

# **NPDES Systems – Nutrient Limitations and Impact on Water Quality**

OTCO Wastewater Workshop

March 6, 2019

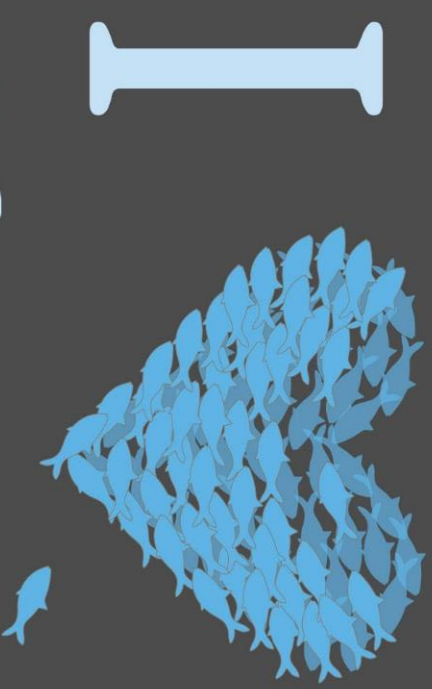
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# Today's Discussion

- A. Clean Water Act Water Quality Standard Overview
- B. Ohio's Nutrient Water Quality Standards
- C. Ohio's NPDES Limitation Process
- D. Future Nutrient Standard Changes

# A - Water Quality Standards (WQS) Overview

- Who Establishes WQS
- What are WQS



Clean  
Water

# Who sets WQS?

- U.S. EPA publishes national recommendations
- States establish standards under the Clean Water Act
- U.S. EPA must approve State standards
- U.S. EPA must propose and promulgate federal standards for States that fail to adopt standards that meet CWA requirements

# What are WQS?

- Statement of how clean we want our waters-  
three elements
  - Use Designations
    - Water supply, recreation, fish and wildlife
  - Criteria
    - **narrative and numeric criteria and values** derived from methods described in rule
  - Antidegradation
- Found in Ohio Administrative Code  
3745-1



# Use Designations

Defined in 3745-1-07;

Assigned in 3745-1-08 to -32

- Aquatic Life
  - Warmwater
  - Exceptional warmwater
  - Modified warmwater
  - Seasonal salmonid
  - Coldwater
  - Limited resource water
- Water Supply
  - Public
  - Agricultural
  - Industrial
- Recreation
  - Bathing waters
  - Primary contact
  - Secondary contact

Table 9-1. Use designations for water bodies in the Scioto river drainage basin.

Water Body Segment	Use Designations												Comments	
	Aquatic Life Habitat						Water Supply			Recreation				
	S R W	W W H	E W H	M W H	S S H	C W H	L R W	P W S	A W S	I W S	B W	P C R		S C R
Scioto river - at RM 33.6								o	+	+			+	PWS intake - U.S. Enrichment (emergency intake)
- Greenlawn dam (RM 129.8) to the mouth								+	+	+			+	ECBP ecoregion - impounded
- Olenlangy river (RM 132.3) to Greenlawn dam						+		+	+	+			+	
- Dublin rd. WTP dam (RM 133.4) to the Olenlangy river (RM 132.3)									+	+			+	PWS intake - Columbus
- O'Shaughnessy dam (RM 148.8) to the Dublin rd. WTP dam								+	+	+			+	PWS intake - Marion
- at RM 180.04								o	+	+			+	
- all other segments								+	+	+			+	
Pond creek								+	+	+			+	
Dry run								+	+	+			+	
Wolf run								*	*	*			*	
Carroll run								*	*	*			*	
Sheep Pen run								*	*	*			*	
Scioto Brush creek - headwaters to st. rte. 32 (RM 33.55)								+	+	+			+	
- st. rte. 32 to the mouth								+	+	+			+	
Duck run								+	+	+			+	
Sweeney run								*	*	*			*	
McCullough creek								+	+	+			+	

# Water Quality Criteria

1. Narrative 3745-04
  - Free From
2. Numerical 3745-33 to -37
  - Aquatic life (chemical and biological)
  - Human health & Wildlife
  - Water Supply
  - Recreational & Aesthetics



# Antidegradation – National Program

## 3745-01-05

- Decision making process for proposed or expanding discharges & dredge/fill activities
- Levels of Protection
  - Tier I - existing uses must be protected (whether designated in rule or not)
  - Tier II – higher quality waters can be lowered only if a need is shown, but must maintain use
  - Tier III – Outstanding national resource waters, water quality cannot be lowered \*

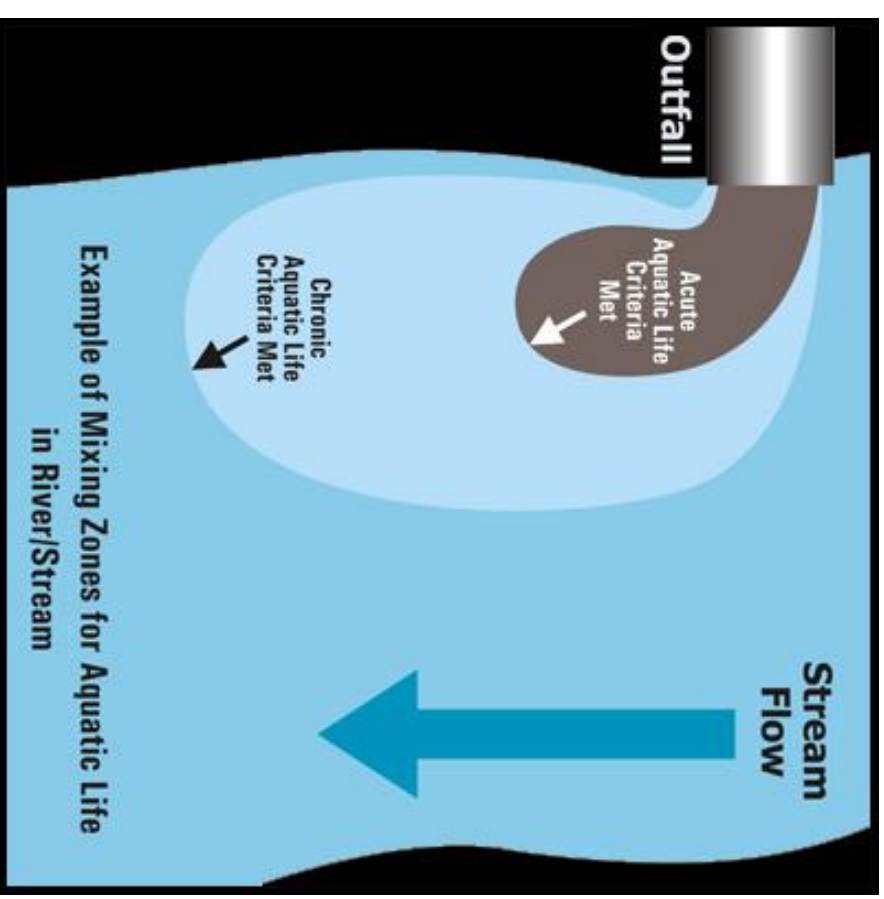
# B – Ohio's Nutrient Water Quality Standards

- Mixing Zones
- Numerical Criteria
  - Nitrogen
    - Ammonia
    - Nitrate + Nitrite
  - Total Phosphorus
- Antidegradation (BADCT)



# Stream Mixing Zones

- Acute Impact (max)
  - Inside Mixing Zone Maximum (IMZM)
  - Outside Mixing Zone Maximum (OMZM)
- Chronic Impact (ave)
  - Outside Mixing Zone Average (OMZA)



# Example - Receiving Stream



- Pristine Creek, Ohio River Basin
  - Aquatic Life = Warmwater
    - Critical Conditions - Winter water temp 10 °C, pH 8
  - Water Supply = Public, Agriculture, Industrial
  - Recreation = Primary

# Ammonia - Aquatic Life

3745-1-35

3

Table 35-1. Statewide water quality criteria for the protection of aquatic life.  
Page 1 of 2

Chemical	Form <sup>1</sup>	Units <sup>2</sup>	IMZM <sup>3</sup>	OMZM <sup>3</sup>	OMZA <sup>3</sup>
Ammonia-N (WVWH)	T	mg/l	--	Table 35-2	Table 35-5
Ammonia-N (EWH)	T	mg/l	--	Table 35-3	Table 35-6
Ammonia-N (MVWH)	T	mg/l	--	Table 35-2	Table 35-7
Ammonia-N (SSH <sup>4</sup> )	T	mg/l	--	Table 35-4	<sup>a</sup>
Ammonia-N (CWH)	T	mg/l	--	Table 35-4	Table 35-8
Ammonia-N (LRW)	T	mg/l	--	Table 35-2	--
Arsenic	D <sup>6</sup>	µg/l	680	340	150
Arsenic	TR <sup>7</sup>	µg/l	680	340	150
Cadmium <sup>8</sup>					
Chlorine					
(WVWH, EWH, MVWH, CWH)	R	µg/l	--	19	11
Chlorine (LRW)	R	µg/l	--	19	--
Chlorine (SSH <sup>4</sup> )	R	µg/l	--	<sup>b</sup>	<sup>b</sup>



# Ammonia- WWH, OMZM

3745-1-35

Table 35-2.

Warmwater habitat, modified warmwater habitat and limited resource water outside mixing zone maximum total ammonia-nitrogen criteria (mg/l).

pH	6.5	6.7	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4
Temp. (°C)	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	12.7	10.6	8.4	6.7	5.4	4.3
1	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	12.5	10.5	8.3	6.6	5.3	4.2
2	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	12.3	10.3	8.2	6.5	5.2	4.2
3	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	12.1	10.2	8.1	6.5	5.2	4.1
4	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	12.0	10.1	8.0	6.4	5.1	4.1
5	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	11.9	9.9	7.9	6.3	5.0	4.0
6	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	11.7	9.8	7.8	6.3	5.0	4.0
7	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	11.6	9.7	7.8	6.2	5.0	4.0
8	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	11.5	9.6	7.7	6.1	4.9	3.9
9	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	11.4	9.6	7.6	6.1	4.9	3.9
10	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	11.3	9.5	7.6	6.0	4.8	3.9

# Nitrate + Nitrite - Drinking Water

3745-1-33

Chemical	Form <sup>1</sup>	Units <sup>2</sup>	OMZA <sup>3</sup>	
			Ohio river	Drinking Lake Erie
Methyl bromide	T	µg/l	48	
Methylene chloride <sup>5</sup>	T	µg/l	5.0 <sup>a</sup>	47
Nickel	TR	µg/l	610	
Nitrate-N + Nitrite-N	T	µg/l	10,000 <sup>a</sup>	10,000
Nitrite-N	T	µg/l	1,000 <sup>a</sup>	
Nitrobenzene	T	µg/l	17	
Nitrosamines <sup>5</sup>	T	µg/l	0.0080	

# Nitrate + Nitrite – Aquatic life

- Nitrogen is also to be limited to the extent necessary to prevent nuisance growths
- Currently Ohio has no numerical nitrogen criteria for aquatic life/aesthetics
- Nitrogen limits to prevent nuisance conditions are determined on a case-by-case basis
  - Using Ohio EPA, Association Between Nutrients, Habitat, and the Aquatic Biota in Ohio Rivers and Streams, 1999



# Total Phosphorus – Aesthetic Conditions

Table 37-1. Statewide water quality criteria for the protection against adverse aesthetic conditions.

Chemical	Form <sup>1</sup>	Units <sup>2</sup>	IMZM <sup>3</sup>	OMZM <sup>3</sup>	Drinking
2-Chlorophenol	T	µg/l	--	--	0.1 <sup>a</sup>
2,4-Dichlorophenol	T	µg/l	--	--	0.3 <sup>a</sup>
MBAS (foaming agents)	T	mg/l	--	0.50	--
Oil & grease	T	mg/l	--	10 <sup>b</sup>	--
Phenol	T	µg/l	--	--	1.0 <sup>a</sup>
Phosphorus	T	mg/l	C	--	C

# Total Phosphorus footnote c

- Total phosphorus shall be limited to the extent necessary to prevent:
  - nuisance growths and algae, weed, and slimes that result in a violation of the water quality criteria set forth in paragraph E of rule 3745-1-04 of the Administrative Code or,
  - for public water supplies, that result in taste or odor problems.
- In areas where such nuisance growths exist, phosphorus discharges from point sources determined significant:
  - shall not exceed a daily average of one milligram per liter as total P,
  - or such stricter requirements as may be imposed in accordance with the International Joint Commission.
- Major Lake Erie Basin Dischargers have a 1 mg/l average per rule OAC 3745-33-06
- Currently Ohio has no numerical phosphorus criteria for aquatic life

# Antidegradation BADCT

Table 5-1. Best available demonstrated control technology for new sources discharging sanitary wastewater.

Parameter	Thirty-day Limit	Daily or Seven-day Limit	Maximum/Minimum Limit
CBOD <sub>5</sub>	10 mg/l	15 mg/l	n/a
Total suspended solids	12 mg/l	18 mg/l	n/a
Ammonia			
(Summer)	1.0 mg/l	1.5 mg/l	n/a
(Winter)	3.0 mg/l	4.5 mg/l	
Dissolved oxygen	n/a	n/a	6.0 mg/l (minimum)
Total residual chlorine	n/a	n/a	0.038 mg/l (maximum)
E. coli*	126 / 100 ml	235 / 100 ml	n/a

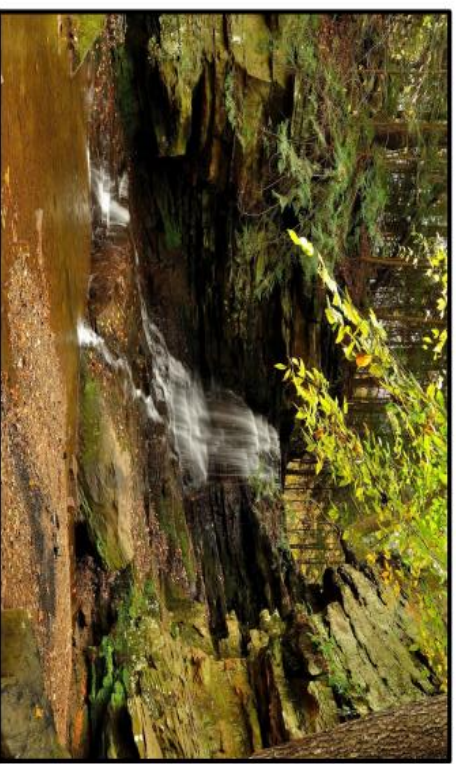
\* E. coli is to be considered a design standard only. Effluent limitations will not be incorporated into a control document based solely on this table.

# C - Ohio's NPDES Permit Process

- NPDES Regulatory Framework
- NPDES Program Areas
- NPDES Permit Limitations
- Technology Based Effluent Limits (TBELs)
- Water Quality Based Effluent Limits (WQBELs)
- Monitoring



Ohio 2016 Integrated  
Water Quality Monitoring  
and Assessment Report



Division of Surface Water  
Final Report

October 2016

# NPDES Regulatory Framework

- National Pollutant Discharge Elimination System (NPDES)
- Authorized by Clean Water Act Section 402, Ohio Revised Code 6111.03
- Regulated under 40 CFR , OAC 3745
- Do I need an NPDES permit?
  - point source
  - pollutants
  - waters of the state

# NPDES Program Areas

- Program Authority
  - US EPA Lead
  - States, Territories, Tribes Lead
  - 5 Areas of Delegation (Individual, General, Pretreatment, Federal Facilities, Sewage Sludge)
- Program Areas
  - Municipal Sources (POTW, Pretreatment, Sludge, Wet Weather, MS4)
  - Non-Municipal Sources (Process, Non-process, Storm Water, CAFOs, Vessels)
- Facility Designation
  - Major (Muni > 1MGD, Non-Muni – rating sheet)
  - Minor
- Permit Types – Individual and General

# Develop TBELs

- Technology Based Effluent Limits (TBELs)
  - Levels Playing Field
  - Based on Industry Categories
    - 56 categories
  - Different Control Levels
    - BPT, BCT, BAT, NSPS
- Applying Effluent Guidelines
  - 40 CFR 400-471
  - New or Existing Source
  - Many are Production Based (lb/day)

# Develop WQBELS

- Water Quality Based Effluent Limits (WQBELS)
  - Determine Water Quality Standards
  - Characterize Effluent & Receiving Water
  - Calculate Parameters
  - Apply Reasonable Potential



# Develop WQBELs – Water Quality Standard

- WQS Components
  - Designated Uses =
    - Warm Water Habitat
    - Water Supply – Drinking, Agriculture, Industrial
    - Primary Recreation
  - Numeric and Narrative Criteria -
  - Antidegradation
    - General High Quality Water

# Develop WQBELs - Characterize

- Identify Pollutants of Concern
  - Identified in 303(d) list - impaired or threatened
- Identify Critical Conditions
  - Low Flow, Temp, pH, hardness
- Model Receiving Water
  - Simple (mass balance)
  - Complex when interactive dischargers
- Calculate Parameters

# WQBEL Example – Mass Balance



Mass (kg/day) = Flow (Q in cfs) \* Pollutant (C in mg/l)

$$Q_r C_r = Q_s C_s + Q_d C_d$$

$Q_s$  = critical upstream flow

$C_s$  = upstream concentration of pollutant

$Q_d$  = discharge flow

$C_d$  = discharge concentration of pollutant

$Q_r$  = downstream flow

$C_r$  = water quality criterion of pollutant



The following values are known for ABC Inc., and Pristine Creek:

$Q_s$  = critical upstream flow = 1.20 cfs

$C_s$  = upstream concentration of pollutant = 0.75 mg/l

$Q_d$  = discharge flow = 0.55 cfs

$Q_r$  = downstream flow = 0.55 + 1.2 = 1.75 cfs

$C_r$  = water quality criterion of pollutant = 1.0 mg/l

$$C_d = \frac{(1.75 \text{ cfs}) \left(1.0 \frac{\text{mg}}{\text{l}}\right) - (1.20 \text{ cfs}) \left(0.75 \frac{\text{mg}}{\text{l}}\right)}{0.55 \text{ cfs}}$$

$C_d = 1.5 \text{ mg/l}$  of pollutant

# Apply NPDES Requirements

- Compare TBELs vs WQBELs
  - Use the most stringent
- Determine Limitations
- Apply Reasonable Potential
  - Which parameters to include
    - Limit > 50% but < 100% of Existing Discharge, Monitoring
    - Limit > 100% of Existing Discharge, Limit
- Include Monitoring Frequency

# NPDES Monitoring and Reporting

- **Monitoring Conditions**
  - Monitoring Location (influent, internal, effluent)
  - Monitoring Frequency
  - Sample Collection (grab, composite)
- **Analytical Methods**
  - 40 CFR 136
- **Reporting Results**
- **Recordkeeping**
  - Sewage Sludge 5 yrs
  - Everything else 3 yrs

# D – Future Nutrient Limit Changes

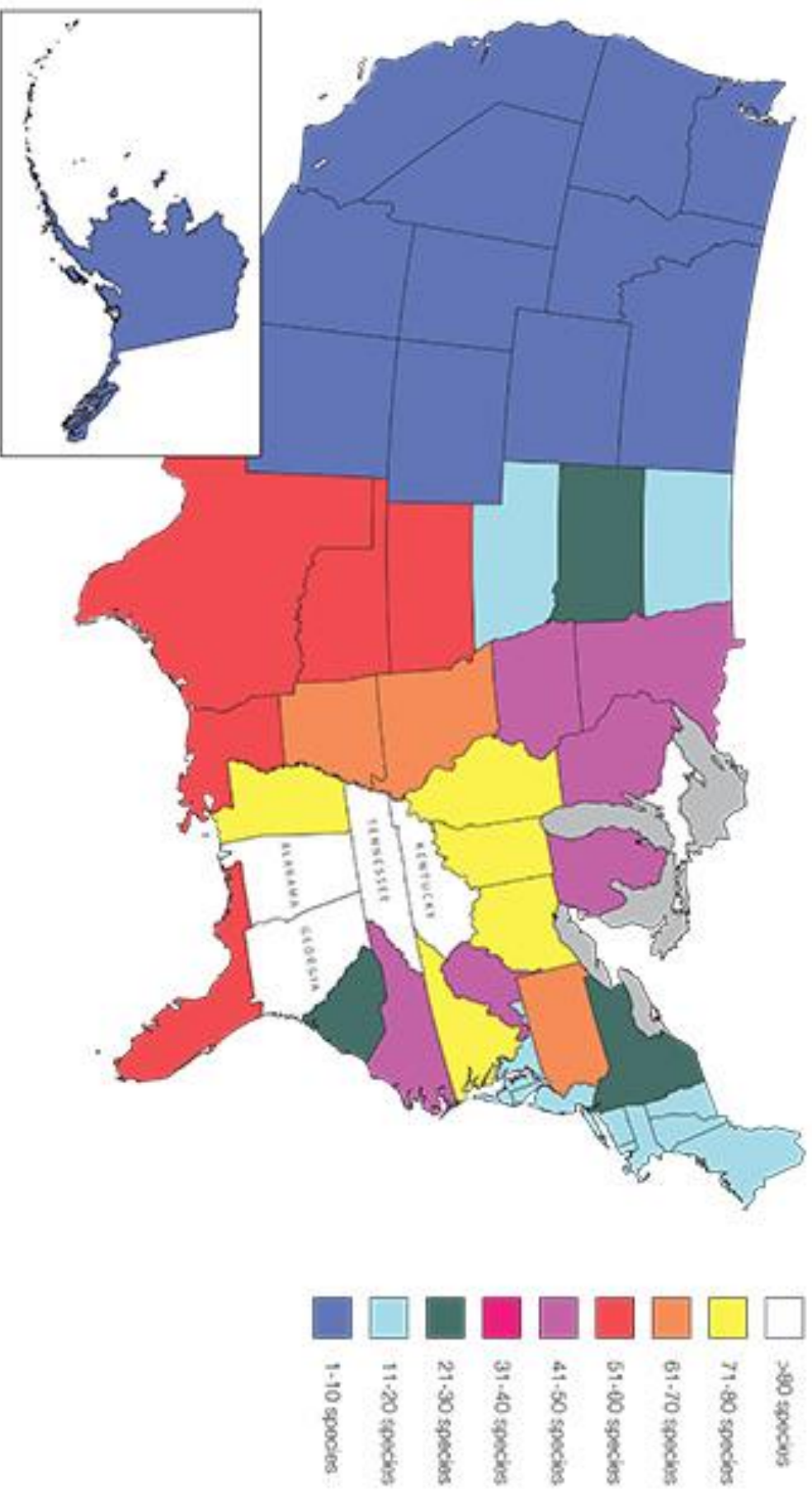
- New Ammonia Aquatic Life Criteria
- Ohio's Aquatic Life Nutrient Water Quality Standards
- USEPA POTW Nutrient Removal Technology Review

# New Ammonia Aquatic Life Criteria

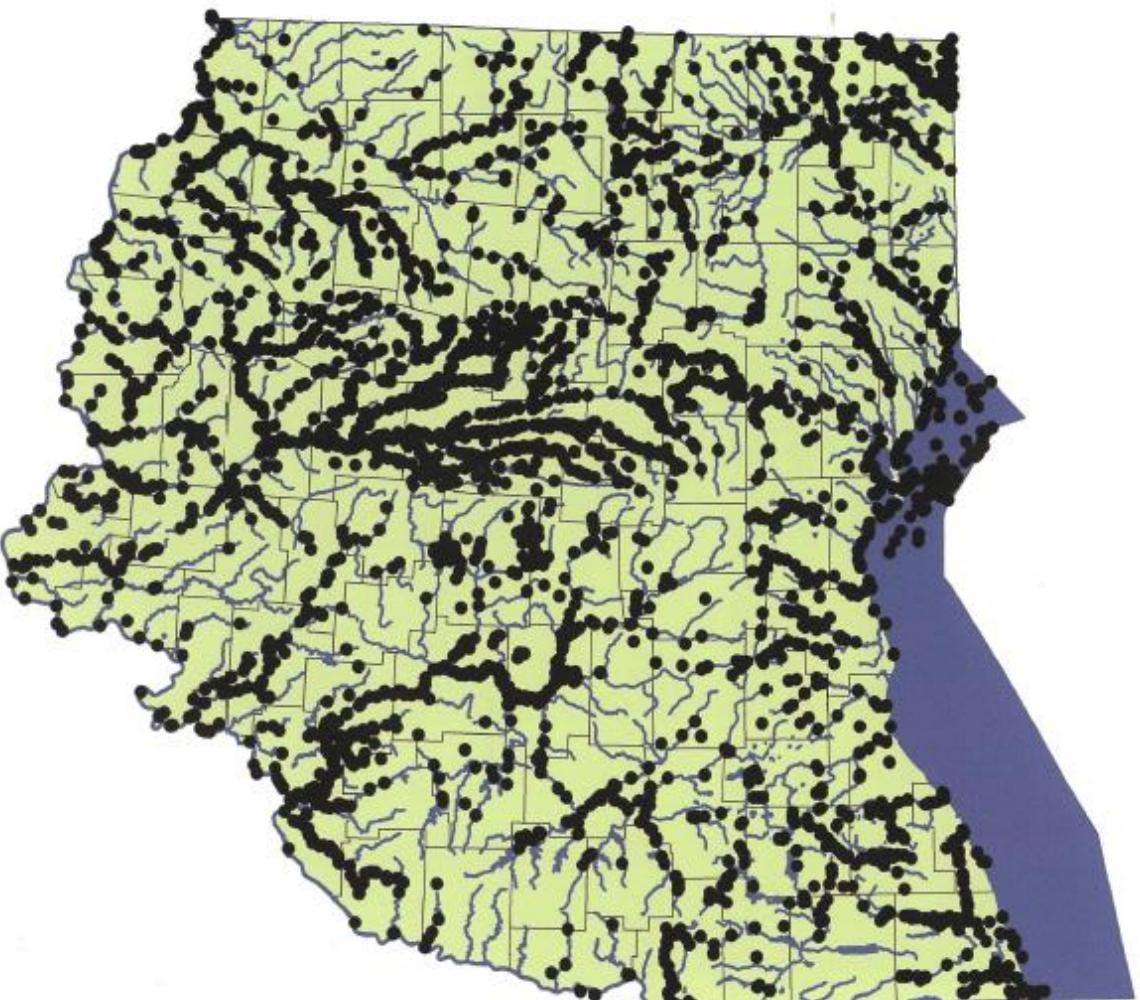
- US EPA new Ammonia Criteria in 2013
  - Includes toxicity data for mussels and snails
- One set of Criteria – based on temp/pH
- US EPA Implementation Flexibility
  - Items to consider – temp/pH, variances, designated uses, dilution, compliance schedules
  - May recalculate for site specific conditions (i.e. use different criteria if mussels are not present)
    - US EPA Guidance on Mussel surveys

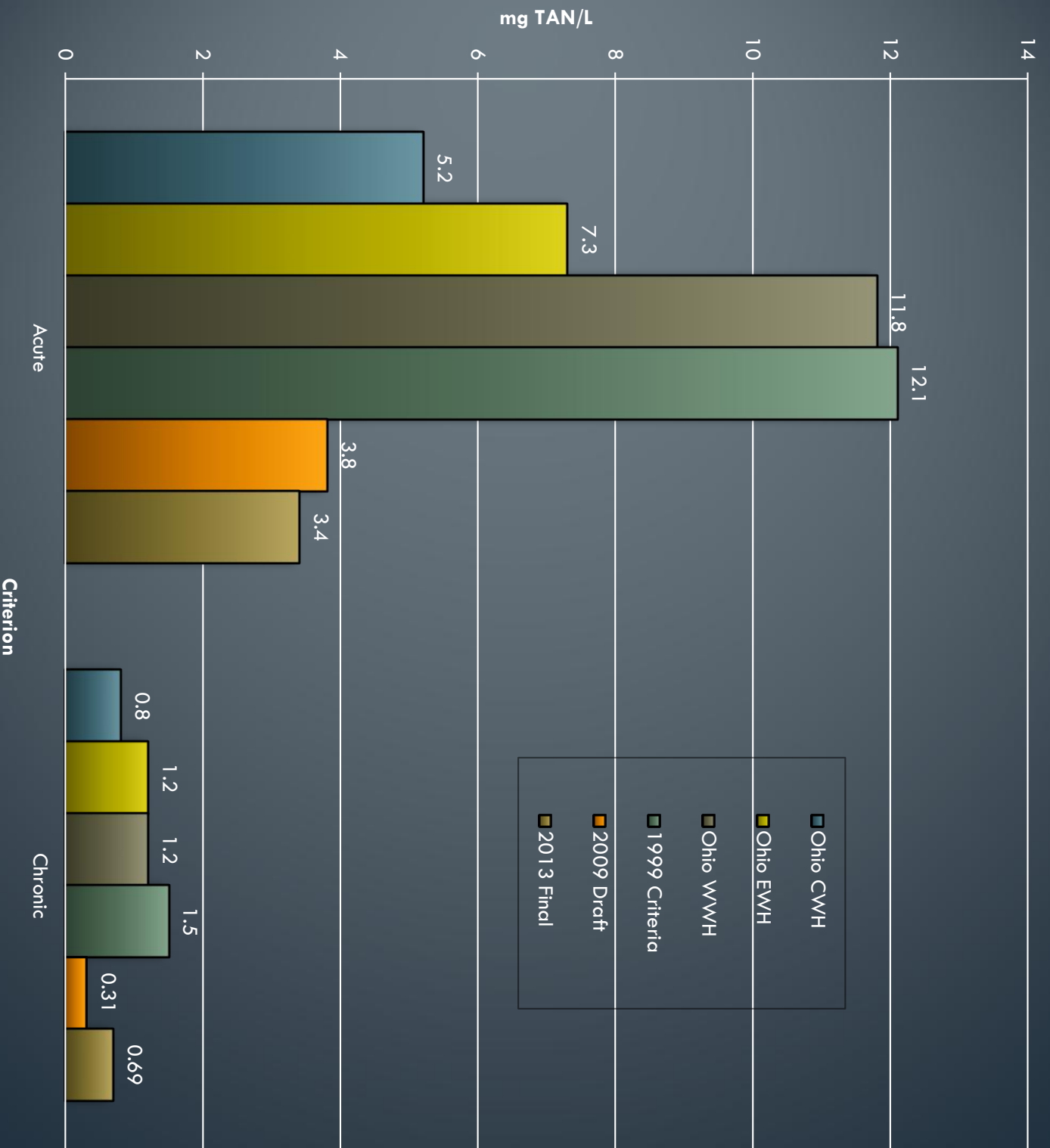


# Mussel Distribution



# Ohio EPA Mussel Collection Sites





pH=7.8; Temp=26; Mussels present; *Oncorhynchus* absent

# New Ammonia Aquatic Life Criteria

- Studies show that activated sludge WWTPs can attain new criteria
  - however lower the margin of safety
- Proposed Criteria was part of the Ohio EPA 2016 Triennial Review
- Ohio EPA Rule development continues

# Ohio's Nutrient Aquatic Life Water Quality Standard (WQS)

- Ohio has been working on WQS for Nitrogen and Phosphorus since early 2000's
- Different Nutrient Criteria for different media
  - *Small to Medium Sized Rivers* – Stream Nutrient Assessment Protocol (SNAP)
    - Technical Advisory Committee 2013 -2015
    - Two Parts to SNAP – Water Quality Standard & Implementation
  - *Large Rivers*
    - Data collection and theory developed
    - Early Stakeholder Outreach and concept presentation in Fall 2018
    - Agency reviewing comments received
  - *Inland Lakes*
    - Part of proposed 2011 Inland Lakes Rule
    - Reassessing Inland Lakes Criteria as part of Agency Triennial Rule Review

# USEPA POTW Nutrient Removal Technology Review

- US EPA planning to conduct national study of POTWs
- Study Goals
  - Obtain nationwide data on nutrient removal to help set realistic and achievable reduction targets
  - Encourage improved & cost effective performance
  - Forum to share best practices
- Questionnaire still under development

# Questions?

# Thank You

