Ohio Nutrient Regulations Update

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Guy Jamesson, PE

Malcolm Pirnie, The Water Division of ARCADIS

Agenda

- Nutrient impacts
- Nutrient criteria development
- Ohio EPA's draft nutrient criteria
- Implementation of Ohio draft nutrient criteria
- Summary

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Nutrient-Caused Water Quality Impacts

Nutrient Impacts

- Significant cause of water quality impairment
- Nutrients can cause over-enrichment in receiving water bodies
  - Eutrophication in streams and lakes
    . . . Excessive algae and other plants growth
  - Non-attainment of biological criteria
    . . . (Listed as “cause” in many TMDLs)
  - Hypoxia – ‘dead zone’ – in coastal waters

Nutrient Impacts

- Over-enrichment in receiving waters
- Excess phosphorus:

  ➔ potential over-enrichment of **freshwaters**
- Excess nitrogen:

  ➔ potential over-enrichment of **oceans & estuaries**

Ammonia-N ➔ oxygen demand

Ammonia-N ➔ toxicity

NOT nutrient issues!

Ohio Nutrient Impacts

Lake Erie watershed

– subject to eutrophication and algal blooms

Ohio Lakes & Streams

– subject to nuisance growths

NOTE: WWTP effluents and urban storm water contribute **12% TP** and **9% TN**. Agricultural sources contribute **80% TP** and **71% TN**.

Ohio River watershed drains to the **Gulf of Mexico**

– subject to summer hypoxia

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Nutrient Water Quality Criteria Development

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EPA Mandate for Nutrient Criteria

- US EPA Nutrient Strategy (1998 - 2001)
  - States required to develop regional, scientifically defensible criteria
- US EPA guidance
  - Eco-region based criteria: "**reference site**" approach
  - Example: typical Guidance TP criteria ~0.07 mg/l
  - Guidance did not promote "**effects-based**" approach
- Slow progress by most states
  … US EPA increasingly displeased

Nutrient Criteria: the Challenge

Issue: Nutrients are different from toxic or conventional pollutants

- Effects not predictable through "dose-response" curves . . . Difficult to develop criteria for nutrients
- In 2010, EPA's Science Advisory Board review critical of US EPA's *"Empirical Approaches for Nutrient Criteria Derivation"*
- WQ Criteria should be based upon: "stressor-response" (*"cause and effect"*)

Stressor-Response Approach *

- Estimate a relationship between nutrient concentrations and biological response
- Relate to designated use (ideally quantitatively)
- Derive nutrient concentrations protective of designated uses from the observed relationships

* Modified from "*Empirical Approaches for Nutrient Criteria Derivation*" draft SAB report, 2009

Stressors for Biological Impairment

- **Nutrients**
- Riparian disturbance
- Streambed sedimentation
- In-stream habitat for fish & aquatic organisms
- Riparian vegetative cover

Habitat

- Salinity (TDS), other water chemistry

Reducing nutrients without solving habitat problems will not attain biocriteria WQS

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Biological Response Variables

- Productivity – algal growth
  - Measurement of chlorophyll
  - Dissolved oxygen swings
- Biological survey
  - Biocriteria indices: ICI, IBI, MIwb
  - Diversity & number of aquatic species (macroinvertebrates and fish)

Existing Ohio Nutrient Regulation

- Current Ohio status (typical of most states):
  - Narrative criteria: **"Free of nutrients in concentrations that may cause algal blooms"**
  - No numeric criteria for Phosphorus or Nitrogen
- *"Associations Report"* (Ohio EPA,1999)
  - Used in many TMDLs to establish wasteload allocations

Flawed approach: statistical associations alone cannot prove cause-and-effect

- Water Quality Trading allows trading credits to reduce nutrients

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Phosphorus and Current Regs

- Concern: TMDLs for many Ohio watersheds have listed **nutrients** as cause of impairment, although data to support listing may be ambiguous
- Phosphorus was 'basis of listing' … in many cases:
  - "*Association Between Nutrients, Habitat, and the Aquatic Biota in Ohio Rivers and Streams*" (Ohio EPA, 1999). . . *aka* '***the Associations Report***'
- Often unclear relationships between nutrients (phosphorus) and excessive enrichment
- Currently: 188 POTWs with TP limits; 353 monitor for TP *

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* Ohio EPA data

Ohio's Current Nutrient Criteria Development

2003 … OEPA nutrient criteria development plan

- Study approach: look for 'cause and effect'
- Biological responses: ♦ Effect on algal biomass (chlorophyll *a*) ♦ Effect on biocriteria ♦ Effect on DO

2004 - 2007 … Data collection

- Typical stream monitoring data, incl: TP; TN (DIN) Chlorophyll *a*; DO; stream physical conditions (cover)
- Mostly small streams; some large rivers in 2007

2008-2009 … Data evaluation, criteria draft

2010-2011 … Working draft rule (small streams & rivers)

Draft Rule: Future Nutrient Design Requirements

- Draft Antidegradation Rule (OAC 3745-1-05)

  → Comment deadline Jun 6, 2011

- Best Available Demonstrated Control Technology (**BADCT**) includes nutrient treatment limits for new sources

Draft **BADCT Design**	**30-d Limit**	**7-d Limit**
Total Nitrogen	10 mg/l	15 mg/l
Total Phosphorus	2.0 mg/l	3.0 mg/l

- If POTW is expanded, then BADCT will apply to new
- No permit limits until entire plant is upgraded

Ohio Environmental Protection Agency

Ohio EPA's Working Draft: Stream Nutrient Rule Package

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Draft Nutrient Rules: 3 Parts

- Criteria for control of nutrient enrichment
  - TIC criterion to indicate enrichment status of stream
  - Nutrient criteria for different streams
- Wasteload Allocation for nutrients
  - How to calculate allowable nutrients discharge
- Reasonable Potential
  - Determine when nutrient criteria are applied

DRAFT: subject to change

TIC : Trophic Index Criterion
Stream Status – Measure of Enrichment

- Multi-metric score based upon evaluations of:
  - Primary productivity
  - Biological health
  - Nutrient concentrations in stream
- TIC will determine applicability of water quality criteria:
  - Total Phosphorus (TP)
  - Dissolved Inorganic Nitrogen (DIN)

DIN = Ammonia + Nitrate + Nitrite
= NH_3-N + NO_3-N + NO_2-N

Trophic Index Criterion:

$TIC = P_{chl\ a} + P_{DO} + B + N$

Metric	Description	Metric Score*
$P_{chl\ a}$	Representative benthic chlorophyll *a* (scrapings from rocks in stream bed)	0 to 4
P_{DO}	Minimum & average instream DO; and 24-hour range (max value minus min value)	0 to 5
B	Biological survey results (ICI, IBI, MIwb) [*ref: OAC 3745-1-07, Table 7-15*]	0 to 6
N	TP (total phosphorus) and DIN (dissolved inorganic nitrogen = NH_3-N + NO_X-N)	0 to 4

* *If no data, metric score is 1*

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Stream Status indicated by TIC

Stream Status == Measure of Enrichment

Status of Stream	TIC
Acceptable – nutrient enrichment is not likely	8 to 19
Threatened – nutrient enrichment is likely now or in the future	4 to 7
Impaired – nutrient enrichment is documented	0 to 3

DRAFT: subject to change

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Draft Nutrient Criteria

Criteria will apply if "reasonable potential" is determined

Aquatic Life Use and QHEI	TP (mg/L)	DIN (mg/L)
Exceptional Warmwater Habitat, and all QHEI scores	0.060	3.0
Warmwater Habitat, and QHEI score = 12 to 64	0.16	3.0
All other aquatic life uses, and all QHEI scores	0.30	3.0

- For most streams with drainage areas up to 1,000 sq miles
- Exception may be made for streams 500 to 1,000 sq miles
- Does not apply to small, historically channelized streams i.e., drainage areas < 3.1 sq. mi. (< 2,000 acres)

Water Quality Trading Option

- If Agency believes WQ trading will address nutrient enrichment conditions ➔ less stringent effluent limits plus WQ trading nutrient reduction may be included
- Option allows up to 3 NPDES permit cycles for existing POTWs to meet final nutrient limits
  - Initial and 2nd permits: TP $\leq$ 1 mg/l ; DIN $\leq$ 10 mg/l
  - Keep interim permit limit as final limit if stream recovers (TIC returns to “acceptable”)

Wasteload Allocation for Nutrients

- Wasteload Allocation: mass balance equation

(Mass of nutrients in upstream) + (Mass of nutrients in discharge) ≤ (Allowable mass of nutrients for WQ Criterion)

  - Design stream flow:
    - Summer flow exceeded 80% of time (**20th-percentile**)
    - Winter flow exceeded 80% of time (**20th-percentile**)

20th-percentile flows are larger than the 7Q10 stream flow used for other pollutant WLAs

Reasonable Potential

- Determines whether NPDES limits are necessary
- Reasonable Potential to cause or contribute to excessive nutrient enrichment (i.e., exceed nutrient WQC) whenever:
  - **for Total Phosphorus (TP)**
    - TIC = 7 or less
  - **for Dissolved Inorganic Nitrogen (DIN)**
    - TIC = 7 or less, ***AND***
    - Receiving water is nitrogen limited (Molar ratio of DIN to TP is 7 to 1 or less)

Subject to Change . . . ?

- Ohio EPA and US EPA not yet in agreement
  - How to account for uncertainty and "reasonable potential"?
- Ohio EPA proposes TIC as multi-metric assessment of overall stream status – 'measurement of enrichment'
  - If 'weight of evidence' suggests no excessive enrichment, then nutrient criteria should not be applied to establish limits in NPDES permit

‘Draft’ Example
TIC and Reasonable Potential:
City of Columbus WWTPs

EXAMPLE

Scioto River downstream of Columbus Southerly & Jackson Pike WWTPs

Metric	Evaluation ('estimate')	Metric Score
$P_{chl\ a}$	No chlorophyll data (default value = 1)	1
P_{DO}	Minimum DO >5.0; 24-hr avg DO >6.0; and 24-hr range < 6.0	5
B	Biological survey (all indices meet warmwater habitat – or non-significant departure from)	6
N	TP = 0.041 to 0.10 mg/l; DIN = 1.1 to 3.0 mg/l	1
TIC	TIC = $P_{chl\ a} + P_{DO} + B + N$	13

If TIC = 8 to 16, stream status = "acceptable"

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EXAMPLE

Scioto River downstream of Columbus Southerly & Jackson Pike WWTPs

- TIC (estimated value = **13**) . . . indicates "nutrient enrichment is not likely" ➔ no TP permit limit

- DIN : TP ratio:
  - DIN = 2.65 mg/l = 0.189 mmole/l
  - TP = 0.32 mg/l = 0.0103 mmole/l
  - Molar DIN : TP ratio = **18.3** . . . indicates stream is not nitrogen limited ➔ no DIN permit limit

Summing Up

Draft Ohio Nutrient Criteria Rules

- Stressor–response concept to develop criteria / rules
- Weight of evidence approach to determine stream status
  - **Trophic Index Criterion (TIC)**
    – *measurement of enrichment*
- TIC used to determine criteria applicability
- DIN criteria applied only if stream is nitrogen limited
- If applied, criteria will be stringent:
  - **TP**: 0.06 *or* 0.16 *or* 0.3 (mg/l)
  - **DIN**: 3.0 (mg/l)

Implementation Details ?

- How to determine metrics for TIC ?
  - Multiple data values: Median? Average? Min / Max?
  - Preponderance of evidence?
- Existing TP limits based upon TMDLs
  - What if TIC indicates no reasonable potential?
- Final rule must be approved by US EPA
  - Will there be changes ?

What Impact on POTWs ?

- Expect most plants will not have effluent nutrient limits
- If nutrient limits – expect TP only in nearly all cases
- Effluent limits may be higher than WQ criteria
  - Depends upon stream flow – if significant dilution then TP limits may be greater than 0.06 / 0.16 / 0.30 mg/l
- Effluent limits could be near treatment technology limits
- WQ trading option to achieve NPS nutrient reductions

Anticipated Schedule for Ohio's Nutrient Rules

✓ *November 2010 – sent 'working draft' rules to Region 5*

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- Spring 2011 – Draft rules for Interested Party Review
- Fall 2011 – File proposed rules
- Spring 2012 – Adopt rules
- Summer 2012 – Rules effective

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Credits

Thanks for information provided by:

Dan Dudley, Bob Miltner &

George Elmaraghy (Ohio EPA)

Questions ?

Guy Jamesson, PE, BCEE

Malcolm Pirnie, The Water Division of ARCADIS

614.430.2632

guy.jamesson@arcadis-us.com