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

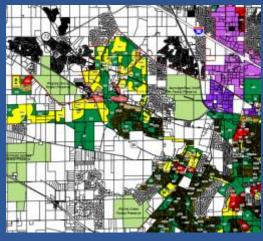
- Northern Gulf of Mexico Hypoxic Zone
 - 6700 Sq. miles (2011)
 - Impacts \$2.8 Billion dollar commercial & recreational fishing industry
 - Caused by excess nutrients (P & N)
- 45% TP reduction needed to meet national goal to address NGOMHZ



In the Beginning...

(1990's & early 2000's)







ILLINOIS INTEGRATED WATER QUALITY REPORT AND SECTION 303(d) LIST, 2012

Clean Water Act Sections 303(d), 305(b) and 314

Water Resource Assessment Information and List of Impaired Waters

Volume I: Surface Water

December 20, 2012

Illinois Environmental Protection Agency Bureau of Water

In the Beginning...

- 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

ILLINOIS INTEGRATED WATER QUALITY REPORT AND SECTION 303(d) LIST, 2012

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- 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 a alternative study to a traditional TMDL to ensure latest monitoring data is used and local input on solutions is maximized.



Fox River Study Group, Inc.

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 8

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)





The Fisx River Study timup (FRSG) is a diverse coeffice of stakeholders winking ogether to assess water quality in the Pox River violenthed. Participants include hends of the Pox River, Sierra Club, Pox River Haber Reclamation Sistrict (Elgan). Fus Metris Mater Rectariation District (Juana), Fus Bove Bookystein Parthership, Brook Environmental Protection Agency (Inch) and Backberry Chesk Watershield Final Implementation (Juana) as Avel as Impresentations from Agencyas, Jurora, Ballavia, Crystal Lake, Bigin, Geneva, Island Lake, Kane County, Lake in the Hills. St. Charles and Yorkvilla.

The industry beginning in the same of states in part have to propose or care
goodning Total Maximum state; coad (THes), shouly on the river. A THO, shouly is
required by Notheral law because these segments of the Fan Fiver appeared on the
Bloom Environmental Protection Agency's last of impales divisions (the 1998
\$15(0) let). These segments, which he landers holiday with and forth Junios, were latted because results from at least one water sample suggest there are water quality concerns. The recent customer concerns enclude low-dissolved energies levels or high conventrations of final colderes bacteris. The 2003 being was updated in 2002, and now includes the order length of the Fox Rover from The Viscousian state are to the near's easily at Ottory with the next remercial wave fitted as flow absention, hybrist afterstors, low dissolved cryglet, harvests, organic enrichment, Publis, statum or appealed calling

Although the emphasis in the original meetings was on monitoring water quality, it soon kecame pleas that the PRRSS presented a unique appartment in Sobter assurances growth throughout the watershed. To guide those efforts, the PRSS reached a consensus oit the following work plan.

The work plan is made up of four phases. Beef descriptions of the objectives of each phase, the schelule, and calmuted costs are given in the table below. This is not to being conducted by the Brids State Water Survey and Noded by the IRSA. Part of the Place Iz of the Table begins in April 2021 when the PRIC. water quality mentoring program stanted collecting samples at seven sites along the Fax Stuer. This program, as all-volunteer affort organized by the Fax Stuer and for Meton water reclamation interface, was carefully despited to startify ingorous data quality requirements of the SFA. Results from this program will be shiped with results from Phase I to identify times and locations where difficed information is needed. Those data, especially information describing on the watershed responds to store events, will be used in Phase ISI To calibrate a model of the Fick River watershed.

Te fourth and final phase of the work plan is to replement and resertain the valerabed model as a management tool. The model will be used to

- Ensure efficient use of taxpayer and private moneys on watershed projects assess the effect of various development actions throughout the watershe
- Evaluate management priorities
- Meetify considers regions within the watersheld Develop effective continuing monitoring programs

For additional leturestine

about Fox River Study Group Cindy Slendrod 925-875-2584

Mailing Address: Fen River Study Group, Inc. P.D. Box 7t Oswege, IL 60543

FOX REVER WATERDHEE HALF

PRESIDENTI Monthering GMA

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



- 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

Phase I

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.

Fox River Watershed Investigation – Stratton Dam to the Illinois River: Water Quality Issues and Data Report to the Fox River Study Group, Inc.

Sally McCoakey, Alena Bartosova, Lian-Shin Lin, Karla Andrew, Michael Machesky, and Chris Jennings

Prepared by:

Illinois State Water Survey Watershed Science Section 2204 Griffith Drive Champaign, Illinois 61820-7495

Prepared for the:

Fox River Study Group, Inc.
Cindy Skrukrod, Steering Committee Chair
and
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276

March 2004

Study Completed March 2004
Funded by IEPA
Available at: 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

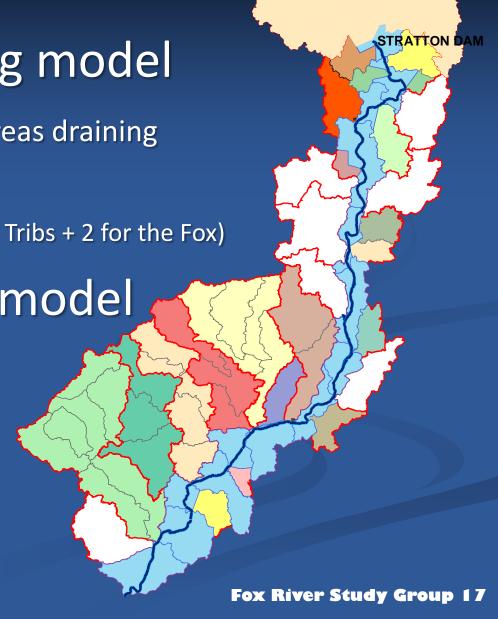
Watershed loading model

■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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Storm event monitoring Completed Sept. 2011

Refinement of Planning Tools

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Phase IV:

2013-...

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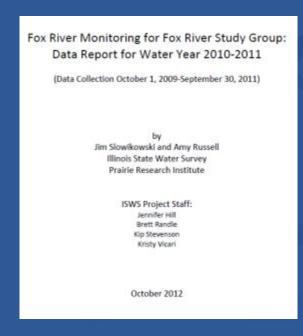
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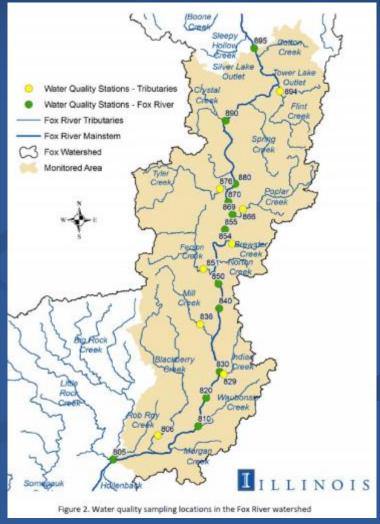
Continued model update & monitoring

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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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Low flow monitoring Completed June 2012

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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

- 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

- 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

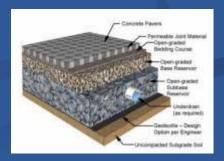
- Combinations of Urban BMPs, Ag BMPs, Point Source Limits, and Dams
- Evaluated impact of upstream influent TP concentration
 - 0.2 mg/L (current)
 - 0.1 mg/L (future)

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.)







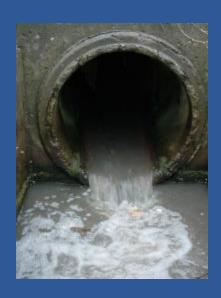
At the level applied in the simulated scenarios:

Tillage practices lower annual sediment loads by 15% and TP loads by 5% in the watershed



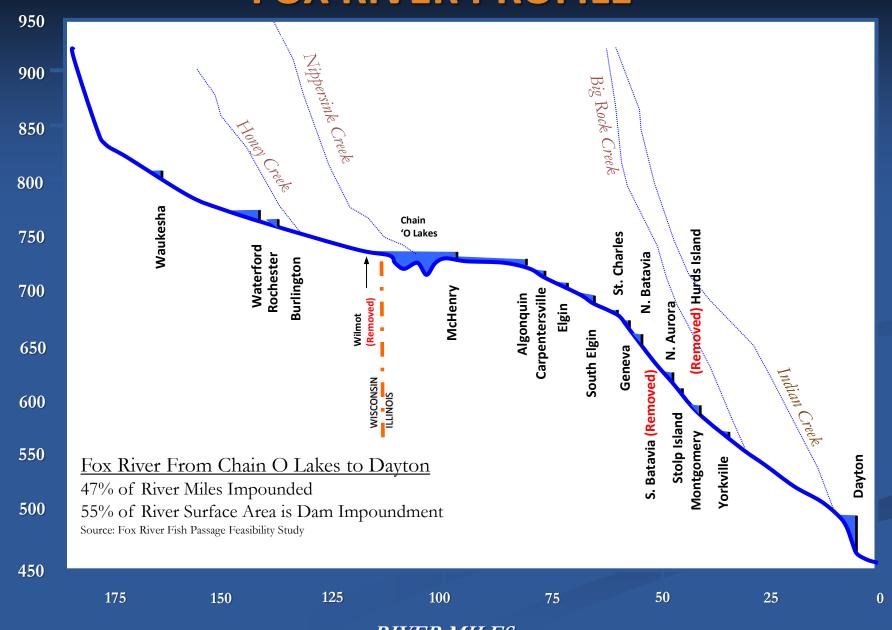
- Limiting TP to 1 mg/L at major NPDES facilities reduces annual total TP load by 33%
- Algae levels significantly affected by dams
- Minimum DO affected by presence of dams and algae
- Limiting TP to 0.1 mg/L at WWTPs did not have significant positive impact on phytoplankton & DO concentrations within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

Take home: Reducing pollutant loads (i.e. TP, BOD, etc.) alone will not solve the DO and algal impairments on the mainstem.





FOX RIVER PROFILE



IMPACTS OF DAMS ON THE ECOSYSTEMS

Low Quality Ecosystem

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

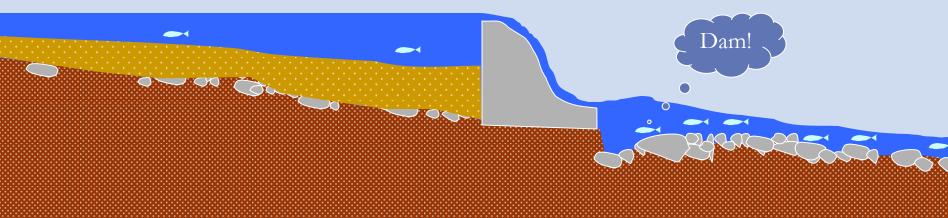
lmpoundment

High Quality Ecosystem

- Variability in Velocity, Depth, etc.
- Adequate Dissolved Oxygen
- Nutrients Distributed & Assimilated
- Sediment Transport Occurs
- Higher Biodiversity

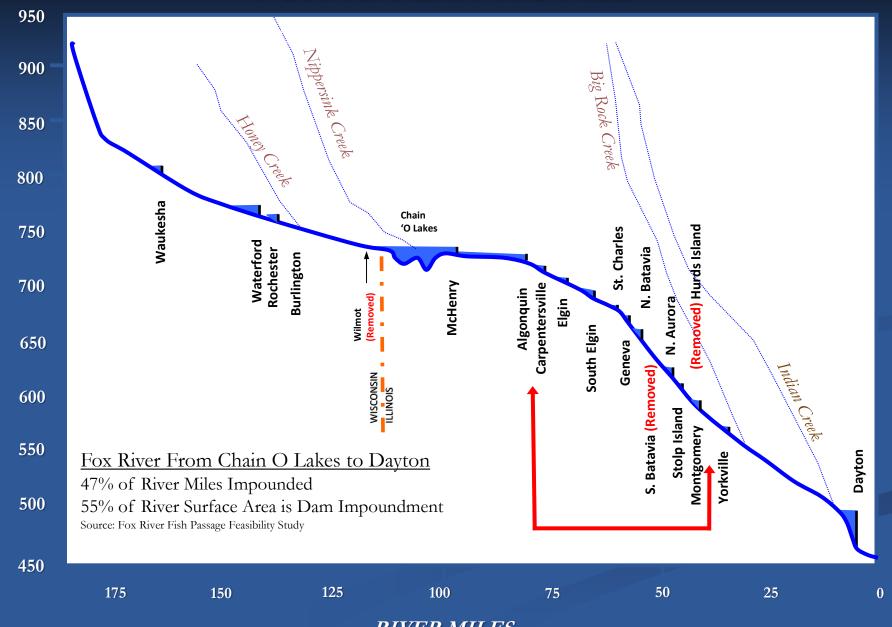
Free - Flowing River

Barrier



ELEVATION IN FEET ABOVE SEA LEVEL

FOX RIVER PROFILE



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Continued model update & monitoring

Expand study area to include upper portion

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.

What the FRIP is **NOT**

- Will NOT address <u>all</u> 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

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 sciend input from local decision makers.



Challenges

- 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

Task No.	Task	20	13		2014												2015				
		Nov	Dec	Jan	Feb	Mar	April	Мау	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	Мау	June
1	Kick-off meeting																				
2	Assess and define water quality targets																				
3	Review model and recommend adjustments (if needed)																				
4	First workshop with FRSG																				
5	Model revised loading scenarios																				
6	Develop alternatives to attain water quality goals																				
7	Second workshop with FRSG																				
8	Prepare Draft WIP																				
9	Third workshop with FRSG																				
10	Prepare Final WIP																				

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"

www.foxriverstudygroup.org

Science-based planning & decision-making

Stakeholder involvement

Join Us!

