard pH units |          | ≤ 10%                          |          | >10%        |          |
| CL/SO <sub>4</sub> /TDS <sup>1</sup> | 250/250/500              |          | ≤ 10%                          |          | >10%        |          |
| TURBIDITY                            |                          |          |                                |          |             |          |
| Base Flows                           | 21 NTU                   |          | ≤ 20%                          |          | >20%        |          |
| All Flows                            | 40 NTU                   |          | ≤ 25%                          |          | >25%        |          |

<sup>1</sup> Except for site specific standards approved in water quality standards.

**ASSESSMENT CRITERIA FOR STREAMS IN THE  
BOSTON MOUNTAINS ECOREGION**

| PARAMETER                            | STANDARD                 |          | SUPPORT                        |          | NON-SUPPORT |          |
|--------------------------------------|--------------------------|----------|--------------------------------|----------|-------------|----------|
|                                      |                          |          | DATA POINTS EXCEEDING CRITERIA |          |             |          |
| TEMPERATURE <sup>1</sup>             | 31° C                    |          | ≤ 10%                          |          | >10%        |          |
| DISSOLVED OXYGEN <sup>1</sup> (mg/L) | Primary                  | Critical | Primary                        | Critical | Primar      | Critical |
| <10 mi <sup>2</sup>                  | 6                        | 2        | ≤ 10%                          |          | >10%        |          |
| > 10 mi <sup>2</sup>                 | 6                        | 6        | ≤ 10%                          |          | >10%        |          |
| pH                                   | 6 to 9 standard pH units |          | ≤ 10%                          |          | >10%        |          |
| CL/SO <sub>4</sub> /TDS <sup>1</sup> | 250/250/500              |          | ≤ 10%                          |          | >10%        |          |
| TURBIDITY                            |                          |          |                                |          |             |          |
| Base Flows                           | 10 NTU                   |          | ≤ 20%                          |          | >20%        |          |
| All Flows                            | 19 NTU                   |          | ≤ 25%                          |          | >25%        |          |

<sup>1</sup> Except for site specific standards approved in water quality standards.

**ASSESSMENT CRITERIA FOR STREAMS IN THE  
DELTA ECOREGION (Channel Altered)**

| PARAMETER                            | STANDARD                 |          | SUPPORT                        |          | NON-SUPPORT |          |
|--------------------------------------|--------------------------|----------|--------------------------------|----------|-------------|----------|
|                                      |                          |          | DATA POINTS EXCEEDING CRITERIA |          |             |          |
| TEMPERATURE <sup>1</sup>             | 32° C                    |          | ≤10%                           |          | >10%        |          |
| DISSOLVED OXYGEN <sup>1</sup> (mg/L) | Primary                  | Critical | Primary                        | Critical | Primary     | Critical |
| <10 mi <sup>2</sup>                  | 5                        | 2        | ≤ 10%                          |          | >10%        |          |
| 10-100 mi <sup>2</sup>               | 5                        | 3        | ≤ 10%                          |          | >10%        |          |
| >100 mi <sup>2</sup>                 | 5                        | 5        | ≤ 10%                          |          | >10%        |          |
| pH                                   | 6 to 9 standard pH units |          | ≤ 10%                          |          | >10%        |          |
| CL/SO <sub>4</sub> /TDS <sup>1</sup> | 250/250/500              |          | ≤ 10%                          |          | >10%        |          |
| TURBIDITY                            |                          |          |                                |          |             |          |
| Base Flows                           | 75 NTU                   |          | ≤ 20%                          |          | >20%        |          |
| All Flows                            | 250 NTU                  |          | ≤ 25%                          |          | >25%        |          |

<sup>1</sup> Except for site specific standards approved in water quality standards.

**ASSESSMENT CRITERIA FOR STREAMS IN THE  
DELTA ECOREGION (Least Altered)**

| PARAMETER                            | STANDARD                 |          | SUPPORT                        |          | NON-SUPPORT |          |
|--------------------------------------|--------------------------|----------|--------------------------------|----------|-------------|----------|
|                                      |                          |          | DATA POINTS EXCEEDING CRITERIA |          |             |          |
| TEMPERATURE <sup>1</sup>             | 30° C                    |          | ≤ 10%                          |          | >10%        |          |
| DISSOLVED OXYGEN <sup>1</sup> (mg/L) | Primary                  | Critical | Primary                        | Critical | Primary     | Critical |
| <10 mi <sup>2</sup>                  | 5                        | 2        | ≤ 10%                          |          | >10%        |          |
| 10-100 mi <sup>2</sup>               | 5                        | 3        | ≤ 10%                          |          | >10%        |          |
| >100 mi <sup>2</sup>                 | 5                        | 5        | ≤ 10%                          |          | >10%        |          |
| pH                                   | 6 to 9 standard pH units |          | ≤ 10%                          |          | >10%        |          |
| CL/SO <sub>4</sub> /TDS <sup>1</sup> | 250/250/500              |          | ≤ 10%                          |          | >10%        |          |
| TURBIDITY                            |                          |          |                                |          |             |          |
| Base Flows                           | 45 NTU                   |          | ≤ 20%                          |          | >20%        |          |
| All Flows                            | 84 NTU                   |          | ≤ 25%                          |          | >25%        |          |

<sup>1</sup> Except for site specific standards approved in water quality standards.

**ASSESSMENT CRITERIA FOR STREAMS IN THE  
GULF COASTAL ECOREGION (Typical Streams)**

| PARAMETER                            | STANDARD                 |          | SUPPORT                        |          | NON-SUPPORT |          |
|--------------------------------------|--------------------------|----------|--------------------------------|----------|-------------|----------|
|                                      |                          |          | DATA POINTS EXCEEDING CRITERIA |          |             |          |
| TEMPERATURE <sup>1</sup>             | 30° C                    |          | ≤ 10%                          |          | >10%        |          |
| DISSOLVED OXYGEN <sup>1</sup> (mg/L) | Primary                  | Critical | Primary                        | Critical | Primary     | Critical |
| <10 mi <sup>2</sup>                  | 5                        | 2        | ≤ 10%                          |          | >10%        |          |
| 10-500 mi <sup>2</sup>               | 5                        | 3        | ≤ 10%                          |          | >10%        |          |
| >500 mi <sup>2</sup>                 | 5                        | 5        | ≤ 10%                          |          | >10%        |          |
| pH                                   | 6 to 9 standard pH units |          | ≤ 10%                          |          | >10%        |          |
| CL/SO <sub>4</sub> /TDS <sup>1</sup> | 250/250/500              |          | ≤ 10%                          |          | >10%        |          |
| TURBIDITY                            |                          |          |                                |          |             |          |
| Base Flows                           | 21 NTU                   |          | ≤ 20%                          |          | >20%        |          |
| All Flows                            | 32 NTU                   |          | ≤ 25%                          |          | >25%        |          |

<sup>1</sup> Except for site specific standards approved in water quality standards.

**ASSESSMENT CRITERIA FOR STREAMS IN THE  
GULF COASTAL ECOREGION (Spring water Influenced)**

| PARAMETER                            | STANDARD                 |          | SUPPORT                        |          | NON-SUPPORT |          |
|--------------------------------------|--------------------------|----------|--------------------------------|----------|-------------|----------|
|                                      |                          |          | DATA POINTS EXCEEDING CRITERIA |          |             |          |
| TEMPERATURE <sup>1</sup>             | 30° C                    |          | ≤ 10%                          |          | >10%        |          |
| DISSOLVED OXYGEN <sup>1</sup> (mg/L) | Primary                  | Critical | Primary                        | Critical | Primary     | Critical |
| ALL WATERSHEDS                       | 6                        | 5        | ≤ 10%                          |          | >10%        |          |
| pH                                   | 6 to 9 standard pH units |          | ≤ 10%                          |          | >10%        |          |
| CL/SO <sub>4</sub> /TDS <sup>1</sup> | 250/250/500              |          | ≤ 10%                          |          | >10%        |          |
| TURBIDITY                            |                          |          |                                |          |             |          |
| Base Flows                           | 21 NTU                   |          | ≤ 20%                          |          | >20%        |          |
| All Flows                            | 32 NTU                   |          | ≤ 25%                          |          | >25%        |          |

<sup>1</sup> Except for site specific standards approved in water quality standards.



**ASSESSMENT CRITERIA FOR STREAMS IN THE  
OUACHITA MOUNTAINS ECOREGION STREAMS**

| PARAMETER                            | STANDARD                 |          | SUPPORT                        |          | NON-SUPPORT |          |
|--------------------------------------|--------------------------|----------|--------------------------------|----------|-------------|----------|
|                                      |                          |          | DATA POINTS EXCEEDING CRITERIA |          |             |          |
| TEMPERATURE <sup>1</sup>             | 30° C                    |          | ≤ 10%                          |          | >10%        |          |
| DISSOLVED OXYGEN <sup>1</sup> (mg/L) | Primary                  | Critical | Primary                        | Critical | Primary     | Critical |
| <10 mi <sup>2</sup>                  | 6                        | 2        | ≤ 10%                          |          | >10%        |          |
| >10 mi <sup>2</sup>                  | 6                        | 6        | ≤ 10%                          |          | >10%        |          |
| pH                                   | 6 to 9 standard pH units |          | ≤ 10%                          |          | >10%        |          |
| CL/SO <sub>4</sub> /TDS <sup>1</sup> | 250/250/500              |          | ≤ 10%                          |          | >10%        |          |
| TURBIDITY                            |                          |          |                                |          |             |          |
| Base Flows                           | 10 NTU                   |          | ≤ 20%                          |          | >20%        |          |
| All Flows                            | 18 NTU                   |          | ≤ 25%                          |          | >25%        |          |

<sup>1</sup> Except for site specific standards approved in water quality standards.

**ASSESSMENT CRITERIA FOR STREAMS IN THE  
OZARK HIGHLANDS ECOREGION STREAMS**

| PARAMETER                            | STANDARD                 |          | SUPPORT                        |          | NON-SUPPORT |          |
|--------------------------------------|--------------------------|----------|--------------------------------|----------|-------------|----------|
|                                      |                          |          | DATA POINTS EXCEEDING CRITERIA |          |             |          |
| TEMPERATURE <sup>1</sup>             | 29° C                    |          | ≤ 10%                          |          | >10%        |          |
| DISSOLVED OXYGEN <sup>1</sup> (mg/L) | Primary                  | Critical | Primary                        | Critical | Primary     | Critical |
| <10 mi <sup>2</sup>                  | 6                        | 2        | ≤ 10%                          |          | >10%        |          |
| 10-100 mi <sup>2</sup>               | 6                        | 5        | ≤ 10%                          |          | >10%        |          |
| > 100 mi <sup>2</sup>                | 6                        | 6        | ≤ 10%                          |          | >10%        |          |
| Trout Waters                         | 6                        | 6        | ≤ 10%                          |          | >10%        |          |
| pH                                   | 6 to 9 standard pH units |          | ≤ 10%                          |          | >10%        |          |
| CL/SO <sub>4</sub> /TDS <sup>1</sup> | 250/250/500              |          | ≤ 10%                          |          | >10%        |          |
| TURBIDITY                            |                          |          |                                |          |             |          |
| Base Flows                           | 10 NTU                   |          | ≤ 20%                          |          | >20%        |          |
| All Flows                            | 17 NTU                   |          | ≤ 25%                          |          | >25%        |          |

<sup>1</sup> Except for site specific standards approved in water quality standards.

APPENDIX B

ASSESSMENT CRITERIA FOR LAKES

| PARAMETER                            | STANDARD                 | SUPPORT                        | NON-SUPPORT |
|--------------------------------------|--------------------------|--------------------------------|-------------|
|                                      |                          | DATA POINTS EXCEEDING CRITERIA |             |
| TEMPERATURE <sup>1</sup>             | 32° C                    | ≤ 10%                          | >10%        |
| DISSOLVED OXYGEN <sup>1</sup> (mg/L) | 5                        | ≤ 10%                          | >10%        |
| pH                                   | 6 to 9 standard pH units | ≤ 10%                          | >10%        |
| CL/SO <sub>4</sub> /TDS <sup>1</sup> | 250/250/500              | ≤ 10%                          | >10%        |
| TURBIDITY                            |                          |                                |             |
| Base Flows                           | 25 NTU                   | ≤ 20%                          | >20%        |
| All Flows                            | 45 NTU                   | ≤ 25%                          | >25%        |

<sup>1</sup> Except for site specific standards approved in water quality standards.

## APPENDIX C

### ASSESSMENT CRITERIA FOR THE ARKANSAS RIVER

| PARAMETER                            | STANDARD                 |          | SUPPORT                        |          | NON-SUPPORT |          |
|--------------------------------------|--------------------------|----------|--------------------------------|----------|-------------|----------|
|                                      |                          |          | DATA POINTS EXCEEDING CRITERIA |          |             |          |
| TEMPERATURE <sup>1</sup>             | 32° C                    |          | ≤ 10%                          |          | >10%        |          |
| DISSOLVED OXYGEN <sup>1</sup> (mg/L) | Primary                  | Critical | Primary                        | Critical | Primary     | Critical |
| ALL WATERS                           | 5                        | 5        | ≤ 10%                          |          | >10%        |          |
| pH                                   | 6 to 9 standard pH units |          | ≤ 10%                          |          | >10%        |          |
| TURBIDITY                            |                          |          |                                |          |             |          |
| Base Flows                           | 50 NTU                   |          | ≤ 20%                          |          | >20%        |          |
| All Flows                            | 52 NTU                   |          | ≤ 25%                          |          | >25%        |          |

<sup>1</sup> Except for site specific standards approved in water quality standards.

### ASSESSMENT CRITERIA FOR THE MISSISSIPPI RIVER

| PARAMETER                            | STANDARD                 |          | SUPPORT                        |          | NON-SUPPORT |          |
|--------------------------------------|--------------------------|----------|--------------------------------|----------|-------------|----------|
|                                      |                          |          | DATA POINTS EXCEEDING CRITERIA |          |             |          |
| TEMPERATURE <sup>1</sup>             | 32° C                    |          | ≤ 10%                          |          | >10%        |          |
| DISSOLVED OXYGEN <sup>1</sup> (mg/L) | Primary                  | Critical | Primary                        | Critical | Primary     | Critical |
| ALL WATERS                           | 5                        | 5        | ≤ 10%                          |          | >10%        |          |
| pH                                   | 6 to 9 standard pH units |          | ≤ 10%                          |          | >10%        |          |
| TURBIDITY                            |                          |          |                                |          |             |          |
| Base Flows                           | 50 NTU                   |          | ≤ 20%                          |          | >20%        |          |
| All Flows                            | 75 NTU                   |          | ≤ 25%                          |          | >25%        |          |

<sup>1</sup> Except for site specific standards approved in water quality standards.

**ASSESSMENT CRITERIA FOR THE OUACHITA RIVER**

| PARAMETER                            | STANDARD                 |          | SUPPORT                        |          | NON-SUPPORT |          |
|--------------------------------------|--------------------------|----------|--------------------------------|----------|-------------|----------|
|                                      |                          |          | DATA POINTS EXCEEDING CRITERIA |          |             |          |
| TEMPERATURE <sup>1</sup>             | 32° C                    |          | ≤ 10%                          |          | >10%        |          |
| L. MISSOURI TO S.LINE                | 32° C                    |          | ≤ 10%                          |          | >10%        |          |
| ABOVE L. MISSOURI                    | 30° C                    |          | ≤ 10%                          |          | >10%        |          |
| DISSOLVED OXYGEN <sup>1</sup> (mg/L) | Primary                  | Critical | Primary                        | Critical | Primary     | Critical |
| ALL WATERS                           | 5                        | 5        | ≤ 10%                          |          | >10%        |          |
| pH                                   | 6 to 9 standard pH units |          | ≤ 10%                          |          | >10%        |          |
| TURBIDITY                            |                          |          |                                |          |             |          |
| Base Flows                           | 21 NTU                   |          | ≤ 20%                          |          | >20%        |          |
| All Flows                            | 32 NTU                   |          | ≤ 25%                          |          | >25%        |          |

<sup>1</sup> Except for site specific standards approved in water quality standards.

**ASSESSMENT CRITERIA FOR THE RED RIVER**

| PARAMETER                            | STANDARD           |          | SUPPORT                        |          | NON-SUPPORT |          |
|--------------------------------------|--------------------|----------|--------------------------------|----------|-------------|----------|
|                                      |                    |          | DATA POINTS EXCEEDING CRITERIA |          |             |          |
| TEMPERATURE <sup>1</sup>             | 32° C              |          | ≤ 10%                          |          | >10%        |          |
| DISSOLVED OXYGEN <sup>1</sup> (mg/L) | Primary            | Critical | Primary                        | Critical | Primary     | Critical |
| ALL WATERS                           | 5                  | 5        | ≤ 10%                          |          | >10%        |          |
| pH                                   | 6 to 9 standard pH |          | ≤ 10%                          |          | >10%        |          |
| TURBIDITY                            |                    |          |                                |          |             |          |
| Base Flows                           | 50 NTU             |          | ≤ 20%                          |          | >20%        |          |
| All Flows                            | 150 NTU            |          | ≤ 25%                          |          | >25%        |          |

<sup>1</sup> Except for site specific standards approved in water quality standards.

**ASSESSMENT CRITERIA FOR ST. FRANCIS RIVER**

| PARAMETER                            | STANDARD                 |          | SUPPORT                        |          | NON-SUPPORT |          |
|--------------------------------------|--------------------------|----------|--------------------------------|----------|-------------|----------|
|                                      |                          |          | DATA POINTS EXCEEDING CRITERIA |          |             |          |
| TEMPERATURE <sup>1</sup>             | 32° C                    |          | ≤ 10%                          |          | >10%        |          |
| DISSOLVED OXYGEN <sup>1</sup> (mg/L) | Primary                  | Critical | Primary                        | Critical | Primary     | Critical |
| ALL WATERS                           | 5                        | 5        | ≤ 10%                          |          | >10%        |          |
| pH                                   | 6 to 9 standard pH units |          | ≤ 10%                          |          | >10%        |          |
| TURBIDITY                            |                          |          |                                |          |             |          |
| Base Flows                           | 75 NTU                   |          | ≤ 20%                          |          | >20%        |          |
| All Flows                            | 100 NTU                  |          | ≤ 25%                          |          | >25%        |          |

<sup>1</sup> Except for site specific standards approved in water quality standards.

**ASSESSMENT CRITERIA FOR WHITE RIVER (MAIN STEM)**

| PARAMETER                                | STANDARD                 |          | SUPPORT                        |          | NON-SUPPORT |          |
|--|--------------------------|----------|--------------------------------|----------|-------------|----------|
|  |                          |          | DATA POINTS EXCEEDING CRITERIA |          |             |          |
| TEMPERATURE <sup>1</sup>                 |                          |          |                                |          |             |          |
| DAM #1 TO MOUTH                          | 32° C                    |          | ≤ 10%                          |          | >10%        |          |
| OZARK HIGHLANDS                          | 29° C                    |          | ≤ 10%                          |          | >10%        |          |
| TROUT WATERS                             | 20° C                    |          | ≤ 10%                          |          | >10%        |          |
| DISSOLVED OXYGEN <sup>1</sup> (mg/L)     | Primary                  | Critical | Primary                        | Critical | Primary     | Critical |
| DELTA                                    | 5                        | 5        | ≤ 10%                          |          | >10%        |          |
| OZARK HIGHLANDS                          | 6                        | 6        | ≤ 10%                          |          | >10%        |          |
| TROUT WATERS                             | 6                        | 6        | ≤ 10%                          |          | >10%        |          |
| pH                                       | 6 to 9 standard pH units |          | ≤ 10%                          |          | >10%        |          |
| TURBIDITY                                |                          |          |                                |          |             |          |
| Base Flows - Delta                       | 45 NTU                   |          | ≤ 20%                          |          | >20%        |          |
| All Flows - Delta <sup>2</sup>           | 84 NTU                   |          | ≤ 25%                          |          | >25%        |          |
| Base Flows - Ozark Highlands             | 10 NTU                   |          | ≤ 20%                          |          | >20%        |          |
| All Flows - Ozark Highlands <sup>2</sup> | 17 NTU                   |          | ≤ 25%                          |          | >25%        |          |

<sup>1</sup> Except for site specific standards approved in water quality standards.

<sup>2</sup> Criteria based on 90th percentile of ecoregion values.

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