Nutrient Water Quality Standards in Illinois

Bob Mosher
Illinois Environmental Protection Agency
April 7, 2015
Topics

• Characteristics of Illinois Land Use/Streams/Nutrient Loads
• Examples of Illinois Streams, their nutrient concentrations, dissolved oxygen characteristics and biota
• Use of a Narrative Water Quality Standard rather than Numeric WQSs to regulate local impacts from nutrients
• Early settlement Illinois-1820
  • 59% Prairie
  • 38% Forested

• Among the 50 states, Illinois ranks:
  • 49th in % of land in original cover
  • 6th in % of wetlands lost
  • 2nd in “flatness”
• Current Illinois Land cover

• 76% Agriculture
• 11% Forest
• 7% Urban
• 4% Wetland
• 2% Surface Water
Illinois Socio-Economical Features

- Population-13 million
  - Concentrated in Northeast portion
- Unique in Midwest
  - Large population
  - Large % of land dedicated to row crop agriculture
• Illinois Nutrient Loss Reduction Strategy
• Recently released draft
• Explains steps to
  – Reduce both N and P by 45% statewide
  – Help eliminate the Gulf of Mexico Dead Zone
• Available at: http://www.epa.state.il.us/water/nutrient/documents/illinois-nlrs-public-comment-11-20-14.pdf
Illinois Nutrient Loss

- Leading (or close runner-up) nutrient loss state in U.S.
  - Exit via Mississippi River
- Phosphorus
  - 38 M pounds
  - 48% from point sources
- Nitrogen
  - 410 M pounds
  - 18% from point sources
Illinois Nutrient Loss

Non-point sources

- **Agriculture**
  - 48% Total P
  - 82% Total N

- **Urban runoff**
  - 4% Total P
  - 2% Total N

**Total N**
- 82%
- 16%
- 2%

**Nitrate-N**
- 80%
- 18%
- 2%

**Total P**
- 48%
- 48%
- 4%
Total Phosphorus Concentrations

- Total Phosphorous
  - State wide average
    - 0.379 mg/l
  - Majority of state - Mean TP
    - 0.15 – 0.30 mg/l
  - Downstream of point sources
    - Up to 3.0 mg/l
  - Southeastern Shawnee Forest watershed average
    - 0.04 mg/l
Total Nitrogen Concentrations in Illinois Streams

- **Total Nitrogen**
  - State wide average
    - 5.28 mg/l
  - Majority of state - mean TN
    - above 4.0 mg/l
  - Downstream of point sources
    - Up to 30 mg/l
  - Southern third of the state
    - less than 2.0 mg/l
Existing Nutrient Standards

- Monthly average P limit – 1.0 mg/l
  - Discharges upstream of lakes
  - New/expanded treatment plants
    - DAF – 1 MGD or greater

- Total phosphorus WQS-0.05 mg/l
  - Lakes 20 acres or larger
  - 79% of lakes regulated
  - Standard hard to meet in most lakes

- 10 mg/l nitrate standard
  - Drinking water sources
Narrative Nutrient Water Quality Standard

- Offensive Conditions

  - Prohibits plant or algae growth other than natural origin
  - Identifies lakes/streams that are impaired due to excessive plant or algae growth
  - Linked to excess P
  - 55 stream segments listed as impaired due to aquatic algae or plants in 2014 cycle
Numeric Nutrient Standard Development

Stressor Response Analysis

- USEPA conducted analysis twice
- Utilized biological and nutrient water quality data for Illinois streams
- Unable to identify numeric phosphorus or nitrogen concentrations that correlated to aquatic life impairment
- USEPA remains adamant that states must adopt numeric water quality standards for nutrients
Nutrient Concentration in Illinois Streams

Illinois Streams

- Differ across state
  - Varied habitats, riparian zones, and gradients
- Higher nutrient concentrations as compared to neighboring states due to greater proportion of
  - Urban area
  - Agricultural lands
- 61% of assessed Illinois stream miles fully support aquatic life uses (2014 Integrated Basin Report)
Illinois Stream Examples

- Salt Fork Vermilion
  - Cobble/gravel/boulder substrate
  - Partially forested riparian
- Upper Salt Fork Ditch
  - Sand/gravel/claypan substrate
  - Grass/ag riparian-drainage ditch
- North Fork Kaskaskia
  - Claypan/silt/sand substrate
  - Forested riparian
  - Low flow/gradient
Salt Fork Vermilion River

- Biologically Significant Stream (IDNR)
  - Diversity Rating – A
  - Integrity Rating – B
- Full support
  - Aquatic Life
  - Aesthetic Quality
- Highly Valued Mussel Resource
  - 13 live mussel species
  - High species richness
  - Several rare species present
Salt Fork Vermilion River (01/2000 - 09/2011)

Average Total P
0.53 mg/l

Average DO
6.94 mg/l
Upper Salt Fork Drainage Ditch

- Ranked “D” for Diversity and Integrity (IDNR)
- Non support
  - Aquatic Life
  - Aesthetic Quality
- Impairments
  - Aquatic Algae
  - Total Phosphorus
- Sources
  - Municipal Dischargers
  - Crop Production
- Restricted Mussel Resource
  - No live mussels
  - Dead/Relict shell only
Average Total N: 4.63 mg/l
Upper Salt Creek Drainage Ditch (06/2001 - 09/2011)

Average Total P 0.83 mg/l
Upper Salt Fork Drainage Ditch (08/03/2011 - 08/10/2011)

Average DO
- 10.17 mg/l

DO Swing
- 0.18 to 23.98
North Fork Kaskaskia

- Ranked “C” for Diversity and Integrity (IDNR)
- Non support
  - Aquatic Life
- Impairments
  - Atrazine
  - Manganese
  - Dissolved Oxygen
  - Total Phosphorus
  - Terbufos
- Sources
  - Surface and abandoned mines
  - Agriculture/crop production
  - Unknown
- Limited Mussel Resource
  - 1 live species
  - Low species richness
North Fork Kaskaskia River (01/2000 - 10/2007)

Average Total N
1.56 mg/l
North Fork Kaskaskia River (01/2000 - 10/2007)

Average Total P
0.37 mg/l
North Fork Kaskaskia River (06/5/2012 - 06/12/2012)

Average DO 4.24 mg/l
Parameter Comparison

mg/l

Salt Fork Vermilion  | U Salt Fork Ditch  | North Fork Kaskaskia

Min DO  | Max DO  | Avg DO  | Total N  | Total P

Graph shows a comparison of parameter levels for Salt Fork Vermilion, U Salt Fork Ditch, and North Fork Kaskaskia. The x-axis represents different water bodies, and the y-axis represents the concentration of various parameters in mg/l.
Nutrient Water Quality Standards for Illinois

• Clearly, one-size-fits-all numeric nutrient water quality standards do not seem appropriate for Illinois streams.
• A Narrative water quality standard based on the adverse impact of nutrients to dissolved oxygen – the “Dissolved Oxygen Signature”- will allow nutrient impaired streams to be identified as such.
• Reduction of nutrients may then be focused where needed.
The Narrative Standard

• Phosphorus ➔ Excess algae ➔ Supersaturation and low dissolved oxygen

• Update “Offensive Conditions” 302.203
  – “Waters of the State shall be free from sludge or bottom deposits, floating debris, visible oil, odor, plant or algal growth, color or turbidity of other than natural origin”

• Define and prohibit Nutrient Impairment
  – “…when, in any 24 hour period, dissolved oxygen violates the water quality standard and exceeds 100% saturation”
Phosphorus reduction

Scenario A:

Scenario B:
Socio-Economic Consequences of Numeric Standards

• With a numeric phosphorus standard, hundreds of facilities (mostly small) would need a Water Quality Based Effluent Limit (WQBEL) even though there is no indication of adverse nutrient impact downstream.

• Nearly all of these small plants are incapable of removing nutrients down to a limiting concentration.

• The cost of new treatment plants, or where feasible, land application effluent disposal systems, would not be affordable.
Conclusions

• No strong correlation between nutrients and aquatic biota
• Intact stream ecosystems have the ability to withstand impact from excess nutrient concentrations, i.e. Salt Fork Vermilion River
• Altered habitat plus the resulting failure of the ecosystem allows nutrient impacts to be manifested.
• Local stream impacts from nutrients are better dealt with through a narrative standard – “No WQBELs where no benefits will occur”.
• Larger treatment plants will be required to remove nutrients to fulfill Gulf Hypoxia reduction goals.
• Illinois EPA will continue searching for numeric nutrient WQS – a Nutrient Science Advisory Committee is now being formed to develop numeric nutrient standards.