TAG – NUTRIENT RULEMAKING – IMPLEMENTATION ISSUES

1 – Will permit limits be imposed in advance of SNAP?
--if so, how derived? (Associations Report? case-by-case based on existing narrative WQS?, other?)
--per RM, OEPA has default target values in mind: 0.3 mg/l (technology based); and 0.13 (a biological breakpoint, based on OEPA's nutrient study (technical support document)

2 – Will SNAP be performed in any context other than TMDLs? If so, will SNAP results be subject to review, comment, legal challenge by third parties? When? How?

3 – How/when will SNAP be incorporated into TMDLs, permit limits?

4 – How will a SNAP-derived threatened or impaired assessment be translated into stream segment(s)? Could a Watershed Management Plan be developed and implemented in lieu of a TMDL? If a TMDL is conducted, ideally the targets would be dissolved oxygen and benthic algae so that acceptable TP/DIN loads could be established. In lieu of these other actions, could WQBELs for WWTP NPDES permits be calculated based on instream TP of 0.131 mg/l and DIN of 3.6 mg/l?
--will SNAP be performed on basin, sub-basin, stream, or stream segment basis?

5 – What happens if SNAP determines nutrients are not (or may not) be a problem when an existing TMDL or permit has recommended P limits?

--should TMDLs with P recommendations (based on 1999 Associations Report) be vacated pending SNAP of relevant stream?

--what about TMDLs currently in development

--same question re existing NPDES permits with P limits

6- If SNAP determines that stressors (unrelated to nutrients) are the source of impairment (Flow Chart B) or potential impairment (Flow Chart A), will any action be taken regarding TP and DIN loads?

7 – Should implementation strategy be different if stream is threatened, but not impaired? How so? Should implementation strategy be different if a nutrient management plan (NPDES or TMDL) has been approved? How so?

8 – What should be the metric(s) for determining whether nutrient reductions by PSs should be required (and when):

b. stream is impaired

a. stream is threatened, but not impaired

c. nutrient reductions from PSs will (materially) improve (near-field) biology, or

d. nutrient reductions from PSs will restore designated use

e. non-nutrient stressors prevent materially improved biology (and such stressors are unlikely (or unknown) to be abated in, say, 5/10/50/other years

f. other non-nutrient stressors prevent attainment of use (material improvement of biology)

g. are far field impacts relevant. If so, how

h. NPS or other (e.g., HSTS) “unregulated” [meaning unlikely to be materially abated in the (near?) future] sources are a _____ source of nutrients:

i. a “material” source of nutrients—NPS discharge will prevent attainment, but will not prevent (material) biol. Improvement (if PS discharges are reduced)

ii. a “significant” source of nutrients—NPS discharge will prevent (material) biol. improvement.

9 – Will limitations on nutrient discharges be required for NPS? If so, which, under what circumstances, etc?

10 – What will be the criteria for allocating nutrient reductions among contributing sources?

--will PS be treated differently than NPS

--will all PS be treated identically (i.e. = % reduction) or will flow be considered and, if so, how?

11 – Effluent Trading Issues

a. Will PS be required to reduce discharge of nutrients by a percentage greater than they contribute to a stream segment?

b. Under what circumstances, to what degree?

c. If answer to “a” is yes, then there is need for robust ET program

1. what are the elements of good ET program?

d. Even if answer to “a” is no, it may be less expensive for POTW to treat NPS than reduce its own P discharge.

12 – Will PSs that have already reduced nutrients be given “credit” for having done so?

a. if yes, what are the criteria for determining eligibility for the “credit?”

b. what form will the credit take: e.g., extended compliance schedule, less restrictive limits, etc?

13- Technical feasibility/Economic Reasonableness

a. Should there be “off ramps” for technical (e.g. lagoon systems), size, or economic factors?

b. Are there any foreseeable technical limitations? What?

c. For economic limitations, need different metrics for POTWs and private

d. For POTWs, should affordability use USEPA CSO policy—2% of MHI—or other? If other, what?

e. Should integrated planning be incorporated into the rule? Should it include wastewater-related obligations, storm water, drinking water?

f. If unaffordable, what is the relief: extended compliance schedule, less restrictive permit limits, other?

14 – Over (a) what streams and (b) range of stream size does SNAP apply?

a. channelized watercourses? County ditches? Other?

b. size

--is there a maximum size drainage age? A minimum? (in previous draft rule, OEPA used 3.1 sq.mi. (=2000 acreas) as minimum)

--ponds, lakes?

--wetlands?

-- streams with drainage areas

--other exclusions/qualifications (in previous OEPA draft, it allowed the Director to not apply the rule if drainage area of stream stream was 500-1000 sq. mi and water depth, stream width, canopy, etc. warranted non-application of TIC.

15 – Wasteload allocations (see draft OEPA rule 3745-2-13, attached)

a. what stream flow should be used: 7Q10, other?

b. what model(s) should be used to translate SNAP

16 – Permit limits

a. compliance schedule
b. different limits based on seasons?/ summer only?
c. are limits monthly, seasonal, annual average, harmonic mean, other?
d. interim limits

17– How will reasonable potential and antidegradation be considered if a SNAP determines that a) biological condition is considered to be threatened, or b) biological condition is not threatened (under existing loads)?

18 – Will SNAP be incorporated into regulatory decisions (i.e., permits) other than NPDES: storm water, MS4, general storm water? If so, how?

19 – Data requirements

a. what is there is insufficient data (chemical or biological) for one of the SNAP factors?
b. what constitutes sufficient data?

20 – Will DST uses/attainment be relevant to determining permit WQBELs/TMDLs? How will it be done?

21 – Adaptive management

a. will AM be incorporated into nutrient reduction rule?

b. what does AM mean in this context?

c. how will the amount of time it takes for nutrient reduction measures to be manifested be accounted for? How will this be reflected in NPDES permits?

d. How will upward or downward trends in nutrient levels and/or biocriteria scores that have not yet been manifested in meeting (or exceeding) attainment be accounted for?

22 – Identification/incorporation of drinking water issues: nitrate, cyanobacteria, other?

23 – Variances

24 – Sludge Management Issues

25 – Should new/expanded facilities be treated differently than existing PSs?

26 – Nutrient Ratios

--what are data requirements? Over what period of time (seasonal impacts)

--this would impact whether N is a problem and whether N limits would (also) be required

27 – Margin of Safety; Margin for future growth?

28 – How will LAs and WLAs be addressed?

29 – What should the rule say about monitoring by PS (NPS?)

* SNAP Implementation- Issue #8 Overview

* *8 – What should be the metric(s) for determining whether nutrient reductions by point sources (PSs) should be required (and when)?*
  a. stream is threatened, but not impaired
  b. stream is impaired

* SNAP flowchart addresses these situations in terms of documenting the causal assessment and linkage to stressors.
* If the stream is threatened due to nutrients, then nutrient management plans such as NPDES permits or TMDLs are developed and/or implemented.
* If there are limited data to link nutrients to the impairment and nutrients are being attenuated, then Ohio EPA will address reasonable potential and antidegradation.

* *8 - What should be the metric(s) for determining whether nutrient reductions by point sources (PSs) should be required (and when)?*
  c. nutrient reductions from PSs will (materially) improve (near-field) biology, or

* If reduction of point sources is expected to materially improve near-field biology, then technology-based, interim limits should be explored. Because the cost and performance of technology is site-specific, the permittee should conduct a feasibility study.

* *8 – What should be the metric(s) for determining whether nutrient reductions by point sources (PSs) should be required (and when)?*
  d. nutrient reductions from PSs will restore designated use

* If reduction of point sources will restore the designated use, then feasibility studies should be conducted (including an affordability assessment) and a compliance schedule developed.

* ***8 – What should be the metric(s) for determining whether nutrient reductions by point sources (PSs) should be required (and when)?***
  e. non-nutrient stressors prevent materially improved biology (and such stressors are unlikely (or unknown) to be abated in, say, 5/10/50/other years

  * If non-nutrient stressors (like habitat or lack of flow) prevent improvements in biology, these should be addressed prior to requiring nutrient controls.

* *8 – What should be the metric(s) for determining whether nutrient reductions by point sources (PSs) should be required (and when)?*

  f. other non-nutrient stressors prevent attainment of use (material improvement of biology)

* If non-nutrient stressors (like habitat or lack of flow) are causing the non-attainment, these stressors should be addressed prior to requiring nutrient controls.

* *8 – What should be the metric(s) for determining whether nutrient reductions by point sources (PSs) should be required (and when)?*
g. are far field impacts relevant. If so, how

* Far-field impacts may be relevant if the local sources are a significant contributor to a far-field nutrient problem and the need for reductions has been quantified. In these cases, it is important for the state to provide flexibility and for the sources to coordinate local and far field solutions so that regulatory requirements do not result in having to upgrade facilities twice.

* *8 – What should be the metric(s) for determining whether nutrient reductions by point sources (PSs) should be required (and when)?*

  h. Nonpoint sources (NPS) or other (e.g., HSTS) "unregulated" [meaning unlikely to be materially abated in the (near?) future] sources are a ______ source of nutrients:

* *A "material" source of nutrients—NPS discharge will prevent attainment, but will not prevent (material) biological improvement (if PS discharges are reduced)*
  * Both NPS and PS reductions should be required.
* *A significant" source of nutrients—NPS discharge will prevent (material) biological improvement.*
  * Watershed plan or TMDL/Watershed Implementation Plan should be developed that determines the necessary reductions. PSs should be encouraged to evaluate ways to optimize existing facilities to reduce nutrients but should not be required to undertake significant capital expenditures.

OEPA Nutrient TAG Implementation Issue #13: Technical Feasibility and Economic Reasonableness

For Discussion at the Ohio EPA Nutrient TAG Meeting
on September 11, 2014

Prepared By Dale Kocarek

(a) Should there be "off ramps" for technical (e.g. lagoon systems), size, or economic factors?

- The rule making process should recognize the potential cost and difficulty of implementing nutrient controls may be substantial and will vary between entities.

- Costs and difficulty factors for more stringent levels of nutrient controls will increase in a non linear manner when implementing technologies more complicated than multi-point chemical addition.

- When determining reasonable and affordable nutrient controls, decisions to implement increasingly more stringent requirements should be based on a benefit-cost analysis, which takes into consideration:

  - Nitrogen control, Phosphorus Control, or Both
  - Levels of control sought or imposed by OEPA
  - Compliance averaging period (Another White Paper)
  - Existing investments in nutrient controls
  - User cost and existing debt
  - Implementation challenges (space, technology and size)
  - Competing requirements (wet weather – integrated planning?)

(b) Are there any foreseeable technical limitations?

- Traditionally, most facilities in Ohio required to remove TP to meet an effluent limit of 1.0 mg/l employ multi-point chemical feeding system where iron or aluminum salts are added to form a particulate, which is settled in a final clarifier and in some instances removed by tertiary filtration.
- For some POTWs, the biological reactor process is configured to provide limited biological removal of DIN and TP with supplemental chemical feed. This trend is expected to continue in Ohio as new facilities are planned and designed with the anticipation of nutrient controls.
- POTWs with the activated sludge process, operating at long MCRTs, and with available space on their property to construct new process systems including tertiary filters will be much better positioned to remove DIN and TPs to stringent levels than those without these features.
- Treatment systems that use lagoons or trickling filters may will be more difficult to retrofit with nutrient controls to meet stringent effluent limits.
- Small size facilities face challenges due to technology and lack of financial resources.
- OEPA should provide guidance on nutrient control in *Ten States Standards*.

(b) Are there any foreseeable technical limitations?

- The level of control required will be a significant factor in determining the cost to the user and the compliance schedule.

- For situations that require a POTW to remove DIN and TP to 10 mg/l and 1.0 mg/l respectively, the cost for most "major" dischargers (those over 1.0 MGD), is not expected to create an undue hardship if the facilities have been "pre-positioned" for nutrient limits.

- As effluent requirements become more stringent, the possibility for adverse economic impact will increase significantly. Capital and operational costs for nutrient controls may become significant when the following conditions are met:

  - Effluent limits for TP < 0.7 mg/l
  - Effluent limits for DIN < 8.0 mg/l
  - The biological process is different than activated sludge.
  - If the process cannot be expanded to site constraints
  - If no trading options are available
  - If other costs for compliance such as wet weather already cause a financial burden

(c) For economic limitations, do we need different metrics for POTWs and private entities?

- For POTWs, the traditional approach involves conducting a financial analysis of the population in conjunction with ongoing and projected operational costs, current and future debt associated and the users' ability for afford.

- Decisions for new private enterprises (deciding on where to locate) are based on comprehensive market analysis, which includes the labor market, transportation, local and statewide taxes, political atmosphere, cost of raw materials, local/national economic factors, and reliable water and sewer.

- Return on investment asked by corporate boards is very short compared to the public sector.

- Most private sector organizations are not opposed to environmental regulations as long as they are well understood and applied to competition fairly.

(d) For POTWs, should affordability use USEPA CSO policy—2% of MHI—or other?

- The water and wastewater utilities industry has been engaged in discussion about the USEPA CSO 2% criteria.

- Positions taken by WEF, AWWA, NACWA and the Council of Mayors do not support USEPA's 2% position and believe that more factors must be considered to make it a more fair and accurate indicator.

- The current criteria does not consider factions of the population at risk including fixed income, elderly, and those living under the official poverty levels.

- This issue should be carried into this discussion as part of the integrated planning framework.

(e) Should integrated planning be incorporated into the rule? Should it include wastewater-related obligations, storm water, and drinking water?

- We believe that the integrated planning (IP) framework should be a component of the overall implementation strategy.

- The IP framework should provide a forum to establish priorities to meet a plethora of regulatory requirements including drinking water, wet weather, storm water, and nutrient removal for <u>Total</u> system compliance.

- There appears to be little overall guidance on how IPs are to be prepared, reviewed, and approved or if everything remains “at the permit holder’s risk” with no guarantees.

- The implementation strategy for nutrients should involve a gradual implementation of controls, followed by stream evaluation over multiple permit cycles to determine improvement based on reasonable potential. If the first level of controls are not effective, subsequent controls may be required.

(f) If unaffordable, what is the relief: extended compliance schedule, less restrictive permit limits or other?

- The Rule must recognize that the cost of nutrient controls will vary from manageable to burdensome.
- Remedies must include all reasonable options, including extended compliance schedules, less restrictive or “stepping stone” limits, or effluent trading.
- Another option is an economic variance conducted through a cost-benefit analysis taking into account an improved metric of affordability.
- It is important to recognize that the time to plan, design, construct, and commission new facilities in a best case scenarios will often exceed five years and may approach ten.
- We recommend that communities allow for staged implementation over multiple permit cycles to reduce cost concerns while simultaneously providing a gradual water quality benefit.

ISSUE #13 - TECHNICAL FEASIBILITY/ECONOMIC REASONABLENESS

Revised September 8, 2014

TAG members: Dale Kocarek, Bill M, Adrienne, Gary, Steve H, Jason

OEPA resources: Gary Stuhlfauth (Dan Gill)*

(a) Should there be "off ramps" for technical (e.g. lagoon systems), size, or economic factors?

The rule making process should recognize that the potential cost and difficulty of implementing nutrient controls may vary substantially depending on a number of factors, including wet weather compliance requirements and level of nutrient removal required. The rule should also reflect that fact that the cost of nutrient related compliance is generally not linear based on the increasing amount of reduction required. In most cases, where removal requires more than multi-point chemical addition, the cost of achieving increasing levels of treatment over the prior level will be exponential.

When determining reasonable and affordable nutrient controls, decisions to implement more stringent requirements should be based on a benefit-cost analysis, which takes into consideration the following: nutrient/phosphorus control or both, effluent limits, compliance averaging period (another white paper), configuration and type of existing biological reactor, prior investments in nutrient controls, user cost, debt retirement, space requirements, wet weather compliance issues, and other environmental compliance initiatives (such as MS4 compliance).

To establish context, the following is presented as a "best case" scenario for nutrient controls: a conventional activated sludge system operated at a long Mean Cell Retention Times (MCRTs), abundance of available space to construct new process systems including tertiary filters, flexibility to pursue some degree of biological DIN and TP removal to offset chemical costs, no significant wet weather initiatives, and manageable debt structure.

Treatment technology and size has a significant impact on the community's ability to implement nutrient controls in a practical and affordable manner. Technologies such as lagoons and intermittent/recirculating sand filter technologies, which were planned and designed to provide a good sustainable treatment for small rural communities lacking resources for operation and maintenance, and generally not designed for nutrient removal in mind. They provide secondary treatment with little ability to remove ammonia nitrogen.

Consideration should be provided in the rule to exempt communities with small flows and/or those that use lagoon or small system "filter type" technologies. Otherwise, the lagoon process, which was implemented to be a sustainable and reasonable technology for small communities, may have to be abandoned in favor of regionalization or "mechanical style" processes, which exceed the limitations and sophistication of the community to construct or maintain.

Another technology that may be difficult to retrofit with stringent nutrient controls are conventional trickling filter systems, which is an attached growth process. Many of these systems were constructed in the 1930s through the 1960s to primarily remove $CBOD_5$ and TSS and use rock and synthetic style media as the biological conversion process. It should be noted hybrid systems that feature aspects of both attached and fixed growth systems including the integrated fixed-film activated Sludge (IFAS) and moving-bed biofilm reactor (MBBR) will have more flexibility for biological nutrient removal than attached growth systems alone.

The Rule should include “off ramps” to provide relief for very small communities and should fully exempt lagoon systems. One option may be to established thresholds for the degree of nutrient removal to the size of the facility based on NPDES Permit rated capacity. POTWs smaller than 0.1 MGD, which are covered for PTI issuance under the auspice of the *Ohio EPA Green B*ook, may be wholly exempt from nutrient limits, while those less than 0.5 MGD may be required to provide a less stringent level of nutrient control.

Finally, the discussion would not be complete without acknowledging on-site sewage disposal systems, which have been shown to a source of nutrient impairment in certain stream segments. While these are not point sources, they contribute significantly to the problems across the State of Ohio. As a rule, on site treatment systems lack both the ability to removal ammonia-nitrogen, and those that do, lack the ability to remove DIN.

(b) Are there any foreseeable technical limitations?

There are a number of technical limitations depending on the type of treatment process, the size and the level of controls required. As was stated above, POTWs with the activated sludge process, operating at long MCRTs, and with available space on their property to construct new process systems including tertiary filters will be much better positioned to remove DIN and TPs to stringent levels than those without these features.

Traditionally, most facilities in Ohio that are required to remove TP to meet an effluent limit of 1.0 mg/l do so with a multi-point chemical feeding system where iron or aluminum salts are added to form a particulate, which is settled in a final clarifier and in some instances removed by tertiary filtration. For some POTWs, the biological reactor process is configured in a manner to provide limited biological removal of DIN and TP with supplemental chemical feed. This trend is expected to continue in Ohio as new facilities are planned and designed with the anticipation of nutrient controls.

The level of control required will be a significant factor in determining the cost to the user and the compliance schedule. For situations that require a POTW to remove DIN and TP to 10 mg/l and 1.0 mg/l respectively, the cost for most “major” dischargers (those over 1.0 MGD), is not expected to create an undue hardship. However, as the effluent requirements become more stringent, the possibility for adverse economic impact will increase significantly. Capital and operational costs for nutrient controls may become significant when the following conditions are met:

- Effluent limits for TP < 0.7 mg/l
- Effluent limits for DIN < 8.0 mg/l
- The biological process does not include activated sludge or some form of suspended growth process.
- If the process is such that it cannot be expanded or if there is no physical space on site
- If no trading options are available

- If other costs for compliance such as wet weather already cause a financial burden

Discussion on treatment technologies and size limitations for on-site, very small and small communities and typical small systems technologies is provided above.

Anther technical concern is the treatability of the nitrogen and phosphorus in the waste stream. POTWs that receive significant industrial loadings may be concerned about the inorganic / organic split of their influent nitrogen and the extent that it is amenable to biological treatment. This will be a factor of possible concern for communities with significant industrial flows and loadings.

In determining critical trigger points for control, the time used for data averaging is critical. Data averaged over a longer period of time—seasonal or annual—is believed to be more appropriate by POTWs than shorter period of time, such as weekly or monthly. The subject of data monitoring and the reporting period is discussed elsewhere. Also, the time of year for nutrient control is important. The critical times for Lake Erie are in late winter and early spring.

The operation of nutrient removal facilities, and particularly those that incorporate biological treatment, is impacted by wet weather and snow melt. It has been established that the kinetic rates of reaction for biological nutrient removal slow dramatically during cold weather and the time when treatment plant flows increase due to inflow and infiltration. The Rule should consider establishing the concept of a minimum temperature such as 5 to 10 degrees C range. Flows in many systems subject to I/I may increase substantially for dry day winter weather periods, making treatment requirements and associated costs even more expensive.

This combination of factors must be clearly articulated to both the regulated and design communities through updated editions of *Ten States Standards*. (A good example of a document may be a document such as TR 16 in New England.) Facilities sized to handle warm weather conditions may be dramatically undersized for cold weather operations. The value of designing facilities to handling cold weather operations must be reconciled against impacts/benefits to the receiving stream.

(c) For economic limitations, do we need different metrics for POTWs and private entities?

Affordability for public and private entities is different and will require different approaches to determine economic limitations. For POTWs, the traditional metrics involve determining a financial analysis of the population in conjunction with ongoing and projected operational costs, current and future debt associated with nutrient controls. The subject of affordability in the context of the public sector is discussed further below.

A more customized approach may be required for private entities since decision is very different. It will depend on the industry, the location; its viability, and corporate expectations for profitability. In many instances, decisions for new enterprises to locate in an area are initially based on a comparison with other suitable locations. Additional criteria include things that have little or nothing with environmental controls other than a comparative analysis and existing/projected water and sewer rates. For existing entities, decisions for staying in an area of moving out of state will be based on maximizing the rate of return for a particularly factory/operation in a large organization. Sometimes, even the smallest change can cause a plant to close its doors and locate in another area.

(d) For POTWs, should affordability use USEPA CSO policy—2% of MHI—or other?

The water and wastewater utilities industry has been engaged in discussion about the appropriateness of the continued reliance on the USEPA CSO policy guideline of 2% of MHI. Positions taken by WEF, AWWA, NACWA and the Council of Mayors do not believe that USEPA's 2% is a maximum threshold for affordability. Rather they view it as guidance.

The current criteria is viewed as a "one size fits all" approach and does not appropriate consider factions of the population at risk such as fixed income, elderly, and those living under the official poverty levels.

(e) Should integrated planning be incorporated into the rule? Should it include wastewater-related obligations, storm water, and drinking water?

We believe that the integrated planning framework must be a central component of the overall implementation strategy. The integrated planning framework provides a forum to establish priorities to meet a plethora of regulatory requirements. These may include drinking water, wet weather, storm water, and nutrient removal. The implementation strategy for nutrients should involve a gradual implementation of controls to determine if a set level of control will address problems associated with near field impairment to a receiving stream to meet its reasonable potential. Then, if the first level of controls is not effective, subsequent controls may be required. It has been recognized that this process will occur over subsequent permit cycles.

Nutrient controls should certainly be one of the key planning criteria for total system compliance. However, there appears to be little overall guidance on how truly useful and effective plans are to be prepared, reviewed, and approved or if everything remains "at the permit holder's risk" with no guarantees.

(f) If unaffordable, what is the relief: extended compliance schedule, less restrictive permit limits or other?

The Rule must recognize that the cost of nutrient controls will vary from manageable to burdensome on a case by case basis. The cost may be well beyond a community's ability to afford even with an extended compliance schedule. Remedies must include all reasonable options, including extended compliance schedules, less restrictive or "stepping stone" limits, or effluent trading.

In evaluating the time to implement nutrient controls, the time to plan, design, construct, and commission new facilities must be considered. For large and complex systems, it would not be unreasonable for this length of time to approach ten (10) years.

Another option is an economic variance conducted through a cost-benefit analysis taking into account an improved metric of affordability other than the ubiquitous 2% MHI which was taken from the USEPA CSO Policy.

Where possible, we recommend that communities allow for staged implementation over multiple permit cycles to ameliorate cost concerns while simultaneously providing an associated water quality benefit would be much preferred over those that advocate a more aggressive approach from the start without a burden of proof. This implementation strategy is consistent with continued monitoring of impaired waters to determine incremental levels of improvement over time consistent with the manner by which aquatic environments exist in reality.

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Implementation Group 14
Where does the SNAP apply?

Elizabeth Toot-Levy, Anthony Sasson, Rob Reash, Larry Antosh, Adrienne Nemura

For what streams does SNAP apply?

- Must have TALU and suite of data necessary to determine attainment of biocriteria.
- Streams with drainage area from 3.1 mi^2 to 1000 mi^2

Discussion Points

- What about headwater streams?
  - Drainage area 3.1 mi^2 to 20 mi^2
  - IBI scores but not MIwb or ICI
  - Is there actually a need to determine minimum size or is it sufficient to say SNAP only applies if there is TALU and all biological data
  - Are there petition ditches with TALU?

Discussion Points

- Does degree of canopy cover need to be evaluated separately from the QHEI?
- Do streams with drainage areas >500 mi^2 need *chlorophyll a* evaluation based on water column *chlorophyll a* concentrations instead of benthic?

Implementation ISSUE #14 – Where does SNAP apply?
TAG members: Elizabeth Toot-Levy, Anthony Sasson, Rob Reash, Larry Antosh, Adrienne Nemura

Over (a) what streams and (b) range of stream size does SNAP apply?

a. channelized watercourses? County ditches? Other?

b. size

--is there a maximum size drainage age? A minimum? (in previous draft rule, OEPA used 3.1 sq.mi. (=2000 acreas) as minimum)

--ponds, lakes?

--wetlands?

-- streams with drainage areas

--other exclusions/qualifications (in previous OEPA draft, it allowed the Director to not apply the rule if drainage area of stream stream was 500-1000 sq. mi and water depth, stream width, canopy, etc. warranted non-application of TIC.

Ohio's rivers and streams are assigned tiered aquatic life uses based on the potential of a stream segment to support the use. The tiered basis of the system provides for varying levels of protection based on the actually potential of the waterbody. These use designations contain criteria based on biological indices of stream fish assemblages (IBI and MIwb) and macroinvertebrate assemblages (ICI). The newly developed SNAP applies only to waterbodies that have a tiered aquatic life use and the entire suite of data necessary to support a decision regarding attainment of the biocriteria. Therefore, the SNAP does not apply to ponds, lakes, or wetlands.

- What about headwater streams? There are biocriteria and the potential for IBI but not MIwb or ICI? Headwaters streams with drainage areas of 3.1 square miles to 20 square miles.
- Are there petition ditches with tiered aquatic life uses?
- Does degree of canopy cover need to be considered separately from QHEI?

The SNAP can apply to streams in Ohio with drainage areas up to 1000 square miles. However, for streams with drainage areas between 500 and 1,000 square miles the director must determine that the specific features of the stream in question do not depart significantly from the typical features of average water depth, stream width, water clarity and degree of open or closed canopy that Ohio EPA associates with small stream systems and determine the SNAP is applicable. For streams with drainage areas less than 3.1 square miles the director shall not apply this rule if the stream is a historically channelized watercourse as defined in section 6111.01 of the Revised Code.

- Do larger streams (>500) need to have chlorophyll a metric based on instream chlorophyll concentration?
- Do we need to identify a minimum size for the SNAP? Or is it sufficient to say that the SNAP only applies if there is a tiered aquatic life use and is evaluated for the biological parameters necessary to determine attainment with the use.

IMPLEMENTATION ITEM 15
WASTELOAD ALLOCATION

BILL HALL
(LARRY ANTOSCH, MIKE BROM, DAVE CARANI, GUY JAMESSON, CHRISTINE MORGAN, ADRIENNE NEMURA)

15. WASTELOAD ALLOCATION

- APPLICABILITY
  - SNAP ANALYSIS – THREATENED OR IMPAIRED
  - ADAPTIVE MANAGEMENT ASSESSMENT COMPLETED
- WATER QUALITY TARGET (WQT)
  - MASS LOADING
  - TP or DIN or TP/DIN
  - DETERMINED THROUGH ADAPTIVE MANAGEMENT ASSESSMENT
- WASTELOAD ALLOCATION (WLA)
  - WLA = WQT – LA
  - LOAD ALLOCATION (LA) BASED ON GROWING SEASON STREAM FLOW EXCEEDED 80% OF TIME
  - AVERAGING PERIOD BASED ON DEVELOPMENT OF WQT

15. WASTELOAD ALLOCATION

- TRADING
  - ALLOWED TO AUGMENT WLA
  - 1:1 BASIS (CONSISTENT WITH MODELING)
  - REQUIRES DEMONSTRATION
- SEASONALITY
  - WLA ONLY APPLIES DURING GROWING SEASON TO PROTECT FLOWING WATERS
  - NON-GROWING SEASON WLA MAY BE NECESSARY FOR DOWNSTREAM WATERS
- ALLOCATION TO MULTIPLE DISCHARGES
  - DISTRIBUTION OF LOAD ALLOWED
  - ADJUSTMENT TO ACCOUNT FOR COMBINING LOADS FROM MULTIPLE FACILITIES

3745-2-13 **Wasteload allocations for nutrients.**

(A) Applicability: This section applies to flowing receiving waters that have been identified through a SNAP analysis as either threatened or impaired by nutrients, and that have undergone an adaptive management assessment as specified in rule 3745-2-XX of the Administrative Code to identify the need for a water quality target (WQT, kg/day) for TP and/or DIN.

(B) For discharges of nutrients (total phosphorus and/or dissolved inorganic nitrogen) to flowing receiving waters, the WQT necessary to protect those waters from the adverse effects associated with excessive benthic chlorophyll-a and/or high D.O. swings shall be determined through the adaptive management procedures specified in rule 3745-2-XX of the Administrative Code.

Where the adaptive management procedure determines that the receiving stream is threatened or impaired by nutrients, the WQT will be determined for total phosphorus only, unless a specific determination is made through the adaptive management procedure that a WQT is necessary for DIN. In such case, a WQT will be determined for DIN only. Dual WQTs for TP and DIN shall only be developed when a specific determination is made that both allocations are necessary to maintain or restore aquatic life uses.)

(C) For point source dischargers of nutrients to flowing receiving waters, the wasteload allocation (WLA) shall be calculated using the following mass balance equation:

$$WLA = WQT - LA$$

Where:

LA = load allocation assigned to non-point source discharges

The LA shall be based on the growing season stream flow exceeded 80 percent of the time. The averaging period for the WLA shall be consistent with the manner in which the WQT was developed.

(D) Where a point source discharger implements best management practices to reduce a non-point source load, the load reduction shall be added to the WLA for that discharger on a demonstration, acceptable to the Department, that the non-point source load has been removed.

(E) The WLA for the protection of flowing waters shall only apply during the growing season used for the SNAP assessment. Unless otherwise specified, the growing season is assumed to be June through October. The WLA shall not apply outside the growing season for the protection of flowing waters. However, a non-growing season WLA may be necessary to address downstream impacts.

(F) Multiple discharges. When the director determines that it is necessary to consider multiple discharges in a WLA, the loading capacity may be distributed among discharges using a method deemed scientifically defensible and cost effective, based on site-specific considerations. The combined load from multiple dischargers may consider the probability characteristics of each discharge in calculating the individual WLAs provided that the probability of exceeding the WLA is less than 1%.

Issue # 16 – Permit Limits: Preliminary Approach for Discussion

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This issue applies to NPDES permit nutrient discharge limitations imposed as a result of:

First – OEPA performing the SNAP (whether as part of watershed monitoring program, 303(d) impaired waters determination and TMDL development, or as part of NPDES issuance/renewal) which determines likely nutrient caused impairment or threat, and

Second – subsequent determination using nutrient-specific reasonable potential (RP) analysis as developed as part of this rule. Existing RP analysis procedures in OAC 3745-2-06 (which were developed primarily for toxic pollutants) should for the most part not apply to nutrients. RP may be determined similar to Ohio EPA's 2010 'working draft' rules for nutrients (submitted to USEPA for review/comment). For phosphorus, RP would be the determination by the SNAP that nutrients are a cause or threat to impairment. For nitrogen, the determination by the SNAP that nutrients are a cause or threat to impairment and also that the nitrogen to phosphorus ratio (mass or molar) exceeds a threshold value that indicates probable nitrogen limiting in the water body.

The following issues should be considered for incorporation into the final rules:

(a) Limit averaging periods (e.g., weekly, monthly, seasonal, annual?)

CWA specifies that discharge limits for POTWs shall, "unless impracticable", be stated as average weekly and average monthly discharge limits. However, water quality impacts caused by excessive nutrient enrichment tend to be longer term than the typical weekly and monthly averaging period limits used for toxic and conventional pollutants. Accordingly, weekly/monthly limits can be considered impracticable. Future Ohio rules should provide for WQ based nutrient limits that apply seasonal averaging periods. Following are three examples of NPDES limits with longer averaging periods in use and approved by various state agencies and USEPA.

- Wisconsin DNR recently received USEPA approval for a rule that states the impracticability of weekly/monthly discharge limits for nutrient water quality issues, based upon a WDNR Justification Paper. The rule allows WDNR to establish monthly average or six-month average limits for nutrients, with six-month average limits requiring a monthly limit of 3 times the WLA.

- Michigan DEQ issued the most recent NPDES permit for City of Detroit WWTP effective 1/1/2015 with monthly average TP limit of 0.7 mg/l (no weekly average limit) applicable all year, and a "growing season" average of 0.6 mg/l applied as a single six month average from April through September. The permit also includes mass limits based upon these monthly and six month average limits using peak hourly flow for the WWTP (*not design average flow!*).

- Ohio EPA has issued NPDES permits for several Upper Little Miami watershed POTWs for several permit cycles with both summer (May – Oct) monthly average TP limits of 1.0 mg/l (and corresponding mass limits) plus a single six month (May - Oct) mass loading limit based upon WLA from the watershed TMDL (2002). For most of the permits in this watershed the mass loading limit was based upon a TMDL target 0.5 mg/l TP concentration and the respective POTW design average flow. The six month mass loading limit is calculated using the median flow (May - Oct) for the previous 5 years and the current year (May - Oct) median daily effluent TP concentration. Using the previous 5 years' median flow evens out wet and dry year variation and provides the POTW with a known target for the current year. The 1.0 mg/l monthly average limit represents a technology-based 'baseline' for treatment performance, and the six-month mass loading is a water quality-based WLA limit. Note however that these permits also include a summer (May - Oct) weekly limit (1.5 mg/l), which is an inappropriate averaging period for nutrients.

- The International Joint Commission (IJC) recently requested that Ohio EPA establish seasonal TP limits for dischargers into the Lake Erie basin. Ohio EPA has just issued the first of these new NPDES permits to the City of Lakewood with TP monthly average of 1.0 mg/l, weekly 1.5 mg/l, and seasonal average (Apr - Sep) limit of 0.7 mg/l. The seasonal average concentration is calculated once per year in October. As previously noted, the weekly limit is an inappropriate averaging period for nutrients.

The future Ohio rule should include a determination of the impracticability of monthly/weekly average nutrient limits, and should generally apply seasonal limits with flexibility to specify appropriate seasonal period on a case-by-case basis. In many instances the appropriate season may be different than Ohio's commonly used "summer season", which is usually six months from May through October. The 2014 IJC Lake Erie report concludes that the most critical loading period to Lake Erie is the "spring season" (March through June). Accordingly, it may be appropriate for Lake Erie basin permits to have similar spring season limits. Use of multi-year time-averaging effluent flows (as done in the Ohio permits in the Upper Little Miami watershed) should be encouraged as a means to resolve the wet year mass loading compliance problem. Annual average limits may be appropriate for instances where the discharge flows to longer detention time water bodies.

(b) Mass vs. concentration based limits

With respect to nutrient impacts on receiving waters, the mass loading is often the measurement of concern. Accordingly, many if not most NPDES nutrient limitations should be developed and imposed based on mass loads. The flow basis for determination of mass limits must consider the individual treatment facility – and should provide allowance for POTWs with combined sewers. Average basis of design flow is inappropriate to calculate a mass limit for treatment systems with significant wet weather flows, especially since many such communities are implementing wet weather management programs that will increase flows into their treatment facilities. Concentration limits may be simpler/easier for compliance monitoring, and accordingly may be desired for some permits. In general, permits should use mass or concentration limits, but not both.

(c) Compliance schedule

Nutrient limits to be imposed on a discharger for the first time should always be accompanied by a reasonable compliance timetable. The allowable compliance schedule duration should typically last through multiple NPDES permit cycles. During the compliance schedule period, appropriate interim discharge limits should be included in the permit. Such compliance schedule periods provide for the following activities:

- Allow the permit holder reasonable time to perform necessary engineering study(ies) to evaluate the best and most cost effective treatment process modifications and/or alternative watershed phosphorus reduction actions (such as implementation of watershed management practices, water quality trading, watershed restoration or habitat restoration/improvement).
- Provide suitable time for detailed engineering design, construction contract bidding, construction, and startup and initial process troubleshooting for treatment facilities or alternative nutrient reduction strategies.
- When interim limits are in effect, provide time to assess the impact of reduced nutrient loadings to the receiving water body – i.e., given the uncertain relationship between specific nutrient concentrations and biological water quality – which may be affected by other stressors – there should be time to assess the impact of nutrient reductions resulting from interim limits and/or other watershed restoration or habitat improvements. As new water body monitoring data is collected, re-assessment using the SNAP should be performed to determine potential improving water body condition with respect to nutrients.

The compliance schedule should also accommodate coordination with multiple dischargers

Compliance schedule should incorporate the following timeframe, with permit cycles assumed to be five years for each permit issuance:

First permit – initial interim effluent limits established. Compliance schedule may allow a reasonable period (typically up to five years, unless permittee justifies need for longer period) to meet initial interim limits, i.e., time provided to perform appropriate study and alternatives evaluation, and construction/implementation of selected plan.

Second permit – if reassessment of SNAP and RP analysis determines that additional nutrient controls are still necessary, interim limits established in first permit may be continued through term of second permit. This will provide an adaptive management period – assessment of interim limits and implemented controls on receiving water quality, and consideration to allow revision to the nutrient control plan as appropriate.

Third permit – if reassessment of SNAP and RP analysis determines that additional nutrient controls are still necessary, final limits may be imposed in permit. Compliance schedule may allow a reasonable period (up to five years, unless permittee justifies need for longer period) to meet final limits.

At any time following initial permit, if reassessment of SNAP and RP analysis determines that no further nutrient controls are necessary, the initial interim limits will be established as final limits.

(d) Interim and final limits

Interim nutrient limits should be based upon a reasonable level of treatment technology. Total Phosphorus (TP) limits should generally be 1.0 mg/l. There may be some exception based upon treatability issues at a specific wastewater treatment facility. Nitrogen limits are expected to be rare, but if nitrogen limits are determined to be necessary, interim limits for Dissolved Inorganic Nitrogen (DIN) should generally be 10 mg/l, (although site-specific determination should be made, depending upon existing treatment facility). Permit limits may be mass or concentration.

Final limits for TP and DIN shall be calculated in accordance with the wasteload allocation calculation procedure provided in the nutrients rule. Permit limits may be mass or concentration, but generally not both.

DIN nutrient limits shall be imposed in an NPDES permit only if the RP analysis determines that nitrogen is a potential limiting nutrient for the water body, in accordance with procedures to be developed in this rule.

(e) Additional considerations for permit limits

New or more stringent permit limits for nutrients shall not be imposed on point sources unless:

- The point source(s) is/are shown to be a primary contributing cause for the nutrient nonattainment condition; and
- The application of additional treatment and/or alternative nutrient reduction or habitat improvement can reasonably be expected to lead to attainment of the designated use or material water quality improvement; and
- The determination of water quality based effluent limits has complied with ORC 6111.03 (H): “the director … shall give consideration to, and base the determination on, evidence relating to the technical feasibility and economic reasonableness of removing the polluting properties from those wastes and to evidence relating to conditions calculated to result from that action and their relation to benefits to the people of the state and to accomplishment of the purposes of this chapter.”

Ohio EPA Nutrient Criteria TAG
Implementation Issue: Reasonable Potential

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AEP – Environmental Services

(w/ Bill, Larry, Adrienne, Mike, Christy)

RP – Current Methodology

- OAC 3745-2-06(A)(3); with the exception of RP for pollutants in intake water, RP ***can only be assessed*** by comparison of PEQ to PEL.

- Group 5 parameters, generally, require a WQBEL. One justification of a Group 5 parameter WQBEL is “evidence…that the designated use…is impaired or threatened.” ***Could be*** the basis of new or more stringent nutrient WQBEL.

- Two other means that Ohio EPA could implement nutrient WQBELs: “free from” narrative criteria violation, and Best Professional Judgment (BPJ).

Justification for Nutrient-Specific RP

- Daily maximum and monthly average limitations not a good fit for nutrients, as biological effects (sometime subtle) are typically elicited only after long-term exposures.

- Long-term biological monitoring database provides insights into real world stressor-response relationships. These were presented in draft nutrient threshold TSD.

- Laboratory-based toxicity studies (e.g., those for trace elements) do not capture the ***mechanism*** of nutrient effects (1° productivity enrichment → DO effects → population/community effects).

Recommended Nutrient RP

- Primary method: SNAP with “yes/no” charts.

- Advantage: the SNAP begins with attributes ***of the receiving stream***; PEQ/PEL method is statistical and theoretical.

- SNAP can be flexible and iterative for both agency and regulated entities.

Implementation Issue 17: Procedures to Evaluate Nutrient Reasonable Potential

Introduction

Reasonable potential is the procedure used to "determine whether a discharge, alone or in combination with other sources of pollutants to a waterbody and under a set of conditions arrived at by making a series of reasonable assumptions, could lead to an excursion above an applicable water quality standard." (US EPA, 2010). Pursuant to federal regulations, a finding of reasonable potential (RP) – however the procedure – must result in the permitting authority requiring effluent limitations (besides those that are technology-based), referred to as water quality-based effluent limits (WQBELs):

> *When the permitting authority determines that a discharge causes, has the reasonable potential to cause, or contributes to an in-stream excursion above the allowable ambient concentration of a State numeric criteria within a State water quality standard for an individual pollutant, the permit must contain effluent limits for that pollutant. 40 CFR 122.44(d)(1)(iii).*

Thus, RP is the procedure a permitting agency uses to assess: 1) whether a new WQBEL is required; 2) whether an existing WQBEL is justified in the renewal permit; or 3) whether no WQBEL is required or an existing WQBEL can be revoked. When determining the RP of a discharge to cause or contribute to the exceedance of a criterion, the permitting agency must consider the following factors, per 40 CFR 122.44(d)(1)(ii):

- Existing controls on point and nonpoint sources. For POTW facilities, these factors are: pretreatment, industrial loadings, number of taps, unit processes, treatment efficiencies, and chlorination/ammonia problems.
- Variability of the pollutant or pollutant parameter in the effluent.
- Sensitivity of the species to toxicity testing.
- Dilution of the effluent in the receiving water.

US EPA guidance provides flexibility on how RP is to be evaluated. RP can be assessed when valid effluent data are available or when such data are absent; and, both quantitative and qualitative methods can be used (US EPA 1991; 2010).

Current Ohio EPA RP Procedures

Ohio EPA's existing RP procedure is contained in OAC 3745-2-06(A)(3). This section is clear that, with the exception of elucidating reasonable potential for pollutants in intake water, RP can only be evaluated by comparing preliminary effluent quality (PEQ) with preliminary effluent limitations (PEL). In OAC 3745-2-06(B)(1)(b), Ohio EPA can require a WQBEL when the PEQ is 75% or greater of the applicable PEL (a "group five" parameter). There are several conditions that, alone or in combination, must be met for the agency to require a WQBEL. One of the conditions, that may have relevance to nutrient RP, is “evidence suggests that the designated use of the receiving water is impaired or threatened…”[OAC 3745-2-06(B)(1)(b)(iv)]. While this specific “trigger” could, in theory, be used to determine the need for nutrient WQBELs without further rule changes, the considerable progress that the nutrient technical advisory group (TAG) has accomplished to date (i.e., crafting a proposed empirical weight-of-evidence evaluation procedure *specific for total phosphorus and dissolved inorganic nitrogen*) obviates the sole reliance on this clause for assessing nutrient RP. This factor, and the fact that the outcome of the TAG process will likely not result in the formal adoption of numeric nutrient criteria for the protection of aquatic life, reinforces the need for nutrient-specific RP methods.

Ohio EPA, typically, does not impose WQBELs in the absence of adequate effluent data. Some level of effluent nutrient data (in addition to receiving stream data) can assumed to be available in most, if not all, cases. Thus, it is unlikely that nutrient RP will be evaluated where no valid effluent nutrient data exists.

Ohio EPA’s narrative “free from” criteria applicable to all waters and mixing zones (OAC 3745-1-04) are another means to prevent eutrophication that could impair a designated use. While enforcement and/or remedial action taken by some states using narrative criteria has been upheld by numerous courts, a level of subjectivity is required to implement these. Protecting the attainment of designated uses using numeric (or even semi-quantitative) criteria is more effective and, in the case of regulated entities, prior knowledge of potential applicable WQBELs is beneficial in case additional wastewater treatment is required to meet one or more limitation.

Lastly, wastewater limitations for nutrients may be incorporated into permits using best professional judgment (BPJ). Pursuant to federal regulations, states must address several factors – and have adequate justification – to implement BPJ-based limitations.

<u>Need for Nutrient-Specific RP</u>

Where RP is determined, resulting WQBELs are expressed having one of three averaging periods: monthly average, weekly average, and daily maximum. These averaging periods conform to some extent to the length of time used in laboratory toxicity studies, of which most numeric water quality criteria are based on. Adverse effects caused by nutrients, however, are typically elicited over a longer period of time (e.g., several months). Biological responses may be subtle, and these effects are translated in endpoints that differ from exposure to traditional toxic pollutants. As such, there are compelling reasons why RP methods for nutrients should be separate from those used for traditional toxic pollutants, or at least supplemental evaluations *in addition to* the typical RP method used by Ohio EPA. RP methods that are quantitative, or semi-empirical will be more defensible from a technical and legal standpoint. Brown and Caldwell (2014) state:

> *In general, the complexities of eutrophic responses are such that purely qualitative RPAs are not recommended for nutrients. The most defensible RPAs will be quantitative, based on calibrated load-response models…If semi-quantitative RPA approaches are used, they must be objective, reproducible, considerate of the assimilative capacity, and take into account the major factors that controls eutrophic responses of the receiving water. (p. 4-2)*

The proposed stream nutrient assessment procedure (SNAP) embeds a RP method, but specifically for nutrients. In contrast to the PEQ/PEL RP method that evaluates risk using levels of stressors (effluent pollutant concentrations), the SNAP begins with an evaluation of *receiving stream* attributes. The main SNAP table has quantitative response variables (biological criteria attainment, in-stream levels of dissolved oxygen and benthic chlorophyll). These variables were chosen based on statistical analyses of biological community indices and concomitant water quality parameters. Brown and Caldwell (2014) state that one method of quantitative RP for nutrients is stressor-linkage models. For states that do not have an extensive biological monitoring program, such a model (validated and calibrated) may be beneficial. The SNAP reflects the status of eutrophication using actual measurable stressor-linkages.

In the proposed SNAP, RP is determined when there is evidence of high dissolved oxygen swings, elevated benthic chlorophyll, and non-attainment of biological criteria. Flowcharts A, B, and C are used as confirmatory steps of use attainment, non-attainment/threatened caused by nutrients, or non-attainment/threatened caused by stressors other than nutrients. Just as the PEQ/PEL RP method can result in effluent limitations for pollutants where levels of pollutants do not equal or exceed the most stringent wasteload allocation, the SNAP identifies those settings where the aquatic life use is threatened and reductions in existing loads, or a prevention of additional loads, may be necessary.

<u>Literature Cited</u>

Brown and Caldwell, 2014. Review of USEPA Methods for Setting Water Quality-Based Effluent Limits for Nutrients. Prepared for National Association of Clean Water Agencies.

US EPA. 1991. Technical Support Document for Water Quality-based Toxics Control. EPA 505/2-90-001. US EPA Office of Water, Washington, DC.

US EPA. 2010. National Pollutant Discharge Elimination System (NPDES) Permit Writer's Manual. EPA-833-K-10-001. US EPA Office of Wastewater Management, Washington, DC.

Implementation Issue 21 – Adaptive Management

- Background

The SNAP was developed to evaluate the effects of excessive nutrients on aquatic life use attainment in streams. However, the link between nutrients and the biological indices used to assess aquatic life use attainment in streams is influenced by numerous factors, making a direct link tenuous. Consequently, other indicators of eutrophication (benthic algae chlorophyll-a and D.O. swing) were identified to assess whether nutrients were contributing to or threatening aquatic life use impairment. In the context of the SNAP, if D.O. swing and benthic chlorophyll-a levels are maintained within normal levels, nutrient-related impairment is not occurring. Alternatively, if either or both of these factors is outside of the normal range, nutrient related impairment may be occurring or may threaten to cause impairment.

In the context of Adaptive Management for the restoration/maintenance of aquatic life uses, these stream responses will be evaluated to drive Adaptive Management decisions as a watershed is managed. This process encompasses management practices and/or stepwise nutrient load reductions with sufficient time between activities to assess the effect of the mitigation process on the relevant impairment indicators (benthic chlorophyll-a and D.O. swing).

- Scientific Understanding

Benthic algal biomass accrual is a natural component of stream ecology. This growth experiences seasonal variation and is naturally regulated by numerous factors including the availability of substrate for colonization by diatoms and algae, the supply of necessary nutrients (nitrogen, phosphorus, silica, carbonate), the availability of light (canopy cover, stream orientation, width, depth, water color), predation, scouring, and temperature. Similarly, diurnal D.O. variability is a natural component of stream ecology and is influenced by numerous factors including hydrology (flow, current velocity, water depth), temperature, re-aeration rate, oxygen demand, and algal photosynthesis/ respiration.

The conditions that favor benthic algal biomass accrual are separate and distinct from the conditions that favor elevated diurnal D.O. swings. Significant algal growth frequently occurs in the spring before the canopy leafs out. This growth occurs under conditions of higher flow while water temperature and nutrient concentration is low. Under these conditions, the average D.O. is elevated and diurnal D.O. swings are dampened. As the canopy foliates, benthic algal biomass is reduced in response to light limitation in streams protected by canopy cover, regardless of the ambient nutrient concentration. In streams without canopy protection, benthic algal biomass accrual continues until some perturbation of the system occurs, such as a scouring event.

As the seasons change from relatively high flow to relatively low flow, conditions favoring increasing diurnal D.O. swing take over. Under lower flow conditions, stream temperatures tend to increase and average D.O. concentration decreases in response to lower saturation and greater rates of decomposition. In addition, the effect of benthic algae on diurnal D.O. variability increases in response to reduced water depth and current velocity. If the benthic algal biomass is sufficient, algal respiration can drive the diurnal D.O. below 4.0 mg/L. This, in combination with algal photosynthesis, results in excessive D.O. swings that are the focus of the SNAP.

As described above in the conceptual model, excessive diurnal D.O. swings associated with elevated algal growth depends upon the propagation of dense algal growth in the period leading up to low flow conditions in the stream.

- Approach

Within the context of the SNAP, the adaptive management approach is a strategy to attain/maintain normal D.O. swings and benthic algae chlorophyll-a concentrations in streams, as soon as possible, in the most scientifically supported, reasonable, cost effective, and economically efficient manner, taking into consideration the factors that influence these conditions in Ohio streams. These factors include hydrology, habitat, and contributions of nutrients (dissolved inorganic nitrogen, total phosphorus) from point and nonpoint sources in a watershed.

The Ohio Adaptive Management approach allows for these factors to be manipulated in the most cost-effective manner, if possible, to demonstrate that benthic algae growth will not become excessive and D.O. swings will remain in or return to the normal range. If Adaptive Management of the watershed cannot attain normal D.O. swings and non-excessive benthic algae chlorophyll-a concentrations with an exceedance frequency of once every three years on average, then nutrient reductions may be required in accordance with rule 3745-2-13, unless nutrient reduction cannot achieve these goals due to natural or irretrievable man-made conditions.

Upon a determination that a site (reach) is either threatened or impaired by nutrients, using the SNAP assessment, the watershed will be characterized through a series of sequential steps to validate the assessments made in Flow Chart A and Flow Chart C of the SNAP and implement management actions to reduce D.O. swing and/or benthic chlorophyll.

Flow Chart A: an adverse assessment under Flow Chart A yields a conclusion that a site (reach) is threatened due to nutrient-related factors. Under this scenario, nutrient loads would be capped at existing conditions while additional assessments are made to confirm the cause of the threat. The assessments made under Flow Chart C provide a useful basis for making this assessment.

Flow Chart C: this flow chart addresses two fundamental questions: (1) Would abatement alone of stressors unrelated to nutrient restore the biological condition and, (2) Would additional abatement of nutrient stressors restore the biological condition? The answer to these questions yields four potential outcomes that are the focus of the Adaptive Management Approach:

i. Identify and implement non-nutrient related stressor abatement necessary to restore normal D.O. swings and benthic algal biomass.
ii. Identify and implement nutrient related stressor abatement necessary to restore normal D.O. swings and benthic algal biomass.
iii. Identify a combination of nutrient and non-nutrient stressor abatements necessary to restore normal D.O. swings and benthic algal biomass.
iv. Conclude that nutrient and non-nutrient stressor abatements alone or together cannot restore normal D.O. swings and benthic algal biomass due to natural or irretrievable manmade conditions.

- Components of Adaptive Management Approach

Implementation of the Adaptive Management approach entails four components: load characterization, assessment of appropriate controls, active watershed management, and confirmation of status in response to management. Each of these is described below.

i. Load Characterization

Current nutrient loads relevant to the benthic algae growing season will be characterized to determine the current loading rates for TP and DIN from point and non-point sources. In addition, the options for load reductions from all sources will be assessed relative to available treatment alternatives and proven best management practices. Costs associated with the various levels of treatment and BMPs will be developed.

ii. Assessment of Appropriate Controls

This assessment will entail the development of a water quality model to assess benthic algal growth and diurnal D.O. swings in relation to habitat restoration, nutrient load reduction, and other engineering controls. The purpose of this initial assessment will be to screen and categorize management options for further consideration and to confirm the assessments made in Flow Chart C of the SNAP.

[Note: The development of a calibrated water quality model capable of making scientifically defensible TMDL determinations is time consuming, data intensive, expensive and subject to challenge. While such a model may be required at the end of this process, we probably can use a simpler model to answer initial questions concerning suitability of alternative approaches such as enhanced canopy and load reduction requirements.]

Subsequent assessments, using data collected following mitigation efforts, will be used to refine the model and assess the effect of those efforts.

iii. Active Watershed Management

Watershed management activities will be informed by the modeling assessment. On initiation of Adaptive Management for a given watershed, nutrient loads will be capped at existing levels while the status of the watershed is confirmed and the appropriate controls are assessed. The load cap shall be considered a temporary measure while the assessment is ongoing (e.g., not subject to anti-backsliding).

The initial model results will be used to guide implementation of alternative habitat restoration efforts and/or nutrient load reductions. Data collected following these activities will be used to guide subsequent actions to address the Flow Chart C outcomes.

iv. Confirmation of Status

As active management of the watershed proceeds, the original SNAP determination will be verified through collection of subsequent data to document changes in response to watershed management for biological condition/trend, benthic algal level, and D.O. swing. Based on the observed changes, the direction of active watershed management will be adjusted and the Adaptive Management cycle will be repeated.

IMPLEMENTATION ITEM 21 - ADAPTIVE MANAGEMENT

MIKE BROM

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21. ADAPTIVE MANAGEMENT

- BACKGROUND
  - TRIGGER: SNAP ASSESSMENT
  - PURPOSE: ITERATIVE ASSESSMENT OF CONTROL FACTORS TO MITIGATE BENTHIC ALGAL CONCENTRATIONS AND D.O. SWINGS IN A COST-EFFECTIVE MANNER SO THAT SNAP IS NOT TRIGGERED
- SCIENTIFIC UNDERSTANDING
  - BENTHIC ALGAL LEVELS AND DISSOLVED OXYGEN SWINGS IN FLOWING WATERS ARE INFLUENCE BY NUTRIENT AND NON-NUTRIENT STRESSORS, POTENTIALLY SUBJECT TO CONTROL (E.G., HABITAT, LIGHT, HYDROLOGY, NUTRIENTS).
  - CONDITIONS THAT FAVOR BENTHIC ALGAL GROWTH ARE NOT THE SAME CONDITIONS THAT FAVOR ELEVATED D.O. SWINGS.

21. ADAPTIVE MANAGEMENT

- APPROACH
  - VALIDATE SNAP DETERMINATIONS IN FLOW CHART A/C
    - NON-NUTRIENT STRESSORS
    - NUTRIENT STRESSORS
    - BIOLOGICAL TRENDS
  - IMPLEMENTATION
    - ITERATIVE APPROACH
    - COST EFFECTIVE
    - DOCUMENT EFFECTIVENESS
    - SNAP REASSESSMENT

21. ADAPTIVE MANAGEMENT

- COMPONENTS
  - CHARACTERIZE NUTRIENT LOAD
    - POINT SOURCES
    - NON-POINT SOURCES
    - IDENTIFY LOAD REDUCTION OPTIONS
  - ASSESS OPTIONS FOR ALGAE/D.O. CONTROL
    - LIKELIHOOD OF ACHIEVING GOALS (MODELING EXERCISE)
  - ACTIVE WATERSHED MANAGEMENT
    - CAP NUTRIENT LOADS AT EXISTING CONDITIONS
    - IMPLEMENT HABITAT MODIFICATIONS/LOAD REDUCTIONS IN STEPWISE MANNER
    - DOCUMENT WATERSHED RESPONSE
  - EVALUATE SNAP STATUS AND REASSESS MANAGEMENT OPTIONS