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## **Section 4: 2004 – 2005 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 table of contents)
2. Phosphorus and Sediment Export in Streams in the Lower Fox River Watershed, Kevin Fermanich, Paul Baumgart, and Dave Graczyk. Wisconsin Chapter of the American Water Resources Association Meeting, Delavan, WI. March 3-4, 2005.
3. The Effects of Urbanization on Baird Creek, Green Bay, WI, Jessie Fink, Kevin Fermanich, and Timothy Ehlinger. Wisconsin Chapter of the American Water Resources Association Meeting, Delavan, WI. March 3-4, 2005. (Award for Top Student Oral Presentation)
4. Total Suspended Solids-Turbidity Correlation in Northeastern Wisconsin Streams, Timothy Randerson, Jessie Fink, Kevin Fermanich, Paul Baumgart, and Timothy Ehlinger. Wisconsin Chapter of the American Water Resources Association Meeting, Delavan, WI. March 3-4, 2005. (Award for Top Student Poster Presentation)
5. Developing a Relationship between Total Suspended Solids and Turbidity in Northeast Wisconsin Streams, Jessie Fink, Kevin Fermanich, and Timothy Ehlinger. Midwest Environmental Chemistry Workshop, Madison, WI. October 15-17, 2004.

## **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 sediment concentrations. 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 over 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.

## ***Phosphorus and Sediment Export in streams in the Lower Fox River Watershed***

Fermanich, Kevin. J., *fermanik@uwgb.edu*, Paul Baumgart, *baumgarp@uwgb.edu*, University of Wisconsin – Green Bay, 2420 Nicolet Drive, Green Bay, WI 54311; and David J. Graczyk, U.S. Geological Survey, 8505 Research Way, Middleton, WI 53562, *dgraczyk@usgs.gov*

Previous studies have shown that tributaries in the lower Fox River subbasin disproportionately contribute high sediment and phosphorus loads to the Fox River and lower Green Bay. A better understanding of the phosphorus and sediment yields and forms in which phosphorus is delivered is needed to manage tributary loads and improve our ability to assess basin-wide source areas and estimate future loads. 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 started. The tributaries include Apple, Ashwaubenon, Baird, and Duck Creeks, and the East River. Each tributary was sampled during 10-12 events plus periodically during baseflow. The majority of events were associated with above normal spring rains, including the second wettest May on record.

Median event concentrations were greater than 0.34 mg/L for TP, 0.13 mg/L for DP, and 100 mg/L for TSS. TP concentrations equaled or exceeded 2 mg/L at all 5 sites, and exceeded 2 mg/L during 3 separate events at the Baird Creek station. Median DP/TP ratios during events ranged from 0.38 to 0.54 and from 0.42 to 0.79 during low flow conditions. Constituent load estimates and watershed yield comparisons will be presented. Consistent with other studies done in the basin, it appears that DP makes up the majority of phosphorus being transported by streams in this area.

- Keywords: phosphorus, stream monitoring, water quality
- Presentation Preference: either
- Student Presentation: No

***The Effects of Urbanization on Baird Creek, Green Bay, Wisconsin***

Fink, Jessie C., University of Wisconsin – Green Bay, 2420 Nicolet Drive, Green Bay, WI 54311, [finkjc07@uwgb.edu](mailto:finkjc07@uwgb.edu); Fermanich, Kevin, University of Wisconsin – Green Bay, [fermanik@uwgb.edu](mailto:fermanik@uwgb.edu); Ehlinger, Timothy, University of Wisconsin-Milwaukee, 2200 E. Kenwood Blvd., Milwaukee, WI 53201, [ehlinger@uwm.edu](mailto:ehlinger@uwm.edu).

The Baird Creek watershed is rapidly changing from agricultural to urban land use. This project assessed the effects of urbanization on stream quality through real-time monitoring of several water quality parameters, collecting storm event and baseflow samples for sediment and phosphorus analysis, and evaluating fish and macroinvertebrate populations.

In 2004, sampling was conducted 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 dissolved phosphorus. A YSI multi-parameter sonde at each location recorded temperature, pH, dissolved oxygen, turbidity, conductance, and depth.

Storm event concentrations of TSS ranged from 29 to 996 mg/L for the agricultural watershed and from 26 to over 2,000 mg/L for the urban tributary. Analyses related biota and water quality to land use, evaluated the fraction of dissolved phosphorus, and determined a relationship between TSS and turbidity. Overall, this study will assist the City of Green Bay and the Baird Creek Preservation Foundation in making informed land management decisions to protect the unique habitat of the Baird Creek Greenway.

- Keywords: stream monitoring, water quality, urbanization
- Presentation Preference: Oral
- Student Presentation: Yes

### ***Total Suspended Solids-Turbidity Correlation in Northeastern Wisconsin Streams***

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To estimate sediment loading, total suspended solids (TSS) and turbidity are sampled with automated sampling equipment within the Lower Fox River watershed in northeastern Wisconsin. Knowledge of sediment loading is fundamental to assessing non-point source pollution. However, collection and analysis of sediment samples is costly. These costs could be reduced if TSS could be accurately estimated from continuously monitored turbidity.

This poster presents 2003-2004 turbidity and storm event sample data for Apple, Ashwaubenon, Baird, and Duck Creeks. Displayed are comparisons between sites, and within site comparisons for seasonality, rising versus falling stage, and event versus low flow. The water sample collection and analysis adhered to established USGS methods. YSI-6200 multi-parameter sondes were deployed for continuous turbidity measurement.

Linear regression ( $R^2$ ) ranged from 0.78-0.98 for the different streams. We hypothesize that the weaker relationships are due to variances in hydrologic response and watershed land use. Also, certain sonde data were excluded due to equipment-associated false spikes in turbidity.

In conclusion, continuous monitoring of turbidity appears to offer a viable alternative for TSS estimation in these Lower Fox River watershed locales. Evaluation of pollutant transport under changing land use could be accelerated with this straightforward information alternative.

- Keywords: Turbidity, Total Suspended Solids
- Presentation Preference: Poster
- Student Presentation: Yes

## **Developing a Relationship between Total Suspended Solids and Turbidity in Northeast Wisconsin Streams**

Jessie Fink<sup>1</sup>, Kevin Fermanich<sup>1</sup>, Timothy Ehlinger<sup>2</sup>

<sup>1</sup>*University of Wisconsin-Green Bay*, <sup>2</sup>*University of Wisconsin-Milwaukee*

Estimation of sediment loading in a stream typically requires utilizing automated event samplers to collect a limited number of total suspended solids (TSS) samples for laboratory analysis. Results from other studies have shown that continuous turbidity measurements obtained from optical sensors may correlate closely with TSS concentrations in streams. This poster presents continuous turbidity and storm event sample data collected during 2003 and 2004 at two locations on Baird Creek in Brown County, Wisconsin, as part of a larger study of sediment and phosphorus loading from tributaries of the Fox River. The project used established USGS methods for gaging streamflow and for collecting, processing, and analyzing water samples. YSI-6200 multi-parameter sondes were also deployed to continuously measure turbidity and water depth. Linear regression analysis showed that a strong relationship existed between TSS concentrations and turbidity readings in Baird Creek; however, the relationship differed between upstream and downstream locations. We hypothesize that the difference is directly related to land use and associated hydrologic response differences between the primarily agriculture upstream site and the urban residential downstream site. Continuous turbidity monitoring appears to be a reasonable surrogate for TSS sampling on Baird Creek, and may provide cost effective and rapid information on the effects of land use change on watershed sediment delivery. Our investigations of TSS-turbidity relationships for other tributaries and the influence of seasonality and other factors are ongoing.

## **Section 5: Selected Oral Presentations by the LFRWMP Team**

*Second Annual Watershed Symposium*, March 9, 2005 at NWTC:

1. Plenary Session: Linking Watershed Landscapes to Aquatic Ecosystems, Tim Ehlinger, UW-Milwaukee.
2. Fox Watershed Monitoring Program: 2004 Update, Kevin Fermanich, UW-Green Bay and Tim Ehlinger, UW-Milwaukee.
3. Phosphorus and Sediment Sources and Impacts in the Lower Fox River Subbasin: What's Next? Bud Harris and Kevin Fermanich. Presentation to the WDNR, Madison, WI. April 6, 2005.
4. Phosphorus and Sediment Export in Streams in the Lower Fox River Watershed, Kevin Fermanich, Paul Baumgart, and Dave Graczyk. Wisconsin Chapter of the American Water Resources Association Meeting, Delavan, WI. March 3-4, 2005.
5. The Effects of Urbanization on Baird Creek, Green Bay, WI, Jessie Fink, Kevin Fermanich, and Timothy Ehlinger. Wisconsin Chapter of the American Water Resources Association Meeting, Delavan, WI. March 3-4, 2005. (Award for Top Student Oral Presentation)
6. Lower Fox River Watershed Monitoring Program Update, Paul Baumgart. Fox-Wolf Watershed Alliance Fall Research Meeting, UW-Oshkosh. October 6, 2004.

## **Section 6: Selected Poster Presentations by the LFRWMP Team**

*Second Annual Watershed Symposium, March 9, 2005 at NWTC:*

1. The Lower Fox River Watershed Monitoring Program, UW-Green Bay, UW-Milwaukee, and USGS.
2. Lower Fox River Watershed School-Based Monitoring Program, UW-Green Bay and UW-Milwaukee.
3. Preliminary Monitoring Results – Annual Flow, Precip., TSS and Phosphorus: WY 2004, UW-Green Bay and USGS.
4. Biological Monitoring of the Lower Fox River Watershed, UW-Milwaukee.
5. Stream Sampling Methods Used for the Lower Fox River Watershed Monitoring Program, UW-Green Bay, UW-Milwaukee, and USGS.
6. Water Quality Monitoring on the East River, Green Bay Metropolitan Sewerage District.
  
7. Total Suspended Solids-Turbidity Correlation in Northeastern Wisconsin Streams, Timothy Randerson, Jessie Fink, Kevin Fermanich, Paul Baumgart, and Timothy Ehlinger. Wisconsin Chapter of the American Water Resources Association Meeting, Delavan, WI. March 3-4, 2005. (Award for Top Student Poster Presentation)