“So, How's the Water?” - Analyzing Long Term Water Quality Trends in Indiana Streams

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Indiana Department of Environmental Management
Office of Water Quality
Watershed Assessment and Planning Branch
Objective

• “Each state shall prepare and submit ... a report which shall include ... a description of the water quality of all navigable waters in such State during the preceding year ...” [CWA § 305 (b)(1)]

• “...restore and maintain the chemical, physical, and biological integrity of the waters of the state.” [327 IAC 2-1-1.5]

• “All waters ... will be capable of supporting a well-balanced, warm water aquatic community” [327 IAC 2-1-3]
Probabilistic Sampling Design

• Probabilistic design provides statistically valid, unbiased assessment of water quality and biotic condition

• Multiple uses:
  – Integrated Water Quality Monitoring and Assessment Report to U.S. EPA (305 (b) report and 303 (d) list)
  – Assess 100% of Indiana’s rivers & streams
  – Identify waterbodies not meeting designated uses
  – Identify parameters of concern and track changes over time
  – Refer smaller watersheds for targeted sampling
  – Determine extent, cause, and source of impairments
  – Prioritize watersheds across water quality management programs
First 3 Five-Year Cycles

5 Great Lakes
(Ohio River Tributaries)

3 Upper Wabash River

4 Lower Wabash River
Kankakee River

1 West Fork
White River
Patoka River

2 East Fork White River
Whitewater River

5 Ohio River Tributaries
(Great Lakes)

Map Projection: UTM Zone 16 N, Map Datum: NAD83
Mapped By: JWood, Office of Water Quality, February 26, 2019

Current 9-Year Cycle: 2011 - 2019

7 Upper Illinois River

8 Great Lakes

5 Upper Wabash River

6 Lower Wabash River

4 Great Miami River

3 East Fork White River

2 Patoka River

9 Ohio River Tributaries

Data Sources – Obtained from the State of Indiana Geographic Information Office Library
Map Projection/Datum: UTM, Zone 16N/NAD83
IDEM Probabilistic Sites 1996-2018
Sampling Methods

• Fish Community
  – 1 sample between June 1 – Oct. 15
  – Sample 15x wetted width, from 50m – 500m
  – Regional Indices of Biotic Integrity, 0 – 60 with <36 = impaired

• Macroinvertebrate Community
  – 1 sample between July 15 – Nov. 15
  – Multihabitat sampling over 50m
  – Identified to lowest taxonomic level
  – Statewide mIBI, 12 – 60 with <36 = impaired

• Ambient *Escherichia coli* concentrations
  – Sites sampled for five consecutive weeks April – Oct.
Sampling Methods

• Habitat Evaluations
  – Qualitative Habitat Evaluation Index (QHEI)
  – Range 0 – 100, with <51 = poor habitat

• Water Chemistry and Nutrients
  – 3 sampling events between May – Oct.
  – Field and laboratory water chemistry, metals, and nutrients
  – Nutrient Chlorophyll \( a \) measurements
    • Periphyton/Seston grab sample
    • Diatom IBI being developed
  – Violations: Water Quality Standards
Probabilistic Sampling Results

West Fork of the White River
East Fork of the White River
Great Miami (Whitewater) River
Probabilistic Sampling Results

Lower Wabash River
Upper Illinois (Kankakee) River
Upper Wabash River
Probabilistic Sampling Results

Great Lakes Tributaries
Ohio River Tributaries
Patoka River
Probabilistic Sampling Results

- Aluminum, Ammonia, Cadmium, Chloride, Copper, Cyanide, Lead impact <1%
- pH, Ammonia, Habitat, Sulfate high risks to biology
### Probabilistic Sampling Results

#### Percent impacted Indiana stream miles by basin and parameter

<table>
<thead>
<tr>
<th></th>
<th>Fish</th>
<th>Macro</th>
<th>Habitat</th>
<th>DO</th>
<th>Nutrients</th>
<th>Phosphorus</th>
<th>TDS</th>
<th>Nitrate + Nitrite</th>
<th>pH</th>
<th>Sulfate</th>
<th>Lead</th>
<th>Ammonia</th>
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<td>West Fork of the White River</td>
<td>29.6</td>
<td>23.8</td>
<td>23.3</td>
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Targeted Sampling

- Watershed characterization collects same parameters using modified geometric design
- Used to determine impairment source/extent to develop TMDLs and provide data to local watershed groups
- Watershed groups then use 319 grants to implement Best Management Practices
## Watershed Report Card

### Deep River Watershed Characterization (2013)

<table>
<thead>
<tr>
<th>L-Site #</th>
<th>Location</th>
<th>Drainage Area (mi²)</th>
<th>MIBI</th>
<th>IBI</th>
<th>QHEI</th>
<th>E. coli^* (per 100mL)</th>
<th>Dissolved Oxygen (DO)^7 (mg/l)</th>
<th>Total Phosphorous^7 (mg/l)</th>
<th>Potential Cause(s) of Impairment</th>
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<tbody>
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<td><strong>Headwaters Main Beaver Dam Ditch (40400010501)</strong></td>
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Performance Monitoring

- Targeted sampling at previously sampled sites
- Limited to parameters for which site was impaired
- Conducted several years after implementation of Best Management Practices
- Fish IBI scores increased to passing (≥36) for all sites

<table>
<thead>
<tr>
<th></th>
<th>Bull Run</th>
<th>West Creek</th>
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<tr>
<td></td>
<td>101&lt;sup&gt;st&lt;/sup&gt; Ave.(1)</td>
<td>101&lt;sup&gt;st&lt;/sup&gt; Ave.(2)</td>
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<td>1999-Probabilistic</td>
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• Acknowledgments
  – IDEM Watershed Assessment and Planning Branch
  – Tony Olsen, U.S. EPA

• Additional information
  – Watershed Assessment and Planning Branch
    www.idem.IN.gov/cleanwater/2338.htm
  – Water Monitoring Strategy
    www.idem.IN.gov/cleanwater/2537.htm
  – Watershed Restoration Success Stories
    www.idem.IN.gov/nps/3360.htm
Questions?