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6. Course Syllabus: Independent Study Course, Lower Fox River Watershed Monitoring Program, Appleton East High School.

Newspaper Coverage of the 2005 Teacher Workshop

Paper: Green Bay Press-Gazette (WI)
Title: Area teachers, students take to the water
Date: June 28, 2005

Project studies problems of Fox River watershed

HOBART -- While some teachers might be basking in the comfort of their air-conditioned houses during these hot and hazy days of summer, a group of area high school teachers and students are in a school of sorts.

They're taking part in the third annual Lower Fox River Watershed Monitoring Program Teacher Workshop conducted by the University of Wisconsin-Green Bay.

The three-day workshop features educational opportunities to learn more about watershed management, storm water and construction site erosion, and Monday's field visit to Duck Creek.

Tim Ehlinger, professor of biological sciences at UW-Milwaukee, said the teachers have become part of a mission to improve the health of the Fox River.

"These teachers are part of a project where we are monitoring the streams that feed into the Fox River," he said. "As part of the larger issues of restoring the Fox River, we are very concerned that people pay attention to the tributaries that feed into the river because it is really the health of those tributaries that will influence whether or not the river itself is healthy. You can't have healthy water downstream unless you take care of the issues upstream."

Ehlinger got his feet wet Monday afternoon in Duck Creek as he captured different fish species and educated the teachers about them.

"Today we are conducting a survey of the fish on Duck Creek," he said. "This survey will give us an idea of what the integrity is of the ecology of this system."

Ehlinger said they would be measuring a variety of species and their abundances in the water. He said by doing this, they find out whether the stream is healthy, if it is improving or declining.

Lynn Terrien, the lead-coordinating teacher of the project and currently in her 13th year of teaching at Green Bay Southwest High School, said that while the teachers have gone on field trips with their students before, an experience like this offers better resources to learn about the watershed.

"It's a great way to get the kids out to do some community service, collect some data and know that maybe some day down the road this data could affect some important decisions that are made along the watershed."

Workshop details

* What: A three-day workshop to monitor and research tributary watersheds to the Fox River.

* Schools include: Green Bay Southwest, Green Bay Preble, Luxemburg-Casco and West De Pere.

* Sessions lead by: Professors Kevin Fermanich and Scott Ashmann of UW-Green Bay; Professor Timothy Ehlinger of UW-Milwaukee; and UW-Extension Basin Educator Kendra Axness.

* Funded By: $1.5 million grant from Arjo Wiggins of Appleton.

Author: Adam Wise, awise@greenbaypressgazette.com
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THE LOWER FOX RIVER watershed monitoring program

Third Annual Watershed Symposium
Evaluation Summary
March 15, 2006

The following is a summary of evaluations returned by high school students who attended the 2006 LFRWMP student symposium on March 15, 2006. Forty-three evaluations were received from a total of 53 students who attended the symposium.

Note that the number in parentheses indicates the number of students giving that response.

General Project:

1) What is your year in school: **Freshman (7) Sophomore (15) Junior (14) Senior (5)**

2) How long have you been participating in the LFRWMP? **1 yr (18); 2 yrs (11); 3 yrs (11)**

3) Which type of monitoring most interests you (1 = not interesting; 4 = very interesting):

a.	Water quality	**1 (4)**	**2 (9)**	**3 (14)**	**4 (14)**
b.	Habitat	**1 (2)**	**2 (6)**	**3 (21)**	**4 (12)**
c.	Macroinvertebrates	**1 (3)**	**2 (11)**	**3 (11)**	**4 (16)**
d.	Amphibians	**1 (3)**	**2 (7)**	**3 (10)**	**4 (19)**
e.	Birds	**1 (3)**	**2 (11)**	**3 (11)**	**4 (14)**

4) Have you participated in (please circle all that you have participated in):

a.	Water quality:	Training (**23**)	Field monitoring **(33)**
b.	Stream habitat:	Training **(19)**	Field monitoring **(24)**
c.	Macroinvertebrates:	Training **(19)**	Field monitoring **(15)**
d.	Amphibians:	Training **(16)**	Field monitoring **(14)**
e.	Birds:	Training **(18)**	Field monitoring **(15)**

5) How often have you discussed your watershed monitoring activities/project involvement with:

a.	Family members:	Never **(6)**	1-2x **(20)**	Often **(15**)
b.	Others outside of school:	Never **(12)**	1-2x **(21)**	Often **(8)**

6) What has been the impact of the LFRWMP on you? Has it impacted your future education or career choices?

Symposium:

Rank each session from 1-4 (1 = not informative → 4 = very helpful)
Please give an explanation of your ranking.

		Ranking				Explanation
7)	Welcome & Update	**1 (1)**	**2 (8)**	**3 (17)**	**4 (15)**	
8)	Student/Professional Presentations	**1 (1)**	**2 (1)**	**3 (16)**	**4 (22)**	
9)	Poster Session	**1 (1)**	**2 (7)**	**3 (21)**	**4 (10)**	
10)	Break-out sessions:					
	a. Cofrin Grants	**1 (4)**	**2 (8)**	**3 (16)**	**4 (10)**	
	b. Quiz Bowl	**1 (1)**	**2 (1)**	**3 (6)**	**4 (20)**	
	c. GPS Skills	**1 (9)**	**2 (3)**	**3 (6)**	**4 (12)**	

11) What would you like to see included in next year's symposium (or – do you have any suggestions for next year's symposium?)

THE LOWER FOX RIVER watershed monitoring program

Third Annual Watershed Symposium

Evaluation Summary Addendum

March 15, 2006

General Project

12) What has been the impact of the LFRWMP on you? Has it impacted your future education or career choices?

- It allows me to do what I love in more ways than one. It lets me learn things I never would have thought of knowing.
- Fox River Monitoring has made a big influence. I am interested in stream quality and testing and I am thinking about considering this for college.
- I am more interested in a field of science.
- Better realization of the world around me and how humans are affecting it; LFRWMP has definitely swung my career choices more toward environmental science.
- It has helped me improve my laboratory skills, but has not affected any decisions.
- No, but it educates me and gives me a better understanding.
- It has given me an idea of what my career might be like. I have always wanted to be a wildlife biologist.
- Yes, I believe I want to have a career doing something outdoors.
- I really enjoy chemistry and being in the LFRWMP has helped me realize that I like the researching aspect of a science career.
- Taught me about the environment, and what watersheds are.
- Allowed me to see what real world research is like.
- I'm not far enough in my education to determine that.
- More awareness of watersheds. Not much.
- Not really, because it doesn't have much to do with medicine.
- I thought it was very interesting though I am not currently pursuing a career in science, I am still very open.
- Interests me in biology. Maybe.
- I don't really know yet….
- I don't know yet.
- Better understanding of nature. Yes.
- Interesting. Not sure.
- See how important watersheds are. Somewhat.
- Want to help the earth.
- It has very much helped me to decide to go to school in this type of field.
- Great impact – I am looking into the science field. So yes, it helped me narrow my choices for the future.
- Gave me a much better understanding of watersheds and their impact on our ecosystem.
- It has helped me think about college.
- It has given me an idea of what career I would like.
- I want to move into the fields of science, particularly biology.
- Helps me understand today's environmental problems.
- Yes, yes.
- None.
- None.
- Interesting. No.
- Gotten to learn about the environment. Opened my eyes to the different options in the science field.
- Got me interested in biology.
- Makes me more interested in critters.
- I want cleaner water. No.
- It's great experience for environmental science studies in college.

Symposium:

13) What would you like to see included in next year's symposium (or – do you have any suggestions for next year's symposium?)

- I really liked the hands-on stuff. GPS is great. If there is other stuff to do like that.
- More quiz bowl – interaction with students from different schools.
- If you stayed to see the grant poster presentations, you could not see the individual student presentations. You should make time for 'everyone can see everything.'
- MORE QUIZ BOWL!
- Remember your level of students, high school students may need more explanations on presentations given by professionals.
- More GPS.
- Make GPS work right if possible.
- Better GPS units.
- Better organized break-out sessions and we want more activity based items.
- Maybe more organized poster session.
- More activities and games between.
- I thought it was fun. I like the Quiz Bowl. I think more activities and hands-on. The posters should be more organized
- More outdoor activities.
- Make the GPS systems work, get out side more.
- GPS tutorial.
- Competition.
- Competition between schools in quiz bowl.
- More active.
- This was fun!
- More interaction with other schools, less "lecture" time.
- Presentations (students)
- It should be the same.
- More training on different monitoring.
- More hands-on. Less classroom.
- GPS coordinates should work
- More food.
- Nothing.
- Nothing.

Stream Ecosystem Monitoring Field Experience
Env Sci 283x, Spring 2006
UW – Green Bay

Instructors: Associate Professor Kevin Fermanich (instructor of record),
Natural and Applied Sciences, UW Green Bay
465-2240; fermanik@uwgb.edu

Participating high school teachers:
Lynn Hudock Terrien and Rick Berken Green Bay Southwest
Charles Frisk Luxemburg Casco
Kevin Hendricksen and Chris Hansel, Green Bay Preble
Dana Lex, West DePere
Kara Pezzi and Ryan Marx , Appleton East
David Burbach , Markesan School District

Course description:

Students in this course will be from high schools participating in the Lower Fox River Watershed Monitoring Program administered through the Department of Natural and Applied Sciences at UWGB. Students will normally begin participating in watershed monitoring activities prior to completion of their Junior year in high school and then complete this course for credit during the Spring semester of their Senior year. Students will perform the following stream ecosystem monitoring activities on a periodic basis: collection and analysis of physical and chemical water quality parameters; assessment of stream corridor habitat; and surveys of amphibians, macroinvertebrates and birds. In addition, students will present findings at an annual student watershed symposium, and prepare a final report.

Number of Credits: 1

Required Prerequisites:

Students must be nominated by and work with a teacher who has completed training in the Lower Fox River Watershed Monitoring Program teacher training workshop.

Course objectives:

1. provide hands-on experience in watershed science, including water quality, habitat and biotic monitoring procedures
2. enhance student knowledge and understanding of land use impacts on water quality and stream ecosystems
3. develop ability to communicate scientific results in oral and written formats

Course requirements:

- Participate in monitoring technique training and a minimum of 35 field monitoring hours
- Participate in a field day with university staff
- Maintain a log of activities
- Present oral or poster presentation at annual symposium
- Prepare a report of monitoring activities and interpretation

Course references:

- Lindbo, D. Torrey, and Stacy L. Renfro, 2003, *Riparian and Aquatic Ecosystem Monitoring: A Manual of Field and Lab Procedures*; 4th Edition, Saturday Academy's Student Watershed research Project (SWRP): Oregon,2003.
- Project-specific hand-outs and reference materials (available at www.uwgb.edu/watershed).
- McCafferty, W. Patrick, 1983, Aquatic Entomology: *The Fisherman's guide and Ecologists' Illustrated Guide to Insects and Their Relatives*, Jones and Bartlett: Boston, MA.
- Peterson, Roger Tory, and Virginia Marie Peterson, 2002, *Birds of eastern and Central North America*, 5th edition, Houghton Mifflin Company, Boston.
- Various bird CDs
- Water Action Volunteers, *Key to Macroinvertebrate Life in the River,* UW-Extension and Wisconsin DNR
- EcoWatch® for Windows™ software, YSI, Inc.
- Lower Fox River Watershed Monitoring Program website (www.uwgb.edu/watershed) and procedures

Schedule:

Each student is expected to participate in monitoring technique training sessions conducted by participating teachers and/or UWGB staff prior to each of the various field sessions.

Schedule of Major Activities:

3rd wk. Sept. – 3rd wk. Oct.	Water quality monitoring
March	Annual Student Symposium at UW Green Bay
April – June	Amphibian monitoring
4th wk April - 2nd wk May	Water quality monitoring
June 1 - July 1	Bird Monitoring
2nd wk July – 1st wk Aug.	Water quality, habitat & invertebrate monitoring

Evaluation and Assessment:

Field trip participation and log	50%
Symposium presentation	20%
Report	30%

THE LOWER FOX RIVER watershed monitoring program

Lower Fox River Watershed Monitoring Program
2005-2006

Independent Study (Appleton East High School)

Instructors

Kara Pezzi	Chemistry	pezzikara@aasd.k12.wi.us	997-1399 x 2775
Ryan Marx	Environmental Science	marxryan@aasd.k12.wi.us	997-1399 x 9576

Credits

0.5 credits/year; credit awarded in spring semester; can be repeated for a total of 2 credits

Prerequisite

Concurrent enrollment in a traditional science class.

Time Commitment (averages)

classroom: 0.5 hour/week
reading/research: 1 hour/week
fieldwork: 12 hours/semester (summer work is divided equally between semester 1 and 2 of following school year)
NOTE: as students gain laboratory skill, the amount of classroom time will diminish and the amount of reading/research and fieldwork will increase

Course Objectives

1. Provide hands-on experience in watershed science, including water quality, habitat and biotic monitoring procedures.
2. Enhance student knowledge and understanding of land use impacts on water quality and stream ecosystems.
3. Develop ability to communicate scientific results in oral and written formats.

Course Description

Students in this course will be participating in the Lower Fox River Watershed Monitoring Program administered through the Department of Natural and Applied Sciences at UWGB. Students will perform the following stream ecosystem monitoring activities on a periodic basis: collection and analysis of physical and chemical water quality parameters; assessment of stream corridor habitat; and surveys of amphibians, macroinvertebrates and birds.

First year students

Learn about watersheds and become proficient in all water quality lab tests. Assist in sample collection and analysis for water quality parameters and stream corridor habitat. Participation in surveys of amphibians, macroinvertebrates, and birds is encouraged. Maintain a binder of resources and a journal of activities. Attend an annual student watershed symposium.

Second year students

Maintain proficiency in all water quality tests. Assist in sample collection and analysis for water quality parameters and stream corridor habitat. Select a research project and begin data collection. Choose at least one survey in which to participate: amphibians, macroinvertebrates, or birds. Maintain a binder of resources and a journal of activities. Present findings at an annual student watershed symposium.

Third and fourth year students

Maintain proficiency in all water quality tests. Lead training in water quality lab tests. Assist in sample collection and analysis for water quality parameters and stream corridor habitat. Continue data collection for research project. Choose at least two surveys in which to participate: amphibians, macroinvertebrates, or birds. Maintain a binder of resources and a journal of activities. Present findings at an annual student watershed symposium and prepare a written report of research.

Course Resources

- Lindbo, D. Torrey, and Stacy L. Renfro, 2003, *Riparian and Aquatic Ecosystem Monitoring: A Manual of Field and Lab Procedures*; 4th Edition, Saturday Academy's Student Watershed research Project (SWRP): Oregon, 2003.
- Project-specific handouts and reference materials.
- McCafferty, W. Patrick, 1983, Aquatic Entomology: *The Fisherman's guide and Ecologists' Illustrated Guide to Insects and Their Relatives*, Jones and Bartlett: Boston, MA.
- Peterson, Roger Tory, and Virginia Marie Peterson, 2002, *Birds of Eastern and Central North America*, 5th edition, Houghton Mifflin Company, Boston.
- Various bird CDs
- Water Action Volunteers, *Key to Macroinvertebrate Life in the River*, UW-Extension and Wisconsin DNR
- EcoWatch® for Windows™ software, YSI, Inc.
- Lower Fox River Watershed Monitoring Program website (www.uwgb.edu/watershed) and procedures

Assessment

	Percent of Grade			
	Year 1	Year 2	Year 3	Year 4
Classroom Participation	50	30	10	10
Field Work	30	40	50	50
Binder and Journal	10	10	10	10
Symposium	10	20	20	20
Written Report	NA	NA	10	10

Fieldwork Schedule

September – October	Water quality monitoring
March	Annual Student Symposium at UW Green Bay
April – June	Amphibian monitoring
March – November	Research – Retention Basin
May	Water quality monitoring
May – August	Research – Stream Restoration
June – July	Bird Monitoring
July – August	Water quality, habitat and macroinvertebrate monitoring

Section 3:
3rd Annual Symposium Student Research Presentations

Appleton East High School:

1. Effect of Algae on Reproducibility of Phosphorus Method, Miranda Hada and Pratha Muthiah.
2. Effect of Cow Manure on Nutrient Levels, Kevin Dombrock and Jon Fischer.
3. The Effectiveness of Detention Basins on Apple Creek, Greta Jochman and Bryan Swanson.

Green Bay Preble / Luxemburg-Casco High School

4. Poster: Phosphorous Levels in Baird's Creek, Jordan Palubicki, Alli Thut, Alicia DeGroot, Kevin McDonald, Preble High School.

Green Bay Southwest High School:

5. Poster: Artificial Substrates….To Do or Not to Do? Fei Yin Luk and Nicole Martin.
6. Poster: Got Frogs? Brittany Mertens.

Markesan High School:

7. Seasonal Diversity and Population Density of Macro-invertebrates in Spring Brook, Matt Fenske, Kaylin Werth, and Josiah Zacharias.
8. Factors That Are Directly Affecting the Spring Brook Watershed, Ryan Pollesh.

Poster: Phosphorus Levels in Baird's Creek, Jordan Palubicki, Alli Thut, Alicia DeGroot, Kevin McDonald, Green Bay Preble High School.

Poster: Artificial Substrates….To Do or Not To Do?, Fei Ying Luk and Nicole Martin, Green Bay Southwest High School.

Poster: Got Frogs?, Brittany Mertens, Green Bay Southwest High School.

Section 4:
2005 – 2006 Publication Abstracts

1. The Effects of Urbanization on Baird Creek, Green Bay, Wisconsin, Jessie C. Fink. Master's Thesis: Environmental Science and Policy, UW-Green Bay, May 2005. (Includes final draft of published table of contents)
2. Source Allocation of Suspended Sediment and Phosphorus Loads to Green Bay from the Lower Fox River Sub-basin Using the Soil and Water Assessment Tool (SWAT**),** Paul Baumgart. Lake Michigan: State of the Lake & Great Lakes Beach Association Joint Conference, Green Bay,WI., November 2-3, 2005
3. Monitoring and Assessing Watershed Contributions of Sediment and Phosphorus to the Lower Fox River and Green Bay, Kevin Fermanich, Paul Baumgart, Dave Graczyk, and Jessie Fink. Lake Michigan: State of the Lake & Great Lakes Beach Association Joint Conference, Green Bay,WI., November 2-3, 2005
4. Phosphorus and Suspended Solids TMDL For the Lower Fox River/Green Bay Area of Concern – Putting the Pieces Together, Bud Harris, P. Sager, D. Scheberle, V. Harris, P. Baumgart, D. Robertson, K. Fermanich, M. Finney, J. Kennedy, J. V. Klump. Lake Michigan: State of the Lake & Great Lakes Beach Association Joint Conference, Green Bay,WI., November 2-3, 2005
5. Phosphorus Forms and Fate in the Lower Fox River Watershed, Paul Baumgart, Kevin Fermanich, and Nick Reckinger. Wisconsin Chapter of the American Water Resources Association Meeting, Elkhart Lake, WI. March 2-3, 2006

ABSTRACT

THE EFFECTS OF URBANIZATION ON BAIRD CREEK, GREEN BAY, WISCONSIN

Jessie C. Fink

The Baird Creek watershed in Green Bay, Wisconsin, is rapidly changing from agricultural to urban land use between Northview Road and Interstate 43. To assess how urbanization is impacting the aquatic ecosystem of Baird Creek and to assist the City of Green Bay and the Baird Creek Preservation Foundation in making informed land management decisions within the watershed, this project established the following research questions: (1) Do differences exist in the water quality of the agricultural and urbanizing tributaries of Baird Creek? (2) Has the channel morphology of Baird Creek and its tributaries changed in response to hydrologic alterations in the urbanizing watershed? (3) Is the L-THIA watershed development assessment tool a viable model for assessing the impact of future development in the Baird Creek watershed?

Land use, percent impervious cover, and current construction activity were first assessed for the subwatersheds of Baird Creek. Storm event and low-flow sampling was conducted from April to December 2004 at three locations on Baird Creek: an agricultural tributary, a tributary transitioning to urban land use, and the main channel downstream of the confluence. Water samples were analyzed for total suspended solids (TSS), total phosphorus, and total dissolved phosphorus. Continuous temperature, pH, dissolved oxygen, turbidity, conductance, and depth data were recorded at each location. A relationship was established between turbidity measurements and TSS concentrations, which were used as a surrogate for sediment. Changes in channel morphology were assessed at twelve sites previously measured in 2002. Finally, data from water quality sampling and projected future land use was used to evaluate the L-THIA watershed assessment model as a tool to predict changes in pollutant export due to development.

Overall, the study found that urbanization is adversely impacting Baird Creek. Statistical analysis showed that event concentrations of sediment and total phosphorus were significantly higher on the urbanizing tributary than the agricultural branch. Also, although the urbanizing portion of the watershed comprised only 18.5% of the total land area, it contributed 60-70% of the total sediment load during a period of summer storm events. The channel morphology assessment showed that the cross-sectional area and bankfull width of sites located on urbanizing tributaries increased dramatically between the 2002 and 2004 surveys, but fewer impacts were seen at the sites downstream on the main channel. Finally, an evaluation of the L-THIA model as a potential development assessment tool indicated that care must be taken to fully understand the hydrological processes being modeled in order to avoid underestimating impacts of development.

pp. 17-18

BAUMGART, PAUL D., Lower Fox River Watershed Monitoring Program, University of Wisconsin - Green Bay, 2420 Nicolet Dr, Green Bay, WI 54311-7001. **Source Allocation of Suspended Sediment and Phosphorus Loads to Green Bay from the Lower Fox River Sub-basin using the Soil and Water Assessment Tool (SWAT).**

This study was conducted to assist in the development of load allocations within the 1580 km^2 Lower Fox River sub-basin by quantifying major sources of phosphorus and suspended sediment export to lower Green Bay through watershed model simulations with a modified version of the USDA-ARS Soil and Water Assessment Tool model (SWAT). Simulations were conducted for a 1977 to 2000 climatic period under (1) 1992 baseline conditions; (2) 2000 current conditions; and (3) a variety of alternative management scenarios. The calibrated model was able to provide reasonable predictions of water yield and loads of phosphorus and sediment during validation periods. Constituent loads and sources were determined at sub-watershed, watershed and sub-basin scales. Under modeled year 2000 landuse conditions, the Lake Winnebago outlet was the largest source of suspended sediment to lower Green Bay (37%, 46,500 t/yr), followed by agriculture (29%, 36,300 t/yr), estimated river growth of biotic solids (16%, 20,000 t/yr) and urban and urbanizing sources (16%, 18,300 t/yr), point sources (2.4%, 3,000 t/yr), and other sources (1.6%, 2,000 t/yr). Similarly, the Lake Winnebago outlet was the largest source of phosphorus to lower Green Bay (57%, 288,000 kg/yr), followed by agriculture (19.7%, 99,600 kg/yr), point sources (16.4%, 83,000 kg/yr), urban and urbanizing sources (5.6%, 28,500 kg/yr), and other sources (1.3%, 6,800 kg/yr). A large range in sediment and phosphorus reductions was simulated for the alternative scenarios. The largest reductions related to agricultural BMP's were obtained through wide-scale adoption of intensive rotational grazing, followed by conservation tillage and nutrient management. The simulated phosphorus load to lower Green Bay decreased 31% by reducing and stabilizing soil phosphorus concentrations in the sub-basin to the mid-1970's average of 25 ppm Bray-P. Some of the higher simulated BMP adoption rates are not likely to be achieved in the near future.

FERMANICH, KEVIN J.[1], BAUMGART, P.[1], GRACZYK, D.[2], FINK, J.[3], [1] Department of Natural and Applied Sciences, University of Wisconsin Green Bay, 2420 Nicolet Drive, Green Bay, WI 54311-7001; [2] USGS, Middleton, WI; [3] JJR, Madison, WI.
Monitoring and Assessing Watershed Contributions of Sediment and Phosphorus to the Lower Fox River and Green Bay.

Tributaries in the lower Fox River subbasin disproportionately contribute high sediment and phosphorus loads to the Fox River and lower Green Bay. In 2003, a cooperative, multi-year monitoring program designed to quantify sediment (suspended solids, TSS), total phosphorus (TP), and dissolved phosphorus (DP) loads and yields from five key tributaries was initiated. The tributaries include Apple, Ashwaubenon, Baird, and Duck Creeks, and the East River. Each tributary was sampled during 8-12 events and during baseflow for water years 2004 and 2005. In WY2004 the majority of events were associated with above normal spring rains, including the second wettest May on record. There were fewer and smaller events in WY2005.

In WY2004 median event concentrations were 0.56-0.76 mg/L TP and 171-192 mg/L TSS for Apple, Ashwaubenon and Baird Creeks. Duck Creek and East River concentrations were about 50% of those from the other tributaries. Dissolved P made up about half of the TP. Median event WY2005 concentrations were 10-25% lower than WY2004. The yield of sediment from the clay soil Apple, Ashwaubenon, and Baird watersheds ranged from 0.70 to 0.93 t/ha in WY2004. Total P yield ranged from 1.90 to 2.29 kg/ha. Loading was highly event driven. More than half of the annual WY2004 TP and >70% of the annual sediment load occurred during 8 days (5 events) for Apple Creek. We estimate that approximately 91,000 tons of sediment and 260,000 kg of P were delivered to the Lower Fox River by tributary streams in WY2004. Although these watersheds are predominantly agricultural, urban and urbanizing areas are contributing significant amounts to the overall loads. In a study of an urbanizing subwatershed we found that 60-70% of the total sediment load during a period of summer storm events came from only about 18% of the total land area. We also quantified evidence of channel enlargement in the urbanizing tributaries.

Oral Presentation Abstracts

Lake Michigan: State of the Lake
Great Lakes Beach Association
November 2-3, 2005

pp. 35-36

HARRIS, H.J.[1], SAGER, P.[1], ROBERTSON, D.[2], FINNEY, M.[3], HARRIS, V.[4], KENNEDY, J.[5], BAUMGART, P.[1], FERMANICH, K.[1], and SCHEBERLY, D.[1], [1]University of Wisconsin Green Bay, 2420 Nicolet Drive, Green Bay, WI 54311-7001; [2]USGS, Madison, WI; [3]Oneida Tribe; [4]UW Sea Grant Institute, 2420 Nicolet Drive, Green Bay, WI 54311; [5]Green Bay Metropolitan Sewerage District, 2231 North Quincy St, Green Bay, WI 54307. **A Total Phosphorus and Suspended Solids TMDL Framework for Lower Fox River and Green Bay Area of Concern (AOC) – Putting the Pieces Together.**

Following the Great Lakes Water Quality Agreement, marked reductions in point source discharges of total phosphorus (TP) resulted in lower ambient concentrations in Green Bay during the late 1970s to mid 1980s. Since then, ambient TP concentrations have increased to early 1970 levels and continue to cause widespread impairment of beneficial uses. The need for TP and TSS TMDLs for the AOC is clear. While in theory the TMDL process is straightforward, even elegant in design, the formulation in practice is much more problematic. For Green Bay, problem identification began in 1970 with estimates of Fox River TP and TSS loads to the Bay of approximately 712 $mt \cdot yr^{-1}$ and 79,000 $mt \cdot yr^{-1}$ respectively. The first source assessment was published in 1975. From 1978 to the early 1990s studies of trophic dynamics and the impact of TP and TSS loading on light climate and the littoral zone provided the basis for water quality indicators and numeric target development. Impaired water body uses due to TP and TSS were officially recognized in the 1988 Lower Fox River and Green Bay Remedial Action Plan (RAP) and initial target values for TP and TSS identified. These were later revised by the RAP Science and Technical Advisory Committee to 45 ug/l and 7.5 mg/l respectively. Annual monitoring of Green Bay was initiated in 1986 and flow and concentration monitoring in the Fox/Wolf sub-basins occurred sporadically from the late 1970s to present. The Green Bay PCB Mass Balance study estimated TP loads for 1988-89 and provided data to construct sedimentary TP cycling and a TP mass balance for Green Bay. Use of computer models for source identification and allocation were initiated in the late 1980s. After thirty some years of investigations we believe that the formulation of a credible TMDL for TP and TSS for the Green Bay AC is feasible and should become a priority parallel to the PCB cleanup.

Phosphorus Forms and Fate in the Lower Fox River Watershed

Baumgart, Paul D., University of Wisconsin – Green Bay, 2420 Nicolet Drive, Green Bay, WI 54311, baumgarp@uwgb.edu,

Kevin J. Fermanich, University of Wisconsin – Green Bay, 2420 Nicolet Drive, Green Bay, WI 54311, fermanik@uwgb.edu,

Nick A. Reckinger, University of Wisconsin – Green Bay, 2420 Nicolet Drive, Green Bay, WI 54311, reckna20@uwgb.edu,

The effectiveness of phosphorus reduction strategies may depend on whether phosphorus (P) is in the dissolved (DP) or particulate phase as it leaves the source area. Recent analysis of historical monitoring data has shown that mean concentrations of DP range from 40 to 75% of total P (TP) in rural streams within the Lower Fox River sub-basin. This study was initiated to better understand the form in which P leaves source areas and is transported by streams through tracking DP, TP and TSS from different source areas and at different scales in the Apple Creek watershed.

Sampling was conducted at eleven rural source area sites (0.25 to 2.5 $km^{2)}$ and four integrator sites (12 to 85 km^2) during runoff events in 2004-05. Continuous discharge and intensive sampling data was also collected on the main stem of Apple Creek (117 km^2), which served as the final integrator site. Excluding 2005 data, mean TP was 0.61 mg/L from source areas, 0.43 mg/L from integrator sites, and 0.58 mg/L at the main stem. DP concentrations at two sites were significantly lower than most sites. Mean DP percentage was 41% from source areas, 44% from integrator sites and 36% from the main stem. Significant differences were detected between source areas for TP, DP, and percent DP. No significant difference was detected between events for DP. Land use, management practices and site characteristics will be examined to determine which factors best explain our monitoring results.

Section 5:
Copies of Selected PowerPoint Presentations by the LFRWMP Team

1. LFRWMP 2006 Update, Kevin Fermanich, UW-Green Bay, Third Annual Watershed Symposium, March 15, 2006 at UW-Green Bay.
2. Phosphorus Forms and Fate in the Lower Fox River Watershed, Paul Baumgart, Kevin Fermanich, and Nick Reckinger. Wisconsin Chapter of the American Water Resources Association Meeting, Elkhart Lake, WI. March 2-3, 2006

State of the Lake Conference, November 2-3, 2005 at KI Center, Green Bay:

3. Monitoring and Assessing Watershed Contributions of Sediment and Phosphorus to the Lower Fox River and Green Bay, Kevin Fermanich, UW-Green Bay, Joint meeting of the Lake Michigan: State of the Lake 4th Biennial Conference and the Great Lakes Beach Association 5th Annual Meeting, KI Center, Green Bay, WI. November 2-3, 2005.
4. Source Allocation of Suspended Sediment and Phosphorus Loads to Green Bay from the Lower Fox River Sub-basin using the Soil and Water Assessment Tool (SWAT), Paul Baumgart, UW-Green Bay. Joint meeting of the Lake Michigan: State of the Lake 4th Biennial Conference and the Great Lakes Beach Association 5th Annual Meeting, KI Center, Green Bay, WI. November 2-3, 2005.
5. A Total Phosphorus and Suspended Solids TMDL Framework for Lower Fox River and Green Bay Area of Concern (AOC) – Putting the Pieces Together. Bud Harris, UW-Green Bay. Joint meeting of the Lake Michigan: State of the Lake 4th Biennial Conference and the Great Lakes Beach Association 5th Annual Meeting, KI Center, Green Bay, WI. November 2-3, 2005.

Section 6:
Selected Poster Presentations by the LFRWMP Team

Third Annual Watershed Symposium, March 15, 2006 at UWGB:

1. Lower Fox River Watershed School-Based Monitoring Program, UW-Green Bay and UW-Milwaukee.
2. Provisional Monitoring Results – Annual Flow, Precip., TSS and Phosphorus: WY 2004 – 05, UW-Green Bay and USGS.
3. Biological Monitoring of the Lower Fox River Watershed: 2005 Update. Dani Anholzer, Jennifer Grzesik, Brianna McDowell, Richard Shaker, and Timothy Ehlinger; UW-Milwaukee.
4. Ambient Water Quality Monitoring Program and Lower Fox River Watershed Monitoring Program, Green Bay Metropolitan Sewerage District.
5. Phosphorus Forms and Fate in the Lower Fox River Watershed, March 2006. Paul Baumgart, Kevin Fermanich, Nick Reckinger, UW-Green Bay and Dale Robertson, USGS.