Nutrient Reductions and Dam Removal:
Developing an Implementation Plan to Address
Dissolved Oxygen and Algae Problems in the Fox River

March 2014

Rob Linke, P.E., CFM
Board Member
Fox River Study Group, Inc.
Fox River Watershed

- 2658 Sq. miles
  - 938 Sq. miles WI
  - 1720 Sq. miles in IL
- 223 miles long
- Population > 1 Million
- 16 Dams
- 32 WWTPs on river
Managing a Multi-Purpose Resource

- Drinking water for 300,000+ people
- Wastewater and stormwater conveyance
- Recreation for inhabitants and visitors
- Habitat for aquatic and terrestrial species
- Aesthetic value
Impacts of Our River Nationally

- Northern Gulf of Mexico Hypoxic Zone
  - 6700 Sq. miles (2011)
  - Impacts $2.8 Billion dollar commercial & recreational fishing industry
  - Caused by excess nutrients (P & N)
- 45% TP reduction needed to meet national goal to address NGOMHZ
In the Beginning...

(1990’s & early 2000’s)
Reports by IEPA list Fox River and several of its tributaries as impaired waters.

Sources:
- Hydromodification
- Flow Regulation
- Urban Runoff
- CSOs
- Municipal Point Sources

Causes:
- Flow alterations
- Habitat (lack of)
- Sedimentation/Siltation
- Dissolved Oxygen
- Suspended Solids
- Excess algal growth
- Total Phosphorus
- Fecal coliform bacteria
- PCBs
- Mercury

78% of Fox River mainstem classified as non-supporting for Aquatic Life
- 50% non-supporting for primary contact
- 100% non-supporting for fish consumption
In the Beginning...

- IEPA asks Point Source Dischargers and Environmental Groups to work together to address river quality issues and improve the permitting process for WWTPs

- Stakeholders concerned about a future TMDL by IEPA based on limited WQ data for the Fox River

- Stakeholders begin collecting WQ data in preparation for IEPA-driven TMDL process

- Group discusses using data to create an alternative study to a traditional TMDL to ensure latest monitoring data is used and local input on solutions is maximized.
Our Mission:

To bring a diverse coalition of stakeholders together to work to preserve and enhance water quality in the Fox River watershed.
Fox River Study Group is born!

- Incorporated as a Not For Profit in 2003
  - City of Aurora
  - City of Elgin
  - Fox Metro Water Reclamation District
  - Fox River Ecosystem Partnership
  - Fox River Water Reclamation District
  - Friends of the Fox River
  - Kane County
  - Sierra Club - Illinois Chapter
  - Tri-Cities (Batavia, Geneva, St. Charles)
Financial Supporters

- USEPA
- Illinois EPA
- IL River Coordinating Council/Lt. Gov. Pat Quinn
- Lt. Gov. Corinne Wood
- Chicago Metropolitan Agency for Planning
- City of Aurora
- City of Elgin
- City of St. Charles
- City of Batavia
- City of Geneva
- City of Plano
- ConAgra Foods
- Dunham Fund
- Fox River Water Reclamation District
- Kane County Riverboat Fund
- The Conservation Foundation
- Village of Algonquin
- Village of Lakemoor
- Village of Port Barrington
- United City of Yorkville
- Yorkville-Bristol Sanitary District
In-Kind Contributors

- Fox River Water Reclamation District
- Fox Metro Water Reclamation District
- IL EPA
- IL State Water Survey
- Northern Moraine Water Reclamation District
- Village of Algonquin
- City of Aurora
- City of Crystal Lake
- City of Elgin
- City of St. Charles
- City of Geneva
- Sierra Club
- Friends of the Fox River
- Environmental Defenders of McHenry County
- Lake in the Hills Sanitary District
- The Conservation Foundation
- Kane County
- Gardner Carton & Douglas
- WE Deuchler Associates
Four Phase Approach

Phase I: 2002-2003
Understand Available Information
- Water quality (FoxDB)
- GIS data
- Literature review and publication database
- How to address the issues

Phase II: 2003-2009
Develop Planning Tools
- HSPF: loads, storm events
- QUAL2K: DO regime during low flows
- Monitoring plan
- Biological data (FoxDB modified)

Phase III: 2006-2013
Integrated Monitoring/Refine models
- Low flow monitoring
- Storm event monitoring
- Refinement of Planning Tools
- Evaluate management options (scenarios)

Phase IV: 2013-...
Implementation
- Fox River Implementation Plan
  - Propose & promote management actions
- Evaluate planned WWTP expansions, NPDES permits, etc.
- Continued model update & monitoring
- Expand study area to include upper portion
Illinois State Water Survey: Critical Review of Data

Some parameters exceed standards/recommendations:

- Total Nitrogen
- Total Phosphorus
- Dissolved Oxygen
- pH
- Fecal coliform bacteria

Recommended modeling approach to evaluate management scenarios that would address current WQ problems and prevent future degradation from happening.

Study Completed March 2004
Funded by IEPA
Available at: [http://ilrdss.isws.illinois.edu/fox/](http://ilrdss.isws.illinois.edu/fox/)
Volunteer Water Quality Monitoring

Methods

- Monthly since 2002
- IEPA-approved QA/QC program
- Volunteer collection, transport and analysis
- Samples analyzed by Fox Metro & Fox River WRDs & City of Elgin Water Dept.
- Constituents: Temp, pH, DO, conductivity, BOD, TSS, fecal coliform, TKN, Ammonia N, Nitrate N, Organic N, chlorophyll a, est. biomass, Total P, Dissolved P, Chloride, Turbidity

Sites

- Seven sites on the Fox River- Johnsburg to Yorkville
- Sleepy Hollow Creek
- Tyler Creek
- Silver Creek
- Indian Creek
- Crystal Creek
- Ferson Creek
- Blackberry Creek
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Phase II – Tool Development

- Watershed loading model
  - 31 Tributaries + Areas draining directly to Fox R.
  - 33 HSPF Models (Tribs + 2 for the Fox)

- Receiving stream model
  - QUAL2K (1 model)
  - Steady State
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**Phase III:**
2006-2013
Integrated Monitoring/Refine models
- Storm event monitoring
  Completed Sept. 2011
- Low flow monitoring
- Refinement of Planning Tools
- Evaluate management options (scenarios)

**Phase IV:**
2013-
Implementation
- Fox River Implementation Plan
  Proposal & promote management actions
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Phase III – Storm Monitoring

- 20 Sites
- 4 Rain Gages
- 4 Stream Flow Gages
  - In addition to USGS gages
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**Phase III:** 2006-2013
- Integrated Monitoring/Refine models
  - Low flow monitoring
    - Completed June 2012
  - Storm event monitoring
  - Refinement of Planning Tools
  - Evaluate management options (scenarios)

**Phase IV:** 2013-
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Phase III- Low Flow Monitoring

- Originally planned to be completed in Summer 2006
- No “low flows” in river again until Summer 2012.
- Joint effort by ISWS & Deuchler Environmental, Inc.
- Intensive sampling over 72 period once “low flows” are measured at gages.
- Low flow = 360 cfs Algonquin/ 523 cfs Montgomery
Phase III - Initial Management Scenarios

- Best management practices for non-point runoff
  - Ag lands - increase no-till practices for row crops (corn and soybeans) by 100%
    - From 4% of all row crop areas to 8% of all row crop areas
  - Urban area BMPs
    - Applied to 5% of all urbanized area

- Modified point source discharges - reductions in phosphorus discharges

- Dam removal
Phase III - Initial Management Scenarios

- Modified point source discharges
  - Evaluate all major WWTPs at 1 mg/L TP limit
  - Evaluate all major WWTPs at 0.5 mg/L TP limit
  - Evaluate all major WWTPs at 0.1 mg/L TP limit

- Dam removal
  - Evaluate 7 of 12 dams removed
    - Excludes Stratton
  - Evaluate ALL 12 dams removed
    - Including Dayton
Phase III - Initial Management Scenarios

- Combinations of Urban BMPs, Ag BMPs, Point Source Limits, and Dams
- Evaluated impact of upstream influent TP concentration
  - 0.2 mg/L (current)
  - 0.1 mg/L (future)
Phase III- Initial Management Scenario Results

At the level applied in the simulated scenarios:

- Minimum impact from urban BMPs applied to 5% of urban areas
  - Less than 1% reduction in total load from watershed
  - At watershed scale, these site-scale green infrastructure BMPs may not have significant impact on main stem DO issues, but at the tributary stream scale, they likely have a significant impact (reduce flashiness of flows, lower runoff temps, less TSS, less urban pollutants into local streams, etc.)
Phase III - Initial Management Scenario Results

At the level applied in the simulated scenarios:

- Tillage practices lower annual sediment loads by 15% and TP loads by 5% in the watershed
Phase III- Initial Management Scenario Results

- Limiting TP to 1 mg/L at major NPDES facilities reduces annual total TP load by 33%
- Algae levels significantly affected by dams
- Minimum DO affected by presence of dams and algae
- Limiting TP to 0.1 mg/L at WWTPs did not have significant positive impact on phytoplankton & DO concentrations within dam impoundments
Phase III- Initial Management Scenario Results

- **Take home:** Reducing pollutant loads (i.e. TP, BOD, etc.) alone will not solve the DO and algal impairments on the mainstem.
Fox River From Chain O Lakes to Dayton
47% of River Miles Impounded
55% of River Surface Area is Dam Impoundment
Source: Fox River Fish Passage Feasibility Study
IMPACTS OF DAMS ON THE ECOSYSTEMS

**Low Quality Ecosystem**
- Enlarged Surface Area, Low Velocity = Increased Water Temp & Nutrient Concentrations
- High Temp + Trapped Nutrients = Excessive Algal Growth & Low DO
- Low velocity, artificially flattened hydraulic gradient = Sediment Transport Reduced
- Little Variability in Substrate, Depth, etc.
- Net Result: Low Biodiversity

**High Quality Ecosystem**
- Variability in Velocity, Depth, etc.
- Adequate Dissolved Oxygen
- Nutrients Distributed & Assimilated
- Sediment Transport Occurs
- Higher Biodiversity
Fox River From Chain O Lakes to Dayton
47% of River Miles Impounded
55% of River Surface Area is Dam Impoundment
Source: Fox River Fish Passage Feasibility Study

(RIVER MILES)

ELEVATION IN FEET ABOVE SEA LEVEL

(ADAPTED FROM KNAPP, 1988 & WILDMAN 2001)
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Phase IV- Management Decisions/Policy
Recommendations/Implementation

Next Steps

- Efforts incorporated as condition in NPDES permits
- Major Dischargers (> 1 MGD) to evaluate feasibility of reducing phosphorus discharges to 1 and 0.5 mg/L levels
- Further modeling/recommendations
- Develop Fox River Implementation Plan by June 15, 2015
What is the FRSG FRIP?

It will be the roadmap for watershed decision makers that will define the reductions in pollutant discharges needed and in-stream projects to be executed that, when implemented, will improve the water quality of the Fox River.
Fox River Implementation Plan

What the FRIP is **NOT**

- Will NOT address **all** the pollutants in the IEPA 303(d) Listing
  - Example: Doesn’t address PCBs, Mercury, or Fecal Coliforms
- Will NOT identify site-specific NPS BMPs
- Will NOT identify individual, plant-specific capital projects for each WWTP (on the mainstem or tributaries)
- Is NOT being created by Bureaucrats far removed from the watershed
Fox River Implementation Plan

Goals

- Resolve the dissolved oxygen and algal impairments which cause the Fox River to not meet it’s Designated Uses as defined by the IEPA [303(d) List].
- Replace a traditional TMDL plan.
- Create a plan that is fair to all stakeholders
- Recommendations developed based on good science input from local decision makers.
Not all municipalities (MS4s) & point source dischargers are “at the table”

Dam removal is a sensitive/emotional topic if liability and costs aren’t in the discussion.

Costs of improvements will be in the hundreds of millions of dollars watershed-wide.
FRIP Development Team

- Fox River Study Group Board
- Consultant Team- LimnoTech / Crawford, Murphy, Tilly / Baetis Environmental
- ISWS- Advisory role to FRSG Board
- IEPA Staff
- YOU!
## FRIP Schedule

<table>
<thead>
<tr>
<th>Task No.</th>
<th>Task</th>
<th>Task</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
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<tr>
<td>1</td>
<td>Kick-off meeting</td>
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<td>Nov</td>
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<td>2</td>
<td>Assess and define water quality targets</td>
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<td>Dec</td>
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<td>3</td>
<td>Review model and recommend adjustments (if needed)</td>
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<td>4</td>
<td>First workshop with FRSG</td>
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<td>5</td>
<td>Model revised loading scenarios</td>
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<td>6</td>
<td>Develop alternatives to attain water quality goals</td>
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<td>June</td>
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<td>Second workshop with FRSG</td>
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<td>Prepare Draft WIP</td>
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<td>Third workshop with FRSG</td>
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<td>Prepare Final WIP</td>
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Be Involved

- All municipalities, wastewater treatment plants, watershed groups and ag community will need to do their part!

- Fox River Study Group Meetings
  - 4th Thursday 9:30 AM
  - Fox Metro, Rt. 31 in Oswego

- 3/27/14 Regular Meeting

- Special Meetings – see FRSG website for notices or email us to be “on the list”
Science-based planning & decision-making

Stakeholder involvement

Join Us!

www.foxriverstudygroup.org