

# Developing Numeric Nutrient Criteria for Mississippi



## Stakeholder Update

MDEQ Amite Street Office  
Jackson, MS  
November 18, 2015

# Criteria are required by law



- Water quality standards (WQS) are required by the Clean Water Act for waterbodies in MS
  - A water quality standard = A designated use + **criteria** to protect the use + policy to prevent degradation
  - MDEQ has many criteria to protect designated uses from different pollutants

# Water Quality Criteria



- A concentration, level, or narrative statement
- Represent a level of water quality that supports a particular designated use
- States must adopt criteria that protect the designated use(s)
  - Based on a sound, scientific rationale
  - Sufficient parameters to protect the designated use
  - Must support the most sensitive use

# Nutrient Criteria



- Nutrients are a major pollutant contributing to impairment of waters nationwide
- EPA developed an Action Plan for nutrients in 2001 that included states developing numeric nutrient criteria to protect uses from nutrient pollution
- Early on...MDEQ developed a task force and a plan for developing nutrient criteria
- MDEQ's Mission:  
Develop appropriate and protective numeric nutrient criteria for Mississippi's waters that are scientifically defensible.

# MS Nutrient Task Force



- **Initiated criteria planning in 2000**
- **Decided that criteria should be developed based on water body type**
  - Lakes and Reservoirs
  - Streams and Rivers
  - Estuaries and Coastal Waters
- **Established different committees to focus on different water body types**
- **Developed the first Nutrient Criteria Development Plan for Mississippi**

# Implementing Our Plan



- Took action on the Task Force's recommendations
- Data and information gaps were identified by the Task Force
- Efforts were initiated to address these gaps
  - Data collection across various water body types
  - Establishing biological indicators
  - Preliminary nutrient criteria analyses

# A Work In Progress



- **Collecting data to fill data gaps identified**
  - Data collection across various water body types
  - Establishing biological indicators
  - Nutrient criteria analyses
- **Tool development**
  - Multiple tools in an attempt to make the connection between nutrient concentrations and biological response
    - ✦ M-BISQ Recalibration
    - ✦ Benthic Index for Coastal Waters
    - ✦ Benthic Index for Delta Waters
    - ✦ Fish data for Delta waters

# Timeline



- **Mutually-agreed upon plan (Oct 2010) with EPA**
  - Public Comment Period for Non-Delta Waters begins no earlier than June 30, 2013
  - Public Comment Period for Delta Waters begins no earlier than November 30, 2014
  - Postponed public notice of criteria to focus on implementation planning
- **Updated plan/timeline will be submitted (officially) to EPA Region 4 very soon**
  - **Sequenced Approach with “rolling timeline”**
    - ✦ Lakes and Reservoirs – target date: release to public notice by June 2016
    - ✦ Coastal and Estuarine Waters
    - ✦ Streams (Non-Delta)
    - ✦ Delta Waters
  - Large Rivers will be addressed through site-specific criteria in the order that they are prioritized/needed and as resources allow
- **Criteria adoption/approval includes**
  - Public notice/public comment period/public hearing
  - Respond to comments received
  - Adoption by the Commission
  - Approval by EPA

# MS Nutrient Technical Advisory Group



- MDEQ is committed to a defensible, science driven process for deriving protective criteria
- At the core of this process is the input, review, and guidance of technical work by a committee of research, state and federal agency scientists with technical expertise relevant to nutrient science
- MDEQ formed the Nutrient TAG to be this committee
- **TAG's Mission:**  
Provide technical expertise and regional knowledge to MDEQ for the development of scientifically defensible numeric nutrient criteria.

# MS Nutrient Technical Advisory Group



US Army Corps  
of Engineers®



GULF COAST  
RESEARCH LABORATORY  
THE UNIVERSITY OF SOUTHERN MISSISSIPPI



United States Department Of Agriculture  
Agricultural Research Service

# Nutrient Criteria Analysis



- **Goal: scientifically defensible, protective criteria developed using a transparent, well-documented process**
- **Methods based on USEPA Nutrient Criteria Guidance**
  - Data Compilation
  - Classification of Waters
  - Data Analysis using Multiple Lines of Evidence
  - Criteria Derivation

# Data Analysis: Multiple Lines of Evidence



- Using multiple lines of analysis to define a specific endpoint
- Alternative to single analysis approaches
- Especially useful with complex systems

“A weight of evidence approach that combines any or all of the three approaches above will produce criteria of greater scientific validity”

-USEPA 2000, SAB 2010

# Lines of Evidence



- **Distributions of nutrient values in minimally disturbed sites and sites attaining designated uses**
- **Stressor-response empirical models of nutrients versus biological/chemical responses**
- **Mechanistic water quality model output**
- **Scientific literature on nutrient effects**

# Waterbody Updates



# Lakes and Reservoirs (Non-Delta)



MS Non-Delta Lake and  
Reservoir NNC  
Draft Proposal

# Goals

- Review Previous Options
- Review/Discuss Recommended Option
- Discuss proposal

# Options for Lake Criteria

## Option 1 Single values

	Chlorophyll a (ug/L)	TP (mg/L)	TN (mg/L)
Magnitude	20	0.090	1.10

Duration: Seasonal (June-October) Geometric Means

Frequency: Not to be exceeded more than 2/5 years

Implementation: As for any other WQ constituent

Option 2  
Combined criteria  
with site specific  
adjustment

	Chlorophyll a (ug/L)	TP (mg/L)	TN (mg/L)
Magnitude	20	0.050 – 0.160 (0.080 – 0.120)	0.680 – 1.700 (0.700 – 1.300)

Duration: Seasonal (June-October) Geometric Means

Frequency: Not to be exceeded more than 2/5 years

Implementation:

If Chl a > criterion – impaired (if nutrients below range, more stringent may be needed)

If nutrients above upper range – impaired

If Chl a < criterion and nutrients in range or below, but DO or nuisance narrative violated – impaired

If Chl a < criterion and nutrients in range or below and DO and nuisance narrative met – not impaired

One time site specific adjustment to lesser of long-term 75<sup>th</sup> percentile or upper range value

Assess against this simple numeric moving forward

If no data available, site evaluated based on default numeric nutrient value within range (TBD)

Option 3  
Combined criteria  
with NO site  
specific  
adjustment

	Chlorophyll a (ug/L)	TP (mg/L)	TN (mg/L)
Magnitude	20	0.050 – 0.160 (0.080 – 0.120)	0.680 – 1.700 (0.700 – 1.300)

Duration: Seasonal (June-October) Geometric Means

Frequency: Not to be exceeded more than 2/5 years

Implementation:

If Chl a > criterion – impaired (if nutrients below range, more stringent may be needed)

If nutrients above upper range – impaired

If Chl a < criterion and nutrients in range or below, but DO or nuisance narrative violated – impaired

If Chl a < criterion and nutrients in range or below and DO and nuisance narrative met – not impaired

If no data available, site evaluated based on default numeric nutrient value within range (TBD)

**Proposed Numeric Nutrient Criteria  
For  
Mississippi Non-Delta Lakes and  
Reservoirs**



Photo: Mississippi Department of Wildlife, Fisheries, and Parks

**November 5, 2015**

# Recommended Criteria

## Retain the Narrative

MS retains its narrative, but adds the term “including nutrients” to Section II.3

“3. Waters shall be free from materials, including nutrients, attributable to municipal, industrial, agricultural, or other discharges producing color, odor, taste, total suspended or dissolved solids, sediment, turbidity, or other conditions in such degree as to create a nuisance, render the waters injurious to public health, recreation, or to aquatic life and wildlife, or adversely affect the palatability of fish, aesthetic quality, or impair the waters for any designated use.

## Elements of Options 2 and 3

Add numeric interpretation of narrative

For lakes/reservoirs > 100 acres, numeric interpretation of the narrative are the following values:

	Seasonal (June – October) Geometric Mean Chlorophyll a (mg/L)	Seasonal (June – October) Geometric Mean Total Phosphorus (mg/L)	Seasonal (June – October) Geometric Mean Total Nitrogen (mg/L)
Magnitude	20	0.050 - 0.160 Default: 0.090	0.680 - 1.700 Default: 1.10

Interpretations made every year.

Not to be exceeded more than 2 in 5 years.

Interpreted as achieving the narrative if:

Chlorophyll < 20 and

Nutrients < upper range values and

DO criterion met.

## Elements of Option 2

Add site specific language option

	Seasonal (June – October) Geometric Mean Chlorophyll a (mg/L)	Seasonal (June – October) Geometric Mean Total Phosphorus (mg/L)	Seasonal (June – October) Geometric Mean Total Nitrogen (mg/L)
Magnitude	20	0.050 - 0.160 Default: 0.090	0.680 - 1.700 Default: 1.10

For select waters that achieve the standard, the state may choose to set site specific, single numeric TN and TP criteria as:

The lesser of the long-term 75<sup>th</sup> percentile or  
Upper range values

Encoded as site specific TN/TP criteria

Implemented as single numeric values along with chlorophyll a as combined criteria

## Elements of Option 1

Default used  
for permitting  
and TMDLs

	Seasonal (June – October) Geometric Mean Chlorophyll a (mg/L)	Seasonal (June – October) Geometric Mean Total Phosphorus (mg/L)	Seasonal (June – October) Geometric Mean Total Nitrogen (mg/L)
Magnitude	20	0.050 - 0.160 Default: 0.090	0.680 - 1.700 Default: 1.10

The default single numeric magnitude values in the table are to be used along with the duration (seasonal geomean) and frequency (no more than 2 in 5 years).

## Justification language

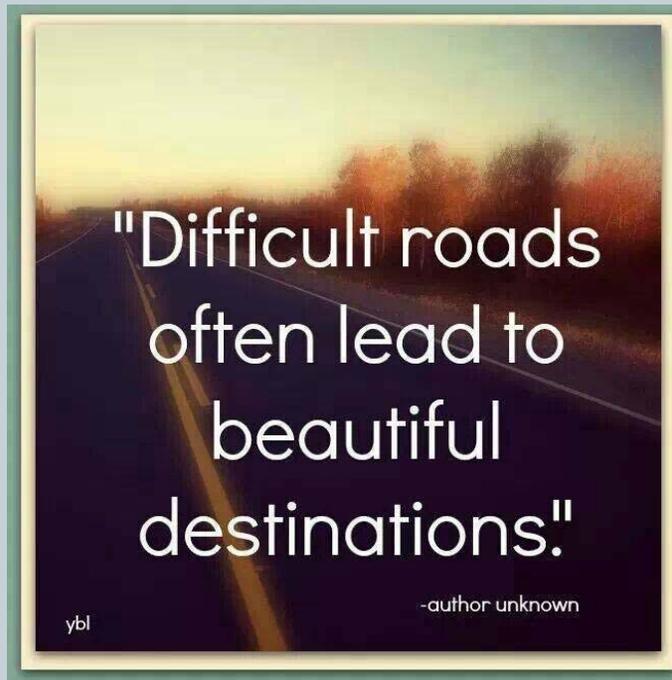
- Discusses technical support documents
  - Origin of 20 ug/L chl a in MSFish, DO sag, and hypolimnetic DO deficit
  - TN and TP from nutrient – chlorophyll yield curves for target of 20

# Proposal Package

## NNC Proposal Package

- Will include proposed change to standards presented here with brief justification
- Will include an edited version (redline) of MS WQS
- Will include a more detailed justification memo
- Will include Technical Support Documents including decision agreement memo for lakes
- Will include implementation plan/guidance document

# Status of Technical Efforts for Other Waters



# Streams



# Streams



- **Analysis Essentially Complete**
- **Multiple Lines of Evidence**
  - Reference
  - Stressor-Response
- **Two Technical Support Documents**
- **Decision Agreement Analysis (per Stakeholder feedback)**
- **Options Developed**

# Streams

Option 1- Single values



**Magnitude:**

TP: 0.060 - 0.150 mg/l

TN: 0.75 - 1.20 mg/l

**Duration: Geometric annual mean**

- Based on underlying data

**Frequency: Not to be exceeded more than 2 out of 5 years**

- Based on variability analysis

# Streams

Option 2 – Combined criteria  
with site specific adjustment



**Magnitude:**

TP: 0.040 - 0.2 mg/l

TN: 0.45 - 1.40 mg/l

**Duration:** Geometric annual mean

**Frequency:** Not to be exceeded more than 2 out of 5 years

**Implementation:** As long as MBISQ/DO/nuisance criteria are met and nutrients are within range or below, nutrient criteria not violated.

Site specific nutrient numeric adjusted to the long-term 75th percentile seasonal geometric mean within the range for assessment moving forward.

If there are no data on responses, a default single numeric value (e.g., within the range) would be used

# Streams

## Option 3 – Combined Criteria with no adjustment



**Magnitude:**

TP: 0.040 - 0.2 mg/l

TN: 0.45 - 1.40 mg/l

**Duration:** Geometric annual mean

**Frequency:** Not to be exceeded more than 2 out of 5 years

**Implementation:** As long as MBISQ/DO/nuisance criteria are met and nutrients are within range or below, nutrient criteria not violated.

If there are no data on responses, a default single numeric value (e.g., within the range) would be used

# Coastal and Estuarine Waters



# Focus of TAG Meeting Yesterday



- MDEQ has completed a 2<sup>nd</sup> Coastal Technical Support Document (TAG currently reviewing)
- Coastal Empirical Analysis
  - Existing condition reference based approach based on data, existing information on response conditions, and literature
  - Stressor-response analyses preventing excess algal growth and DO impacts
- Supported by site specific mechanistic models

# Coastal Empirical Analysis

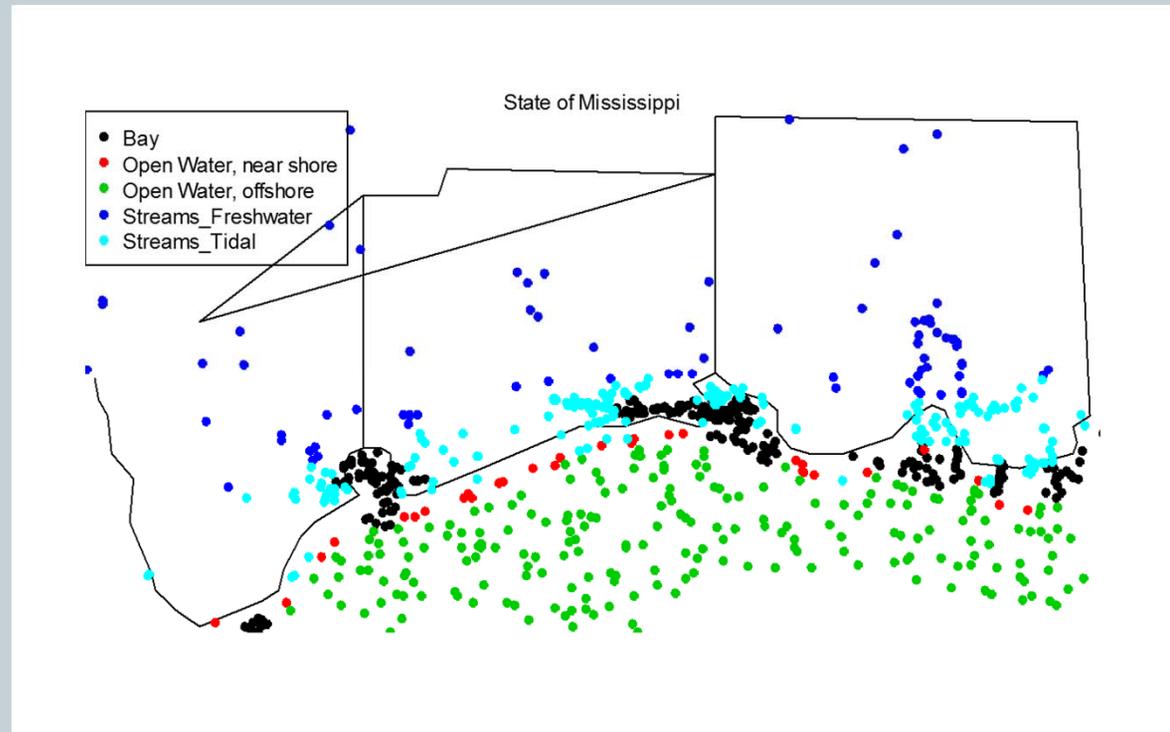


- **Using coastal/estuarine/tidal water quality data**
- **Classification**
  - Open sound, estuaries, and tidal waters were defensible
- **Literature**
  - MS Coastal Region generally medium-low eutrophication
- **Reference (Existing Condition)**
  - Based on identifying and using existing conditions to set criteria
- **Stressor-response modeling**
  - Developing nutrient-response models for different classes

# Classification



- Sound
- Bays
- Tidal Creeks
  
- Most sensible and defensible classes



# Empirical Analysis Results



## Empirical Results in Coastal Report

- **Magnitude:**
  - Ranges from multiple analyses to date (SLB)
    - ✦ Chl a: 10 – 20 ug/L
    - ✦ TN: 0.70 – 0.9 mg/L (few small bays)  
1.0 – 1.2 mg/L (other coastal waters)
    - ✦ TP: 0.08 – 0.10 mg/L (few small bays)  
0.15 – 0.23 mg/L (other coastal waters)
- **Duration: Seasonal (June-October) Geometric Means**
- **Frequency: Not to be exceeded more than 2/5 years**
- **Implementation: Same options as for other waters**

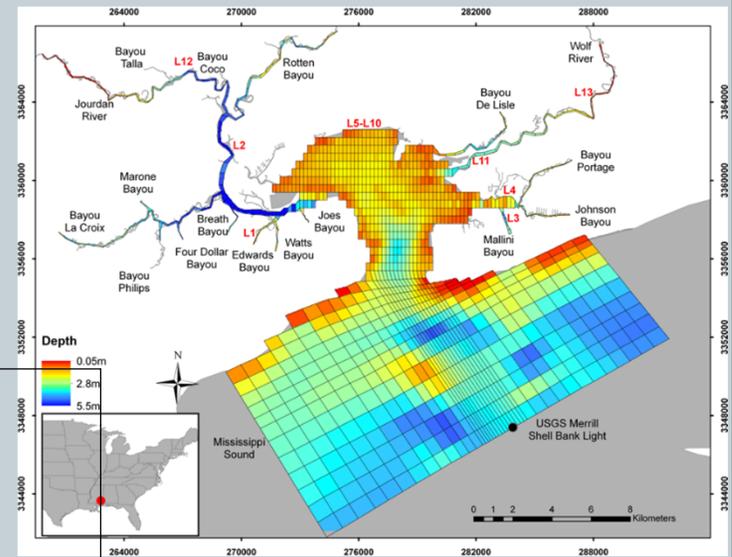
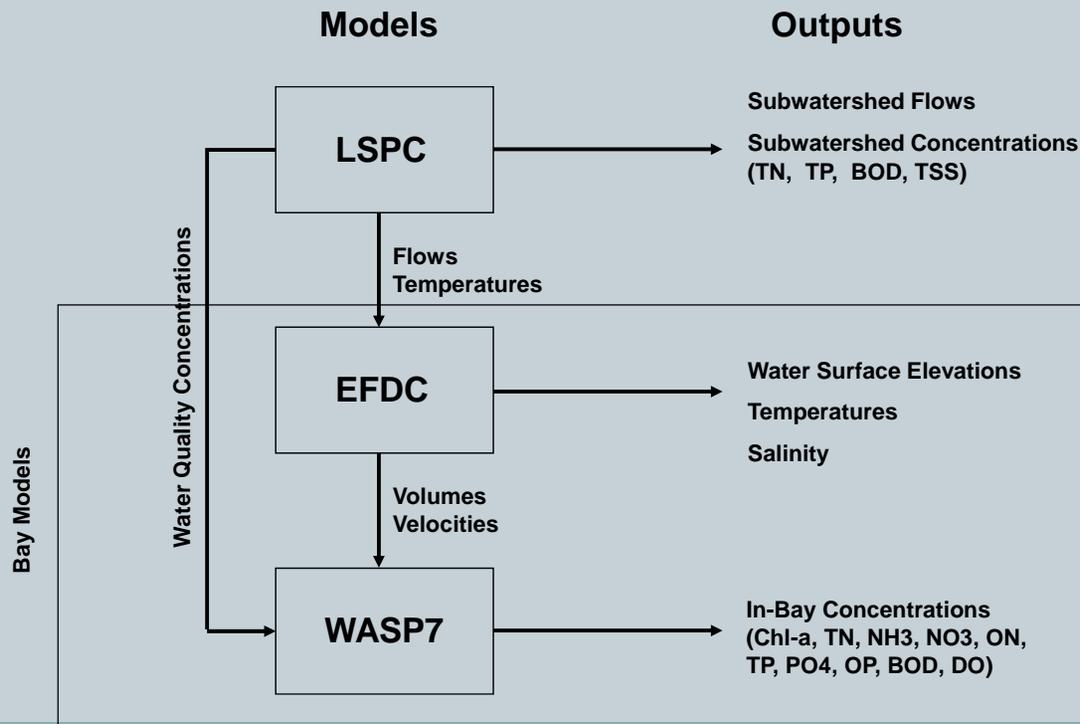
# Mechanistic Modeling



- **St. Louis Bay, MS: Nutrient Sources, Fate, Transport, and Effects Study**
  - Funded by the USEPA Gulf of Mexico Program
  - Part of several case studies through the Gulf of Mexico Alliance (FL, TX, AL)
  - Comprehensive estuarine water quality model with field calibration/validation

# Mechanistic Model – Bay Saint Louis

- Linked watershed loading (LSPC) - hydrodynamic (EFDC) - water quality (WASP7) models



# Mechanistic Model – Candidate Thresholds



- Modeling found similarly small response of algae/DO to range of nutrient scenarios.
- 90<sup>th</sup> percentile of geometric mean annual concentrations (estimated)

<b>Nutrient load scenario</b>				
	<b>Current</b>	<b>100% ↓</b>	<b>50% ↓</b>	<b>50% ↑</b>
<b>TN</b>	0.66	0.53	0.6	0.72
<b>TP</b>	0.065	0.053	0.055	0.073
<b>Chl<sub>a</sub></b>	16	12	15	18

# Mechanistic Model



- Results similar to empirical analysis
- Seeking to replicate mechanistic modeling effort for other, individual estuaries in MS (e.g., Biloxi, Pascagoula, etc.)
  - To support empirically derived endpoints

# Delta Waters



# Mississippi Delta – April 2015



- **EPA HQ and R4: Introduction to Delta and Tour of Delta Waters**
- **TAG meeting focused on NNC for MS Delta Waters:**
  - Revisited and further developed the Delta Waters NNC Study Plan (building on work from previous Delta TAG meetings)
    - ✦ Problem Formulation
    - ✦ Data inventory and Conceptual Model Building
    - ✦ Classification
    - ✦ Assessment Endpoint Development
    - ✦ Exploratory Analysis
- **Continuing to develop a strategy and workplan and working to find funding for implementation**
- **Considering/Exploring Revised Uses**
  - May precede criteria development

# Mississippi Delta – Hill Streams



- **Nutrient gradient study pilot**
  - USGS/MDEQ/EPA partnership
- **Algal endpoints, DO diel, habitat, chlorophyll a, macroinvertebrates, nutrients**
- **Exploring stressor-response relationships along nutrient gradient in hill streams**
- **Potential to expand to other parts of the state if pilot study results are promising**

# Refining Water Body Classifications



**ONGOING MS WQS PROGRAM EFFORT**

# History



## Water Body Use Revisions

- MDEQ has a single aquatic life use classification and narrative criteria
- Identified the need to revisit and perhaps refine this use and the associated criteria
- Desired an exploration of options

# Revising Aquatic Life Use Options: Status



- **Developed a framework of potential options for aquatic life use revisions issues for MDEQ**
- **Exploring both natural and modified uses/classifications**
- **Agency will be moving forward into this effort and starting to develop more detail about new categories/classes and how they would fit into the current WQS classification structure**

# NNC Implementation Planning



# Beyond the Number



- Many questions surround NNC implementation both internally and from our stakeholders
- MDEQ Interdivisional Implementation Workgroup formed to work through issues identified by MDEQ staff, partners, and stakeholders
  - Permitting implications
    - ✦ Compliance Schedules
    - ✦ Variances/Mixing Zones/Others
  - Assessment implications
  - TMDLs/WLAs
  - Watershed Planning

# Beyond the Number: Implementation Planning



- **MDEQ Implementation Planning Workgroup developed a list of implementation questions such as**
  - How will the number be written into our standards?
  - How will we monitor/assess for nutrients?
  - How will we incorporate this number into permits?
  - How long will it be before facilities see nutrient limits in their permits?
  - How long will facilities have to comply with new permit limits?
- **Implementation questions will ultimately be addressed in a Nutrient Criteria Implementation Document**
  - Will be developed and finalized in a parallel effort to the nutrient criteria development process
  - Will accompany criteria when released to provide details on exactly how the criteria will be implemented

# Draft Implementation Plan



- **Subcommittees developed responses to questions to the extent possible**
- **Responses are included as part of draft implementation plan**
- **Current draft includes sections on:**
  - **Criteria Options**
  - **Standards**
  - **Assessment and Monitoring**
  - **TMDLs/WLA/NPDES**
- **Implementation planning is on-going, parallel effort to NNC development**
  - **MDEQ adding more information to plan over time as more details about draft criteria values are determined**

Implementing Numeric Nutrient Criteria into Mississippi DEQ Water Quality Programs:  
Question and Answers

Prepared for  
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Draft  
8.11.2014

# Moving Forward



# Moving Forward in MS



- **Revised Nutrient Criteria Development Plan and Timeline**
- **MDEQ continuing criteria development process with TAG support and stakeholder input**
- **Upcoming Activities**
  - MDEQ management considers lake criteria options and draft proposal
    - ✦ Pros, cons, implementation aspects will be considered
  - Begin preparing Lake Nutrient Criteria Package for public comment
    - ✦ Move forward with more details regarding Lake NNC implementation planning
  - Publish Second Coastal Technical Support Document
    - ✦ Begin developing coastal criteria options
  - Continue development of Delta Waters NNC strategy
  - Analyze and publish Delta-Hill nutrient gradient study
  - Continue efforts exploring potential water body use refinements

# Moving Forward in MS



- **Stakeholder Outreach an MDEQ Priority**
  - MDEQ will continue regular Stakeholder Update Sessions
  - Continue to provide the opportunity for stakeholders to stay informed and also express their comments and/or concerns regarding both the criteria development efforts and plans for implementation of those criteria
- **We are not currently in the formal comment period – that will come later....however....**

The sooner we know about your concerns, questions, and suggestions the better...  
MDEQ can start looking at those now

Questions? Comments? Suggestions?



**THANK YOU FOR BEING HERE TODAY!**

