Kentucky’s Listing Methodology using Narrative Nutrient Criteria: Where we’ve been and where we’re going

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Narrative Nutrient Criteria Updates
Approved by EPA November 15, 2013

• **401 KAR 10:031.** Surface Water Standards

Nutrients Criterion. Nutrients shall not be elevated in a surface water to a level that results in eutrophication. [Nutrient limits. In lakes and reservoirs and their tributaries and other surface waters where eutrophication problems may exist, nitrogen, phosphorus, carbon and contributing trace element discharges shall be limited in accordance with:

1. The scope of the problem;
2. The geography of the affected area; and
3. Relative contributions from existing and proposed sources.]

• **401 KAR 10:001.** Definitions for 401 KAR Chapter 10.

‘Eutrophication’ means the enrichment of a surface water with nutrients nitrogen and phosphorus resulting in adverse effects on water chemistry and the indigenous aquatic community. Resulting adverse effects on water chemistry manifest by daily dissolved oxygen supersaturation followed by low dissolved oxygen concentrations and diurnal increase in pH. Resulting adverse effects on the indigenous aquatic community include:

a. Nuisance algae blooms;
b. Proliferation of nuisance aquatic plants;
c. Displacement of diverse fish or macroinvertebrate community by species tolerant of nutrient-enriched environments; or
d. Fish kills brought on by severe, sudden episodes of plant nutrient enrichment by the discharge or addition of a nutrient.
What does the data need to demonstrate?

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Impairment due to Nutrient/Eutrophication Biological Indicators

Indicators to support listing (or lack of listing)
New narrative, new method

Goal: Improve confidence, reproducibility, and transparency in assessment decisions

- Increase data collection on response indicators and manage these data effectively
- Derive nutrient screening values based on accumulated data on biological response and natural regional variation
- Outline steps and considerations inherent in “BPJ” decisions
- Expand staff participation in assessments to increase capacity, redundancy, diversity of expertise involved
- Improve documentation of indicators in assessment process
  - Better understanding of the problem and the target for management (e.g., TMDL)
  - Increased ability to identify potential delistings
  - Prioritize follow up monitoring for listing where current data may be insufficient
Data Collection, Management, and Analysis

- Are we, and our data partners, collecting the right type of data?
  - New method triggered review of monitoring protocols
- Can we store this data? Including observations and photos
  - New method also coincided with data base updates
    - Started using K-WADE in 2015
    - Started using KATTS in 2018
- Can we query this data?
- What does our data tell us about the relationship between N & P and our biological indices?
What are elevated values of N & P in Kentucky? That depends...

<table>
<thead>
<tr>
<th>Bioregion</th>
<th>Reference Only</th>
<th>Bluegrass without Inner BG</th>
<th>Inner Bluegrass</th>
<th>Pennroyal without 71e</th>
<th>71e*</th>
<th>MVIR</th>
<th>Mountains</th>
</tr>
</thead>
<tbody>
<tr>
<td>75th percentile <strong>NO2/3</strong></td>
<td>0.78</td>
<td>2.11</td>
<td>0.72</td>
<td>6.16</td>
<td>0.87</td>
<td>0.19</td>
<td></td>
</tr>
</tbody>
</table>

- * Included all programs, not just reference

**Kentucky Division of Water - Bioregions of Kentucky (Generalized)**

- Bluegrass
- Mississippi Valley Interior River
- Mountains
- Mountains/ Cumberland Above Falls
- Pennyroyal
- Pennyroyal/ Upper Green

**DO Supersaturation followed by low DO Diurnal increase in pH**
Resulting adverse effects on water chemistry *manifest* by daily dissolved oxygen supersaturation followed by low dissolved oxygen concentrations and diurnal increase in pH.

Asked field crews to target certain times of day (switch up the order each time).

USGS *gage* data brought in where available.

Calibration logs from external data partners.
First pass at ecoregion/bioregion scale screening values for NO2/3 and TP

- Related NO2/3 and TP to macroinvertebrates that scored a good or excellent on the MBI
  - Screening values for nitrate/nitrite (mg/L) per bioregion (71e separated from PR, and Inner Bluegrass separated from Bluegrass), based on the 95th percentile of sites that scored a good or excellent on the MBI
  - Screening values for total phosphorus (mg/L) per bioregion (Inner Bluegrass separated from Bluegrass), based on the 95th percentile of sites that scored a good or excellent on the MBI

- Growing season evaluation (April – October) for wadeable streams (<200 mi² catchment area)
- Minimum of monthly samples
- High flow events reviewed
- If more than one screening value excursion occurs outside high flow, then evidence for enrichment
- Statewide screening values for TKN and TOC

These excursions put us on the path of “nutrients as a candidate cause”, where the other parts of the narrative nutrient criteria are evaluated before listing.
Kentucky has a Macroinvertebrate Biological Index (MBI) and a Fish Index of Biological Integrity (KIBI)

From original MBI and KIBI papers, general relationship between MBI/KIBI and nutrient enrichment demonstrated. Some individual metrics perform better than others. Bioregion level relationships not evaluated.
Algae and macrophyte observations – new field form and database entry to accompany water chemistry results.

We send this same field form to external data partners. USACE sends us these observations, which we enter into our database, since the USACE database doesn’t have observations.

**Definitions for Algae and Macrophytes**

**Filamentous Algae**

- % COVER—how much of the in-stream habitat is covered with filamentous algae, e.g., Cladophora. This can be in long flowing strands, or short dumps (after peak flow event). Look carefully—it can look like moss.
- GROWTH STAGE—Growing if >75% of the filamentous algae is bright green. 'Senesced' if >75% of the algae is yellow-brown (not just covered in silt). 'Mixed' if both conditions occur and neither is >75%.

**Microalgae**

- THICKNESS—how thick is the unicellular (NOT filamentous) algae on the in-stream rock surfaces. 'Nuisance' algae not noticeable, or barely noticeable on surfaces. 'Moderate' algae is noticeable on surface of substrate, but not slick or thick. 'Severe' algae is noticeably thick in many areas of the stream channel.

**Macrophytes**

Macrophytes are NOT algae, they include mosses and any vascular plants growing in the wetted width of the stream, either fully submerged, or emergent. Estimate the percentage of the surface area in each habitat category that is covered by submerged or emergent mosses and/or vascular plants.
Trial Run: 2018/2020 and 2022 cycles

- All the comments/observations/photos/etc. entered into database (K-WADE) along with water chemistry results and *in situ* measurements
  - Training and QC ensures data management occurring as expected
- Scorecard data reports generated that compiles all pertinent information for listing (R-script)
  - Field staff complete scorecards, which helps them in making more informed comments/observations when in the field
<table>
<thead>
<tr>
<th>Activity Date</th>
<th>Index Name</th>
<th>Index Score</th>
<th>Lower Bound</th>
<th>Index Rating</th>
<th>Fair/Good Cutoff</th>
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<tbody>
<tr>
<td>05/30/2020</td>
<td>mMBI-W</td>
<td>13.109</td>
<td>21</td>
<td>Poor</td>
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<tr>
<td>05/22/2019</td>
<td>0X</td>
<td>0.41</td>
<td>0.28</td>
<td>Below Reference</td>
<td>54</td>
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</tbody>
</table>
Assessment Decisions and Documentation in Assessment Database (KATTS)

- Narrative criteria related to indicators -> Indicators related to parameter -> Parameter status (meeting, not meeting, insufficient) informed by indicators
- Assessors use all available scorecards from an AU to make final assessment decision
Next Steps

- Since Screening Values developed, around 400 new macroinvertebrate index scores and about 200 new fish index scores
  - Accompanied by water chemistry, in situ, observations, etc.
- Review/update Screening Values using newly available data
- Data analysis to review relationships between individual metrics per bioregion/ecoregion that are sensitive to elevated nutrients
- Expand method in KY’s CALM
Thank You! Questions?