

# ARKANSAS NUTRIENT CRITERIA DEVELOPMENT

EPA Region 6 Nutrient RTAG

Dallas, Texas

April 14, 2015

# CRITERIA DEVELOPMENT MILESTONES

Assessment Methodology

Beaver Lake

Wadeable Streams

Nutrient Trading-Act 335 of 2015

Site-Specific Criteria



*"To protect, enhance, and restore the natural environment for the well-being of all Arkansans."*

# 2016 Nutrient Assessment Methodology

- Clarification of text
- Addition of methodology for Beaver Lake
- Addition and/or refinement of translators

# Beaver Lake

## Criteria

Proposed and adopted by APC&EC (2013 Triennial Review)

Growing season GM chlorophyll a concentration - 8 ug/L

Secchi transparency: annual average 1.1 meters (43.3 inches)

*Awaiting ROD from EPA*

## Assessment Method

Beaver Lake Workgroup

University of Arkansas

Three year study

- Objective 1-Derive an initial AM based on methods used to develop SSC
- Objective 2-Assess variation of Chl-a and ST across multiple spatial and temporal scales
- Objective 3-Quantify trends in Chl-a, ST, and nutrients in Beaver Lake and major inflowing rivers



*"To protect, enhance, and restore the natural environment for the well-being of all Arkansans."*

# Chapter 6.9 Nutrients 2016 AM

## Beaver Lake

### **LISTING METHODOLOGY FOR BEAVER LAKE:**

The upper portion of Beaver Lake will be listed as non-support of its drinking water designated use when there are three or more ( $\geq 3$ ) exceedances of the growing season chlorophyll *a* criteria within the five-year period of record. Samples collected 1.0 meter below the surface of the water will be used to make lake and reservoir attainment decisions.

The upper portion of Beaver Lake will be listed as non-support of its drinking water designated use when there are three or more ( $\geq 3$ ) exceedances of the annual average secchi transparency criteria within the five-year period of record.

### **DELISTING METHODOLOGY FOR BEAVER LAKE:**

The upper portion of Beaver Lake will be listed as supporting its drinking water designated use when there are no more than two (2) exceedances of the growing season chlorophyll *a* criteria *and* no more than two (2) exceedances of the annual average secchi transparency criteria within the five-year period of record. Samples collected 1.0 meter below the surface of the water will be used to make lake and reservoir attainment decisions for chlorophyll *a*.



*"To protect, enhance, and restore the natural environment for the well-being of all Arkansans."*

- Reg. 2.509 Nutrients

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.

- **Reg. 2.509 Nutrients**

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.

# **Historic Assessment of Nutrient Narrative Criteria**

## 2006-2008

Waters will be assessed as “non-support” when violation of any narrative water quality standard has been verified by ADEQ. Waters will be assessed as “non-support” if any associated numeric standard is violated pursuant to ADEQ’s assessment methodology.

## 2010-2012

Waters will be assessed as “non-support” when violation of any narrative water quality standard has been verified by ADEQ. This will be accomplished by use of reports documenting a water quality standards impairment caused by exceedance of a narrative criterion. The validity of the report must have been verified by an ADEQ Water Division Planning Branch employee. 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.

## 2014

Ecoregion Screening Criteria

Nutrient Assessment Criteria (flowchart)



# Chapter 6.9 Nutrients 2016 AM

## Wadeable Streams and Rivers

### **LISTING METHODOLOGY FOR WADEABLE STREAMS:**

Wadeable stream and river monitoring segments will be listed as non-support for nutrients when the following conditions occur:

The mean total phosphorus or total nitrogen concentration of the monitoring segment is greater than the 75<sup>th</sup> percentile of the total phosphorus or total nitrogen data from wadeable stream and river monitoring segments within an ecoregion, and

When both of the 72-hour data sets indicate at least two of the four water quality translators as listed in the flow chart are exceeded, and

One or both biological assemblages as listed in the flow chart are evaluated as impaired.

Water quality translators are dissolved oxygen fluctuation, dissolved oxygen concentrations, dissolved oxygen percent saturation, and pH. Two separate, 72-hour data sets within the same critical season (when water temperatures are greater than 22°C) are required for evaluation.

The dissolved oxygen fluctuation translator is considered exceeded when there is a greater than 3 mg/L fluctuation in concentration. The dissolved oxygen concentration translator is considered to be exceeded when dissolved oxygen concentration is below the applicable standard for greater than four consecutive hours. The dissolved oxygen saturation translator is considered exceeded when saturation is greater than 125% for four consecutive hours. The pH translator is considered to be exceeded when pH varies from the standard of between 6.0 and 9.0 standard units.

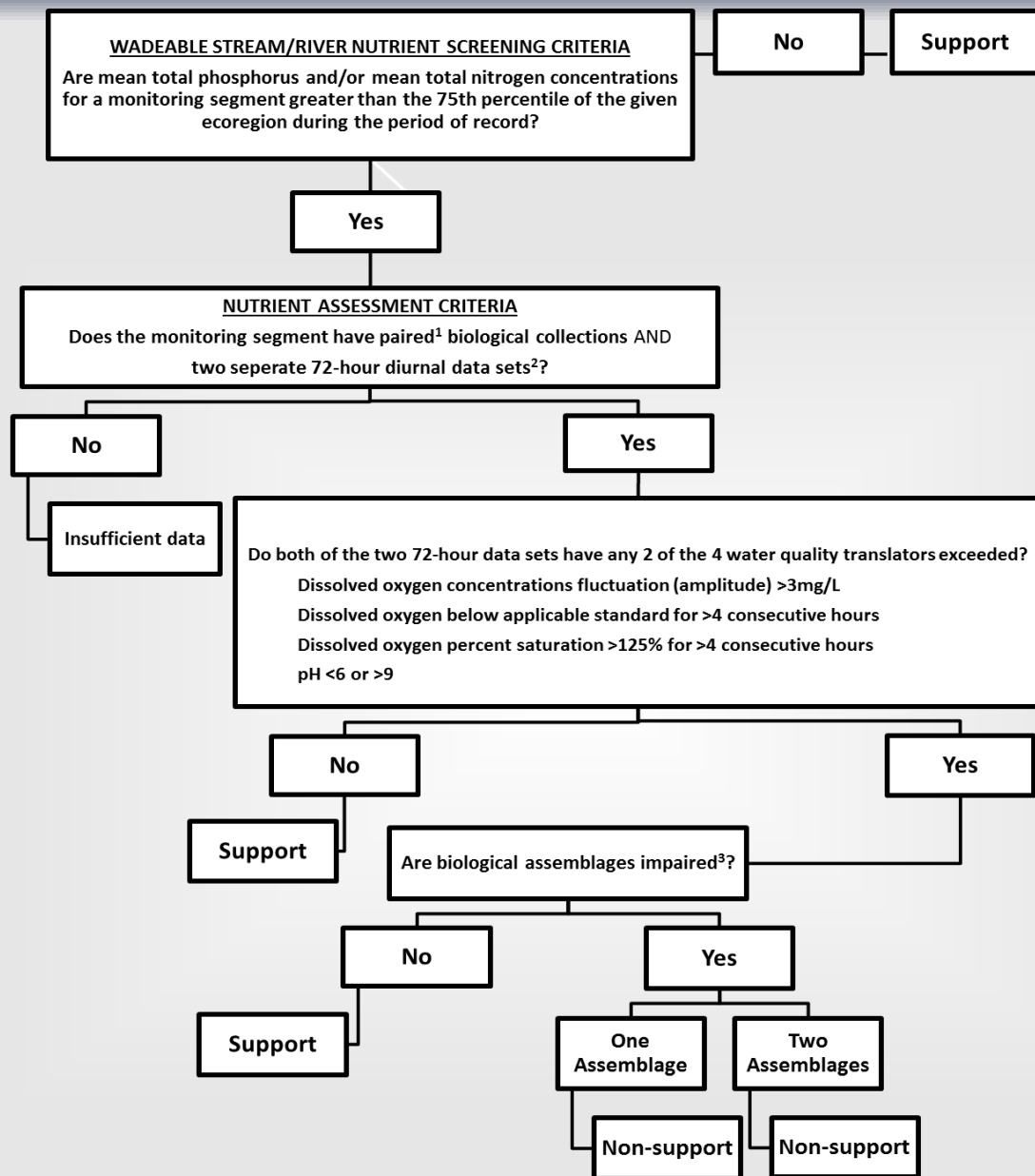
Any wadeable stream or river segment that exceeds screening level criteria, but lacks adequate data to assess will be placed into Category 3 (Insufficient Data). Category 3 streams will be prioritized based on the magnitude of nutrient concentration, available data, and staff resources.

### **DELISTING METHODOLOGY FOR WADEABLE STREAMS:**

Wadeable stream and river monitoring segments will be listed as support for nutrients if there are fewer than two (<2) exceedances of nutrient translators for each 72-hour data set and biological assemblages are fully supported.



*"To protect, enhance, and restore the natural environment for the well-being of all Arkansans."*



<sup>1</sup>Paired data/ collections are defined as combined physical, chemical, and biological collections within the same calendar year and/or season.

<sup>2</sup> 72-hour diurnal dissolved oxygen deployments must occur during the same critical season (water temperature is >22° C).

<sup>3</sup>Section 5.1 discusses the determining factors for biological impairment.

# Results of 2014 Assessment

## 75<sup>th</sup> Percentile Screening Criteria

	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)
Ozark Highlands	0.10	2.56
Ouachita Mountains	0.05	0.54
Boston Mountains	0.05	0.45
Arkansas River Valley	0.12	1.13
Gulf Coastal Plains	0.27	1.37
Mississippi Alluvial Valley	0.12	1.12



*"To protect, enhance, and restore the natural environment for the well-being of all Arkansans."*

# Results of 2014 Assessment

The 2014 AM resulted in no new impairments for total phosphorus or total nitrogen

However, many streams exceeded screening criteria, but lacked sufficient data (Category 3 Insufficient Data).

	Total Phosphorus	Total Nitrogen
Ozark Highlands	19%	21%
Ouachita Mountains	33%	21%
Boston Mountains	18%	15%
Arkansas River Valley	21%	20%
Gulf Coastal Plains	28%	28%
Mississippi Alluvial Valley	35%	40%



*"To protect, enhance, and restore the natural environment for the well-being of all Arkansans."*

# ARKANSAS 2015 NUTRIENT LAW

## Act 335

For an act to amend the laws pertaining to the promulgation of water quality regulations and the issuance of wastewater discharge permits; to authorize the implementation of nutrient water quality trading, credits, offsets, and compliance associations; and for other purposes.

## Subtitle

To amend the laws regarding water quality regulations and wastewater discharge permits; an to authorize nutrient water quality trading, credits, offsets, and compliance associations.



*"To protect, enhance, and restore the natural environment for the well-being of all Arkansans."*

# ARKANSAS 2015 NUTRIENT LAW

## Act 335:

Section 2. Arkansas Code Title 8, Chapter 4, Subchapter 2, is amended to add an additional section to read as follows:

### 8-4-232 Nutrient water quality trading programs.

(b)(1) The APC&EC may adopt regulation that specify requirement, standards, and procedures governing the establishment and implementation of nutrient water quality trading programs, including without limitation program scope, eligibility, and threshold treatment requirements.



*"To protect, enhance, and restore the natural environment for the well-being of all Arkansans."*

# ARKANSAS 2015 NUTRIENT LAW

## Act 335:

Section 2. Arkansas Code Title 8, Chapter 4, Subchapter 2, is amended to add an additional section to read as follows:

8-4-232 (b)(2) The nutrient water quality trading programs may included without limitation the following:

- The establishment and regulation of nutrient water quality trading exchanges;
- The establishment and regulation of nutrient water quality compliance associations;
- The authorization and regulation of nutrient water quality trading credits;
- The authorization and regulation of nutrient water quality offsets;
- The establishment of a schedule for user fees to be collected by ADEQ from persons or entities utilizing nutrient water quality trades or offsets to comply with permit limits; provided that such fees are based on a record calculating a reasonable costs to the agency of implementing and enforcing the trading, credit, or offset program in question; and
- The establishment of a Nutrient Water Quality Trading Advisory Panel



*"To protect, enhance, and restore the natural environment for the well-being of all Arkansans."*

# Extraordinary Resource Waterbody

## Ecoregion Based

Ozark Highlands 2012-2014

Boston Mountain 2013-2015

Ouachita Mountains 2015-2017

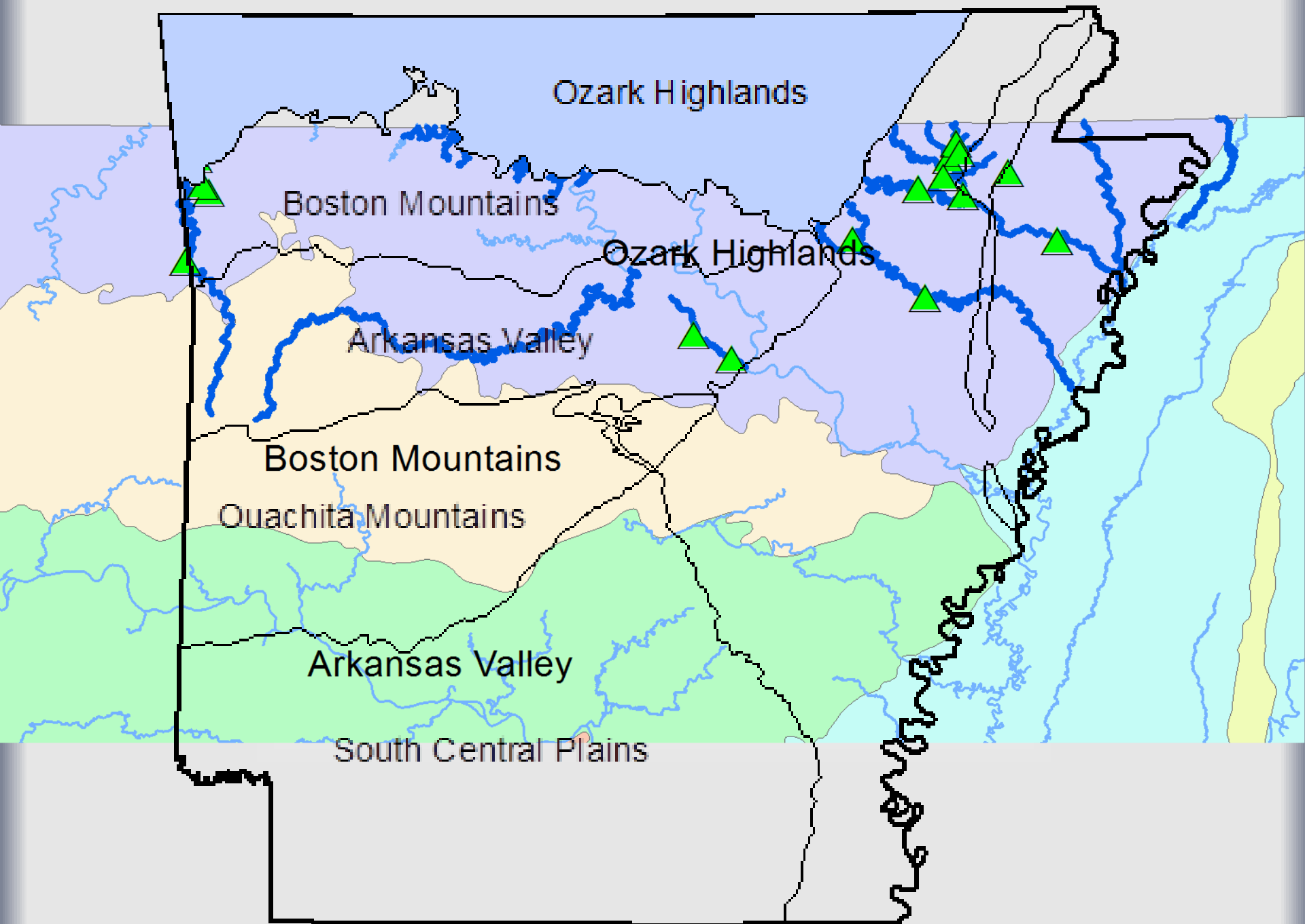


*"To protect, enhance, and restore the natural environment for the well-being of all Arkansans."*



# Methodology

- Compile and analyze historic water quality data
  - Fourteen (14) Ozark Highland ERWs
    - Five (5) no water quality or biological data
    - One (1) reservoir
    - Watershed sizes range from 6.52 to 2611 mi<sup>2</sup>
      - Wadeable ERW Streams (10)
        - 6.52-540mi<sup>2</sup>



# Methodology

## Water Quality Assessments

### In-situ parameters

- Water chemistry
- Diurnal dissolved oxygen assessments
  - Deploy continuous read meters twice during critical season
    - pH
    - Temperature
    - Conductivity





# Physical Habitat Assessment

## (Two-Tiered Approach)

Tier One: Quantitative Assessment of:

Bank Stability, riparian corridor, channel morphology,  
embeddedness, substrate size class, in-channel  
cover, canopy cover, depth profiles, discharge

Tier Two: Qualitative Assessment following Barbour et al. 1999



# Periphyton Assemblage Assessment

## Quantitative Assessments of Periphyton

Spring and Summer (critical season)

Biomass (Ash Free Dry Mass AFDM)

Chlorophyll a





# Macroinvertebrate and Fish Assemblage Assessment

Spring/Fall

Summer (critical season)



# Data Analysis

Descriptive Statistics

Seasonal Differences

Spearman Correlations

## Physical

Canopy Cover

Pebble Size D25

Pebble Size D50

Discharge

Riffle Surface Area

Riffle Slope

Percent Forest

Percent Urban

Percent Pasture

Turbidity

## Chemical

Total Phosphorus

Total Nitrogen

Total Kjeldahl Nitrogen

Nitrite-Nitrate Nitrogen

Watershed Size

## Biological

Benthic Chlorophyll a

Periphyton Biomass

Macroinvertebrate Assemblage

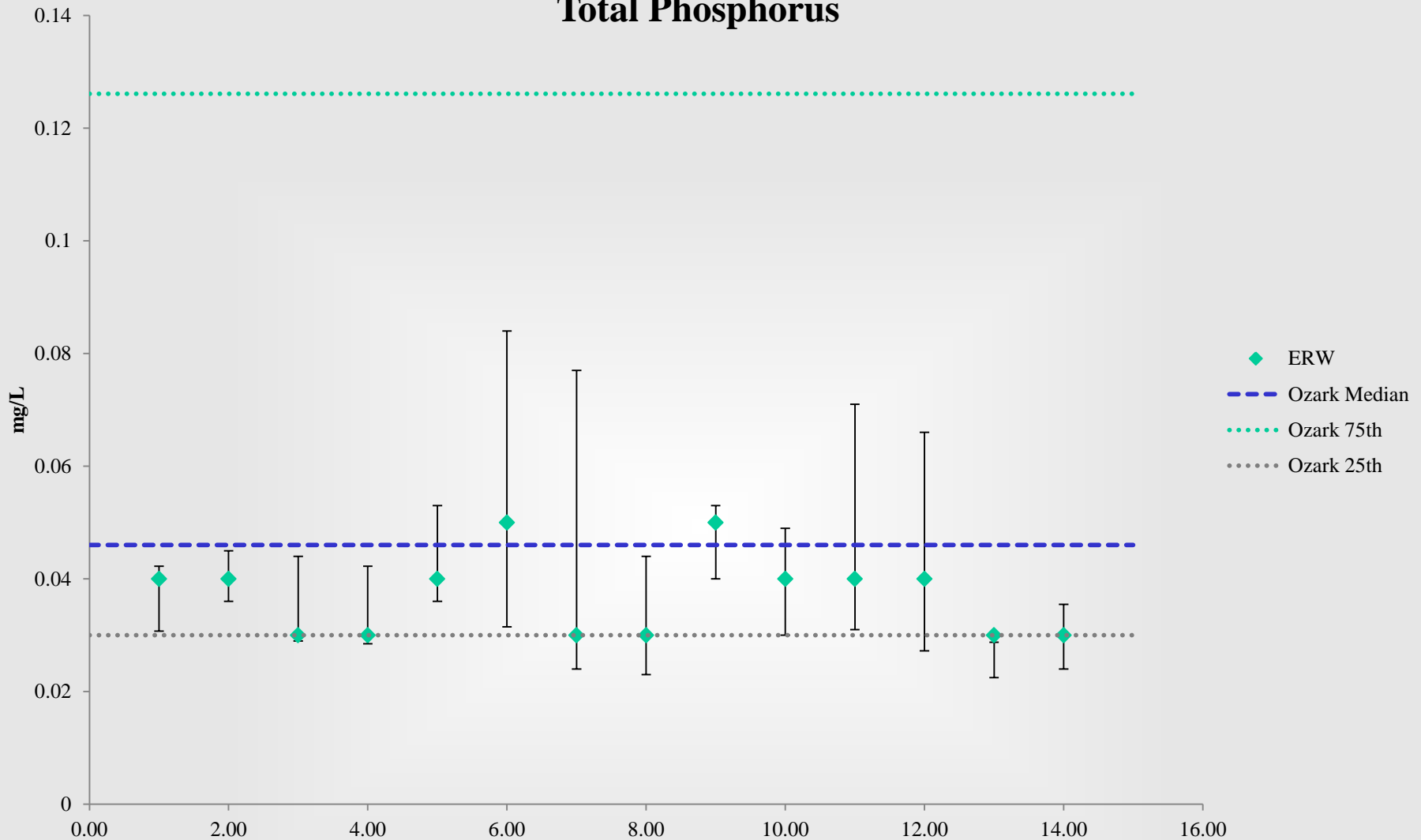
Fish Assemblage

TN:TP



*"To protect, enhance, and restore the natural environment for the well-being of all Arkansans."*

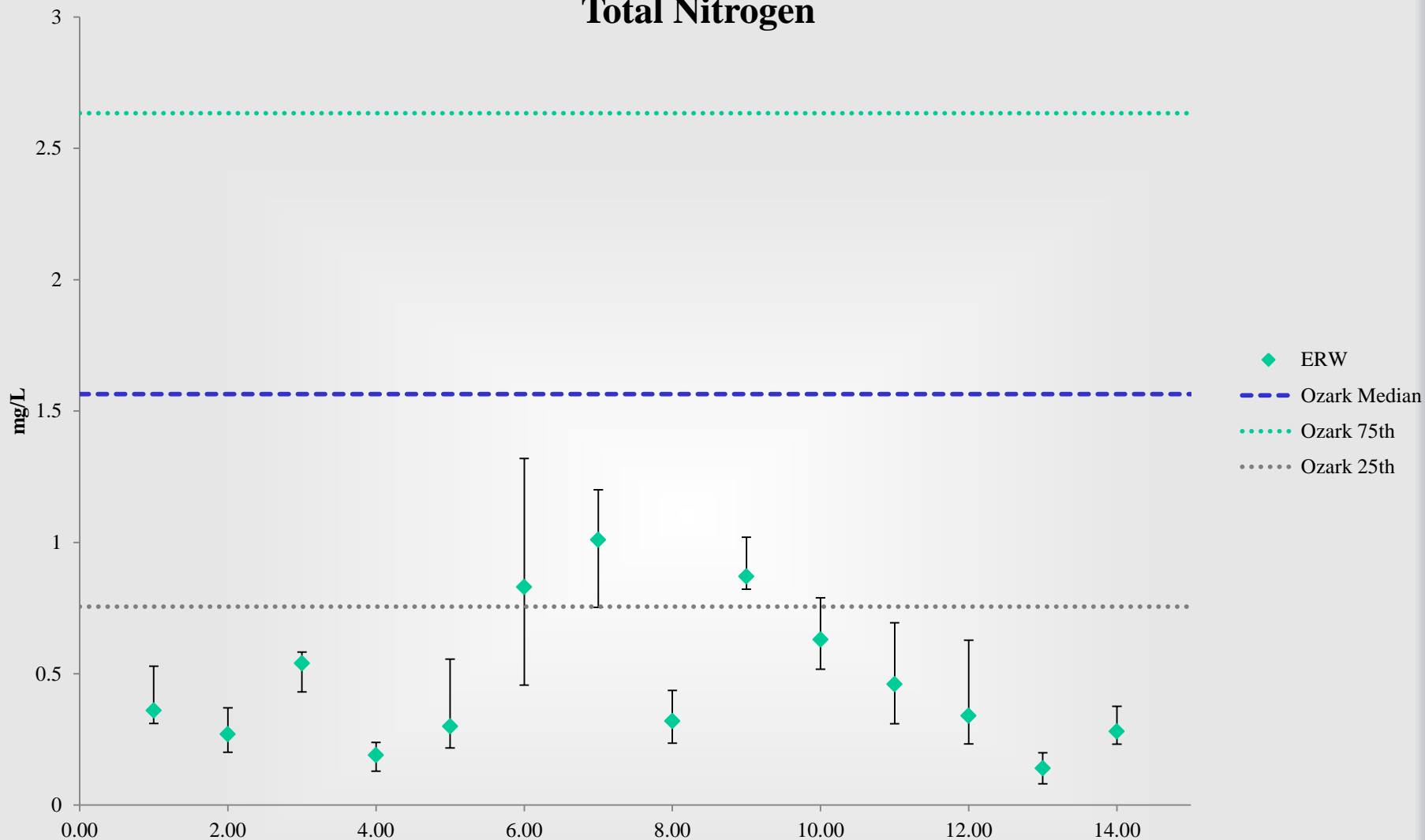
# Total Phosphorus



*"To protect, enhance, and restore the natural environment for the well-being of all Arkansans."*



# Total Nitrogen



*"To protect, enhance, and restore the natural environment for the well-being of all Arkansans."*

# Development of Site-Specific Criteria

## Ozark Highlands

	5 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	EPA 2001
Total Nitrogen (mg/L)	0.324	0.665	1.3	2.56	0.31
Total Phosphorus (mg/L)	0.018	0.034	0.053	0.099	0.01

2008-2013, n=2611

## Ozark ERWs

	5 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	EPA 2001
Total Nitrogen (mg/L)	0.175	0.302	0.54	0.885	0.31
Total Phosphorus (mg/L)	0.019	0.028	0.038	0.05	0.01

2012-2015, n=292

# Development of Wadeable Stream ERW SSC

White, M.A., B.E. Haggard, J.T. Scott. 2013. A Review of Stream Nutrient Criteria Development in the United States. Journal of Environmental Quality: 42: 1002-1014.

-25<sup>th</sup> percentile of all data more conservative than 75<sup>th</sup> percentile of reference/least-disturbed conditions

-Percentile method estimates were often within CI of biological (algae, macroinvertebrates, fish) thresholds



*"To protect, enhance, and restore the natural environment for the well-being of all Arkansans."*

# Development of Wadeable Stream ERW SSC

## N-STEPs

- Synoptic review of existing data
- Conceptual model of nutrient impact(s) in ERWs
- Summarize narrative nutrient criteria and AM
- New analyses of existing data (classifications, geospatial models, empirical models, etc.)



*"To protect, enhance, and restore the natural environment for the well-being of all Arkansans."*

# Future Milestones

## Development of Wadeable Stream ERW SSC

Ozark Highland 2012-2014

Boston Mountain 2013-2015

Ouachita Mountains 2015-2017

Arkansas River Valley 2016-2018

## Proposal and Adoption to Reg. 2

Phased approach-2019

Bulk approach-2022

## NCDP

As early as 2016, likely post adoption of SSC



*"To protect, enhance, and restore the natural environment for the well-being of all Arkansans."*